The Impact of the Internationalisation of Higher Education on Scientists' Multimodal Communication: A case study from Catalonia

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TESI DOCTORAL

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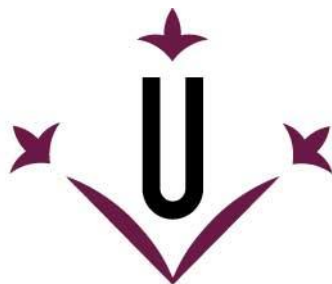
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A les veritables científiques[1], le-s-àvies: iaia Maria José, abuelita Lola, yaya Pilar i padrina Maria

Als veritables científics, el-s-avis: padrí Josep, iaio Antolín, abuelito Miguel i yayo Frutos

To the real scientists[2], our grandmothers and grandfathers

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[1] Del llatí 'scientia' (coneixement)

[2] From the Latin 'scientia' (knowledge)

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Abstract

Universities worldwide are urged to engage in the process of 'internationalisation' as a hallmark of quality and as a lure to attract students. This process often materialises in activities like mobility programmes for students and staff, cross-border programme delivery, international credit recognition and transfer, and the internationalisation of the curriculum. The current study approaches this issue from the context of Catalan higher education institutions, which have responded to this trend by designing language policy plans that deal with the dilemma of supporting the local language(s) and at the same time embracing multilingualism and especially English.

The main aim of this thesis is to examine the impact of the internationalisation of higher education on the daily communication of an under-researched population: scientists. Departing from the assumption that science today is done in groups, the research group (RG) has been taken as the social unit to be analysed. Ethnographic data, consisting of field notes, interviews, audio and video recordings of daily practices, photographs and original documents (i.e. emails and paper drafts), have been collected throughout a period of 11 months from two multinational RGs based in a Catalan university, and contrasted with data taken from a RG based in Germany and with insights from the researcher's own RG.

From the empirical objective has derived a theoretical objective, consisting in designing and proving a suitable theoretical framework to study the phenomenon holistically. To this aim, an articulated theoretical framework has been devised that combines the community of practice theory (Lave & Wenger, 1991), the ethnography of communication (Hymes, 1964), multimodal social semiotics (Kress, 2010) and some concepts from Bourdieu's (1977) theory of practice and Giddens' (1984) structuration theory. The data have been analysed through content and thematic analysis. The theoretical framework designed has guided the data analysis by providing an etic coding scheme, which has been combined with an emic approach to the field (by identifying phenomena, issues and themes that have "emerged" from the data). Following Faiclough's (1992) three-dimensional analysis, three levels of analysis (the micro, the meso and the macro) have been approached. Critical discourse analysis has been adopted across all levels in order to unveil ideological stances and power relations across issues and topics.

This study aims to contribute to the limited body of research describing "scientists' actual communication practices" (Searle, 2013: 50), and especially to the literature describing scientists' "informal" and unpublished practices, as well as to the literature on the internationalisation of higher education. On a practical level, this work is intended to aid in the improvement of internationalisation policies of higher education institutions in Catalonia, in Europe and potentially in other contexts worldwide.

Resum

Les universitats de tot el món són instades a participar en el procés d' 'internacionalització' com a distintiu de qualitat i com a reclam per atraure estudiants. Aquest procés es materialitza sovint en activitats com ara els programes de mobilitat per a estudiants i personal, la impartició de programes a l'estranger, el reconeixement i transferència internacional de crèdits i la internacionalització del currículum. Aquest estudi aborda aquesta qüestió des del context de les institucions catalanes d'educació superior, que han respost a aquesta tendència dissenyant plans de política lingüística que tracten el dilema de donar suport a la/les llengua/gües local/s i, alhora, abraçar el multilingüisme i, sobretot, l'anglès.

L'objectiu principal d'aquesta tesi és examinar l'impacte de la internacionalització de l'educació superior en la comunicació diària d'una població poc investigada: els científics. Partint de la suposició que la ciència avui es fa en grups, hem pres el grup de recerca (RG) com a unitat social analitzada. Les dades etnogràfiques, que consten de notes de camp, entrevistes, enregistraments d'àudio i vídeo de pràctiques diàries, fotografies i documents originals (p. ex. correus electrònics i esborranys d'articles), s'han recopilat al llarg d'un període d'11 mesos d'observació de dos RGs multinacionals amb seu a una universitat catalana, i s'han contrastat amb dades extretes d'un RG amb seu a Alemanya i amb idees inspirades en les pràctiques del RG de la pròpia investigadora d'aquest estudi.

De l'objectiu empíric n'ha derivat un objectiu teòric, que consisteix a dissenyar i provar un marc teòric adequat per estudiar el fenomen proposat de manera integral. Amb aquest objectiu, s'ha ideat un marc teòric articulat que combina la teoria de la comunitat de pràctica (Lave & Wenger, 1991), l'etnografia de la comunicació (Hymes, 1964), la semiòtica social multimodal (Kress, 2010) i alguns conceptes de la teoria de la pràctica de Bourdieu (1977) i de la teoria de l'estructuració de Giddens (1984). Les dades s'han analitzat mitjançant l'anàlisi de continguts i l'anàlisi temàtica. El marc teòric dissenyat ha guiat l'anàlisi de dades proporcionant un esquema ètic de codificació, que s'ha combinat amb un apropament èmic al camp (mitjançant la identificació de fenòmens, qüestions i temes que han "emergit" de les dades). Seguint la proposta d'anàlisi tridimensional de Faiclough (1992), s'ha realitzat una anàlisi en tres nivells (el micro, el meso i el macro). L'anàlisi crítica del discurs s'ha adoptat a tots els nivells per tal de donar a conèixer postures ideològiques i relacions de poder a través de les diverses qüestions i temes.

Aquest estudi té l'objectiu de contribuir a la limitada recerca que descriu les "pràctiques de comunicació reals dels científics" (Searle, 2013: 50), i especialment a la literatura que descriu aquelles pràctiques "informals" i inèdites dels científics, així com a la literatura sobre la

internacionalització de l'ensenyament superior. A nivell pràctic, aquest treball pretén contribuir a la millora de les polítiques d'internacionalització de les institucions d'ensenyament superior de Catalunya, d'Europa i potencialment d'altres contextos arreu del món.

Resumen

Las universidades de todo el mundo son instadas a participar en el proceso de 'internacionalización' como distintivo de calidad y como reclamo para atraer estudiantes. Este proceso se materializa a menudo en actividades tales como los programas de movilidad para estudiantes y personal, la impartición de programas en el extranjero, el reconocimiento y transferencia internacional de créditos y la internacionalización del currículo. Este estudio aborda esta cuestión desde el contexto de las instituciones catalanas de educación superior, que han respondido a esta tendencia diseñando planes de política lingüística que tratan el dilema de apoyar la/s lengua/s local/es y, a la vez, abrazar el multilingüismo y, sobre todo, el inglés.

El objetivo principal de esta tesis es examinar el impacto de la internacionalización de la educación superior en la comunicación diaria de una población poco investigada: los científicos. Partiendo de la suposición de que la ciencia se hace hoy en grupos, hemos tomado el grupo de investigación (RG) como la unidad social analizada. Los datos etnográficos, que constan de notas de campo, entrevistas, grabaciones de audio y vídeo de prácticas diarias, fotografías y documentos originales (p. Ej. Correos electrónicos y borradores de artículos), se han recopilado a lo largo de un período de 11 meses de observación de dos RGs multinacionales con sede en una universidad catalana, y se han contrastado con datos extraídos de un RG con sede en Alemania y con ideas inspiradas en las prácticas del RG de la propia investigadora de este estudio.

Del objetivo empírico ha derivado un objetivo teórico, que consiste en diseñar y probar un marco teórico adecuado para estudiar el fenómeno propuesto de manera integral. Con este objetivo, se ha ideado un marco teórico articulado que combina la teoría de la comunidad de práctica (Lave & Wenger, 1991), la etnografía de la comunicación (Hymes, 1964), la semiótica social multimodal (Kress, 2010) y algunos conceptos de la teoría de la práctica de Bourdieu (1977) y de la teoría de la estructuración de Giddens (1984). Los datos se han analizado mediante el análisis de contenidos y el análisis temático. El marco teórico diseñado ha guiado el análisis de datos proporcionando un esquema ético de codificación, que se ha combinado con un acercamiento émico el campo (mediante la identificación de fenómenos, cuestiones y temas que han "emergido" de los datos). Siguiendo la propuesta de análisis tridimensional de Faiclough (1992), se ha realizado un análisis en tres niveles (el micro, el meso y el macro). El análisis crítico del discurso se ha adoptado a todos los niveles con el fin de dar a conocer posturas ideológicas y relaciones de poder sobre las diversas cuestiones y temas.

Este estudio tiene el objetivo de contribuir a la limitada investigación que describe las "prácticas de comunicación reales de los científicos" (Searle, 2013: 50), y especialmente a la literatura que describe aquellas prácticas "informales" e inéditas de los científicos, así como en la literatura

sobre la internacionalización de la enseñanza superior. A nivel práctico, este trabajo pretende contribuir a la mejora de las políticas de internacionalización de las instituciones de enseñanza superior de Cataluña, de Europa y potencialmente de otros contextos en todo el mundo.

Table of Contents

List of excerpts

List of pictures

List of tables

List of figures

List of abbreviations

ACE	American Council on Education
AGAUR	Agència de Gestió d'Ajuts Universitaris i de Recerca
AQU	Agència per a la Qualitat del Sistema Universitari de Catalunya
AUCC	Association of Universities and Colleges of Canada
CDA	Critical Discourse Analysis
CDS	Critical Discourse Studies
CHEA	Council for Higher Education Accreditation
CL	Critical Linguistics
CoP	Community of Practice
COST	European Cooperation in the Field of Science and Technology
CYTED	Science and Tecnology for DEvelopment
DA	Discourse Analysis
EAHE	European Area of Higher Education
EC	European Commission
ELF	English as a Lingua Franca
EMBC	European Conference on Molecular Biology
EMBL	European Laboratory of Molecular Biology
EMBO	European Molecular Biology Organisation
EMI	English as a Medium of Instruction
EoC	Ethnography of Communication
ERA	European Research Area
ERAC	European Research Area and Innovation Committee
ESF	European Science Foundation
EUA	European University Education
EUA-CDE	European University Association-Council for Doctoral Education

GATS	General Agreement of Trade in Services
GBAORD	Government Budget Appropriations or Outlays for Research and Development
HE	Higher Education
IoHE	Internationalisation of Higher Education
JPI	Joint Programming Initiatives
L1	First Language
L2	Second Language
LE	Linguistic Ethnography
MCDS	Multimodal Critical Discourse Studies
MMSS	Multimodal Social Semiotics
OECD	Organisation for Economic Co-operation and Development
PR	Public Relations
RD	Research Diary
RG	Research Group
SGR	Support to Research Groups
SME	Small-and-Medium-Sized Enterprises
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WTO	World Trade Organisations
3-D	Three-dimensional

Transcription conventions (based on Payrató & Alturo, 2002)

@	Laughter particles, approximating syllable number; utterances spoken laughingly appear between square brackets []
.	Prolongation of the immediately prior sound
/	Rising pitch movement
\	Falling pitch movement
_	Level pitch
*	Reformulation
(…)	Words omitted
&	Unfinished word
+	Interjections appear between +: +uh+
=	Overlapping talk
{(?)}	Words or phrases which cannot be reliably identified
X	Unintelligible utterances, approximating syllable number

Utterances in languages other than the main language used by the speaker appear between square brackets {} with the language indicated: {(Eng)}, {(Spa)}.

All repetitions of words and phrases are transcribed.

Introduction

Globalisation seems to have influenced European higher education in the sense of pushing universities towards a process known as 'internationalisation', namely international mobility of students and staff, attracting international students, and implementing measures to "become international", such as increasing the presence of English in courses and official documents. Some of the most explicit consequences of this 'international turn' are the language policy documents that, in the last decade, European universities have started to design, with an interest in highlighting their multilingualism while maintaining the local language/s. The current study is framed within the context of Catalan higher education (HE) institutions, which are increasingly called to meet the requirements of internationalisation, and which, regarding communication in science, have reflected this process through language policy plans that deal with the dilemma of supporting the local language(s) and at the same time embracing multilingualism and expressly the preeminent international language: English. In order to address this phenomenon (the interplay between the internationalisation of higher education and university language policy, language practices and the beliefs of the actors involved), the research group Cercle de Lingüística Aplicada of the University of Lleida engaged in a project within which this thesis is framed.

Specifically, the current study is part of the project *Intercultural, European citizenship and English as a lingua franca: between policy and practice in international higher education mobility programmes*, funded by the Spanish Ministry of Science and Innovation (FFI2012-35834, 2013-2015). The aim of the larger project was to explore language policies, attitudes and communicative practices with relation to multilingualism and interculturality within university. As part of it, the current study was intended to offer a complementary perspective to other studies in the project (i.e. Gallego Balsà, 2014, on incoming mobility students' language practices, and Mas-Alcolea, 2017, on the impact of study abroad on outgoing Erasmus students as regards their linguistic and cultural development) by shifting the focus of the experience of multilingualism and internationalisation from undergraduate students to researchers working in multinational research groups.

The main objective of this study is thus to analyse the impact of the process of internationalisation of higher education on the daily communication of a specific and key sector of the university population, as researchers are, in order to contribute to the understanding of the internationaisation phenomenon and to the improvement of internationalisation policies of higher education institutions. Consequently, the first and foremost research question of the

project is as follows: In what ways does the process of the internationalisation of higher education that prevails nowadays influence scientists' daily communication?

The phenomenon of globalisation has been acknowledged to have particularly affected the scientific world as regards communication, in multiple ways. For instance, it has had an impact on the development of global networks, the increased flow of information and the augmented mobility of scientists (see Khattab & Fenton, 2015; Paasi, 2005; Scellato, Franzoni, & Stephan, 2015). Also, a linguistic shift has activated worldwide through the progressive incorporation of English as a lingua franca in the scientific field. The globalisation of science may carry effects, disorders, and the interaction of numerous intervening factors, which may be relevant for the internationalisation of European higher education, which hosts countless scientific hubs. Consequently, European higher education institutions could potentially benefit from sociolinguistic research that contributes to the comprehension of this process.

Despite this urge, research in scientific communication has mainly focused on the dissemination of research to the general public (Treise & Weigold, 2002), instead of exploring the most frequent communicative practices reported by scientists, that is, the "mixture of informal and formal situations", and especially face-to-face communication (Searle, 2013: 50). This thesis aims to contribute to the limited body of research describing "scientists' actual communication practices" (Searle, 2013: 50), and especially to the literature describing "informal" and unpublished practices, which cannot be accessed neither by the general public nor by the media.

Departing from the assumption that science today is done in groups (either under the same institution, research project, or official affiliation), this research project has been designed as a case study of two research groups, with additional data from another group and insights from a fourth group. I departed from the "nearly venerable already" (Kress, 2011: 239) ethnographic approach, with the aim of obtaining an emic perspective of the phenomena observed, to which theoretical perspectives would be added.

This study therefore has a twofold objective: empirical and theoretical. On the one hand, it aims at investigating the influence of the IoHE on scientists' daily communication. And on the other hand, it aims at designing and proving a suitable theoretical framework to study this under-researched phenomenon holistically.

This thesis is structured in nine chapters. Chapter 1, the *Literature review*, presents relevant works in different academic fields related with either scientists' communication, the internationalisation of higher education, or both. Section 1.1 tackles the sociological take on scientists' communication (Lynch & Woolgar, 1988). Section 1.2 is devoted to the literature on science communication and (multimodal) communication among scientists (Mondada, 2005).

Section 1.3 presents relevant works in workplace communication and learning (Delamont & Atkinson, 2001). In section 1.4, the literature on academic literacies (Lillis & Scott, 2007) that most connects with this thesis' topic is discussed. And in section 1.5, communication among scientists is contextualised within the literature on the internationalisation of higher education (Huisman & Van der Wende, 2005). This chapter concludes with the identification of a research gap that this thesis intends to contribute to.

Chapter 2, the *Theoretical framework*, describes the theoretical approaches chosen to guide the design of this project as well as the data analysis. Section 2.1 puts forth my ideology as a researcher and my personal understanding of sociolinguistic research. Section 2.2, presents some main tenets of Critical Discourse Analysis (Fairclough, 2003; Van Dijk, 2008; Wodak & Meyer, 2001), an approach adopted cross-sectionally in this study, as well as some concepts from Bourdieu's (1977) *theory of practice* and Giddens' (1984) *structuration theory*. Section 2.3 deals with the sociology of language (Fishman, 1968) and the ethnography of communication (Hymes, 1964). Section 2.4 presents the community of practice theory (Lave & Wenger, 1991). In section 2.5, some main concepts of multimodal social semiotics (Kress, 2010) are described. And section 2.6 argues about the compatibility of the approaches chosen and illustrates the outcome of their combination: an articulated theoretical framework for the exploration of scientists' communication.

In chapter 3, the *Methodology*, details on the methods for data collection and analysis are provided, as well as descriptions of the cases and the participants studied. First, the research questions and sub-questions that guide this study are specified and the participants described (section 3.1). Second, the cases analysed, the research groups, are defined (section 3.2). Section 3.3 presents the methods for data collection as well as the database generated after it, and discusses some issues and difficulties faced during the data collection phase. Finally, section 3.4 explains the methods for data analysis.

Chapter 4, titled *Contextualising the research*, frames the research study within the trend of the internationalisation of higher education globally (section 4.1), in Europe (section 4.2), in Spain (section 4.3) and in Catalonia (section 4.4).

The following four chapters (chapters 5, 6, 7 and 8) are devoted to the data analysis and to the discussion of findings. Following Fairclough's (1992) three-dimensional model for discourse analysis, each dimension is addressed by one or two analytical chapters. The first dimension addressed is the meso level of analysis, corresponding to the consumption, production and distribution of texts (Fairclough, 1989; 1995), given that the research group is considered to be a mid-level social aggregate. This level of analysis is tackled in chapters 5 and 6. Chapter 5,

entitled *Analysing the research group (RG) as a community of practice (CoP),* is guided by the research sub-question: *In what ways do the RGs studied constitute CoPs?* Sections 5.1, 5.2 and 5.3 explore the extent to which three dimensions through which the relationship between 'practice' and 'community' has been established in the CoP theory are present in the participant RGs. These are *mutual engagement* (section 5.1), a *joint enterprise* (and/or a *domain*) (section 5.2) and a *shared repertoire* (section 5.3). Section 5.4 centres on the analysis of *practice*, *boundary objects* and *brokering* in the research groups studied. Section 5.5 discusses the findings presented in the previous sections in the light of the related literature.

After having discussed the aptness of the community of practice theory for approaching the scientific group as the community to be analysed, chapter 6, *The RG's (internationalised) communication policy: Learning by doing (and communicating?),* explores the communicative aspects of the meso level of analysis. It thus presents the place and role of (multimodal) communication within the research group. To this end, this chapter addresses the following research sub-questions: *What kind of multimodal communication policy does the group abide by?*, and *How is this multimodal communication policy influenced by the internationalisation of higher education?* Following Saville-Troike's (2003) proposal for the ethnographic exploration of a community's communication (e.g. by identifying regular events and significant components), section 6.1 is dedicated to the identification and description of *communicative events* taking place in the research groups studied, as well as to the explanation of the development of 'competence' by their members. Section 6.2 examines the nature of the events' boundary markers signalling their beginning and end, as well as the features that distinguish one from the other. Section 6.3 deals with the language policy of the research groups studied. Section 6.4 explores the hints of the internationalisation of higher education in the research groups' communication policy. And section 6.5 offers a discussion of the findings presented in the chapter.

After having addressed the meso level of analysis, chapter 7, entitled *The internationalisation of scientists' communication along the local trajectory of the experiment*, illustrates different ways in which the internationalisation of higher education permeates the micro dimension of analysis. It thus centres on how this process becomes evident in the formal characteristics of 'texts', the outcomes of the participants' communication. To this end, the research sub-question that guides this chapter is: *What is the influence of the internationalisation of higher education on scientists' communication at the level of text form?* The first section of this chapter (section 7.1) frames the analysis of data carried out in this chapter. Sections 7.2-7.6 offer an analysis of a multimodal text each: a scientific protocol (section 7.2), a 'doing experiments' event (section 7.3), a lab notebook page (section 7.4), a lab meeting (section 7.5) and a report (section 7.6). In

section 7.7, the hints of the internationalisation of higher education are tracked across these texts. And section 7.8 presents a discussion of the chapter's findings.

After having tackled the meso and the micro levels of analysis, in chapter 8, titled *Scientists' communication for international success*, the macro level of analysis is approached, concerning socio-cultural aspects of the group's communication that transcend the research group itself. The research sub-question that guides this chapter is *What is the influence of the internationalisation of higher education on scientists' communication regarded as a socio-cultural practice?* Section 8.1 deals with the relevance of publishing for scientists' success, as well as with other facets of success in science, such as one's work visibility, networking, professional-personal life balancing and fundraising, among others. Section 8.2 offers an overview of the elements that contribute to scientists' and research groups' competitiveness, with a special focus on those aspects related with communication. Section 8.3 establishes some connections between science and social, political and economic discourses, in order to unveil the ways in which these discourses affect scientists' communication. In section 8.4, the significance of the internationalisation activity of mobility for scientists is investigated, as well as its effects on their communication. Finally, section 8.5 discusses the findings presented in relation to the relevant literature.

The thesis concludes with chapter 9, the *Conclusions*, which summarises the main conclusions put forth throughout the work and offers a succinct response to the overarching research question that this study intended to answer, as well as to the diverse research sub-questions tackled in each chapter of analysis. In this chapter, some limitations of the study are pointed at, as well as possible solutions proposed. Finally, the contribution of this study to the fields of the internationalisation of higher education and scientists' communication is underscored, and ideas for further research in this line are provided.

This research project has been a long journey, having started in October 2nd 2013. It was conceived as a research about researchers, by a researcher, for other researchers. The resulting work may hence look like a game of mirrors in which the different actors might see themselves reflected in others. It has thus been an exoteric as well as an esoteric journey for its author, and it might potentially be such for its readership. Let the game begin…

Chapter 1: Literature review[3]

The wide scope of this project's research topic, the influence of the IoHE on the multimodal communication policy of a research group, which encompasses aspects like (a) the communication of a scientific group in a holistic way, (b) a workplace setting, and (c) the influence of the IoHE on communication, positions this project at the crossroad of diverse disciplines and research areas. In particular, communication in science has been addressed by four research strands: (1) the sociology of science (e.g. Latour & Woolgar, 1986 [1979]; Lynch & Woolgar, 1988; Knorr-Cetina, 1999), (2) multimodal scientific communication (e.g. Lemke, 1990; Kress *et al.*, 2001; Mondada, 2005), (3) science communication (e.g. Rennie & Stocklmayer, 2003; Bruine de Bruin & Bostrom, 2013; Bucchi & Trench, 2016), and (4) academic literacies (e.g. Lea & Street, 1998; Archer, 2006; Lillis & Curry, 2010). Finally, besides these four research areas, studies on (5) workplace communication and learning (e.g. Mondada, 2011; Zemel, Koschmann & LeBaron, 2011; Bezemer *et al.*, 2013), and on (6) communication in the context of the inernationalisation of higher education (e.g. Huisman & Van der Wende, 2005; Knight, 2008; De Wit, 2010), though not explicitly dealing with science, may also contribute with relevant insights to the current project.

In this chapter, the literature in these diverse areas most directly related to our topic will be presented, despite not following this same order, and its main arguments will be discussed so as to identify chief findings, gaps and lines for further development. First, the sociological take on scientists' communication will be approached (section 1.1); second, relevant literature on science communication will be discussed (section 1.2); third, tenets in workplace communication and learning will be exposed (section 1.3); fourth, related topics on academic literacies will be dealt with (section 1.4); and finally, communication among scientists will be contextualised within the literature on the internationalisation of higher education (section 1.5). In the light of this literature, the potential contribution of this study will be underscored.

1.1. The sociological take on communication in science and on scientific representation

The *sociology of science,* or otherwise the *sociology of scientific knowledge,* which emerged as a research area on its own in the early 1960s, was originally (in the early 1930s) conceived as a

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[3] This chapter has been partially published in Torres-Purroy, H., & Mas-Alcolea, S. (2020). The internationalization of scientists' communication: An essential literature review. In P. K. Turner, S. Bardhan, T.Q. Holden, E.M. Mutua (Eds.), *Internationalizing the Communication Curriculum in an Age of Globalization*. Routledge.

branch of the *sociology of knowledge* and it focused on three main aspects: (a) unveiling the mechanisms of knowledge generation in science like the demystification of scientific knowledge and its approximation to common-sense reasoning, (b) downplaying the image of 'the scientist' as unchallengeable authority, and (c) questioning notions and processes such as rationality, consensus formation, discovery, etc. (Lynch, 1985). Relevant topics of inquiry were abstract normative and institutional issues such as ethical norms, reward systems and community configurations (Lynch & Woolgar, 1988), which were approached from a historical and philosophical standpoint, through the analysis of scientific texts from diverse sources. Two major theorists following this strand are Thomas Kuhn and Barry Barnes (see Kuhn, 1962; Barnes, 1974).

The sociology of science has contributed relevant studies for the present project, especially from the 1970s, when sociologists started to be increasingly appealed by the construction of scientific knowledge and to explore it through ethnographic-like methods. This 'new version' of the sociology of science (Law, 1986), also named 'the new sociology of scientific knowledge' (Pinch, 1985), constituted a theoretical and epistemological turn in the field. The so-called 'practice turn', which is still today a predominant paradigm in this research area, involved the reconstruction of science from the observation of its practice *in situ*, which turned up to be seen as "immanently practical, locally organized, and infused with interpersonal trust and tacit knowledge" (Coopmans *et al.*, 2014: 3). This (then) new approach to the sociology of science, consisting in the exploration of case studies and the analysis of specific instances of scientific practice, is particularly relevant for this project, both methodologically as well as in terms of its inquiries and main findings. The object of study of the new sociology of scientific knowledge were the 'technical contents' resulting from situated processes of knowledge production. From this perspective, "[s]ocial contingencies are viewed as determinants of the course of knowledge, and facts are conceived to be socially constructed" (Collins & Restivo, 1983: 196). In order to approach these 'contents', sociologists – now 'sociologists of science' – started to adopt ethnomethodological (e.g. Garfinkel, 1967) and interactionist methods (see Blumer, 1969) (e.g. direct observation, the recording of "shop talk", etc.) to explore specific practices. This way, the so-called 'laboratory studies' (Woolgar, 1982), somehow constituting an 'anthropology of science', became "something of a minor fashion in the sociology of science since 1978" (Lynch, 1985: xiii).

Although communication was not their central focus, these studies have given important insights into aspects of communication among scientists in the laboratory as well as into scientific representation more generally. One instance of these is Bruno Latour's and Steve Woolgar's (1986 [1979]) two-year anthropological study in a scientific laboratory, observing the

daily practices of its members, and exploring the "social construction" of scientific facts, that is, "the process by which scientists make sense of their observations" (Latour & Woolgar, 1986 [1979]: 32), or how frameworks are constructed and imposed by scientists to the variety of possible interpretations in order to reduce background noise and be able to offer a coherent account. Other examples are Karin D. Knorr-Cetina's two ethnographic-like studies in different research centres, first looking at the 'nature of scientific facts' (Knorr-Cetina, 1981) and afterwards unveiling the machineries that contribute to the production of scientific knowledge (Knorr-Cetina, 1999). These studies tackle aspects revolving around communication in science, such as the consensus-like validation of scientific knowledge, the importance of communication within the scientific community, the organisation of scientific work, the political strength of collaborations, the units and institutions (i.e. the experiment, the laboratory) that take part in scientific practice, and identity construction of individual scientists, among others. A third example of laboratory studies is the work of Michael Lynch (1985), who also carried out an ethnography in which he investigated social aspects of the scientific practice in a specific lab. He linked them directly with communicational aspects such as how agreement is achieved, the social accountability of laboratory productions, and the different modes of discourse that "talking about science" and "talking science" constitute. As can be noted, these studies share a conception of science "as a constructive, socially-situated, and socially-contingent discursive enterprise" (Collins & Restivo, 1983: 196), coinciding with the approach adopted in the current project.

Parallel to the practice strand was a concurrent strand of studies more centred on "textual" documents or otherwise 'scientists' written and oral discourse' (Lynch, 1985), such as published articles, prize acceptances, scientific reports, etc. These studies contrasted the formal characteristics of scientific textual discourse with those of scientific practice, in order to challenge the traditional view of scientific documents as faithful descriptions of natural phenomena. They attempted to demonstrate the constructive and relativistic facet of scientific reports by emphasising the rhetorical strategies they followed. Examples of these are Bazerman, (1981), Lynch (1988) and Mody (2014).

Both strands, laboratory studies and studies on the analysis of scientific documents, focus on similar aspects of communication in science, like "the 'rhetoric' of scientific writing, the collaborative performance of experiments, and informal agreements and disagreements over the sense and import of laboratory data" (Lynch & Woolgar, 1988: 103). Although they depart from a different entry point ('science practice') from that of the current study ('communicative practice'), the analysis and interpretation of the 'representational products' of scientific work and the exploration of daily practices of scientists are clearly connected with semiotics and

communication. Moreover, approaching them from a sociological perspective and with discourse analytical tools is a patent antecedent of the present research project, which is framed within the area of sociolinguistics.

Still within the sociology of science, cultural and social constructionist perspectives consolidated in the 1990s in the form of several edited volumes that encompassed a multiplicity of approaches and views on science (i.e. Bijker & Law, 1992; Clarke & Fujimura, 1992; Star, 1995; Galison & Stump, 1996). Nonetheless, the turn of the century has brought about a new turn in the sociology of science, coinciding with the new attention drawn by anthropologists and feminists "to macrosociological categories of analysis, social problems, culture and power, and interactions with lay groups and social movements" (Hess, 2006: 124). This turn has consisted in a renewed attention to structural and institutional factors "such as states, markets, and social movements" (Hess, 2006: 124), often materialised in monographs, like those on democracy and politics (Kleinman, 2000; Latour, 2004; Brown, 2009; Gauchat, 2012; Bolsen & Druckman, 2015), on the impact of science on culture (Erickson, 2005), on industry-university relations (Croissant & Restivo, 2001), and on the role of feminism in science (Creager, Lunbeck & Schiebinger, 2001). These works advocated for a renewed focus on the social context of science, as claimed by David L. Kleinman:

> ...it is impossible to understand the dynamics and character of university biology today without understanding the social environment in which the university and university science are embedded. (...) the practices of university sciences are shaped by the world in which they are situated, and that commerce, in the broadest possible sense, is a significant feature of that world. (Kleinman, 2003: 138-9)

This strand, which focuses on structural and institutional aspects, encompasses "the new studies of regulatory politics and expertise, commercialization and privatization, civil society, social movements, public understanding of science, and public participation in science" (Hess, 2006: 124). Differently to past studies on the social structure of science, this renewed trend "invokes a broader and decisively less deterministic analysis of the social relations of science" and "explicitly avoids the structural-functionalist assumptions characteristic of earlier institutional analyses of science " (Frickel & Moore, 2006: 9).

Some of these studies follow the strand of Stuart Blume's (1974) political sociology of science "founded upon the assumption that the social institution of modern science is essentially political and that, moreover, the scientific role is an integral part of the political system of the modern state" (Blume, 1974: 1). These studies constitute the 'new political sociology of science' (NPSS), which is "an empirical project guided by a neo-Weberian emphasis on the relationships

embedding scientific knowledge systems within and across economic, legal, political, and civil society institutions" (Frickel & Moore, 2006: 9). In this context, 'culture', encompassing "rituals, symbols, language, and other meaning systems", is conceived as being "embedded in structured relationships of power" (Frickel & Moore, 2006: 9). This approach, which is "armed theoretically and methodologically to meet new challenges posed by the changing political and economic realities that structure the sciences of today and that will indelibly influence the organisation and conduct of the sciences of tomorrow" (Frickel & Moore, 2006: 5), inquires about issues like profit-driven research, the conventions that guide decision-making concerning research, access to knowledge, and the reasons why certain knowledge is constructed while other is not.

Although the present study does not focus on the sociology of scientific knowledge in particular, it is a cross-sectional project, which merges traits from three strands in the field: laboratory studies, document analysis and an interest in structural and/or institutional issues of science, especially concerning political aspects and power relations. Relevant insights from studies following these trends will be summarised in what follows, regarding three recurrent topics in the literature that are especially relevant for this thesis. These are: the scientific construction of reality (subsection 1.1.1), scientific representation (subsection 1.1.2), and the global dimension of science (subsection 1.1.3).

1.1.1. The scientific construction of reality

In this section, works addressing the constructionist nature of scientific knowledge in the field of the sociology of science will be presented. Ideas included in these works that are relevant for the current thesis, like how scientific facts are constructed, both historically and interactionally, how scientific products are also imbued by persuasion strategies and how scientific knowledge is influenced by contextual factors, will be presented.

As a reaction against the traditional, hegemonic standpoint of the sociology of scientific knowledge studies, whereby science and especially the natural sciences offered faithful representations of 'nature' and thus of 'reality', studies in the late 1970s and early 1980s approached this phenomenon departing from the assumption that such 'representation' was instead a 'construction'. Although these new studies adopted a sociological perspective, communication was also very present in them. This is illustrated, for instance, in Michel Callon's (1984, 1987) widespread conception of the aim of these studies, which he summarised through the concept of 'translation'. According to Callon, sociologists of science had to unveil the methods used by scientists to "articulate conceptions of the natural and social worlds", to "attempt to impose these on others", and see "the extent to which such attempts are met with

10

success" (Law, 1986: 3). 'Translation' would thus refer to the process whereby "actors (including collectivities) struggle to impose versions of reality on others which define (a) the number of those others, both natural and social, that may be said to exist in the world, (b) their characteristics, (c) the nature of their interrelations, (d) their respective sizes and (e) their positions with respect to the actor attempting the translation" (Law, 1986: 6). Accordingly, communication, in the form of either the expression of representation by a spokesperson, or of negotiation, is a key aspect of the process of translation and of power imposition in science. This constructionist perspective has been deemed a promising approach that has constituted a 'flourishing tradition' in the sociology of science (Pinch & Bijker, 1984: 429).

An influential study following this strand was Latour and Woolgar (1986 [1979]), already mentioned, which explores diverse issues: (1) how facts are constructed in a laboratory, or in other words the historical construction of one particular fact, (2) the processes through which the social and historical circumstances of the construction of a fact are eliminated, (3) the specific negotiations that take place in the laboratory, (4) how the concrete decisions to back the construction of a given fact are made, and (5) the process through which an ordered account of a fact is fabricated. Among these authors' key findings, the most relevant for our sociolinguistic-communicative approach is the fact that reasoning in science is only part of a complex phenomenon that "comprises local, tacit negotiations, constantly changing evaluations, and unconscious and institutionalized gestures" (Latour & Woolgar, 1986 [1979]: 152). Also relevant is the existence of a significant degree of reliance of group members on one another's knowledge and expertise to improve one's own and the idea that the statement of a fact consists of two main processes: (a) the replacement of an analogical path by a logical connection, and (b) the replacement of the complexity of local circumstances by flashes of intuition. Another key finding is that when statements stabilise, they take entity on their own, that is, they become a statement about an object and an object on their own. A final finding is that 'out-there-ness' "is the *consequence* of scientific work rather than its *cause*" (Latour & Woolgar, 1986 [1979]: 182; *original emphasis*). This latter argument illustrates a constructionist view of scientific knowledge and of 'reality', also present in other works of the aforementioned authors, like Latour (1993) and Woolgar (1988).

Woolgar (1988) considers scientists' management of methodological flaws – which he names 'methodological horrors' – to be an interactional accomplishment:

> ...descriptions occurring in the course of the interaction are best understood, neither as direct reflections nor mediated (re)presentations of an independent reality, but as ways of actively constituting the character of the scene which they are taken to be "about". (Woolgar, 1988: 188)

Woolgar underscores the importance of the juxtaposition of subsequent documents for achieving descriptive adequacy and a sense of objectivity: when a new document/utterance is juxtaposed to a previous one, they both give meaning to each other; the old document adopts a sense of established past and the new juxtaposed document serves to claim "a similar sense of family membership" (Woolgar, 1988: 198). Latour (i.e. 1985, 1986), in a slightly different sense, makes reference to 'cascades of inscriptions' to name the progressive transition from complex inscriptions to simple inscriptions, which are easily readable for an insider but at the same time do not give too many clues to outsiders.

In this sense, especially pertinent for this project is Latour and Woolgar's (1986 [1979]: 88) view of laboratory activity as "the organisation of persuasion through literary inscription". 'Inscriptions' are, for these authors, the core principle around which both, laboratories and scientific facts, are articulated:

> We presented the laboratory as a system of literary inscription, an outcome of which is the occasional conviction of others that something is a fact. Such conviction entails the perception that a fact is something which is simply recorded in an article and that it has neither been socially constructed nor possesses its own history of construction. (Latour & Woolgar, 1986 [1979]: 105)

Literary inscription is thus put at the centre of lab work, which is understood here "in terms of the continual generation of a variety of documents, which are used to effect the transformation of statement types and so enhance or detract from their fact-like status" (Latour & Woolgar, 1986 [1979]: 151). Consequently, fact construction is thus the product of inscription and hence of representation and communication.

In a similar vein, Knorr-Cetina (1981) attempts to demonstrate that scientific facts are 'productions' and thus that scientific products are "contextually specific constructions which bear the mark of the situational contingency and interest structure of the process by which they are generated, and which cannot be adequately understood without analysis of their construction" (Knorr-Cetina, 1981: 5). In terms of communication among scientists and related to the impact of the internationalisation of higher education on scientists' communication, which are the main interests of the current project, the author reflects upon the process of validation of scientific knowledge. It is regarded as one of consensus achievement and dependent on (a) the scientists' perception and anticipation of the opinion of other members of the community and (b) the positioning of the potential academic journal: "Decisions are based on what is 'hot' and what is 'out', on what one 'can' or 'cannot' do, on whom they will come up against and with whom they will have to associate by making a specific point" (Knorr-Cetina, 1981: 7). It is hence the

result of a strategy. Moreover, Knorr-Cetina points at the process of 'auto-capitalisation' of science as being core for its evolution:

> ...the selections of previous work constitute a resource which enables scientific enquiry to proceed: they supply the tools, methods, and interpretations upon which a scientist may draw in the process of her own research. (...) This form of auto-capitalisation in regard to selectivity appears as a precondition for the accumulation of scientific results. (Knorr-Cetina, 1981: 6)

Knorr-Cetina also explores the evolution and modifications that scientific discourse undergoes, from the inception of the idea to the publication of a paper and subsequent discussion of it, passing through the different draft versions as a result of several revisions by different agents. In this respect, the author concludes that "[i]n the transition from laboratory work to the scientific paper, the reality of the laboratory changed" (Knorr-Cetina, 1981: 130). According to her, "the situationally contingent, opportunistic logic of research" is replaced by "a generalised context of present and possible worlds" (Knorr-Cetina, 1981: 130). Furthermore, the discourse style has been found to be different depending on the characteristics of the text analysed (lab work, lab conversations, paper drafts, final paper), while undergoing a process of conversion:

> We have seen the reasoned selectivity of laboratory work overruled by formulaic recitations of the doings which emerged from this selectivity, and the measured results of these doings purged of all traces of interdependency with their constructive creation. We have seen the indeterminacy of the laboratory reduced to the careful expression of scientific doubt which the paper allows. (Knorr-Cetina, 1981: 130)

The author finds her thesis confirmed – that scientific facts are productions or contextual constructs – and concludes that "[s]cience illustrates that the perennial problem of social order may not be a problem of "order", but rather a problem of transformation, and of social change" (Knorr-Cetina, 1981: 133). This way, the author highlights the dynamic and unstable nature of scientific knowledge and practice.

Consistent with Knorr-Cetina's (1981) and with Latour and Woolgar's (1986 [1979]) constructionist view of science, Zenzen and Restivo (1982) depict a constructionist picture of laboratory facts and underscore the constitutive nature of contingencies in scientific practice and objects. These scholars identify a sort of *dynamic* figure/ground structure of contingencies, whereby some of them play a direct role in the problematisation of things and in determining forced choices by scientists, and others are part of a background environment, in a variable manner. Among such range of contingencies, there is relative space for researchers' creativity and free will:

> In the deepest sense, the available resources in a given laboratory refer to the researchers' capacities for creative and critical thought, persuasion, communication, conflict, and cooperation. The indeterminacy of scientific criteria, the "looseness" of laboratory research, provide room for the exercise of those capacities. (Zenzen & Restivo, 1982: 466)

In this sense, lab work appears as "a large series of responses to imposed demands, perceived needs, given conditions, etc." (Zenzen & Restivo, 1982: 464), framed within "a constantly shifting set of relevancy systems" (Zenzen & Restivo, 1982: 467); and science documents and publications are the sites where "scientists need to use a *rhetoric of persuasion* in order to draw attention to and legitimate their findings" (Zenzen & Restivo, 1982: 459; *original emphasis*). Zenzen and Restivo's (1982) study is thus in the line of socially constituted, contingent and discursive views on scientific facts. The idea of the relative freedom of choice of scientists among a set of conventions is also supported by other scholars, like Lynch (1988), Myers (1988) and Mody (2014), with reference to representational conventions, and like Harvey (1981) and Pickering (1995), in relation to a culture framing a scientific field and the specific topic that scientists address within it.

Also from a constructionist take, Michael Lynch (1985) contends that the process of agreement pursuit among scientists can be regarded as 'locally organised interactive discovering work', since scientists' agreements may be recognised as 'discovered-accounts of objects'. Lynch's study concludes that vernacular speaking practices of scientists are not significantly different (in terms of vocabulary, organisation of discourse and formal grammatical structures) from the practices of other professionals. In fact, his exploration of both, laboratory 'shop work' and 'shop talk', shows an image of the scientist that contrasts with the popular one – for which scientists are "coolly objective, detached, unemotive, scrupulous, and 'stiff' in comparison to 'ordinary folk'" (Lynch, 1985: 169). The discourse of the scientists in his study is imbued with artifactuality[4], superstitions, modifications and reformulations. What is more, the rhetorical peculiarity of written scientific texts disappears as such in oral instances of communication among scientists in the lab. This author also intends to show how the so-claimed-for 'scientific objectivity' takes the shape of agreement among colleagues in particular instances of scientific 'shop talk': "there can be no independent standard of 'objectivity' with which to decide the correspondence of any member's account with its 'real-world' object. This matter is necessarily

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[4] 'Research artifacts' are defined by Lynch (1985: 81) as "particular 'intrusions' or 'distortions', in the observability of the 'natural' features of the world which derive from the instrumental conditions of their perception" .

left to the parties involved to the practical circumstances of any such determination" (Lynch, 1985: 202-3).

Lynch's findings are consistent with Harry M. Collins' (1975) study, which involved sociological methods in the analysis of in-depth interviews of scientists. This author underscores and illustrates the relativity of scientific knowledge (see also Collins, 1981) and depicts it as a result of the negotiation among scientists of objects and concepts that conform their (scientific) culture. Scientific knowledge is hence a 'cultural artefact'. Collins digs into the original processes of knowledge construction, previous to the existence of 'solid' truths and concludes that:

> In general terms, to make a claim for the existence and character of a phenomenon is to make a demand for a particular organisation of conceptual and perceptual categories so that events which take place at different locations and times and under different circumstances, are seen as the 'same' – i.e. manifestations of the phenomenon. (Collins, 1975: 216)

In the same line, Bill Harvey (1981), analysing the evaluation of knowledge claims by physicists, shows how the construction of scientific facts is built upon unequal negotiations among scientists – due to difference in resources among the parts –, where the socio-cultural context plays an important role. These negotiations mainly rely on the principle of 'plausibility' within a shared cultural framework. The possession of 'truth' may thus often take the form of *monopolisation of plausibility*.

According to all these studies, scientific knowledge might be seen as a discourse rather than as a 'reality', as a negotiation rather than an object, as a process of standardisation and thus of simplification. This latter process had been further analysed by the physician and biologist Ludvig Fleck (1935) – a precursor of key ideas in social constructionism and of critical science and technology studies, and predecessor of Thomas S. Kuhn –, who illustrated the communicative path from specialist to popular science as "a funnel that removes subtleties and shades of meaning from the knowledge that passes through it, reducing it to simple facts attributed with certainty and incontrovertibility" (Bucchi & Trench, 2008: 62). As a result, popular knowledge "appears secure, more rounded and more firmly joined together" (Fleck, 1935: 113). However, this is not a process of simple 'translation' (in Callon's terms) of a scientific notion in each stage, but of deeper modification of the notion. Finally, the progressive solidification of knowledge has also an influence on scientists themselves: "*Certainty, simplicity, vividness originate in popular knowledge. That is where the expert obtains his faith in this triad as the ideal of knowledge*" (Fleck, 1935: 115; *original emphasis*); and the funnel may "expand again towards the specialist levels" (Bucchi & Trench, 2008: 65).

15

This idea of the progressive simplification of scientific knowledge across contexts and publics, resonates also in Whitley's (1985) work. As the author puts it, "[t]he more removed the context of research is from the context of reception in terms of language, intellectual prestige and skill levels, the easier it is to present their work as certain, decontextualised from the conditions of its production, and authoritative" (Whitley, 1985: 13). In this line of argument, Pinch's (1981) analysis of scientists' expression of certainty concludes that such expression relies highly on the audience that scientists address: "when scientists perceive a possible public audience they tend to act defensively and stress the certainty of their own areas while, at the same time, doubting the certainty of others'" (Pinch, 1981: 155). This underscores the social nature of the expression of certainty/uncertainty by scientists, which might be a result of a process of 'social negotiation'.

One more consideration regarding this latter issue – the adaptability of scientists' discourse – is that of Law and Williams (1982), who analyse the discussion of two collaborating research groups about the ways to improve a prospective joint publication. The authors argue that scientific knowledge may very plausibly be determined by market commands: "the structure of bits and pieces in a scientific paper – a structure naturally influenced by market conditions – itself helps to constitute the structure of knowledge, the status of the facts, and their relationship with other findings" (Law & Williams, 1982: 537). When scientists attempt to construct a scientific paper, "they are trying to array people, events, findings in such a way that this array is interpretable by readers as true, useful, good work, and the rest" (Law & Williams, 1982: 537). The authors align with Callon's idea of 'translation imposition' and conclude that the array of elements that writing a paper consists in is at the same time the activity of positioning them in a network of value:

> For Callon, science is a struggle to impose translation: to allocate value to groups, individuals and facts as part of a larger organisation. So it is for us. The construction of arrays is an attempt to suggest appropriate networks. Persuasion is a tentative matter, a constant attempt to propose a set of interrelationships and values. (Law & Williams, 1982: 554)

To explain the idea of the network of value, the authors propose the concept of 'currency', which "depends precisely upon the imposition and stabilization of value across a number of particulars" (Law & Williams, 1982: 538). The authors reflect upon the notion of 'power' in science as an intrinsic aspect of the network of value in science: "Power in science, as elsewhere, comes from the successful capacity to create and impose value. And it is for this capacity that scientists struggle when they write a paper" (Law & Williams, 1982: 539).

Concerning the construction of reality by science, other relevant ideas are Latour's conception of 'artifacts' in science as "full-fledged social actors" (Latour, 1994: 64); and thus the importance of both humans and non-humans in our world:

> ...lab coats have invented *speech prostheses that allow nonhumans to participate in the discussions of humans, when humans become perplexed about the participation of new entities in collective life. (...) ...things become, in the laboratory, by means of instruments, relevant to what we say about them.* (Latour, 2004: 67; *original emphasis*)

Also, the conception of 'nature' as a "historically situated social representation" (Latour, 2004: 232) in 'Western' culture reflects the conception of the social construction of reality. Pickering (1995) brings this idea further in claiming for a 'performative idiom' to reflect on science which positions human and material agencies at equal levels: "a performative image of science, in which science is regarded a field of powers, capacities, and performances, situated in machinic captures of material agency" (Pickering, 1995: 7); and in which "the machine (...) is the balance point, liminal between the human and nonhuman worlds (and liminal, too, between the worlds of science, technology and society)" (Pickering, 1995: 7).

After considering the different studies mentioned in this section, it seems clear that the importance of communication and of discourse in the scientific understanding, and to some extent also 'construction', of reality is undeniable. Although the current project does not focus on the specific description of how scientific knowledge is generated, it does explore how scientific knowledge is conveyed in the framework of the scientific team, with implications at wider levels. It has thus a different focal point, as has been already suggested, but also multiple commonalities with the studies above presented.

1.1.2. Representation in scientific practice

This section will tackle core aspects of scientific representation as addressed in the related literature. After an overview on the evolution of this subject, related issues and concerns will be discussed, like how objectivity, transparency and trustworthiness are achieved in science, the dynamicity of scientific representation, the implications of the use of new technologies for representation in science, and the influence of context-specific conventions on scientific representation.

One aspect of communication among scientists that has attracted much interest in the last 30 years, until it has become "an established topic" and "a rich field of inquiry" (Coopmans *et al.*, 2014: 1) is 'representation in scientific practice'. This refers to scientists' "efforts to 'capture', 'render', and otherwise make available aspects of the world" (Coopmans *et al.*, 2014: 1); or,

defined differently, to the configuration of artifacts that correspond to an original entity in a relation of similitude (Lynch & Woolgar, 1988). Examples of such 'presentations', named also 'inscriptions' (Latour & Woolgar, 1986 [1979]), are graphs, diagrams, equations, models, photographs, instrumental inscriptions, written reports, computer programs, laboratory conversations, and hybrid forms of these (Lynch & Woolgar, 1988). Such inscriptions have been found to be usually the origin and the 'core' of scientific publications (Knorr & Knorr, 1978). These are also deemed "a rich repository of 'social' actions" and "more than simply representations of natural order" (Lynch & Woolgar, 1988: 103). Representing is conceived as endemic of scientific practice, and as involving not only representation but also the performance of what is represented and the claim of authority to represent it (Law, 2014). The analysis of scientific 'inscriptions' thus consists in the disclosure of the process of their crafting: "to analyze representation is to expose the conjurer's tricks through which chains and networks of similitude are laboriously built-up and then 'forgotten' in the presumptive adequacy of their reference to an 'original' " (Lynch & Woolgar, 1988: 105). However, 'resemblance' and 'similitude' are not the only guiding criteria in scientific representation; it entails a deeper process: "It is not enough to represent the object; it must be penetrated by theory and opened-up to an active manipulation of its principles of organisation" (Lynch & Woolgar, 1988: 105). Therefore, for the analyst, scientific representation is an 'invisible' set of creative, craft practices, skills and expertise (Myers, 2014) that need to be unveiled for analytical purposes.

Coopmans *et al.* (2014) present a brief overview on the evolution of representation in science. Developments in this area have been: (1) the increasing emphasis on circumstantial factors in the process of knowledge production, (2) the changes in representational practice triggered by the technological innovations that have been adopted in science (so as to cause the renaming of the field as 'science and technology studies', STS), like computers, colour digital screens, simulators, various software for representation and representation processing, mobile digital devices, etc., besides the traditional means for representation, such as whiteboards, markers, notebooks, pens, books, post-its and labels, (3) the increasingly blurry distinction between laboratory and field, and (4) the 'reframing' of representation from comprising linguistic representation only to encompassing image as well, and "from an expectation that visual traces and numerical measurements were references to independent objects and properties, to a series of open-ended inquiries into how many different kinds of relations, reference among them, are accomplished (...) in the work people do with images" (Coopmans *et al.*, 2014: 3).

Although these works are more distinct from the current project regarding their methodology than the ones previously presented, the study of scientific representation touches directly upon key issues of the multimodal communication policy of the scientific team at all levels of

analysis. One such issue is *objectivity, transparency and trustworthiness* in scientific representation. These are three very closely related topics, though with slightly different nuances. Objectivity makes reference to the reputation of the inscription and/or of the scientific field (whether representation follows 'objective' criteria); transparency refers to the faithfulness of the inscription to an original; and trustworthiness is about the attitude that inscriptions inspire from their recipients, whether these trust the inscription, the scientists and the system.

Objectivity has traditionally been "one of the principal goals of the scientific culture" (Ziman 2000: 265) and the principle that makes knowledge 'scientific'. However, this traditional belief changed later on and objectivity was deemed 'unattainable' in its absolutist sense and assumed to be reached through a collective process, as 'consensual objectivity' (Ziman, 2000). Following this questioning tendency, in recent years there has been a decay in the objectivity ideal, coinciding with the onset of the scientific post-academic era. As Ziman argues, whenever scientific claims are related to external (non-academic) parties, these may lose their sense of loyalty to the ideals of objectivity and disinterestedness:"post-industrial research has no place for disinterested practices, and post-modern thought has no place for objective ideals" (Ziman, 2000: 180).

Concerning representation in science, objectivity takes the form of the *ideal representativeness or transparency* of a scientific inscription. This is dealt with in the literature following two different strands. One consists of *epistemological accounts* of scientific representations (in which the representation stands for an existing entity), and the other one, of *ontological accounts* (whereby the representation *is* the entity or the working object of science). The related literature is concerned with debates around the boundary between object and representation, and around faithful representation, as well as with establishing guidelines for best practices. This applies especially to images, which have traditionally received greater trust than, for instance, writing, since they used to be deemed accurate and pure (non-manipulated) reflections of objects (Kemp, 2014). However, the democratisation of image processing technologies has sharpened the discussion about the 'transparency' of images, which appears to be now especially threatened (Frow, 2014) to the point of causing a 'crisis of trust' (Kemp, 2014). Martin Kemp in fact refers to the 'rhetoric of reality' that often accompanies scientific presentations in order to increase their sense of reality:

> The scientist, even more than the casual maker of family snapshots, is in the business of selective visual pointing. And the scientist makes sure that the look of the image manifests all the signs of authenticity that are current at the time of its making and reception. (Kemp, 2014: 345)

The shape of inscriptions has also been argued to affect the sense of scientific objectivity. Latour (2014) observes that the degree of objectivity attributed to a scientific discipline seems to be linked to the number of 'transforming steps' between two subsequent inscriptions: "The more steps there are *in between* the objects and those who make judgments about them, the more robust those judgments will be" (Latour, 2014: 347). Latour also claims for the abandonment of the mimetic paradigm of scientific representations and the uptake of a new perspective that considers its purposeful referential rationale:

> The idea of science as a "mirror of the world" is a spurious import from the history of figurative paintings into epistemology. (...) ...scientific imagery is never mimetic. If it were, there would be no gain of information between one step and the next. It is the *difference* between each step that allows the reference to move on. (Latour, 2014: 348)

Several studies have also addressed issues of trust in science, very often concerning the reception of scientific representations outside the settings where they were produced. Some of these have found that the style of scientists' discourse – like expressing uncertainty (Johnson & Slovic, 1995, 1998) and/or hedging (Jensen, 2008) – affects their trustworthiness. Others suggest that trust on scientists may also depend on the interlocutors' characteristics (Gauchat, 2012); on the institution with which they are affiliated (Millstone & Van Zwanenberg, 2000); and/or on power inequalities (Weber & Schell Word, 2001). This issue will also be addressed later on in this section with reference to the trustworthiness of scientific representation, especially image.

The use that scientists make of presentations, either as a reference to an object or with other specific purposes, gives place to the study of the *performativity* of representation, or how inscriptions are "a function and consequence of the actions and circumstances in which they are used" (Lynch, 2014: 325). Concerning their use, some authors (e.g. Tibbets, 1990) have advocated for considering scientific representation a combination of a realist and a constructionist account. Barnes (1977: 6) explains this referential-performative facet of scientific representation as follows:

> Representations are actively manufactured renderings of their referents, produced from available cultural resources. The particular forms of construction adopted reflect the predictive or other technical cognitive functions the representation is required to perform when procedures are carried out, competencies executed, or techniques applied. Why such functions are initially required of the representation is generally intelligible, directly or indirectly, in terms of the objectives of some social group.

The referential-performative character of scientific representation has also been approached in the literature concerning scientists' discourse style (see Gilbert & Mulkay, 1984; Michael & Birke, 1994; Burchell, 2007), which has been found to be variable and influenced by contextual factors.

This idea is linked to the notion of the *dynamicity of scientific presentations*, which are "re-presented in sequential chains of practice" (Lynch, 2014: 324). These are "referential chains that allow us, through a series of continual and rule-governed transformations, to assure ourselves of the faithfulness of representations...." (Latour, 2004: 149). And they constitute the cornerstone of the idea of 're-presentation': "Accordingly, re-presentation becomes a matter of presenting an initial *something* again and again; transforming, transposing, and translating the material/semiotic forms of that something; and serially disclosing and detailing what that initial, inchoate *something* was all along" (Lynch, 2014: 324). This gives place to "long cascades of successive traces" (Latour, 2014: 347). Considering this, there is the view that it is the analyst who chooses and delimits convenient units of analysis along this sequence or continuum and treats them as particular presentations, instead of seeing them as clearly or objectively bounded units *per se* (Suchman, 2014).

Finally, another relevant issue in this area is the exploration of 'collateral realities', that is, "all the other more or less indistinct realities also being done in practice in science to which no one attends" (Law, 2014: 338-9). This author proposes one way for their exploration, consisting in the use of *allegory* to recover semi-hidden elements and accessing also the metaphysical dimension of representation.

These considerations about scientific representation set the bases for the multimodal analysis of communication in science. Studies in this area would very plausibly benefit from the conceptual resources being developed in multimodal communication research and any multimodal analysis of scientific communication may gain relevant insights from such studies framed within the sociology of science. Some of these insights are presented in what follows, where relevant studies in this area are commented.

In the line of the constructionist view of scientific representation, Lucy A. Suchman (1988), who explores the use of technologies for representation – or otherwise 'inscription devices' (Latour & Woolgar, 1986 [1979]) – by scientists, concludes that there is "a disparity between the embodied, contingent rationality of scientists' situated inquiries and the abstract, parameterized constructs of rational behavior represented..." (Suchman, 1988: 322). In this specific work, the scholar studies the use of the whiteboard as an inscription device, how

significance is attributed to the marks produced on it, and their function in the structure of its use. In particular, she aims at "uncovering the relationship between (i) the organisation of face-to-face interaction, (ii) the collaborative production of the work at hand and (iii) the use of the whiteboard as an interactional and representational resource" (Suchman, 1988: 318). After data analysis, Suchman contends that (a) the negotiation of practical contingencies of shop talk and its technologies are practices "notably absent from the scientific outcomes and artifacts produced" (Suchman, 1988: 322); (b) representations in science should be regarded "in relation to, as the product of and resource for, situated practice" (Suchman, 1988: 322); and (c) "representational devices assume the local practice of their production and use", which is "the taken-for-granted foundation of scientific reasoning" (Suchman, 1988: 322). In a similar line of argumentation, Michael J. Barany and Donald MacKenzie (2014) argue on the importance of chalk and blackboard for scientific inscription and phenomenon/concept (inter-subjective) construction.

Similarly, Yearley's (1988) study of a series of interviews of scientists resolves that all the diverse accounts offered may be "plausible reconstructions of what the purpose may have been" (Yearley, 1988: 357) instead of unique faithful accounts of what it *was*. These findings support the idea that there is a "continuing tendency of scientists themselves to present accounts of scientific work which make slight reference to political actions and economic adjustments" (Yearley, 1988: 343). And the author goes on to assert that "[i]n the use of such a vocabulary [without reference to political and economic aspects], scientists appear to reinforce the image of science as an autonomous enterprise" (Yearley, 1988: 343), which is called the 'intellectualist' interpretational pattern. The ultimate implications of Yearley's study are that "policy influences can often be omitted from most accounts of scientific development" (Yearley, 1988: 357); that "the connection of policy to research is inherently unpredictable and unsystematic" (Yearley, 1988: 358); and that "research is creative and open-ended" (Yearley, 1988: 358). These findings coincide with Latour and Woolgar's (1986 [1979]) observation that scientists express their motivation differently on diverse occasions, which the researchers in their study attributed to "psychological make-up, ideological climate, group pressure, fashion" (Latour & Woolgar, 1986 [1979]: 208), among other causes; and also with Travis' (1981) findings that even what constitutes a replication of an experiment is often not clear-cut but the result of negotiations of scientists within a research area.

The constructionist view on science is supported also by Bazerman's (1981) analysis of three scientific papers (of the fields of natural sciences, sociology and literature). With reference to the article in natural sciences, the author cautions about the absence in the article of "many psychological, sociological and even random elements" (Bazerman, 1981: 365) present in

scientific practice; the "so-called 'non-scientific' elements of scientific work" (Bazerman, 1981: 365). Bazerman concludes that "the terms of this analysis suggest how texts serve as dynamic mediating mechanisms, creating those elusive linguistic products we call knowledge" (Bazerman, 1981: 379) and that "[t]exts bring together worlds of reality, mind, tradition, and society in complex and varying configurations, and knowledge is in those words that sit in the middle" (Bazerman, 1981: 379). Illustrating this, the author offers an insightful definition of 'scientific article':

> ...an article is an answer to the question, 'Against the background of accumulated knowledge of the discipline, how can I present an original claim about a phenomenon to the appropriate audience convincingly so that thinking and behaviour will be modified accordingly?'(Bazerman, 1981: 363-4)[5]

Indeed, the construction of a scientific text affects not only its producer, but also its interpreter. This is studied by Amerine and Bilmes (1988) in their analysis of third-grade students' enactment of an experiment following instructions. In it, the researchers unveil the necessary skills and competences that such 'translation', that is, the transition from written instructions to embodied scientific action, entails[6]. The two main such skills, according to the authors, are (a) the ability to draw connections between the projected outcome and its corresponding course of action; and (b) their ability to account for unforeseen or inconsistent outcomes in a framework of authority. As the authors contend, these skills depend on the practitioners' mastery of the *indexical* and *reflexive* aspects of instructions:

> ...it is largely by means of achieving competence with respect to the indexical and the reflexive nature of instructions that one becomes able to recognise the essential and unessential features of the accounts embodied in instructions; to fill in the gaps in these accounts, both conceptually and through practical activities; to determine the relevance of particular acts; and to reduce ambiguity by means of practical classifications of phenomena. (Amerine & Bilmes, 1988: 338)

Amerine and Blimes' paper ultimately challenges the idealised and abstract view of science, detached from its social setting. The relevance of this research topic for multimodal approaches is evident, for it tackles a core process in multimodal communication as is the process of modal transduction (or intermodal transition) from a written account to an embodied practice.

The studies exposed so far in this section highlight the constructionist, and often politically influenced, facet of science; they suggest the relevance of contingencies and contextual

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[5] Regarding the significance of circumstantial aspects of science, see also Lynch (1982)

[6] This will be called 'transduction' in multimodal analysis (see chapter 2).

elements in the construction of scientific accounts; and they point to the partiality of scientific presentations, which requires recovery skills from the part of their interpreters. Inscriptions are thus produced in relevant social environments, whose traces are often removed from them, and within authority frameworks of which scientists are aware and take part by adopting an active role in the persuasion game of science. As Latour (1986: 24) puts it:

> We need, in other words, to look at the way in which someone convinces someone else to take up a statement, to pass it along, to make it more of a fact, and to recognise the first author's ownership and originality.

The issues here summarised are in fact communicative aspects of science that may be of interest for the current study.

Another very rich strand of studies in scientific representation is the one devoted to the analysis of graphic representation, or otherwise termed 'visual image' or 'illustrations'. Since Martin Rudwick alerted in 1976[7] about the lack of attention to pictures in scientific publications, studies in this area have proliferated. Lynch (1988) in fact denounces the 'imbalance' in the literature between studies centred on verbal texts in science and those addressing visual displays, which he deems "essential to how scientific objects and orderly relationships are revealed and made analyzable" (Lynch, 1988: 202). According to Lynch, the centrality of visual displays in scientific practice is such that they are present "at all stages of scientific research"; they are "produced, transferred, and modified as research proceeds from initial observation to final publication"; and "constitute the physiognomy of the object of the research" throughout the research project (Lynch, 1988: 202). The field seems to have undergone a 'visual turn' ever since, and "[i]mages have come into their own as a source for the history of science, even if we are still learning how to interpret them and to emancipate ourselves from text-centered analogies such as 'reading images' and 'visual literacy'" (Daston, 2014: 319).

An important consideration regarding visual scientific representation is that 'seeing' may be deemed an active accomplishment ('work') and often a social one ('social work'). This is shown in Amann and Knorr-Cetina's (1988) study, which shows exhaustively an instance of how (3-dimensional) material entities are transformed into "proto-data" – 2-dimensional visual prompts comprising "ambiguously visible unidentified data traces" (Amann & Knorr-Cetina, 1988: 164) –, these into "data" (2-dimensional signals or displays obtained in the laboratory after treating

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[7] Rudwick, M. (1976). The emergence of a visual language for geological science 1760-1840. *History of Science* 14:148-195.

the material objects), and these into "evidence"[8] in published scientific papers, that is, a montage that visually reproduces the scientist's view of "what was seen". In this process, "seeing becomes socially organized in talk", since 'conversational devices' support scientists in "develop[ing] a sense of 'what was seen' on these data displays" (Amann & Knorr-Cetina, 1988: 163). A socio-cultural implication of the paper's arguments is that ways of seeing are predetermined "through shared paradigms, consisting of rules and standards for correct scientific practice. Under this view, what scientists observe should be grounded in their complex commitments to particular research traditions" (Amann & Knorr-Cetina, 1988: 134). Still regarding the 'work' of seeing, Law and Lynch (1988) unveil the contextual skills deployed in the activity of seeing and naming objects. They do this by pointing to the potential "troubles" that inexperienced apprentices (birdwatchers in this case) might find when relying upon three field guidebooks analysed. As the authors suggest, apprentices need to engage in and master what they call a 'literary language game' essential in 'naturalistic observation'. It entails learning to 'read' and 'write' within a specific social organisation. The authors reflect upon the pros and cons of photography and drawings as representations, and conclude that "there are excellent grounds for questioning both the "realism", and the correspondence theory of perception, which underlie the assumption that photographs are 'more true to life' than drawings" (Law & Lynch, 1988: 294). These scholars also contend that "the novice typically accepts the authority of the text while attributing the trouble to her inexperience, problems in perspective, or to an atypical appearance of the particular individual or local variant of the species" (Law & Lynch, 1988: 296). The authors prove that "seeing at a glance" may be "circumstantial" and "dependent upon local expertise" (Law & Lynch, 1988: 297). These findings are especially relevant for the present thesis, since they simultaneously highlight issues of multimodal communication, of the constructionist nature of scientific knowledge, and of authority and power in scientific representation.

The idea of 'seeing' as socially shaped is also present in Rachel Prentice's (2014) study of surgical training in the operating theatre. Seeing, which in this case is intimately linked with touching/acting, is the result of learning the tradition of surgery and of the surgeon's adaptation to the circumstances of the particular, present situation within a 'surgical culture'. This way of seeing is hence a skill embodied by the surgeon's body in interaction with technology. In fact, developments in scientific representation claim for 'an ontological reframing of scientific vision'

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[8] In this case, 'evidence', which in the natural sciences "appears to be embodied in visibility" (Amann & Knorr-Cetina, 1988: 134) is "the aesthetically enhanced, carefully composed rendering of flexible visual objects that, through the meandering interrogatory processes of image analyzing talk, have been "embedded" and entrenched in procedural reconstructions, local experiences and in the landscape of the data display" (Amann & Knorr-Cetina, 1988: 163-4).

that accounts for the interaction of vision, objects and technologies (Carusi & Hoel, 2014). This resonates with Charles Goodwin's notion of 'professional vision', "which consists of socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group" (Goodwin, 1994: 606). Accordingly, "[t]he ability to build and interpret a material cognitive artifact, such as an archaeological map, is embedded within a web of socially articulated discourse" (Goodwin, 1994: 626).

But seeing might also imply the opposite activity: representing or drawing something. Janet Vertesi (2014) analyses how digital imaging and image processing is used, by geochemists in this case, to construct knowledge and affect further visions of one same object. This process of theory-laden representation is named by the author *'drawing as'* and consists in representing the object in a way that highlights those aspects that are more salient for the purposes of its analysis: "Representation in scientific practice, I claim, is always a question of *drawing* a natural object *as* an analytical object; of conflating epistemological and ontological work in the world through purposeful visual construal" (Vertesi, 2014: 18; *original emphasis*). It therefore should be seen as a way of manipulating image for analytical purposes in order to lead analysts' attention towards specific aspects of the object, and not with dubious or deceitful ends. Such theoretical constraints imposed onto the image-presentation, Morana Alač (2014) suggests, may be common within specific research areas and transferred from old-timers to newcomers through generations of scientists. This has been suggested to constitute a 'new genre' of representation that integrates 'design and vision' (Ruivenkamp & Rip, 2014).

Understanding that the main task of lab workers is to organise details of lab work and its visual elements for the constitution and "framing" of a scientific phenomenon "so that it can be measured and mathematically described" (Lynch, 1988: 218), Lynch (1988) examines two series of visual displays used in scientific publications, with reference to two themes: "selection" – "the way scientific methods of visualization simplify and schematize objects of study" (Lynch, 1988: 201) – and "mathematization" – the process by which "natural" objects are attributed mathematical order. Scientific pictures are seen here as "evidence of methodic practices, accomplished by researchers working together in groups, which transform previously hidden phenomena into visual displays for consensual 'seeing' and 'knowing'" (Lynch, 1988: 203). These 'visual displays' are hence the result of a progressive transformation of the object of study:

> As we trace through the sequence of renderings, we see that the object progressively assumes a generalized, hypothetically guided, didactically useful, and mathematically analyzable form. It becomes progressively less recalcitrant to

26

the textual devices of describing, displaying, comparing, causally accounting, mapping, and measuring. (Lynch, 1988: 216)

This transformational process is exemplified by the analysis of a diagram paired to a photograph, in a scientific publication. The author contends that it is a partial process of selection and simplification, as well as of synthesis of form: "it strives to identify in the particular specimen under study 'universal' properties which 'solidify' the object in reference to the current state of the discipline" (Lynch, 1988: 205). It is hence related to a relative universality of traits within the framework of a discipline. Lynch thus concludes that (1) representation in science follows conventions thriving in the particular scientific field; (2) the authority of these conventions lies in previous experience and in a body of assumptions about the represented object; and (3) the process of representation "includes methods for adding visual features which clarify, complete, extend, and identify conformations latent in the incomplete state of the original specimen" (Lynch, 1988: 229). Such transformations follow what Lynch names 'generic pedagogy' and 'abstract theorizing'.

The context-specificity of conventions for representation is also supported by Anne Beaulieu (2002) and by Cyrus Mody (2014). Beaulieu (2002) relates convention traditions in scientific representation with field traditions on what constitutes 'scientific evidence'; and points to technological, methodological, and institutional factors as determining elements of scientists' divergent stances on scientific images (brain maps, in this case). Mody (2014) points to 'institutional and disciplinary networks' as the transmitting agents of information about conventions, and cautions about the controversy around 'heavily aestheticized' scientific presentations, in-between science and art, technical work and marketing, that allow scientists to transcend disciplinary and organisational boundaries (see an elaboration on this issue in Coopmans, 2011). A possible clue for this problem is placing the focus on the 'viewer', since as Beaulieu states: "The image speaks for itself, but not in quite the same way to everyone—the pictorial aspects of these representations predominate in the public's understanding" (Beaulieu, 2002: 75) while "researchers separate the visual appearance from the content, seeing from reasoning, and imaging from experimenting yet rely on the synthetic power of representations to make their object and to inscribe new phenomena..." (Beaulieu, 2002: 78).

Related to field conventions in scientific representation, Myers (1988) examines the pictures of E.O. Wilson's (1975) *Sociobiology: The New Synthesis,* a book about science addressed *also* to non-scientists, ignorant of the conventions of scientific pictures. In the article, the author distinguishes several categories of pictures (photograph, drawing, map, diagram, graph, model, and table), reflects upon "how these pictures relate to the text, and how they are juxtaposed with each other" (Myers, 1988: 237), and finally applies this analysis to other types of media for the

popularisation of sociobiological ideas. Relevant claims made by the author are that "the iconography of popular science is remarkably persistent" (Myers, 1988: 263); that "new technologies of reproduction of images change the sorts of images that can be used" (Myers, 1988: 263); and that interpretation requires reproduction and thus the creative work of the interpreter:

> ...the partial unreality of the images in Sociobiology (or in any printed popularization), requires us to reconstruct the space within them, and allows us to link photos to maps or drawings to graphs and to produce stories out of pictures. (Myers, 1988: 266)

Scientific representation is here related to the experience of the reader/interpreter: "part of our interpretation of each picture depends on how it relates to those we have already seen" (Myers, 1988: 256). Very relevant for the study of internationalisation at the micro level is the author's assertion that "[t]he elimination of these squiggles and splotches is part of the move from the particularity of one observation to the generality of a scientific claim" (Myers, 1988: 239). Besides supporting the constructionist view of scientific representation, this study implicitly underscores the importance of the generic authority and of generic pedagogy – and thus of training in science. This resonates with works on the multimodality of science textbooks (e.g. Dimopoulos, Koulaidis & Sklaveniti, 2003; Bezemer & Kress, 2008).

Another recurrent topic in the literature is the development and use of new technologies and techniques (e.g. modeling, simulation). These bring about both, new affordances and constraints for visual representation (Rijcke & Beaulieu, 2014) and perceptual configurations (Carusi & Hoel, 2014), which has been claimed to require a new 'approach': "As visual renderings in sciences are becoming increasingly entangled with computers and computational formats, their digital materiality calls for a distinct approach" (Alač, 2014: 61).

As has already been announced, the digital era has also brought about greater concerns around trustworthiness of scientific presentations, especially image. As Frow (2014) explains, in the last years, many journals have dictated guidelines for good practices regarding image presentation and manipulation, required for publication. This author argues that, although analogue images could also be manipulated, these guidelines make reference to manipulation possibilities exclusive of digital imaging and chiefly for aesthetic purposes, due to a general belief among journal editors that trustworthiness is higher for unprocessed images:

> ...what is at stake is the virtue of the scientist who performs these manipulations. In the guidelines and commentaries, the virtuous–and trustworthy–scientist is depicted as one who exhibits self-control and does not interfere with the

relationship between data and image after main experimental work has been
done. (Frow, 2014: 255)

Challenging this view, Frow (2014) highlights the possibilities of tracking modifications on
digital images offered by new technologies. In fact, 'traceability' of modifications, along the
'chain' of inscriptions and of translations, has been argued to be key in scientific practice by
Latour (1999):

> An essential property of this chain is that it must remain *reversible*. The
> succession of stages must be traceable, allowing for travel in both directions. If
> the chain is interrupted at any point, it ceases to transport the truth – ceases, that
> is, to produce, to construct, to trace and to conduct it. (Latour, 1999: 69; *original
> emphasis*)

In contrast with journal editors' scepticism, Frow (2014) suggests that digital imaging and new
technologies should be approached as an opportunity for enhanced scientific representation and
higher trustworthiness. Trust in images should be secured by means of adequate formal training
on image-crafting techniques; and common norms of image creation, manipulation, description
and documentation should be negotiated and established within each specialised area.

Other recent concerns in the field of scientific representation are (a) the work and negotiations
connected with representational conventions; (b) new analytical repertoires to better suit
representational practices; and (c) the embodied interactions that are part of representational
work in scientific practice. As Coopmans *et al.* (2014) point out, these interests are framed
within the current enthusiasm for the notion of 'materiality', which brings with it a focus on the
embodied nature of scientific practice, on the objects and technologies used in it, and on the
settings where it takes place. Other current issues of interest in the field of the sociology of
science more broadly that coincide with studies in scientific representation are: (a) how
expertise is produced and contested, (b) renewed notions of objectivity, (c) the situated
production and reception of texts, and (d) the circulation of representations among diverse
audiences across settings, fields, and spheres. Coopmans *et al.* (2014) reflects a tendency in the
literature towards poststructuralist views of scientific representation, which involves the
questioning of boundaries (e.g. visual-nonvisual, epistemic-ontological, science-nonscience).

As has been shown, the analysis of specific instances of scientific representation may provide
key insights for the study of scientific communication, though these may not be sufficient to
approach broader socio-political issues of the topic. These have been addressed by another
strand of studies in the sociology of science, originally deriving from the philosophy of science
and science history. These studies will be presented in the next section.

1.1.3. The global dimension of science

Understanding that "the local–global distinction is merely the spatial version of micro–macro" (Marston, Jones III & Woodward, 2005: 421) and, as these authors argue, also of the binaries agency/structure and concrete/abstract, several topics addressed in the sociology of science literature that may help link these two levels of analysis will be presented here. First, in section 1.1.3.1., eight sites of connection between local and global scales referred to in the literature will be explained: (a) reified objects, (b) standardisation processes, (c) artifact trajectories, (d) scientists' agency, (e) scientists' position in the field, (f) the notion of success in science, (g) scientists' identity and (h) scientific fact production as a collectivization process. Second, in section 2.1.3.2., trends of phenomena related to the macro-social dimension of science will be summarised.

1.1.3.1. Sites of connection between the local and the global

The first of the sites exposed here in which the local and the global, the micro and the macro, have been found to interplay, that is, where abstract entities take the form of concrete matters, are 'reified objects'. As Latour and Woolgar (1986 [1979]: 238) describe it, in science, intellectual and material entities are closely intertwined: "one cannot take for granted the difference between 'material' equipment and 'intellectual' components of laboratory activity: the same set of intellectual components can be shown to become incorporated as a piece of furniture a few years later". It is thus through the process of 'materialisation' or 'reification' that ideas, notions and statements stabilise and become mobile objects, which constitute part of the so-called 'dead capital' of the laboratory: "Once a statement stabilises in the agonistic field, it is reified and becomes part of the tacit skills or material equipment of another laboratory" (Latour & Woolgar, 1986 [1979]: 238). Trevor Pinch (1985) asserts that also the 'context' is reified in the form of objects and practices:

> The evidential context becomes solidified in a particular piece of equipment (and the associated practices). Every time an instrument is used, the evidential context will be reproduced. The sociological importance of this is that the evidential context is of concern to the wider community of scientists. The wider networks of knowledge are thus integrally linked with black-box instruments. (Pinch, 1985: 30)

This way, Pinch (1985: 30) offers "a picture of how instruments and embodied practices are linked to the wider corpus of knowledge". The author summarises this process as follows:

> Instruments, once black-boxed, can be mass produced and distributed. Laboratories all over the world (and in space) can thus be mobilized to reproduce and solidify evidential contexts. Black-boxed instruments can be used as

> components in other instruments which further reproduce the evidential context tied to those instruments. The establishment of evidential context with black-boxed instruments is, at the same time, the establishment of a set of social relations and is perhaps the key to understanding the success and stability of particular parts of science. (Pinch, 1985: 30-1)

This has implications, the author contends, for the study of how scientific culture – understood as 'the "made things" of science' encompassing "skills and social relations, machines and instruments, as well as scientific facts and theories" (Pickering, 1995: 3) – is produced and reproduced.

Another site of connection between the local and the global dimensions are 'standardisation' or 'normalisation' processes. Alač (2014) in fact argues that micro-level scientific presentations may undergo 'normalisation' processes whereby they are conventionalised and acquire a symbolic tenor. The process of standardisation implies "averaging and filtering out local contingency or individual differences" (Alač 2014: 77). However, Alač argues, it is not a process of deletion and reduction, but also of addition and emphasis of relevant aspects, in a reconfigured manner: "An important point is that contingency and context do not simply drop out; they are reconfigured as renderings are called into play in different circumstances in texts, etc." (Alač 2014: 77-8). Sarah de Rijcke and Anne Beaulieu's (2014: 145) assertion, in relation to brain scans, that "huge investments are made in the development of standards and protocols to make scans aggregable and comparable" could be extrapolated to other areas of scientific expertise – e.g. to medical image formatting protocols (Coopmans, 2011) and to forensic science (Jasanoff, 1998). In fact, as Agazzi (2014: 87) asserts, "every science is in principle characterised by its own criteria of protocollarity", understood as "those specific criteria which, within a certain science, permit the determination of which propositions are immediately true". Rijcke and Beaulieu's (2014) analysis of brain scans collections, called 'brain atlases', suggests that these have legitimate authority based on the averaging of data, and the generation of images linked to underlying data, based in turn on sophisticated algorithms. In this vein, Karin Knorr and Dietrich Knorr (1978: 38) put forward that a chief function of 'scientific products' is triggering "official standardization work", rather than their direct consumption. The process of standardisation in science, as opposed to local interpretations/performances of standard methods and formulations, has been also addressed by Knorr-Cetina (1981), Latour and Woolgar (1986 [1979]), and Star and Griesemer (1989). It is worth noting that standardisation processes may also constitute a tool for domination. Referring to Callon's (1984) 'translation' theory, Law (1986: 8) explains how forcing others "to move along particular channels and to bar access to other possibilities" is a key way of imposing oneself and exerting power on others. This is what

Callon calls the 'obligatory point of passage'. In it resides the clue for domination through the process of 'translation' for scientists:

> Their translations are successful in so far as they manage to impose their work as an obligatory point of passage upon those round about them. And their work is spectacularly successful - it becomes 'politics by other means' - in so far as they are able to collapse the distinction between the large and small scale by forcing macro-actors through their laboratories. (Law, 1986: 32-3)

Standardisation thus implies mobility of actors and resources. An example of this is posed by Kleinman (2003), who describes how university laboratories depend on supply industry selling them standardised materials for their experiments. As Law (1986: 33) argues, "[c]entral to long distance translation" are "[t]he processes of converting materials that are less mobile, durable and tractable [like words, objects and gestures] into materials that have these attributes to a greater degree [like drilled bodies and inscriptions]". With reference to mobile materials, Catherine Kell (2015), following Latour (1987), explores whether and how the concepts of "networks of practices and instruments, documents and translations" may "allow us pass from the local to the global" (Kell, 2015: 72). In an intent to fill in a gap in the literature, regarding "how exactly communication occurs across time and space – the actual mechanics of it and the methodologies available to study it" (Kell, 2015: 72), Kell states that 'verticality' in terms of scale and power coincides with crossings across places and/or contexts. For this, the concept of 'mobility', understood as referring to both, individuals moving and the mobilisation of the semiotic resources or 'texts' that they produce and project is key. The idea of mobility leads to that of 'trajectory', as stated by Thomas Hughes (1985: 77):

> The durability of artifacts and of knowledge in a system suggests the notion of trajectory, a physical metaphor similar to momentum. (...) Durable physical artifacts project into the future the socially constructed characteristics acquired in the past when they were designed.

The trajectory of artifacts – as well as of individuals, 'texts' and semiotic resources – is hence another site of connection between the micro and the macro. This topic has been approached diversely, in its multiple facets: (a) studies on the mobility of scientists between industry and university (Kleinman & Vallas, 2006); (b) on boundary objects and their mobility across 'social worlds' in science (Star & Griesemer, 1989), as well as on (c) 'standardized packages' and the "translation" of interests between diverse social realms (Fujimura, 1992); (d) on (learning) trajectories of scientists and (developmental) trajectories of lab artifacts and their common relational trajectories (Nersessian *et al.*, 2003); (e) on trajectories of scientific debates (Shwed & Bearman, 2010); and (f) on trajectories of scientific discourses between performance in the

laboratory and the writing of a scientific paper for publication (Knorr-Cetina, 1981; Latour, 1987).

A fourth way of approaching the global dimension of science is by focusing on scientists' agency. A recurrent topic in the literature in this sense is scientists' motivation(s). This has been addressed by Latour and Woolgar (1986 [1979]), who argue that a 'quest for credit' only cannot account for scientists' behaviour. In contrast with this traditional account, they propose the idea of the 'cycle of credibility investment' to explain the multiplicity of motivations that may interact. According to their model, there are two types of 'credit': 'credit as reward' – "the sharing of rewards and awards which symbolise peers' recognition of a past scientific achievement" (Latour & Woolgar, 1986 [1979]: 198) – and 'credit as credibility' – "scientists' abilities actually to do science" (Latour & Woolgar, 1986 [1979]: 198). Gains of credibility – understood as "the various investments made by scientists and the conversions between different aspects of the laboratory" (Latour & Woolgar, 1986 [1979]: 239) – allow for reinvestment and further gains of credibility in a feedback-loop manner. Such conception of motivation encompasses economic notions, like salary, budget and funding, and epistemological notions, like conviction, proof and certitude, as well as "the type of inscription devices to be employed, the career of scientists concerned, the decisions taken by funding agencies, (...) the nature of the data, the form of paper, the type of journal" (Latour & Woolgar, 1986 [1979]: 239), among others. All these may have an impact of costs (money, time and energy) and may influence further gains of credibility:

> The notion of credibility makes possible the conversion between money, data, prestige, credentials, problem areas, argument, papers, and so on. Whereas many studies of science focus on one or a small section of this cycle, our argument is that each facet is but one part of an endless cycle of investment and conversion. (Latour & Woolgar, 1986 [1979]: 200)

A key characteristic of the *cycle of credibility investment* is that scientists-investors will unavoidably have to go through the whole process, that is, through the diverse stages of investment, independently of their initial aim or motivation. The generalised conversion processes give place to a kind of *market* of credibility. In it, scientists are investors of credibility, and information is a value since it allows for the production of further information by other investors-scientists and the return of invested capital. This implies that there is *demand* for information and a *supply* of information by and for other investors, which, combined with the number of investors and their equipment for production, determine the value of information. The authors explain this phenomenon as follows:

> Taking into account the fluctuation of this market, scientists invest their credibility where it is likely to be most rewarding. Their assessment of these fluctuations both explains scientists' reference to "interesting problems", "rewarding subjects", "good methods", and "reliable colleagues" and explains why scientists constantly move between problem areas, entering into new collaborative projects, grasping and dropping hypotheses as the circumstances demand, shifting between one method and another and submitting everything to the goal of extending the credibility cycle. (Latour & Woolgar, 1986 [1979]: 206-7)

Understanding thus scientific production in economic-like terms, these authors explain, scientific publications may be regarded as products that, after a sort of market analysis, scientists must make attractive and valued by other scientists, who should deem them reliable and relevant. And this resonates with Knorr and Knorr's (1978: 37) reference to a 'market' where scientific papers address "a generalized demand from which the authors can draw symbolic capital if their product is frequently 'bought' by other scientists". This, the authors explain, brings about 'value' and 'success' to the paper and to the scientist, "which we tend to attribute to the inherent quality of scientific results" (Knorr & Knorr, 1978: 37). The power of persuasion of the paper depends largely upon its role as an 'object of value' in this 'market of demands'.

An asset of Latour and Woolgar's 'credibility model' is that it "can accommodate a variety of types of motivations" (Latour & Woolgar, 1986 [1979]: 207). Moreover, it allows for the connection of the micro and the macro dimensions of the social, for instance through the identifications of instances of reification of credibility investment. One such instance is the scientist's CV, which, as Latour and Woolgar point out, could be seen as 'a balance sheet of all his investments to date'. The CV has several values: to "enable him to be admitted to the game"; to prove that the scientist "has the necessary credentials to invest"; to show the positions of the individual in the field and "that he has actually played sufficiently well to have obtained a position"; and, through the list of grants received, to provide "a statement of the extent of investment already placed in the individual" (Latour & Woolgar, 1986 [1979]: 208-9). The authors relate these outcomes of diverse investments (time, money, effort) to Bourdieu's notion of 'cultural capital', which will be explained in chapter 3.

Accordingly, taking into account this model, the 'production of *credible* data' can be deemed "one way of activating the credibility cycle and of setting in motion the 'business of science' or, as Foucault (1978) puts it, 'the political economics of truth'" (Latour & Woolgar 1986 [1979]: 229). The scientist, these scholars argue, is in this context negotiating the 'tension' resulting from two 'systems of pressures' or 'overlapping economical cycles': the management of their

own capital, on the one hand, and the justification of their use of (third-party) money and confidence.

The individual's 'position in the field' (Bourdieu, 1975) – see also in chapter 2 an explanation of Bourdieu's (1969, 1971a, 1971b) notion of 'field' – constitutes another point of connection between the micro and the macro, locality and globality. Latour and Woolgar (1986 [1979]) in fact argue that this is the unique, distinctive characteristic of each scientist. A scientist's position in the field consists of three aspects: *academic rank* (e.g. professor, assistant professor, lecturer, etc.), *situation in the field* (defined by the object of study and the methods used), and *geographical location* (the institution, laboratory and the scientist's colleagues). A material, reified evidence of this position, occupying the micro level, is the scientist's 'list of publications'. Such position, the authors defend, is thus the result of the interplay of *individual strategy* and *field configuration*, each of which might be modified consequently affecting the individual's position. Such position is hence continually negotiated. Given that "individuals' careers constitute an important resource for evaluation of their claims" (Latour & Woolgar 1986 [1979]: 171), these are closely related to scientists' credibility. In this context, a research group can be seen as "the result of the intertwining of several trajectories" within the field, or "the accumulated moves and investments of its members", which result in a hierarchy of administrative positions (Latour & Woolgar, 1986 [1979]: 216).

Also connected to scientists' credibility and their position in the field, there is the issue of 'success' in science. Following Latour and Woolgar's (1986 [1979]) model, success would correspond to the ease of conversion of credibility that each investment allows for and 'the scientist's progression through the cycle':

> For example, a successful investment might mean that people phone him, his abstracts are accepted, others show interest in his work, he is believed more easily and listened to with greater attention, he is offered better positions, his assays work well, data flow more reliably and form a more credible picture. (Latour & Woolgar, 1986 [1979]: 207)

Another facet of 'success' in science is that whereby it is seen as scientists' construction of an individual career for themselves, "clearly separated from the material and economic aspects of laboratory activity" (Latour & Woolgar, 1986 [1979]: 188). On the contrary, unsuccessful individuals would be those whose career is "inextricably bound up with the material elements of the laboratory" (Latour & Woolgar, 1986 [1979]: 188). We can also find in the literature the notion of success as 'achieving an expected outcome', or 'following instructions faithfully' (Amerine & Bilmes, 1988); as an attitudinal accomplishment (Martin & Meyerson, 1998; Beaufaÿs, 2012); as the achievement of academic career positions (Lühe, 2014); as complying

35

with meritocracy (Mawela, 2014); as a combination of relationships, usefulness of research and overcoming challenges (Leahey & Cain, 2013); or as a combination of career achievements (e.g. wage, status, job positions), satisfaction and relative comparative status with colleagues (Abele & Wiese, 2008).

One more aspect linking the micro and the macro, the concrete and the abstract, is scientists' 'identity'. Many studies have pointed to the relevance of authorship in scientific discourse. Latour and Woolgar (1986 [1979]: 163) found out that "[i]nstead of assessing a statement itself, participants tended to talk about its author"; and that "it was clear from participants' discussions that who had made a claim was as important as the claim itself." (Latour & Woolgar, 1986 [1979]: 164). However, scholars have also underscored that it is a habit in scientific discourse to hide one's identity behind the statement of facts (Bazerman, 1981), especially in the 'hard sciences' (Hyland, 2012). This has been argued to be due to modesty and also caution not to impose the personal discourse onto the collective, which has the legitimate authority (Fleck, 1935); but also to the scientist's commitment to universalism, her belief in objectivity and her will to highlight the phenomena over her agency (Hyland, 2012).

Regarding scientists' identity, other studies have addressed the diverse roles that scientists need to play in their professional practice, each of which may be made relevant in different situations. An example of this is Latour and Woolgar's (1986 [1979]: 188) reference to scientists as either 'the workforce responsible for the activation of inscription devices', 'the makers of decisions and investments', and 'the proponents of ideas and arguments'. Central to these multiple tasks and responsibilities, the scientist is responsible for the production of original knowledge (Whitley, 1985). This view positions "the creative expert as the personified intersection of various thought collectives as well as of various lines of development of ideas and as a personal center of new ideas" (Fleck, 1935: 118). Also, David Hess (2006: 140) cautions that scientists need to 'juggle' conflicts among the diverse roles they play; in the case of his participant, "as medical school instructor, manager of a laboratory, research scientist, clinician, public spokesperson, fundraiser, and party to contracts with private sector firms". As this scholar argues, "[t]he level of role conflict and negotiation, coupled with the formalization of requirements for role specificity" may result in "actual or apparent conflicts of interest and subsequent crises of credibility" (Hess, 2006: 140). Credibility might demand role separation, especially between researcher and entrepreneur, but commercialisation interests may hamper it. The author also suggests that the increasing complexity of roles is related to the emergence of new organisations mediating among former delimited fields, like technology transfer offices (mediating between the university and private companies), supporting foundations (mediating among researchers, clinicians, patients, and donors), and start-up companies (mediating among researchers,

investors, and the industry). Other studies on scientists' roles address role conflicts for scientists participation in university and in industry (Lam, 2005; Croissant & Smith-Doerr, 2008); the role of scientists as policy advisors (Spruijt *et al.*, 2014); and changing occupational roles of scientists (Turpin & Deville, 1995).

It has also been reported that, on some occasions, group or lab identity might be more significant than the self: "before being an individual or a mind, each of our informants was part of a laboratory" (Latour & Woolgar, 1986 [1979]: 188). As such, the individual may have also different identities within the group, depending on her role, tasks, responsibilities, status, etc. For instance, the group/lab leader may have quite a different profile from the other members:

> He is a capitalist par excellence, since he can see his capital increase substantially without having directly to engage in the work himself. His work is that of full-time investor. Instead of producing data and making points, he tries to ensure that research is pursued in potentially rewarding areas, that credible data are produced, that the laboratory received the largest possible share of credit, money and collaboration and that conversions from one type of credibility to another can occur as swiftly as possible. (Latour & Woolgar, 1986 [1979]: 223)

The research group/lab is hence a hierarchical organisation, with individual task specialisation. In this context, the value of each member may be determined by "the extent to which people are regarded as replaceable" (Latour & Woolgar, 1986 [1979]: 219).

The study of identities and individualities brings us, therefore, to the collective. Ludwik Fleck (1935), in his pioneering work reflecting on the broader context and process of scientific fact production, contends that this is the result of a 'process of collectivization', that scientific knowledge is culturally conditioned, and that it arises from non-objective factors. A hallmark of his thought, still in force nowadays (see Aeberhard & Rist, 2009; De Camargo, 2002; Pohl *et al.*, 2010), is the concept of 'thought community or commune' [*Denkgemeinschaft*] or also 'thought collective' [*Denkkollektiv*], not necessarily coinciding with the official community of specialists: "The intellectual leadership and the circles that form around it do not coincide with the official hierarchy and organisation" (Fleck, 1935: 103). The thought community establishes its bonds and boundaries through "statutory and customary arrangements, sometimes a separate language, or at least special terminology." (Fleck, 1935: 103). According to Fleck, an induction period into the community is necessary, in which there is a "leading into" or "gentle constraint", which is "not merely formal", but consisting in "a purely authoritarian suggestion of ideas" (Fleck, 1935: 104). The community's structure is formed by an 'esoteric circle' and a 'larger exoteric circle', which mark its hierarchy, extensible also to the initiates. The author describes the process of 'reification' or 'objectification' characteristic of natural sciences, the first step of

which are scientists' statements taken in the context of the historical evolution of a scientific issue. After this, specialised, technical expressions, as well as special symbols, like numbers, alphanumeric expressions, etc., are attached to their statements. In order for statements to be taken as 'truths', the establishment of the maximum number of relations among elements is required. As has been already pointed out, reification allows for the far-reaching exchange of ideas, in this case also between the esoteric and the exoteric circles, and this may generate the sharing of common traits among communities.

Having presented so far several topics that mediate between local and global scales in the sociology of science, like reified objects, standardisation processes, success, and scientists' identity, agency, and field position, in what follows, trends and processes on the macro/global dimension only will be described, especially those related to communication.

1.1.3.2. Trends of macro-social phenomena in science

Current science is immersed in diverse global trends like industrialisation, enculturation processes and hierarchisation. These and other phenomena will be discussed in this section and will be related to communication in science and to the present study.

We have already reported that historical accounts of science like Fleck's one were usual before the emergence of field studies in the sociology of science. These used to be generalising and homogenising; treating 'science' as a solid entity:

> ...the Science that historians and philosophers describe in their literary accounts is a common science: a science that "we" can know, evaluate, compare our own researches to, form opinions about, describe logics for, etc., without having to engage in any or all of the varieties of technical practices glossed under the unitary heading of science. (Lynch, 1985: 146)

The evolution of the field ever since does not necessarily rule out the validity or pertinence of claims made before, whose influence may reach current accounts on science. One of the greatest exponents of the sociology of science in that period was Robert K. Merton (1968, 1970, 1988). Among his contributions to the field, he proposed the four main values and norms of behaviour (the 'normative structure of science') ruling traditional science from the scientific revolution of the 17th century, and ensuring its functioning ever since. These are *universalism* – truth-claims "are to be subjected to *preestablished impersonal criteria*" and "not to depend on the personal or social attributes of their protagonist" (Merton, 1973: 270; *original emphasis*) –, *communism* – findings are 'a product of social collaboration' and 'a common heritage' (Merton, 1973: 273) of the whole scientific community and of society –, *disinterestedness* – scientists, in their pursuit of the development of knowledge, are mutually accountable for their claims, for the sake of the

integrity of science –, and *organised scepticism* – "temporary suspension of judgment" (Merton, 1973: 277) until claims are confirmed through critical assessment based on evidence.

These values seem however to be challenged in contemporary science by a new and different 'scientific ethos'[9]: against the principle of *universalism*, scientists have acknowledged to consider the validity of some results on the basis of the personal characteristics of their authors, their institution, the country where they were working, etc. (Mitroff, 1974). Instead of the prevailing *communism*, new "forms of knowledge valorization which emphasize secrecy and esotericism" (Bucchi, 2015: 237) have been identified in present-day science (e.g. to preserve intellectual property, patents, etc.). There is though an opposite reaction in favour of the traditional 'communism': some scientists are supporting and promoting open-access journals and data bases aside from commercial channels (Kling & Mckim, 2000; Millstone & Van Zwanenberg, 2000; Young, Ioannidis & Al-Ubaydli, 2008). Furthermore, the concept of 'scientific community' is itself in crisis because, in some sectors, heterogeneous networks among experts, quasi-experts and non-experts are forming and gaining importance (Bucchi, 2015). Regarding *disinterestedness*, the literature has reported the existence of diverse interests and aims on the part of scientists (and their institutions), besides their "altruistic" contribution to science (e.g. status, career advancement, employment, provision of resources). In fact, science has been found to be increasingly influenced by market dynamics, one of which is the use of scientific information as an 'economic commodity' (Young, Ioannidis & Al-Ubaydli, 2008). Although Merton also acknowledges the existence of personal and institutional interests influencing scientists, the extent to which these are "negligible and ineffective" (Merton, 1973: 276), or otherwise undermine the integrity of science, remains unclear. Finally, with reference to *organised scepticism,* some voices have pointed out the importance of the criteria followed other than "material evidence" to judge the significance and validity of scientific results: "Scientific studies try to find true relationships, but none are certain of what these relationships are exactly. Published articles, especially in very competitive journals, have on average exaggerated results" (Young, Ioannidis & Al-Ubaydli, 2008: 1419).

These are just some of the ambivalences and dilemmas that science and thus scientists are currently immersed in: "In Ziman's terms, in fact, we should instead conclude that post-

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[9] 'Scientific ethos' has been defined by Merton (1973: 268-9) as "that affectively toned complex of values and norms which is held to be binding in the man of science. (...) ...it can be inferred from the moral consensus of scientists as expressed in use and wont, in countless writings on the scientific spirit and in moral indignation directed toward contraventions of the ethos".

academic Science 2.0[10] is both proprietary and public, concentrated on local problems but embedded in global networks, commissioned for the solution of practical problems, but also somewhat idealistic in its quest for knowledge" (Bucchi, 2015: 239). In this respect, the notion of *sociological ambivalence* has also had certain success among science sociologists (e.g. Mitroff, 1974; Merton, 1976). According to it, the scientist finds herself in a position of having to manage opposing or contradictory forces, in terms of the norms and values she has to comply with, like those of claiming for the originality of her work, on the one hand, and personal humility, on the other (Merton, 1976). Furthermore, the current coexistence and close connections between scientific subcultures and organisational cultures generates the 'institutional isomorphism' of science (Dimaggio & Powell, 1983) or the "asymmetrical convergence" between university and industry (Kleinman & Vallas, 2006), that is, the accommodation of science to forms and processes typical of commercial organisations. Bucchi (2015) in fact argues that the influence and impact of the market on scientific practice is now greater than ever. See a development of this issue in Ziman (2000), Kleinman (2003), and Owen-Smith (2006).

Industrialisation and privatisation are but two of the new trends in contemporary 'post-academic science', regarding the way it is "organised, managed and performed", as described by Ziman (2000: 67). Other such trends are the 'collectivisation' of practices, in multidisciplinary teams, as a result of having to manage more complex and costly instruments, and the difficulty of dealing individually with the great burden of accumulated knowledge. This may challenge, Ziman (2000: 71) alerts, "the traditional structure at every turn, affecting personal autonomy, career prospects, performance criteria, leadership roles, intellectual property rights, and so on". Furthermore, science is reaching 'financial limits', which constrain its growth. As this scholar argues, its fast, increasing growth has become unsustainable and needs to be slowed down. Another pervasive trend is the emphasis on the 'utility' or 'applicability' of science, which is now "under pressure to give more obvious value for money" (Ziman, 2000: 73), as a consequence of being deemed an economic motor of the State. Science thus must be held accountable for its practices before society. The emergence of a new 'science and technology policy' raises questions regarding the aptness of policy makers for managing it, the autonomy of science from government interests, and the credibility of scientists who compete for real money. Finally, science is being increasingly 'bureaucratised', requiring a great burden of paperwork that scientists need to combine with research, as a result of its collectivisation (entailing the management of complex networks) and of its industrialisation (involving business procedures).

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[10] Ziman (2000: 60) characterises 'post-academic science', the contemporary version of science, as being "regulated by a new ethos and a new philosophy of nature".

With reference to the allocation of resources, identified phenomena that takes place in science in this respect is the 'Matthew effect' (Merton, 1968, 1988), meaning that the tendency is for the accumulation of resources on those who had already received them: "Those in positions of visibility and prestige will have privileged access to further resources and positions of visibility, and so on" (Bucchi, 2015: 240). This "complex psychosocial process" (Merton, 1973: 443) acts in cases of collaboration among scientists of different ranks, as well as in those of simultaneous independent discoveries. It is perceived as a "problem" and "a basic inequity in the reward system" (Merton, 1973: 447), although it also affects the communication system of science: publications of higher-rank scientists may have greater visibility than publications of those with a lower rank. This process underscores the hierarchical structure of science and the power asymmetries that prevail and that are continuously perpetuated, in terms of resource allocation, visibility and prestige.

Connected to these dynamics, there are, in terms of communication, two opposite tendencies: on the one hand, there has been in recent years an increase in the number of scientific articles and journals but, on the other hand, only a small group of them attract most of the attention and interest: in life sciences "six journals account for 68%–94% of the 100 most-cited articles in the last decade" (Young, Ioannidis & Al-Ubaydli, 2008: 1420). This is the so-called 'communication function of the Matthew effect', which appears to be "increasing in frequency and intensity with the exponential increase in the volume of scientific publications" (Merton, 1973: 449). According to Young, Ioannidis and Al-Ubaydli (2008), such hierarchical relations among journals are the result of the 'citation game' (Biagioli, 2016). This consists in considering citation among scientists as an 'objective' measure of scientific quality and success. This is the case of the 'impact factor' of scientific journals (see Chew, Villanueva & Van Der Weyden, 2007; Stock, 2009).

Furthermore, there seems to be a motivation to restrict access to journals, and this triggers their behaviour as 'luxury items' (see Ireland, 1994): "The authority of journals increasingly derives from their selectivity. The venue of publication provides a valuable status signal" (Young, Ioannidis & Al-Ubaydli, 2008: 1420). And this gives rise to an 'artificial scarcity': "any situation where, even though a commodity exists in abundance, restrictions of access, distribution, or availability make it seem rare, and thus overpriced" (Young, Ioannidis & Al-Ubaydli, 2008: 1420). As these authors suggest, low acceptance rates trigger exclusivity based on merit and more hectic competition. The 'need for branding' is the cause of the "strange" arrangement between scientist, journals and public-scientists, by which journals-intermediaries "sell" to the scientists or to their institutions the articles those scientists had written with the institution's support.

The existence of a 'scientific star system' has also been suggested, for which few scientists, the 'visible' ones, are recognised even by mass media, raising interest for their professional and personal achievements, and are often asked about diverse topics within and out of their area of expertise (Claessens, 2008; Bucchi, 2015). This results in the 'personalisation' of science: "Dynamics typical of the scientific community and those of the contemporary media thus overlap in accentuating the personalization of contemporary science" (Bucchi, 2015: 245). These visibility dynamics constitute a new 'power mechanism' "whereby the weight of positions and institutions depends on the visibility of the scientists with whom they are able to associate themselves" (Bucchi, 2015: 243). As a consequence, individual reputation of scientists is so relevant for their professional performance that it may influence the perception of validity and success of their scientific practice from the part of their peer scientists. This significance of the individuals' performance as a member of the scientific community has been named '*communitarian* reputation' (Pizzorno, 2007; in Bucchi, 2015). Moreover, there is an increasing *mediatisation* of science (see Clay, 2010; Schäfer, 2014): "the press offices, PR strategies and other activities aimed at achieving media prominence and public visibility have now become a routine, when not a prominent, feature for most research institutions" (Bucchi, 2015: 245).

Also remarkable is the existence of 'gatekeepers' and 'invisible colleges' (Crane, 1972). 'Gatekeepers' are individuals acting as a "quality- and information-control filter" (Nosek & Bar-Anan, 2012: 226) who hold positions of power so that they can decide about the allocation of resources, the distribution of information, an organisation's structure, etc. 'Invisible colleges'[11] are "the informal communities of researchers that form around a particular research topic, and which often prove to be more influential on the production of knowledge than the formal communities (departments, research institutes or scientific committees)" (Bucchi, 2015: 246). As Frow (2014) suggests, journal editors are key gatekeepers in science, who establish norms that constrain author's creativity within a framework of accepted conventions.

Informal communication has also been found very determinant in science: "...scientists tend to claim (on questionnaires) that they use informal means (and even unplanned sources) for the transmission of 'technical' information. (...) Informal communication has then been treated like a more flexibly packaged version of formal communication." (Collins, 1974: 171). Garvey and Griffith (1971) explore 'informal communication' in a specific domain (psychology) and

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[11] This term was first coined by Robert Boyle (1627-1691) to name the group of theorists in the 'new philosophy' he was part of. Derek. J. de Solla Price, in *Little Science, Big Science...and Beyond* (1963), extended it to refer generally to communities of scientists based on 'interpersonal relationships' and linked by informal communication. The existence of such groups was confirmed by several studies like Crane (1972), Mullins (1973), and Chubin (1983).

elaborate a list of functional distinctions between 'informal' and 'formal' scientific communications. These authors offer an interesting summary of the flow of scientific information from the scientist's first research question to the point that her findings are incorporated as accepted scientific knowledge in the field, which may take 12-15 years. The following are some relevant points the authors make: (a) the existence of an oligarchy or elite of few scientists that are most active paper producers, communicating with and meeting one another, etc.; (b) the high reliance of scientists on informal networks; (c) the essential importance of informal information flows for critical feedback and encouragement; and (d) the existence of a hierarchy of journals and conference-organising societies. The authors are clearly in favour of the 'long judicious procedure' of scientific knowledge production and communication, which they deem core in quality assurance. For this, they argue, the boundary between the informal and the formal domain is essential.

Collins (1974: 181-2) lists some important factors for setting up communicational relations among scientists such as (a) having a common history of information exchanges, (b) elements of formal organisation, (c) an earlier period of colleagueship and co-authorship, (d) an element of direct or indirect acquaintanceship, (e) writing a letter to the source laboratory, (f) a personnel transfer – on visiting fellowships, student placements, or just periods of work at the source laboratory –, and (g) friendship relations. However, the author argues, there seem to be more complexities in communication among scientists than can be expressed by scientists themselves inasmuch as there is an important portion of knowledge that remains tacit and hence unconscious. Some of these complexities are: (1) the overt concealment of information (for competition reasons), (2) the relevance of personal and biographical factors, and (3) that specialist (formal) publications may lack significant information. Also in the case of informal communication, there may be: (4) a pretended openness but certain secrecy – this fits with the idea of 'competitive cooperation' prevailing in science (Merton, 1970) –; (5) that the source interlocutor might not be knowledgeable of all the relevant information and therefore one or both interlocutors might be unaware of whether essential details are being conveyed; (6) that skills are not transmitted by written word only, but by personal visits and telephone calls or by transfer of personnel (Collins, 1974). In addition to this, current trends like the increasing competition in science and its growing commercialisation may also affect communication among scientists, especially concerning the sharing of core information (Walsh & Maloney, 2007).

A more recent attempt to explain the historical development of contemporary science is made by Hess (2006). This scholar identifies four recent processes or tendencies experienced by modern science: expansion of scale, differentiation of institutions, universalisation of values,

and denaturalisation of the material world. 'Expansion of scale' means that the cost and scale of research in laboratory sciences has grown so much that it has overtaken their institution's funding possibilities. This has triggered the irruption of private funding organisations in the field, and concurrently the emergence of debates around the autonomy and control of research. The 'differentiation of institutions' makes reference to the difficulties that scientists face to manage their diverse roles, to align the goals of the diverse stakeholders, and to mediate among them: "For example, scientists and universities develop increasingly complex goals as they negotiate their roles in education, research, fundraising, management, policymaking, citizenship, community development, and entrepreneurship" (Hess, 2006: 125). 'Universalisation of values' refers to the increasing efforts of scientific actors to develop formalised methodologies and standards. This contributes to the establishment of more or less homogeneous 'cultures' of scientific fields, but may however generate "conflicts over access to the means of knowledge production and clashes between expert and lay positions on knowledge-making priorities" (Hess, 2006: 125). Finally, the 'denaturalisation of the material world' is the process whereby "[b]oth research technologies and the technologies/products generated by research tend to become increasingly synthetic or distanced from living entities over time" (Hess, 2006: 125). This has spawned debates over societal and environmental issues and the commitment of research with them.

This leads us to the discussion about the relevance of institutional and socio-political factors in science. Latour (1999: 295) in fact underscores the 'politicised' side of science: "Science has been so thoroughly politicized that neither the aims of politics nor those of the sciences have remained visible". In a similar vein, Latour and Woolgar (1986 [1979]: 213) refer to scientists as 'politicians' and 'strategists':

> ...they are strategists, choosing the most opportune moment, engaging in potentially fruitful collaborations, evaluating and grasping opportunities, and rushing to credited information. (...) Their political ability is invested in the heart of doing science. The better politicians and strategists they are, the better the science they produce.

One main cause of this politically-oriented facet of scientists may be the 'reward system' of academia, which places positive motivational drives on certain aspects of scientific practice and thus forces scientists to perform in a certain way and to value some elements over others. Examples of such incentives are peer recognition, publications, prizes, funding, job positions, credit, etc. Taking part in this 'reward game' is unavoidable; it is thus not only a matter of being more highly or less rewarded, but also often a matter of survival in the world of science. Moreover, the reward system of academia as it is set today, not "valu[ing] public and policy

participation" enough inasmuch as it is deemed "a distraction from ''real'' academic work" (Bickford *et al.*, 2012: 76), puts scientists in the position of having to choose between the traditional scientific value of communism and their individual interests:

> Scholars thus sometimes (or often) face a trade-off between being rewarded by academic peers and contributing to a better world. One way of meeting both types of audiences is to publish for one's peers and then translate the ideas for a more general public or for activist audiences. (Woodhouse *et al.*, 2002: 310)

As these authors suggest, the academic reward system exerts pressure on scientists to behave conservatively, in either of these two ways: by prioritising the publication of non-prescriptive, field-relevant scholarly works, or by engaging mostly in attracting research grants, and consequently dismissing or relegating activism to the background. Therefore, the reward system of academia "influences the "class structure" of science by providing a stratified distribution of chances, among scientists, for enlarging their role as investigators" (Merton, 1968: 57).

Furthermore, the increasing intervention of private stakeholders in the academia, the ever more complex structure of scientific organisations, and the ever more intricate scientific networks (Owen-Smith, 2006) are evidencing and even multiplying the deficiencies of the current reward system and increasingly fostering claims for its overhaul (see Sturm, 2006; O'Meara, 2010; Eatman, 2012; O'Meara, Eatman & Peterson, 2015).

Also related to the politics of science more generally are power issues and imposition/domination mechanisms. These have been already mentioned throughout this section, since power is a cross-sectional issue. As has been suggested, power is present in standardisation processes, that is, where one's 'point of passage' (Callon, 1984) is imposed on others. Domination can be also found in communication, when one is established as the spokesperson of many: "how a few obtain the right to express and to represent the many silent actors of the social and natural worlds they have mobilized" (Callon, 1984: 224), like 'elite scientists', or in the form of gatekeepers (i.e. journal editors). Credit is also a domination mechanism, since it triggers the full acceptance of a claim by an audience, when it is deemed compatible with one's cultural tenets (Kahan *et al.*, 2007). This way, the credited author holds an extraordinary degree of influence on its audience. Related to credit, also prestige and recognition for one's identity, position in the field, or accomplishments and success, are sites of power. This in fact illustrates Sergio Sismondo's (2014: 17) statement that "[p]art of the work of successful technoscience, then, is the construction not only of facts and artifacts but also of the societies that accept, use, and validate them". Similarly, Law (1986: 34) asserts that "[i]f science is powerful it is because it has created a network of locations where there is some agreement

about warrantable connections" and that "if science, as an institution, is powerful then this is because it has succeeded, as Latour has argued, in scientising parts of social life".

Accordingly, it might be argued that the success of contemporary science is due, on the one hand, to the standardisation and thus homogenisation of many aspects (i.e. machines, protocols, equipment, processes, materials) it has achieved, for which 'scientific consensus' (Bolsen & Druckman, 2015) is key, and, on the other hand, to its imposition of certain points of passage on society at a global level. The generalisation – meaning the widespread consumption/use – of these reified and standardised products, constitutes a 'point of passage' that marks the domination of their producers upon a great scientific "market". Consequently, it is not surprising that the internationalisation of scientific products may favour their producers or their 'traders' in the first instance (see Kleinman, 2003). The power of science as a culture is such that its norms and values are imposed without the need of clarification and often without even being understood. This corresponds to Collins' 'enculturational model', which "involves the transmission of a *culture* which legitimises and limits the parameters requiring control in the experimental situation, *without necessarily formulating, enumerating or understanding them*" (Collins, 1975: 207; *original emphasis*). A great deal of the success of science is thus its 'enculturation' force.

This would however not have been possible without the important role of communication in science. As Merton (1973: 450) puts it:

> ...for science to be advanced, it is not enough that fruitful ideas be originated or new experiments developed or new problems formulated or new methods instituted. The innovations must be effectively communicated to others. That, after all, is what we mean by a *contribution* to science – something given to the common fund of knowledge. In the end, then, science is a socially shared and socially validated body of knowledge. For the development of science, only work that is effectively perceived and utilised by other scientists, then and there, matters. (*original emphasis*)

The effective communication of science over centuries has brought about the 'cultural authority of science', a very powerful resource for communication, and even for political communication: "confidence in the cultural authority of science has even been shown to withstand the powerful influence of political ideology" (Blank & Shaw, 2015; in Akin & Scheufele, 2017: 31).

Therefore, communicating scientists need also to draw on persuasion strategies, understood as "a tentative matter, a constant attempt to propose a set of interrelationships and values" (Law & Williams, 1982: 554), for achieving power positions. As a social tool, it has to take the recipient's values into account, inasmuch as "both persuasion and power depend, in the last

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instance, on the capacity of whoever seeks to control, to align his array with that of the hearer at valued points" (Law & Williams, 1982: 554). These 'valued points' by the recipient constitute what Knorr and Knorr (1978) call 'field of demands' or 'market of demands', and, as they claim, "it is in reconstructing this market that the persuasion of the paper is achieved" (Knorr & Knorr, 1978: 38). As these authors suggest, scientific texts can thus be analysed considering these fields of demands as a semiotic compound present in them. And this is indeed a chief endeavour of the current thesis.

In the next section we will tackle several aspects of the communication of science that involve two different publics: the general public and scientists themselves. The communication of science for the general public has been approached by studies in the field of 'science communication'; and communication among scientists will be dealt with here from a multimodal social semiotic perspective [see chapter 2].

1.2. Science communication and communication among scientists

Science communication has been defined as "the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the AEIOU vowel analogy): Awareness, Enjoyment, Interest, Opinion-forming, and Understanding" (Burns, Connor & Stocklmayer, 2003: 183), which "may involve science practitioners, mediators, and other members of the general public, either peer-to-peer or between groups" (Burns, Connor & Stocklmayer, 2003: 191). Accordingly, *science communicators* may "serve as a crucial link between the activities of scientists and the public that supports such activities" (Treise & Weigold, 2002: 310). And this is often a task assigned to scientists themselves. Therefore, there are diverse aspects explored within this field that may be relevant to some extent for the current research project: science dissemination to a non-scientific audience (Weber & Schell Word, 2001), values reflected in scientific communication (Dietz, 2013), the technologies used for scientific communication (Lamb & Davidson, 2005), the language/s used (e.g. Meneghini & Packer, 2007), scientific communication through diverse means and/or genres (journal papers, oral presentations, posters, visual representations within these) (e.g. Benestad, 2015). In fact, this latter topic is very closely related to another important line of research: *academic literacies*, which will be introduced in section 1.4.

There is however another strand of research that is most tightly connected to the present study in the types of questions it poses and in the theoretical approach and methodology used. This encompasses those studies exploring *communication among scientists*, and especially those which approach it from a multimodal communicative perspective. For this reason, I will start by

commenting on works of this type and go on afterwards summarising relevant findings in *science communication*.

There have been in recent years interesting pieces of research exploring *one-to-one communication among scientists*, some of which approach it from a multimodal perspective, as is the case of this study. Lorenza Mondada's (2005) work is one of the clearest examples. In this piece of research, Mondada explores multiple interactions among scientists working in Europe, in diverse circumstances (in the same research group, as part of the same interuniversity networks, in interdisciplinary projects, or in international workshops), with diverse purposes and from diverse fields (e.g. cartography, ecology, culture studies, surgery, and history). The researcher adopts the perspective of interactional linguistics – originated from conversation analysis – to analyse, through specific instances of recorded conversations among scientists, several interactional phenomena: (1) how discussions are organised during scientists' work sessions, (2) the collective elaboration of 'knowledge objects' (*objets de savoir*) in scientific practice, (3) how multilingual interactions among scientists develop, and (4) the intertwining of verbal modes of communication (speech and writing) with object manipulation and gesture in scientists' interactions. Mondada makes interesting points as regards the details of the situated, collective construction of scientific knowledge at the micro level, through 'indexical' (local) elements, which give place to 'collective intelligences' in science. The author underscores the influence of the organisation of interactions (how interaction among scientists is structured) on diverse aspects, such as the formats of participation (participants' roles, like moderator, orator confronting an audience, etc.), participants' identity and identity markers (like expert or non-expert), and the trajectories of 'knowledge objects' (constructed more or less collaboratively, more or less dynamically, throughout the interaction). Regarding multilingual exchanges, and contrasting with the general view in the literature on the internationalisation of higher education, Mondada asserts that *English as a lingua franca* is not the only strategy adopted by scientists in their interactions, not even the most widespread one. Instead, multiple languages are diversely used by scientists even within one same communication session, responding to their local accommodation to the contingencies of the particular interaction. As the author claims, "[d]espite the discourses, stereotypes and convictions of actors and institutions, international scientific practices remain multilingual" (Mondada, 2005: 87; *my translation*). This use of diverse linguistic resources might hinder communication but might also, or instead, enrich scientific knowledge by triggering the discussion of the diverse connotations of concepts in each language. Finally, Mondada addresses also the multimodal dimension of scientists' communication. Besides illustrating how gesture, object manipulation and verbal modes are combined in scientists' exchanges, the author emphasises also the 'praxeology of vision', that is,

how perception in science is not clear-cut, but accomplished in practice through the combination of these modes, and how this directs attention and emphasises certain details over others.

Mondada's study of scientists' 'microdecisions' as the origin of generalisation, objectivisation, and reification is undoubtedly inspiring for the present study. First, it approaches the micro level of analysis of communication in science, which is one of the aims of the current project. And second, it makes reference to concepts potentially linking the micro and the macro levels of analysis, such as indexical elements, political aspects of communication and the identity of participants, which may be useful in our analysis.

Although not directly addressing communication among scientists, there is a line of research on communication in the science classroom from a social semiotics perspective that contributes interesting insights to our project. One of these is Jay L. Lemke's (1990) study of communication in the high school science classroom. In it, Lemke considers science as part of a social system composed of resources, a history and values shared by a community of individuals:

> Science does not stand outside the system of social values. Like all meaningful human activity, it depends on socially shared habits, practices, and resources that each individual can mobilize only because he or she is a member of a community with a history and a system of basic values. (Lemke, 1990: 45)

The author cannot conceive of any analysis of communication in a science classroom "if it pretends that teachers and students talk science[12] in ways isolated from wider social values and conflicts" (Lemke, 1990: 48). This critical view on communication is thus indispensable. Besides contending that science is communicated multimodally – involving "reasoning, talking and writing with other forms of action such as using scientific apparatus or computer, and making observations and measurements" (Lemke, 1990: 154) –, Lemke underscores the power asymmetries that can be found in the classroom context and in science more generally:

> Science, no more and no less than any other human activity, has had the history it has because people made choices to explore some areas rather than others, to invest in some kinds of research, to encourage some sorts of questions to be asked, some fields to be considered more important than others. Science, through

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[12] For Lemke (1990: 1), 'talking science' means communicating "in the language of science" and acting "as a member of the community of people who do so", which includes not only using specialized language, but also mastering mental processes, rhetorical strategies, genres typical of scientific practice, as well as practical action, such as "observing, describing, comparing, classifying, analyzing, discussing, hypothesizing, theorizing, questioning, challenging, arguing, designing experiments, following procedures, judging, evaluating, deciding, concluding, generalizing, reporting, writing, lecturing, and teaching in and through the language of science".

its history, embodies value-choices and value systems. And it reflects the interests and power of those groups that have been in a position to influence, however indirectly, its history and course of development. (Lemke, 1990: 46)

Especially inspiring for our project is Lemke's micro analysis of semantic, thematic, (inter)actional, organisational and orientation patterns in specific instances of communication in the science class. The scholar asserts that the mastery of thematic patterns[13] of each topic is "[t]he most essential element in learning to talk science", for these are "highly standardized in each field of science" (Lemke, 1990: 27). Among his findings, the author suggests that: (a) there are evident power inequalities between teacher and students besides differences of interests and values, which might cause conflicts; (b) the science of the 20th century is apparently ruled by a (selected) 'technocratic elite'; and (c) discourses of objectivity and value-neutrality of scientific facts – which contribute to the 'mystification' of science – rely on interests of technocrats and serve to legitimise them. Finally, with reference to the international dimension of science, Lemke (1990: 138) claims that "[s]cience is not limited to one culture, one dialect of English, or one style of communication"; alerting of the primacy of Western culture in science.

In Lemke (2000), the author analyses scientific literacies acquisition of a high school student (grade 12; age 17-18 approximately), and remarks the importance for the science curriculum of encompassing the integration skills of multiple literacies that science requires: "the maximal literacy demands of the scientific curriculum arise from the need to integrate specialized verbal, visual, and mathematical literacies quickly and fluently in real time" (Lemke, 2000: 247). This is what Lemke names 'complex multi-literacy practices'. In this sense, scientific literacies entail not only understanding scientific phenomena and using scientific concepts, but also using representational resources in a specific way:

> What it means to be able to use a scientific concept, and therefore to understand it in the way that a scientist does, is to be able to fluently juggle with its verbal, mathematical, and visual-graphical aspects, applying whichever is most appropriate in the moment and freely translating back and forth among them. (Lemke, 2000: 248)

The implication of this for science education is that it should emphasise and make explicit such generic, multi-dimensional and multi-modal requirements and thus train and assess students in a more targeted way. Also related to the science curriculum and multimodal communication, Arlene Archer (2010) analyses 'scientific discourse', in higher education in this case, from a multimodal social semiotic approach. The author advocates for a 'reciprocal curriculum' in

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[13] 'Thematic patterns' refer to "the patterns of connections among the meanings of words in a particular field" of human activity (Lemke, 1990: 12).

academia in which students' communicative resources of any kind be considered and assessed in their multimodal dimension. This is a claim for a more democratic education that acknowledges students' capital and values their differences.

Still regarding the curriculum of communication in education (and scientific discourse), Kress (1996) underscores the impact on it of the two processes of globalisation and internationalisation, which imply the introduction of "the generic/social structures of one place to another, whether that place has the means to cope with them or not" (Kress, 1996: 190). Among other considerations, and adopting a multimodal communication standpoint, Kress compares two science textbooks (from the 1930s and from the 1980s) and points out the difference in the 'forms of social relation' they project and in the 'pedagogic effects' of these forms. While in the older textbook images are a version of the written text, the more recent textbook offers a different use of them: written text and image supply complementary information. This indicates a 'specialisation of modes of communication', which the scholar deems a 'fundamental change' in education. Besides this, the author foresaw, more than 20 years ago, that the increasing use of electronic technologies and the generalisation of the information-based economy would probably entail a greater importance of visual modes of communication in the future and in more areas of a globalising world.

Kress suggested three ways in which local forces might confront globalisation and internationalisation pressures: opposing them in a reactionary way; yielding to them with cultural nostalgia; or trying to contribute productively with adapted, local cultural values. Especially interesting for the purposes of our project is Kress' (1996: 195) reflection on the demands of internationalisation and globalisation for communication:

> Internationalisation and globalisation of communication will demand quite new kinds of dispositions, attitudes and skills, which go beyond the relatively simple issue of learning a number of languages, though that is an important aspect. If genres and forms of writing, as much as forms of speaking, reflect and encode, enact the social structures and values of one place, then a curriculum will have to make available to its students the resources for communication which reflect global requirements: Utopian forms, literally.

According to the author, these new requirements imply the action of creative individuals that are allowed to manage and transform the semiotic resources they have available to produce innovative designs.

Some of Kress' observations referred to above are confirmed by Dimopoulos, Koulaidis, and Sklaveniti (2003), who, after analysing still images in science textbooks, conclude that the

content specialisation, the elaboration and the abstraction of their visual code increase with the educational level they are aimed at, and that, in these textbooks as well as in press articles, images are used "to attribute a pre-eminent value to real world elements, the salience of which seems to be exploited as an anchor to the introduction of students to the reified and highly abstract world of science" (Dimopoulos, Koulaidis & Sklaveniti, 2003: 203). The increasing relevance of image in the communication of science has been claimed to be a general tendency instead of being exclusive of science:

> ...as the communicational landscape is moving more towards the use of image in
> many domains of communication, especially in popular domains, and as children
> are more and more habituated to getting information visually, there will be a
> tendency to follow that trend because not to do so will seem to harbour the danger
> of not engaging (with) the children's interests (Kress *et al.*, 2001: 175).

Although not dealing with children in this case, current scientists are already heirs to this tendency. The new trends of representation and communication in the academia and in science, mostly working globally, though with a diverse *tempus* and pace, may lead the way of the science of the future.

With reference to the science of the future, where technology may play a significant role, Alač (2005) analyses multimodal interaction among neuroscientists and digital images of human brains, in order to discuss on the conceptual tools available for such analysis. The author explores the properties of multimodal interaction, how the diverse elements of such interaction are coordinated and enable or facilitate one another; and concludes that "the acts of reading 2-D digital images involve embodied performances" (Alač, 2005: 89) and hence the move of information across 'meaning spaces', from a screen to embodied action and vice versa. The author underscores the mapping possibilities of gesture when coordinated with visual representation, as well as its potentialities to represent imaginary events. In relation to these latter, 'imaginary events' in science, Liu and Owyong (2011) explore from a social semiotic approach how metaphors help multiply the meaning of scientific representation. In particular, they analyse symbolic formulas for chemical compounds in their diverse semiotic forms. The authors argue that "the semiotic transition from language to symbolism expands the meaning potential of chemical discourse and re-construes everyday experience as scientific knowledge" (Liu & Owyong, 2011: 822). In order to contribute their insights to science education, these scholars suggest that "achieving scientific literacy can be practically conceptualized as the grasp of the meaning potential of multi-semiotic representations" (Liu & Owyong, 2011: 832) instead

of a matter of purely cognitive skills. These studies aim at contributing to the gap in the literature of methods for the analysis of cross-modal interaction.

The above described studies address science communication at a micro level. However, some of the actors participating in such communication act also as 'brokers' between their research group and policymakers, and thus engage also in meso- and macro-level communication, which requires a "tailoring" of communication "for each audience":

> Science departments must engage with diverse audiences—for example, science users and decision makers, the scientific community, public organisations, and individual citizens—in ways tailored for each audience. This means paying greater attention to the changing contexts in which information is received and used, and consequently the mechanisms and relationships required to produce and transfer scientific information. (Bielak *et al.*, 2008: 201)

This phenomenon has been tackled within the field of *science communication*. As a field of research – also called 'the science of science communication' –, it is concerned with the systematic evaluation of "how scientists and others convey scientific information, how the public receives and interprets it, and the social and political aspects of these dynamics" (Akin & Scheufele, 2017: 25). It thus takes a more generalising approach to scientists' communication than the literature previously referred to. That is, it makes reference to groups of actors, such as 'scientists', 'the public', 'the audience', 'stakeholders', 'policymakers', etc., in a generalising way and hence with a generalising intention, which here could be regarded as a more 'macro' scope.

Even though the public uptake of scientific information is not a central concern of this project, it may be one aspect that our participants, practitioner scientists, may have to deal with. In fact, science communication or 'popularisation' is an activity scientists often need to engage in worldwide (Bucchi, 2008). To that extent, this research study may contribute to the literature on science communication, as well as to other areas related to communication in science.

There is in the literature the belief that the field of science communication has evolved since the predominance of the '(knowledge) deficit model', which views audiences as passive actors that need to be enlightened by (science) communication so that their "knowledge deficit" be filled in. Within this paradigm, the public communication of science was deemed diffusionist, that is, it was conceived as the diffusion of a message, mediated by the media and science journalists, to a passive public-recipient of the information. It was seen as a linear, one-way process of information transmission, and a simple knowledge transfer from the scientific context to the lay public (Bucchi, 2008; Bubela *et al.*, 2009). Among the advocates of the paradigm shift, there is the perception that, since the 1950s in the field of communication and the 1990s in science

communication, this perspective has changed. On the one hand, the theretofore non-problematised 'transfer metaphor' has been challenged:

> Studies have shown, among other things, that different types of filter can contribute to make the transfer a selective process. Filters include selective perception of media messages, previous motivations and attitudes of audiences, and communication intermediaries such as opinion leaders. (Bucchi, 2008: 66)

On the other hand, the 'knowledge deficit model' "has not elicited consistent empirical support" (Akin & Scheufele, 2017: 26) (e.g. Gauchat, 2012).

Therefore, many scholars argue nowadays in favour of 'more recent models' that "recognise the importance of context and social negotiation of meaning" (Burns, Connor & Stocklmayer, 2003: 186), and that hence reflect the complexities of science communication. As a reaction against the 'hierarchical', 'top-down' (Bucchi & Trench, 2016) 'knowledge deficit model', in the last two decades many researchers have focused on highlighting the convenience of two-way- and multiway-dialogue models (where scientists, communicators, policymakers and publics interact) (Akin & Scheufele, 2017).

As part of the dialogue model, the latest tendency is to consider both scientists and the public equally implicated actors in science communication and understanding: scientists have control and understanding of scientific facts and the public has local knowledge and interest in the problems that science is aiming to solve (Burns, Connor & Stocklmayer, 2003). This is known in the related literature as the 'contextual model/approach' to science communication, and is usually related to the use of the plural form "publics" to emphasise the heterogeneity in characteristics and behaviour existing in this group (Bucchi & Trench, 2016). The increasing diversification of practices in communication of the diverse actors (like scientists and institutions) may even problematise the use of the term "scientific community", which denotes "homogeneity and a shared commitment to specific norms and values" (Bucchi & Trench, 2016: 162).

Although these latter models have often been deemed an accurate evolution of the traditional 'deficit model', which many experts regard as obsolete (Bucchi & Trench, 2016), there is also the view among some scholars that the diverse models coexist (e.g. Bucchi, 2008) and that the deficit model is not absolutely overcome: "the notion of absent knowledge of facts, expressed as

a low level of scientific literacy, or scientific illiteracy, remains widely assumed" (Bucchi & Trench, 2016: 155)[14].

The implantation of dialogue models has also reached policymakers and thus policies, as is the European Commission's research programme Horizon 2020 (2014-2020). In it, "support is being given to exploration of participatory mechanisms for deliberating on science, including on agendas for science, where the main agents of public participation are civil society organisations" (Bucchi & Trench, 2016: 158). The willingness for participatory mechanisms, democratic processes and joint establishment of research agendas among diverse social actors has also been named 'participation model' (Trench, 2008): "In many countries, and at the European level, funding schemes and policy documents shifted their keywords from 'public awareness of science' to 'citizen engagement'; from 'communication' to 'dialogue'; from 'science and society' to 'science in society'" (Bucchi, 2008: 68).

Finally, Bucchi (2008: 69) advocates for the need for a variety of communication models to explain the mechanisms of contemporary science communication:

> Companies, environmental organisations and patients' groups have established themselves as legitimate sources and providers of science communication. A feature of the contemporary science in society context is also its intrinsic heterogeneity and fragmentation: communication is subject to the contradictory pressures of knowledge privatisation and commodification, open access and sharing of research results, and citizens' demands for greater involvement. All this makes implausible the use of a single science communication model to account for the varieties of contemporary expert/public configuration.

This author proposes a 'multi-model framework' for which the diverse models (deficit, dialogue and participation) are 'ideal types' that might fit with one specific instance of science communication each, or also fit with it in combination with one another: "simultaneous coexistence of different patterns of communication that may coalesce, depending on specific conditions and on the issues at stake" (Bucchi, 2008: 72). An interesting aspect of this framework is the relevance given in it to the *ideological contexts* and the *aims* of communication. For instance, Bucchi (2008) contends, the participation model is incompatible with the 'knowledge economy' rhetorics in the sense that the latter supports a 'technocracy' that requires the perpetuation of power asymmetries. In fact, despite the apparent push towards co-participation in science communication, "a continuous tension exists between opening up the

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[14] In the field of science communication, *scientific literacy* has a dynamic meaning, "from the ability to read and comprehend science-related articles to its present emphasis on understanding and applying scientific principles to everyday life" (Burns, Connor and Stocklmayer, 2003: 187)

black box of deficit communication for participation and, instead, putting participation back into the deficit box, with groups and institutions publicly struggling to impose their communicative definition of the situation" (Bucchi, 2008: 70).

It is not only policymakers but also scientists themselves that use science communication for political purposes: to generate or regulate scientific debate, for broad-reaching communication with scientists from different disciplines, places, etc., and especially to gain recognition and construct a shared scientific identity for a new research sector. Indeed, the media are an effective means for politics: "Placing scientific notions in these media 'frames' gives them legitimacy and enhances their credibility" (Bucchi, 2008: 64). As has been already suggested, science in itself has been argued to be a political instrument, imbued with a tenor of 'unrealism', 'insensitivity to uncertainty and variability', and 'incapability of admitting its own limits' (Wynne, 1992: 294). And this rhetorical stance, also analysed in the field of science communication, may often be found in scientists' discourse. Characteristics of it, this author suggests, may be standardisation of processes, formal and inflexible methods and procedures, ethos of prediction and control, and exaggerated sense of certainty. Nonetheless, despite these rhetorics of certainty and absoluteness, scientists' communication is not devoid of interferences. Scientists adopting a communicator role may face different difficulties, especially due to their detachment from novice and/or non-expert status: lacking accurate intuitions about people's beliefs and information requirements; composing complex messages, with excessive information; or using specialist jargon (Bruine de Bruin & Bostrom, 2013).

With reference to communication models in science communication, there is also the belief that contemporary trends in science may require new models that integrate it with society: "it is crucial to think about the reshaping of communicative relationships and, above all, to resist conceptualisations of science and society as separate and distinct from each other." (Bucchi & Trench, 2016: 162). And besides the models for "effective" communication, some studies in science communication have addressed other issues, like (a) the influence of audience characteristics on people's interpretation of scientific issues and their attitudes towards them; (b) how audience attitudes are influenced by the socio-cultural context; and (c) identity in relation to credibility and trust in science.

As for the influence of audience characteristics on people's interpretations and attitudes, Dietram Scheufele (2006) argues that audience members draw on their personal values – like deference to scientific authority, and trust on scientists –, their religious and political ideology, and other 'cues from mass media' to make sense of scientific issues and make judgements on them. However, studies show that "trust tends to be more variable and less stable than a deep-

seated confidence in the 'cultural authority' of science (Gauchat, 2012; Scheufele, 2013)" (Akin & Scheufele, 2017: 30). Other potential influences are people's previous mental models, schemes and beliefs (Bruine de Bruin & Bostrom, 2013), motivations for accuracy in their conclusions (reaching 'correct' conclusions), and prior-belief affirmation (Nir, 2011). Other intermediary-level influencing factors, as proved by research on people's decision-making, attitudes and behaviour, are: type of social norms appealed to (Goldstein, Cialdini & Griskevicius, 2008), (group or individual) identity (Kahan *et al.*, 2007), social linkages in communities (Scherer & Cho, 2003), and the social system and one's role within it (Tansey & Rayner, 2009).

Regarding the ways in which audience attitudes can be influenced by 'leveraging social and cultural mechanisms', research in this line has found that (1) justifying opinions on controversial social issues to interlocutors with unknown ideology triggers complex thinking – considering diverse perspectives and making new connections among arguments – and mitigated extremity of own opinions; and (2) interlocutor's ideology expectation elicits the communicator's accommodation to the expected position (Tetlock, 1983). Xenos *et al.* (2011) show that anticipation to having to explain one's view does not prompt information seeking from individuals but it does elicit a focus on persuasive arguments rather than on factual knowledge. And Bolsen and Druckman (2015) conclude that motivating individuals to 'make even-handed judgments' counteracts 'politicised' scientific discourse; and that motivation is enhanced "when individuals anticipate having to explain their opinions to others" (Bolsen & Druckman, 2015: 760).

With reference to *identity*, the strand of thought approaching science communication from the sociology of science situates 'identity' as the umbrella construct which encompasses the other aspects –like credibility and trust – influencing people's attitudes towards science: "the best explanatory concepts for understanding public responses to scientific knowledge and advice are not trust and credibility *per se*, but the social relationships, networks and identities from which these are derived" (Wynne, 1992: 282). From this perspective, people's 'understanding' of scientific issues takes place in a social environment to which it is liable: "'Understanding' or knowledge, its precision and resilience, is a function of social solidarity, mediated by the relational elements of trust, dependency and social identity; constructing that 'intellectual' understanding should be seen as a process of social identity-construction" (Wynne, 1992: 283). For this reason, this author exposes, given that identity is unstable and dynamic, 'coherence' in attitudes such as trust is not the norm, and these are thus non-measurable. Hence, models of science communication should account for such instability and variability.

Exploring such phenomena helps the understanding of general mechanisms of science communication, that is, of the processes of opinion formation about science and scientific facts, of opinion counteraction, of persuasion and support elicitation, of politicisation discourses around science – those emphasising uncertainty on science – , of scientific consensus, and more generally of influencing people's attitudes towards scientific issues through communication. However, treating 'messages' as units of analysis in an experimental or quasi-experimental approach erases the nuances of discourses and their dynamicity. This is something missing in the literature above referred to. In fact, the most general conclusion one can draw from these works is that people's attitudes towards science are variable and, above all, are influenced by many aspects, internal and external. Digging into this complexity is precisely a core mission of this project.

At a more concrete level, such processes may take the form of discourse design, production, consumption and interpretation by specific social actors in the scientific field, which is a central aspect of this thesis. In particular, the ways in which scientific discourses are generated, conveyed and interpreted within the scientific team may have commonalities with the ways in which they are generated, conveyed and interpreted in communications between scientists and other publics. This may be especially true when one considers scientists but one link in the chain of scientific discourse construction and of science communication; they are but one among the many intervening actors. *Scientists* here will not be seen as a homogeneous and stable mass of people, but as subjects with individual and dynamic approaches to science and to scientific discourse, and thus as actors who influence and are influenced at the same time by them.

Consequently, the communication model from which this thesis will depart is not that of sender-prototype scientists sending out messages to diverse prototype publics, who respond to them always influenced by the (socio-cultural) context. The model proposed here is one where scientists perform unstable identities, which evolve over time, throughout their individual (learning) trajectories. They are senders and receivers of scientific messages, producers and consumers of scientific discourse, which is however not exclusive of scientists but pertains to and is shaped by society, that is, by multiple actors acting in diverse fields and organisations, with diverse interests and aims, *all* of them with their own political stances [addressing the politics of science see Epstein (1996), Latour (2004) and Pielke (2007)]. Within the research group, science communication may take the shape of the negotiation of abstraction and concretion, of expectations and anticipations on the part of its members.

This perspective has been named the 'sociology of scientific knowledge' or the 'constructivist approach', according to which "these accounts [on the natural world] are not directly given nature but may be approached as the products of social processes and negotiations that mediate scientists' accounts of the natural world" (Martin & Richards, 1995: 512). As opposed to the 'positivist approach', for which there is one true or 'accurate scientific view', the constructivist approach acknowledges the existence of diverse streams of argumentation and positions, which deserve equal consideration as alternative accounts. This will be also combined here with a 'social structural approach' to the study of scientific discourse and communication (see Martin & Richards, 1995). As will be explained in chapter 2 (*the theoretical framework*), concepts of social structure will be used to make sense, at a macro dimension, of the phenomena and processes observed at more micro dimensions.

My proposal is hence devoid of the 'science-centred basis' traditional in the research programme of science communication, which is based on the assumption that "science is unitary and coherent, and that it should be central to everyday beliefs and practices" (Wynne, 1991: 112). As in the case of other studies in the sociology of science, it departs from the conviction that "there is no clear consensus even among scientists themselves as to what is 'science' or 'scientific knowledge' in any specific context" (Wynne, 1991: 112). *Science* from this standpoint is but an object of interpretation and representation, negotiated among scientists, institutions, publics, policymakers and other stakeholders, and thus variable in its meaning, scope, characteristics, etc.

Acknowledging that research on *science communication* has traditionally evolved in parallel to the sociological study of science, that is, the *sociology of science* (Bucchi, 2008), this thesis may supply tools to fill in this gap by reconciling these two disciplines. This will be attained by the analysis of communication within the research group, which is presumed to be also related to communicative exchanges with external actors, from a sociological (and communicative) perspective [see chapter 2]. In fact, such view may help shed light on the 'imaginary' "sort of trajectory for scientific ideas that leads from the intraspecialist expository context to the popular one, passing through the intermediate levels" (Bucchi, 2008: 61), as is assumed by the 'continuity' model (see Cloitre & Shinn, 1986), and Fleck's and Latour's theorisations on the sociology of science. This is indeed a communicational strategy that scientists sometimes need to adopt, especially taking into account that "[f]ew decisions are made by policymakers and stakeholders without the media in mind" (Bubela *et al.*, 2009: 515-6). Consequently, it is logical to believe that communication within the research group may be unavoidably interconnected with communication between the group and other audiences, such as policymakers, stakeholders

and the general public, who hold an "ever-more-complex relationship" (Bubela *et al.*, 2009: 517).

 In the next section another perspective on scientists' communication will be introduced: workplace communication, and especially communication within the university context.

1.3. Workplace communication and learning, and the doctoral experience

Also related to the present one, there are studies of "naturally organized ordinary activities" (Garfinkel, 2002: 257) – with Harvey Sacks (1972) as precursor –, which approach workplace learning and/or communication. These studies comprise research within and beyond ethnomethodology and conversation analysis, usually adopting ethnographic methods and close to the participants' point of view. Yet, they are not concerned with talk only, but also with embodied practices. As has been already suggested, these studies are connected with science and technology studies in their search for the "missing what", as well as in their aim of examining the 'competency system' in a particular setting or environment (Lynch, 2015). Special focus here is placed on studies addressing specifically communication in the workplace, on the one hand, and on those adopting approaches similar to the ones in this project, like multimodality, and the community of practice, or exploring similar settings to ours, like laboratories or the university context, on the other.

Dealing with communication and interaction among professionals from a multimodal social semiotic perspective there are some remarkable works like Mondada (2011, 2014), Zemel, Koschmann and LeBaron (2011) and Bezemer *et al.* (2013), which analyse pedagogic interactions between trainer and a trainee surgeons in the operating theatre. Also remarkable is Charles Goodwin's (2000a) study, which – analysing archaeologists' actions, among others' – underscores how human action, cognition and talk-in-interaction are coordinated "through the ongoing, changing deployment of multiple semiotic fields which mutually elaborate each other" (Goodwin, 2000b: 166). Here 'semiotic fields' designate 'signs-in-their-media', that is, signs and the material form they take – to constitute *situated activity systems*, or following Ervin Goffman's (1972) understanding of the concept, patterns of participation in daily face-to-face interactions with others where a joint activity is performed through interdependent actions. What these works have in common is their exploration of communication among individuals who "engage in concerted, embodied, meaningful action, which allows them to achieve professional, collaborative work" (Bezemer *et al.*, 2013: 60).

Another insightful work dealing with situated negotiation of meaning is Bezemer *et al.* (2011), which analyses language use in the operating theatre within ephemeral working teams, and

concludes that the shared understanding of the situation among participants is more important than a shared standard of names (for surgery instruments in this case). This may be so in similar situations of instable and diverse working teams, which are increasingly common, as the author argues, in contemporary societies. *In situ* negotiation of meaning and open and participatory power structures are suggested to be key strategies to deal with this new *status quo*.

Especially interesting for the current project are studies that investigate aspects of university doctoral training, like learning, socialisation and research identity. In this line of research, Delamont and Atkinson (2001) explore how doctoral students in laboratory and field sciences are socialised into their profession and discipline, and more specifically how they deal with unsuccessful experiments, those with unexpected and/or unintended outcomes. The authors argue that, contrary to undergraduate experiences, whereby experiments are controlled and monitored so as to produce expected and preferred results, doctoral researchers suffer from a 'reality-shock' when they face these setbacks for the first time and struggle to overcome this situation. Success in this context is conceived as the doctoral students' capacity to acquire the necessary "tacit, indeterminate skills and knowledge" and at the same time to learn how to "omit the uncertainties, contingencies and personal craft skills" (Delamont & Atkinson, 2001: 88) in public reports of their experiments. A similar process of 'reality-shock' is described by Crebert (1991) with reference to new graduates entering the labour market, and thus experiencing the transition from university to the workplace, for the first time. Some relevant discontinuities between these two contexts that these new employees need to manage and adjust to are described, like those between individualism and teamwork, written and oral communication, context independence and contextualised action, generalising and specialised knowledge, symbolic and practical thinking.

A sense of insecurity and uncertainty among junior researchers regarding their professional future has also been identified by Hakala (2009), who carried out a qualitative study around researcher identities in two Finish university research centres. Specifically, the interviewees reflected upon the duties, skills and qualities required to researchers in diverse positions. The study shows how research is conducted by doctoral students mainly, who assume a great deal of responsibilities and embrace a "researcher" rather than a "student" identity. PhD students' training is unstructured, and consists in the execution of tasks for which they must be autonomous and proactive. In this process, doctoral students must rely on senior researchers (post docs), who act as *de facto* supervisors for professors and group leaders often prioritise other duties. With reference to the labour market in science, its characteristics seem to generate insecurity and uncertainty to young researchers, who however become tolerant to this state as a result of their socialisation throughout the PhD.

Still dealing with the impact of doctoral education on students' identity, Holley (2009) studies how engaging in animal research influences students' socialisation and their development of an identity matching their perceived scientific community. Students' socialisation in science at this stage, the author argues, is based on tacit inferences of what skills and actions are most relevant in their field. Students perform their developed 'scientific identity' by complying with what they interpret as being the norms, the beliefs and the practices of their discipline. Inner reflections (on emotions and ethics) are almost exclusive of informal peer groups. The importance of relational interactions, as well as that of reified textual artefacts for the learning of PhD students is highlighted by Hopwood (2010b). This scholar explores how learning occurs for doctoral students who engage in other academic activities besides research (teaching, student mentoring and student journal editing). This study shows how learning in this context may take diverse forms: from formal and structured to spontaneous and serendipitous; from intended to accidental; from symbolic to practical. This implies, as argued by the author, that planning and design of training programmes aimed at specific outcomes may be problematic.

Extending Hopwood's work, Hum (2015) addresses lab doctoral students' experiences from a workplace learning perspective. Relevant findings support the idea that learning is embedded in daily work in an informal manner, and at the same time question the fact that 'soft skills' can be taught formally, since they appear as situated and context dependent (on specific groups, concerns and practices). As argued by the author, success in the PhD depends highly on social and physical workplace support, the research project's characteristics and contingencies, quality of supervision (it being timely and informative), and alignment of individual interests and contextual affordances. Also remarkable is the finding that although lab work includes team collaboration and communication skills, it may most often occur beyond the research group, since in-group collaboration is limited to logistic tasks and undergraduate supervision. Throughout the paper, Hum makes interesting suggestions for the improvement of the doctoral experience, like setting explicit guidelines for supervision, expectations and problem solving, and guiding the process, especially the relationship student-supervisor; fostering lab-mate and extra-lab collaborations and minimising potential conflicts; as well as attending to individual students' career goals and facilitating informed choices by means of rotating lab internships.

In a similar vein, Cumming (2009) investigates a doctoral student's experience, from a case narrative perspective, and compares it with the 'orthodox model' of doctoral studentship in science, which characterises doctoral students as individuals who: (1) participate in a research group, under the supervision of the group leader; (2) contribute with their work to problems of the research team; (3) gain access to the shared knowledge, resources and expertise of the group; (4) conduct laboratory work or fieldwork; and (5) profit from pre-established group-

industry links. This study concludes that the doctoral student experience is more complex than it has been usually reported. The participant's experience converged with the orthodox model in some points, like (a) her membership and participation in a research group, (b) her engagement in both fieldwork and laboratory work, (c) the links of her work with industry, and (d) her contribution to and use of shared knowledge. However, it also differed from it in aspects like (a) the negotiation with the group leader of a skills-training curriculum besides her research topic, (b) the possibilities of development of an interdisciplinary approach, (c) the engagement in fieldwork on two scales (in small and in large teams, like in international collaborations), (d) the mainly solitary work the doctorate entailed, (e) the active participation of industry partners in projects, and (f) the multiplicity of potential audiences and interlocutors that the doctoral student may have. The author proposes the concept of 'doctoral enterprise' to refer to this experience since it is broad enough so as to encompass the complexity of this phenomenon. These results are consistent with the ethnographies in laboratories of the 1970s, which characterised scientific work as "messy" and "contingent" (Lynch, 2015).

Underpinning much of the literature on the doctoral experience there is the conception of workplaces as learning environments. In this line of thought, Billett (2004) reformulates this idea and claims for a new view on workplaces as learning sites that overcomes their traditional characterisation as 'informal' learning environments – as opposed to the 'formal learning' taking place in educational institutions. On the contrary, workplaces are deemed "highly structured and intentional" (Billett, 2004: 313); the result of the intersection of a set of affordances, norms of participation, individuals' agency and engagement following their interests, and an environment consisting of socially and also intentionally pre-defined (cultural) elements and others negotiated *ad hoc*. To capture this complex idea, Billett proposes the concept of 'workplace participatory practices'. This concept summarises the view that "workplaces afford opportunities for learning" and "individuals elect to engage in work activities and with the guidance provided by the workplace" (Billett, 2001b: 209), which Billett deems two 'dual bases' for 'co-participation' at work. It is not however the workplace's affordances *per se* that shape individuals' participation and learning, but the way individuals "construe what is afforded by the workplace" (Billett, 2002: 457). Still in the line of thought conceiving workplaces as the site for situated learning (Lave, 1990), Tynjälä (2008) has emphasised the need to integrate formal and informal learning in both settings, educational institutions and workplaces.

Similarly enough, though in a rather theoretical plane, Fuller *et al.* (2005) test the validity of Lave and Wenger's (1991) concepts of 'legitimate peripheral participation' and 'community of practice' in the study of workplace learning in a real case. The authors argue that the concepts are valid but need further development for encompassing the influence of contemporary

workplaces' particularities on learning opportunities and constraints. They refuse the idea that peripheral participation is the only learning method in the workplace and claim for greater focus on 'teaching' events in this context, be these either formal training events or unstructured teaching practices in the course of the working activity. In Fuller *et al.* (2007), the authors offer some clues for the theorising of learning in the workplace. They point towards the diversity of forms of knowledge creation and use in the workplace and elaborate on an earlier distinction between 'expansive' – deliberately fostering learning opportunities – and 'restrictive' – limiting participation and learning opportunities – learning environments' features (Fuller & Unwin, 2004) in their study of workplaces as productive systems. According to the authors, the types of learning in which employees engage in the workplace depends on diverse variables, such as their personal backgrounds, prior educational experiences and aspirations, their position in the political economy of the workplace, and the organisation's strategies. Importance is also placed on the tools and artefacts mediating learning and knowledge acquisition in the work setting.

Also dealing with workplace learning, Eraut (2007) proposes an 'epistemology of practice' based on the operationalisation of some elements of practice, cognition and the context to understanding the learning progress of novice professionals. This draws on earlier work, where 'confidence' was found a key aspect of learning in the workplace, acting in a triangular relationship with 'challenge' and 'support' (Eraut, 2000). Other relevant factors were value of work, social inclusion, personal agency, sense of choice over work activities, and sense of progress. And related to the context, allocation and structuring of work, Eraut (2007: 419) contends that "the majority of workers' learning occurs in the workplace itself", but formal learning is still an important source as long as it is relevant and well-timed, and combined with workplace learning. Other findings of this work are that opportunities to work in teams may enhance workplace learning; that work should be moderately challenging; and that managers should encourage mutual support among workers and value their learning. In fact, Carmeli, Brueller and Dutton (2009) also highlight the importance of relationships in the workplace for developing a sense of psychological safety and for learning.

Having summarised key findings in the exploration of professional multimodal communication, of doctoral and research experiences, and of workplace learning, the next section will present studies dealing with academic literacies and academic genres, another important facet of scientists' communication.

1.4. Academic literacies[15] and academic genres

A very significant aspect of researchers' communicative practices and also of their research career, which could not be ignored in this literature review, is their production of texts for publication, in journals, books and conferences (Casanave & Vandrick, 2003). This phenomenon has been addressed by scholars in the 'academic literacies' field – "a specific epistemological and ideological approach towards academic writing and communication" (Lillis & Scott, 2007: 13) –, which addresses aspects like university students' and scholars' writing practices, academic genres, publishing processes, and gatekeeping in the academia, among others.

Academic literacies theory developed in the late 1980s in parallel to the 'deficit model' of student writing, challenging the idea that developing student writing ability consists in acquiring certain cognitive skills that could be potentially used in any context (Lillis & Scott, 2007). The academic literacies 'model' thus regards academic literacy practices, that is, reading and writing, as "constitut[ing] central processes through which students learn new subjects and develop their knowledge about new areas of study" (Lea & Street, 1998: 157). Yet, this approach "shifts the focus from the individual to broader social practices" (Badenhorst *et al.*, 2015: 1), understanding that literacy is a cultural and social activity. This framework thus focuses on aspects like identity construction, meaning making, socialisation into communities and acculturation into disciplinary discourses, learning, ideologies, power relations and authority in or through texts. It does not only address the ways in which texts reproduce knowledge, but also how they construct and reproduce "valid" knowledge. This is accomplished through the analysis of diverse academic genres, such as the letter (Bhatia, 1993; Swales, 1996), the lecture (Thompson, 1994; Lee, 2009), the academic essay (Creme, 1996), the research report (Nwogu, 1991), the dissertation (Paltridge & Woodrow, 2012), and the feedback (Lea & Street, 1998). The academic literacies model hence "views the processes involved in acquiring appropriate and effective uses of literacy as more complex, dynamic, nuanced, situated, and involving both epistemological issues and social processes..." (Lea & Street, 2006: 369). For the use of concepts like *apprenticeship*, *socialisation*, *scaffolding*, *novice* and *expert*, this model draws on sociocultural theory, activity theory and the community of practice theory, among other sociological frameworks.

Being our project framed within university and focused on communication and thus on texts, there may be diverse aspects of the literature in academic literacies that relate to it in one way or another. In particular, our approach here is close to that of 'New Literacy Studies' (Street, 1984;

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[15] See Lillis and Scott (2007) for a discussion on the use of the plural form of the word.

Gee, 1991; Barton, 1994; Baynham, 1995; Lea & Street, 1998), a paradigm in the study of language and literacy that views literacy practices – "particular forms of reading and writing and their meanings to different groups of people" (Street, 1997: 50) – as tied to their social, cultural and economic contexts. Accordingly, these are best explored through the observation of naturally-occurring events, and considering the variability of meanings depending on the social-cultural group implicated. Especially insightful for the purposes of this project is Lea and Street's (1998) critical ethnographic perspective of 'academic literacies', which allows us, on the one hand, to transcend the traditional focus on students' written outcomes, and on the other hand, to link researchers' daily communicative practices to their larger socio-cultural context. An antecedent of the current study is thus Lea and Street's (1998: 160) "eclectic approach, merging the importance of understanding both texts and practices in the light of staff and student interpretations of university writing". In what follows different strands of research in the field of academic literacies that are relevant for the current study are summarised.

One such strand in the field of academic literacies is the one focused on the disciplinary and institutional practices that underpin and support students' writing, rather than on writing practices themselves (Lillis, 1999; Lillis & Scott, 2007). Here, institutions are taken as defining boundaries through procedures and regulations. Another current strand in this field is the study of the impact on literacies of new information and communication technologies. This is widening the meaning of the term 'literacies' itself, which in the digital age may not only refer to reading and writing but to the presentation and perception of information in many other forms (Lanham, 1995). There is concern among scholars in this area about the mismatch between the use of these technologies by young people and the flawed formal training received on them (Tusting, 2008). Other aspects of interest are the crossing of boundaries, in terms of genres, on the one hand, giving place to hybrid genres, and in terms of disciplines, on the other; as well as the combination of multiple languages, of different rhetoric resources and of other communicative resources. These may also be aspects to consider in the current study.

As has already been mentioned, I will adopt the multimodal perspective (Kress & Van Leeuwen, 2001) to broaden my focus from logocentric 'academic literacies' to the wide range of resources and practices comprised in the notion of 'multimodal communication' and used on a daily basis in scientific research (Archer, 2006; Prince & Archer, 2014). This is not unfamiliar to the field of academic literacies, which has adopted multimodality in the analysis of 'genre modes' (Lea & Street, 2006), in the exploration of the use of online technologies for teaching and learning in a globalised world (Snyder & Beavis, 2004), in the reflection on new developments in communication and literacy practices that give place to 'multiliteracies' (Cope & Kalantzis, 2000), and in Catherine Kell's (2011: 613) understanding of 'literacy' as 'one

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amongst many semiotic resources', among lines of research. The centrality of the text as a unit of analysis and as a significant artefact that fixes and stabilises meaning is common between literacy studies (in the New Literacy Studies framework) and multimodality. These two research areas indeed converge in the use of concepts like recontextualisation, meaning making trajectory, mode and genre.

It is precisely the concept of genre, approached by research on 'academic genres', that acts as a nexus among diverse dimensions, disciplines and fields of interest. *Genre* has in fact been found to be a linkage between action and structure, agent and institution, past and future (Miller, 2015), the local and the global (Kramsch & Thorne, 2002) and, as in this case, between academic literacies, multimodal communication in science and genre theory – see, for instance Kress *et al.*'s (2001) description of 'scientificness' as the students' compliance with a genre's conventions (not just in writing but also in other modes of communication) and the adoption of a certain 'voice'. *Genre* has also been deemed a cultural phenomenon, and thus key in intercultural encounters (Helal, 2013). In academic contexts, the mastery of genres is regarded as an entry point into the academic (discourse) community (Swales, 1990) and as a sign of competence (Bruce, 2008). In this line, *genre* will be approached here in its facet as an ideologically loaded aspect of literacy (Briggs & Bauman, 1992).

Related to ideology, power issues and policies, there is a line of research interested in gatekeeping practices and the politics of academic knowledge production. This includes the politics behind the use of English as the global lingua franca for academic texts. Following this strand and based on Wallerstein's (2004) 'world systems theory', Bennett (2014a) distinguishes three zones of behaviour in academia (center, semiperiphery and periphery) (see also Santos, 1985, on this idea). These vary in the amount and quality of available resources, in prestige, in the strength of the meritocratic or 'publish or perish' (see Nygaard, 2015) culture, and in the hegemony of English, among other aspects. In this context, semiperipheral institutions act as mediators filtering knowledge, models and techniques from centre institutions and making them available for peripheral ones. In terms of language, semiperipheral nodes are also usually language brokers between English and other languages. The tendency is for the semiperiphery to approach the 'necessary' center – which is source of funding and partnerships – and to enrich it with new inputs, possible only in other positions, whenever the "scorn" for peripheral elements (Bennett, 2014a: 3) is overcome. Despite being in a disprivileged position compared to centre players, the semiperiphery – as in the case of Spain (and Catalonia) –, as a 'contact zone' with less pressure than the centre, may afford also opportunities for alternative practices and in-between positions which might challenge dominant tendencies. Spain is thus the 'middle class' in the global academic context; in a position where national policies that follow centre norms

and trends are being imposed on universities, for instance in the form of national research evaluation frameworks (Burgess, 2014), but also where alternatives may arise and have still some room to be accomplished.

In order to deal with this hierarchisation of academic positions, brokering practices from professionals in central positions have become usual. The influencing positions of these 'literacy brokers' (Lillis & Curry, 2006, 2010) in academic journals, especially in English-medium ones, favours the supremacy of an English-centre literacy orientation, also named "Western Anglo academic literacy practices" (Lillis & Curry, 2006: 30), and this might also trigger the dependency on such brokering practices and thus on such professionals by peripheral, non-Anglophone authors.

Still related to power and politics, Hyland (2015) explains the state of academic publishing influenced by the economic marketplace and the academic prestige marketplace. The author cautions about existing top-down pressures on academics for publishing. These may apparently influence their chosen research topics, which may follow publishers' interests rather than disciplinary interests. As Hyland contends, English is increasingly the chosen language for publication despite initiatives to publish in other languages for reasons like developing a scientific register in those. The increasing pressure on scholars to publish in English has been also noticed by Lillis, Magyar and Robinson-Pant (2010). This pressure is led by Anglophone journals, positioned in centre zones, which impose center-based evaluation systems, privileging material and linguistic resources not easily available to peripheral authors (see also Canagarajah, 2002). Also Uzuner's (2008) review of the literature on multilingual scholars' publishing practices reveals the existence of manifold reasons for the use of English for publication, among which aspirations to reach a wide audience or to participate in the global scientific arena (motivated by intrinsic or extrinsic reasons, like the need to publish in international journals), institutional requirements, and learning aspirations. Some obstacles they encounter are difficulties in accommodating to the discursive conventions, incapability of transcending the local research context, greater time investment for publishing in an L2, and lack of core networks.

The present study might thus also be framed within the field of 'academic literacies', to which it aims to contribute by (a) focusing on an under-researched population in the context of university: scientific researchers, either junior or senior, and (b) gathering a range of different types of texts, such as oral presentations, group discussions, print written and graphic texts, as well as informal interviews, in order to offer a holistic picture of the communicative phenomena that scientists engage in during their daily professional practice. It especially aligns with those

studies considering the whole range of modes used in daily scientific communication, and with those adopting critical ethnography to approach academic literacies (Lillis, 2008). Furthermore, in order to contribute to the filling-in of the "ontological gap between text and context" claimed by some scholars (e.g. Lillis, 2008: 353), I will adopt the ethnography of communication approach (Hymes, 1964) – also pointed as an antecedent of the ethnography of literacy (Baynham, 2004) –, departing from the observation of all types of texts and communicative practices that scientists engage in on their daily work. In the next section, such communicative practices, located in a semiperipheral position, will be situated within the phenomenon of the internationalisation of higher education.

1.5. Scientists' communication in the context of the internationalisation of higher education (IoHE)

Some of the recent trends of scientists' communication at a global scale have already been noted. These align with those summarised by Karlsson (2015): (a) less dependence on the spoken and printed word, (b) quicker dissemination of ideas and consequently of their questioning, (c) the concern for open access publications, (d) the possibility, thank to new technologies, of more powerful means for representation (down to molecular level) and calculation, and (e) the evolution in writing practices of scientists, from publishing in a local language which used to be then translated into an international lingua franca "in order to be accessible for a greater scientific community" (Karlsson, 2015: 63), to publishing directly in English. This section will be devoted to the definition and characterisation of the 'internationalsation of higher education' (IoHE). In subsection 1.5.1, the concepts 'internationalisation' and 'globalisation' will be defined and described. In subsection 1.5.2, these phenomena will be contextualised within higher education (HE), and key elements of the IoHE will be described, drawing on works within higher education research and within the sociology of globalisation. Finally, in subsection 1.5.3, new trends in the IoHE will be explained and related to scientists' communication.

1.5.1. 'Internationalisation' and 'globalisation'

Today the term 'internationalisation' implies the relevance of national (economic, social and cultural) systems in a context of increasing cooperation among states and many more cross-border activities (Huisman & Van der Wende, 2005). Besides the opposition 'national'/'international', 'internationalisation' is often defined in contrast with the notion of 'globalisation'[16]– or otherwise "Americanization" (Readings, 1996), stressing the leading role

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[16] There are different versions on the first usage of the term 'globalisation' with its contemporary meaning. Although the origin of the term with its contemporary meaning goes back to 17th century, the term

of the US' capitalist model as a worldwide paradigm. According to their etymology, the notion of internationalisation highlights the relevance of the national context and the effects of the 'interstate system' (Phillips & Wallerstein, 1985), and the latter stresses the progressive blurring of national boundaries in diverse domains, resulting in interdependent economies and societies (Huisman & Van der Wende, 2005), as a consequence of the increasing flow of goods, information, and people, which has generated the so called 'global market', the 'global economy', the 'global knowledge society', etc. As Urry (1998) points out, the prefix –isation/-ization can refer to either a process or an outcome of the process. This ambiguity added to the multifaceted areas of influence of these phenomena should be the first consideration to make when dealing with the related literature.

The term 'globalisation' has been accused of vagueness and imprecision (Cooper, 2001). Beyond its etymology, 'globalisation' has been used with several connotations: as a synonym of the progressive market liberalization, of current long-reaching "spatial linkages", to name the international unity of capitalism, and as a profitable strategy of a privileged elite, to cite only a few examples. John Urry (1998) identifies in the literature six different connotations or "discourses" attached to the term: (a) an academic discourse around unavoidable global flows that disrupt national systems and structures; (b) a discourse equalling "global" to an ideology defended by advocates of worldwide capitalism; (c) a characteristic of transnational corporations detached from concrete territories, labour forces and governments; (d) as the basis for cross-national social mobilisation, through the construction of "global issues" which involve a wider mass of civil society; (e) similar to the latter, as images encompassing the whole world – such as the "blue earth" –, used by companies and politicians to sell products or ideas; and (f) as a discourse that makes reference to a new medievalist-like scenario with competing organisations, governments and corporative "empires". What is important in Urry's reflections is the remark that 'globalisation' can be either an outcome or a hypothetical process, real or constructed through discourse, and either cultural/environmental and/or economic/political. And thus, it should be analysed with reference to the perspective through which it is approached.

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grounds to the term "*global village*" used by Canadian sociology professor Marshall McLuhan in 1960 in his book titled "Explorations in Communication". According to some other claims, the term *globalisation* was first used in 1980s in the American colleges of Harvard, Stanford and Columbia and popularized by these environments. Another claim is that first formations and forecasts of globalisation were written by American entrepreneur-minister Charles Taze Russell with the term "*corporate giants*" in 1897. The book of Ronald Robertson called "Globalization" has brought in theoretical content to the term. The term which had not been used in the 1980s even by academic environments, started to be increasingly used as a key term in explanations of theories of social change in the 1990s.

Besides its multiple connotations, globalisation has been found to generate opposed effects. Culturally, as in Olivier *et al.* (2008), it has been accused, on the one hand, of producing homogeneity, through the imposition of the American (socio-economic and political-cultural) model, the spread of capitalism and the corporatisation of all domains of society, which has resulted in the coinage of terms like "Americanization", "MacDonaldization" and "Cocacolonization". On the other hand, globalisation has been said to increase diversity, due to the long-reach potential of local phenomena, which may produce so-called "glocal" effects (Swyngedouw, 1997)[17], giving birth to "superdiverse"[18] (Vertovec, 2007) environments. Economically, it has been found to cause either increasing or decreasing inequality (Mills, 2009). Other stated positive effects are: new forms of collaboration and networking, broader access to information, lower transport costs, greater access to technology, stimulated innovation, and larger markets (Eger, 2009). In contrast, some suggested negative effects, besides the above referred increased inequalities within and among countries, are: decrease in interventionist power (Daly, 1999), increased instability: overall economic and consumption volatility (Stiglitz, 2004), and undermined social protection (McMichael, 1996). There is also the view that the "integration of world markets" (as synonym or effect of globalisation) might in the short term benefit core nations but in the long term also the periphery, and thus globalisation would be at the same time beneficial and harmful for both, core and periphery (Krugman & Venables, 1995). Accordingly, this phenomenon might have positive as well as negative effects for different stakeholders, and these effects could vary across time. This diversity of findings has been attributed to the variability of procedures, methodologies and concept operationalisations in the literature (Mills, 2009).

Indeed 'globalisation' has its detractors and its advocates, its promoters and its resisting forces. The literature usually attributes the defence of the "globalisation of markets" (namely the liberalisation of economies) to policy makers and bureaucrats, while scholars tend to highlight its potential damages. Responsible agents facilitating this process-outcome include organisations, prizes, movements and other forms of supra- or para-national institutions, such as the United Nations (UN), the World Bank, Microsoft, CNN, Greenpeace, the European Union (EU), News International, the Oscar ceremony, the World Intellectual Property Organisation,

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[17] As Erik Swyngedouw (2004: 25) defines it, the term 'glocalisation' "refers to the twin process whereby, firstly, institutional/regulatory arrangements shift from the national scale both upwards to supra-national or global scales and downwards to the scale of the individual body or to local, urban or regional configurations and, secondly, economic activities and inter-firm networks are becoming simultaneously more localised/regionalised and transnational".

[18] The term "superdiversity" refers to the great meshing of cultures resulting from the increasing and far-reaching migration movements of the 21st century.

the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the Olympic movement, Friends of the Earth, Nobel prizes, Band-Aid, the Brundtland Report, the Rio Earth Summit, the European Court of Human Rights, and the British Council (Urry, 1998: 6). The managers of most of these organisations make up the "new global elite", "an incipient global ruling class" (McMichael, 1996: 32). The interests and roles of some of such "globalising" organisations have also been contested and attributed to either economic (see Daly, 1999) or ideological (see Stiglitz, 2004) interests.

Globalisation is therefore not just an economic phenomenon, but it has also direct political consequences and scope (Resina, 2013). As McMichael (1996) explains, after World War II, the idea of 'development' – understood as a process of increasing societal welfare – was used to legitimise the political project of the nation-based management of resources (with its correspondent interstate system) across Europe. The debt crisis of the 1980s gave way to a new institutional framework for development, globalisation, in which nations would no longer "develop" but position themselves within the global order. Politically speaking, Resina (2005) equates internationalisation and globalisation, in the sense that both respond to the notion of "post-nationalism" inasmuch as these terms name a new order that transcends the national sovereignty and generates a new hegemony, exerted by supranational forces or by agents with cross-national influence capacity. As the author explains, in the case of Western Europe, the "international" process of integration of the EU seems the only "non-violent" alternative for the expansion of the capitalist power after the failed attempt of territorial annexations, which had led to World War II (Resina, 2005).

This new model of shared hegemony between the powers of the nation-states and the supra-state governance is not without problems, among which Resina (2005) includes the perceived distance between the institutions and the people and the difficulty of forging a "European identity". Although the idea of national identity highlighted in the concept 'internationalisation', is apparently opposed to the understanding of 'globalisation' as the sovereignty of market rules – which advocates for the liberalisation of economy and the equal trade exchange worldwide regardless of national systems –, both processes have similarities and parallelisms in terms of structures and mechanisms. They imply the creation of a new political space beyond national borders dominated by capitalist rules and by trading organisations, which in turn entails new forms of governance and coercive practices (Resina, 2005). Moreover, as Phillips and Wallerstein (1985: 160) point out, "parallel hierarchies of core and periphery within both the world-economy and the interstate system" are continuously reproduced; and thus, the supposedly aimed "equity" – among countries, economies, corporations or peoples – is precisely a much contested feature of 'globalisation'.

The statement that there is an increasing and unavoidable tendency toward globalisation of economies and culture worldwide is also a contested one. While some authors announce the forthcoming "post-national era" (Resina, 2013) – when the nation will no longer be the basic unit for economic, political and social activity –, and some of them claim that the world is undergoing a re-territorialisation where some regions are resurging over others (Brenner, 1999b; MacLeod, 2001), other specialists deny it, arguing that "[t]he resources controlled by governments have never been higher" (Cooper, 2001: 195) and that "for most people in their daily life the 'national' is still of more significance than the global" (Urry, 1998: 14). Furthermore, differences across nations in connection with the internationalisation trend have been highlighted: "there is a marked difference between developing and industrialised regions of the world in the rationales for pursuing internationalization strategies" (Egron-Polak, 2011: 2).

In light of the above-referenced literature, it could be argued that the term 'globalisation' is naming a shift of paradigm, a *de facto* phenomenon which implies changes in the dynamics of the national era. The emergence and proliferation of discourses of the "post-": post-structuralism, post-modernism, post-social, post-national, post-traditional, evidence this fact. In line with the first of these post-concepts, "post-structuralism", the tendency is the questioning of traditionally established entities and categories, and their fragmentation so that they can be analysed internally. The focus is less and less on the dynamics of homogeneous entities – e.g. society, nations, etc. – and more on the heterogeneous behaviours of their components – e.g. communities, institutions, authorities, etc. As Brenner (1999a: 69) puts forward:

> Under these circumstances, the image of global social space as a complex mosaic of superimposed and interpenetrating nodes, levels, scales, and morphologies has become more appropriate than the traditional Cartesian model of homogeneous, interlinked blocks of territory associated with the modern interstate system.

In this sense, globalisation cannot be considered to be as global as the term itself suggests, but multi-layered and diverse in its scope and depth. It may be affecting differently diverse domains of (a) society, including culture (through the increasing flow of people and information), knowledge (through far-reaching, more popular communication media), politics (through the rising influence of the economic powers) and economy (by the overarching power of economic institutions over fiscal governmental authorities), as well as (b) social agents, including people, institutions, corporations, organisations and governments. Diverse approaches and perspectives on this phenomenon lead to different discourses and conclusions: culturally, about the tendency toward cultural homogenisation or diversity; economically, about the difference between core and peripheral regions; socially, about new types of relations and group forms; geographically,

about the restructuring of urban and rural regions, about territorial fixity or erosion; among other issues. Voices around these issues navigate between polarisation and combination of *a priori* contrasting positions. And in fact, though not completely global, globalisation is indeed affecting many aspects and dynamics of our understanding of the world we live in and of our historical moment.

Brenner's (1999a) words above seem to be contrasting the notion of internationalisation as the interaction among supposedly homogeneous entities, the nations, with globalisation, understood as an umbrella framework for diverse kinds of links among different types of entities. Be this opposition homogeneity-heterogeneity accurate or not, when defining and contrasting internationalisation and globalisation the debate seems to lie mainly around the significance of the national context for these relations. Far from being a clear-cut fact, the most agreed-upon conclusion on this issue is the existing diversity of interpretations and opinions, maybe due to the many aspects that these two concepts encompass. Both, detractors and advocates, preferring either of these terms, need to be aware of such complexity and consider the multifaceted potential effects of these phenomena. For those taking part in debates on internationalisation and/or globalisation, it should be considered that any opinions for or against these processes-outcomes regarded as absolute forces might stand on ideological stances rather than on proven facts. Given the uncertainty around these phenomena, what will be my concern here is to contribute to the claim about the need for new representations, conceptualisations, analytical tools and descriptions for the exploration of internationalisation and globalisation, focusing concretely on those aspects related to European higher education, science and communication.

1.5.2 The Internationalisation of Higher Education

Similar to the case of 'internationalisation' in social, economic and cultural terms, the multiplicity of fundamentally different definitions and uses attributed to the concept 'internationalisation of higher education' contribute to the creation of a vague and potentially misleading idea of its meaning. In this regard, efforts have been made to denounce the traditional "misconceptions" (De Wit, 2011b) and the "myths" (Knight, 2011) surrounding this notion, which has inconsistently been defined and characterised to the point that it has become "a catchall phrase" that is "losing its meaning and direction" (Knight, 2011: 14). This confusion might be linked to the origin of the term 'internationalisation' in this context, which has been borrowed by different stakeholders from the field of business management, and only recently imported into the field of higher education (Delgado-Márquez *et al.*, 2011). Consequently, 'internationalisation' can be seen as a process that private companies undergo to adapt to competition in the global market, and similarly, as a script for universities, which, in their

process of privatisation, fostered by the economic crisis (OECD, 2014), are increasingly behaving like transnational private corporations in their struggle to survive in the 'global knowledge economy' (Readings, 1996; Tilak, 2011). This process is taking root so deeply that it has been deemed the next university mission – after those of teaching, research, nationalisation, democratisation and public service (Scott, 2006).

The multiplicity of involved agents – international relations officers, programme managers, international credential evaluators, research and industrial liaison officers, study abroad and foreign student advisers, language experts (Callan, 1998: 54) – may also account for the different approaches and connotations attached to this term. Jane Knight (1994, 1997) made a remarkable contribution to this issue by identifying four types of approaches to the IoHE, which have been and are still chosen and/or combined by the different stakeholders. The 'activity approach' has been the most common, especially in the 1970s and early 1980s, and refers to internationalisation as a set of specific activities or programmes implemented in an organisation or institution, such as academic mobility and curriculum development. A typical criticism to this approach is that it offers a fragmented picture of internationalisation as a set of unconnected, purposeless initiatives. The 'competency approach' focuses on the outcomes in terms of human development, for which internationalisation should aim at the development of certain competencies, skills, knowledge and values by students and staff. This is the favourite approach for the economic sector, since it is based on the idea that these competencies should fulfil the demands of the labour market. The 'ethos approach' (or 'organisational approach') is based on the creation of a belief system and a culture around the concept of internationalisation to support a set of principles and goals. Finally, the 'process approach' views internationalisation as the integration of an intercultural or an international dimension into academic programmes, guiding policies and procedures of the institution. Following this approach, the international dimension includes the following requirements: (1) it must be part of the institution's mission statement, policies, planning and quality review systems; (2) it must be integrated into the primary functions of teaching, learning and research; and (3) internationalisation activities must be well coordinated (Knight, 1997).

In view of the diversity of approaches to the IoHE, the multiplicity of definitions available in the literature becomes understandable. In order to illustrate this diversity, I present a selection of definitions from the related literature. In accordance with the activity approach, Van Damme (2001) defines the 'internationalisation of higher education' as "the activities of higher education institutions, often supported or framed by multilateral agreements or programs, to expand their reach over national borders" (Van Damme, 2001: 417). Altbach *et al.* (2009) offer a definition which combines the activity and the process approach: "Internationalization is

defined as the variety of policies and programs that universities and governments implement to respond to globalisation. These typically include sending students to study abroad, setting up a branch campus overseas, or engaging in some type of inter-institutional partnership" (Altbach *et al.*, 2009: iv). A mainly process-oriented definition is the one preferred by De Wit (2011b): "Internationalization is a process to introduce intercultural, international, and global dimensions in higher education; to improve the goals, functions, and delivery of higher education; and thus to upgrade the quality of education and research" (De Wit, 2011b: 7). Similarly, Knight herself defines it as follows: "Internationalization at the national/sector/institutional levels is the process of integrating an international, intercultural or global dimension into the purpose, functions or delivery of higher education at the institutional and national levels" (Knight, 2008: 21). Therefore, according to this small sample of definitions, 'internationalisation' could be either "a process", "activities" or a set of "policies and programs"; and, following other authors, it could refer to an educational value, a social change, or a combination of them (Callan, 1998).

Despite the difficulties in achieving a unified definition for the concept, Knight emphasises the importance of reaching "a common understanding of the term" so that it is useful as well as the need for increased interest on its study: "What is surprising is the small number of academics and policymakers who are studying the nuances and evolution of the term, given the current changes and challenges" (Knight, 2005: 11). In order to make an asset out of this richness, researchers and any other stakeholders in HE should make explicit what their perspective and interests are, and avoid the invisibilisation of responsible agents and their aims, often blurred behind the the abstraction of semantically collective categories such as 'governments' and '(higher education) institutions'. Indeed, Brandenburg and De Wit (2011) observe that the IoHE is nowadays being used as self-legitimising and as a goal in itself, without an apparent need for its justification.

In this respect, Knight and De Wit (1995) and Knight (1997) identified diverse rationales for internationalisation, which still prevail in current discourses on the IoHE. The importance of digging into these sometimes tacit or even hidden motivations lies, as Knight and De Wit point out, in the fact that "they form the basis of the incentives for internationalisation that are perceived by stakeholders, and the justifications that are made internally and externally" (Knight & De Wit, 1995: 10). According to these scholars, there are political rationales like (a) the view of educational cooperation as a diplomatic instrument for improving a nation's foreign policy, as an alternative means of communication between countries. Similarly, the IoHE can be seen as (b) an opportunity for promoting the national identity abroad or enhancing the nation's prestige internationally. Closer to an economic rationale, the IoHE can be regarded as (c) an investment in future political and economic relations, by means of international students, who are seen as

potential decision-makers of the future. More purely economic-oriented rationales defend that (d) internationalisation raises a country's competitiveness through the development of technology and scientific research; (e) it solves the (supposedly) increasing demand in the labour market of graduates with "international profiles" who can manage in the global market; (f) it is a source of revenue for institutions and national economies, especially through the higher tuition fees of overseas students; and (g) the stimulation of study abroad is a resource for governments who cannot face the flaws and deficiencies of their own HE facilities. Academic-type rationales are those which view internationalisation as (h) a means for academic excellence, through the achievement of international quality standards; and/or (i) a strategy to strengthen the institution's structures, activities and human, technical or management infrastructures (namely "institution-building"), by acquiring resources that could not be found locally through international cooperation. Finally, cultural-educational-social rationales can focus either (j) on the nation, by seeking the preservation, the respect for and the promotion of national cultural and moral values and their export; (k) on the individual, for which internationalisation is regarded as an important value for the individual's development itself, or a means for improving the individual's intercultural and communicational skills; or (l) on the institution, for which the international dimension is integrated into research and teaching to provide resources for critical thinking and inquiry, and raise awareness and understanding of the claimed interdependence among nations and other concomitant phenomena. Knight (2008) suggests that the current tendency is the combination of such rationales in ways that make it difficult to establish a clear-cut distinction among categories (economic, political, etc.) and levels (national, institutional, individual) [for more details about the rationales driving the IoHE, see Knight & De Wit (1995); and Knight (1997, 2004, 2005, 2008)]. As Knight and De Wit (1995) point out, such rationales might be overlapping, multi-levelled, combined and evolving across time, depending on the context and the stakeholders' aims. But the current tendency involves mainly economic and cultural rationales, such as attracting foreign (full-fee paying) students and the creation of a common culture – e.g. in Europe.

Far from being neutral, the rationale followed and the arguments used to pursue and support the IoHE may depend on the interests of the implicated agents. For this reason, Knight (1997) supplies a list of possible involved stakeholders, classified in three sectors: the government (e.g. ministries or departments of education, culture, economic, development, trade, science and technolgy, and foreign affairs agencies), the education (e.g. institutions, such as colleges, universities and institutes, research and discipline groups, professional associations, and students and staff), and the private sector (e.g. diverse kinds of companies depending on the nature of their products or services, their size, and their geographical involvement). Also at the

supranational level there are organisations and treaties supporting the IoHE, like the EU's European Research Area [see chapter 4].

In the new era of the university-business (Nerad & Evans, 2014), the rhetorics of internationalisation are used as a marketing tool to generate visibility and prestige. The 'international' label is often perceived as a hallmark of 'quality' and thus acts as a spur that attracts revenues: "in this competition for the educational dollar, international reputation and university rankings are keys to success" (Nerad & Evans, 2014: 209). For this reason, a common claim in the literature is the demand for quality assurance; the envisaging of quality as the main goal of the IoHE (Van Damme, 2001; Brandenburg & De Wit, 2010), which, as these latter authors remark, is threatened: "[i]nternationalization has become a synonym of "doing good," and people are less into questioning its effectiveness and essential nature: an instrument to improve the quality of education or research" (Brandenburg & De Wit, 2010: 16). There is thus the need for monitoring it at all levels for "the sustainability, credibility, and value of internationalization's contribution to higher education" (Knight, 2001: 242). In this sense, for instance, institutional autonomy, diversification and transparency have been pointed at as signs of quality of HE institutions (Van Vught, 2009).

Resuming the discussion of the differences and commonalities of the terms 'internationalisation' and 'globalisation', as regards higher education in this case, while some scholars state that the term 'globalisation' is displacing 'internationalisation' due to its connotations of "modernity" and "volatility" (Scott, 2000: 4), others observe that the opposition (inter)national/global has often been overlooked and the term 'internationalisation' has been preferred over the latter in the "public debate" on higher education (Teichler, 2004: 23). According to this view, the 'internationalisation of higher education' is a "growing interdependence and interconnectedness of modern institutions" which "obliges HE institutions to face many new challenges, including the internationalisation of knowledge and means" (Kerklaan *et al.*, 2008: 241). In this sense, the concept of the IoHE does not necessarily stress the existence of borders:

> Rather, the term tends to be used for any supra-regional phenomenon related to higher education (anything which seems to take world-wide) and/or anything on a global scale related to higher education characterised by market and competition (notably international competition for status and reputation as well as commercial knowledge transfer across borders). (Teichler, 2004: 23)

Other authors associate the notion of 'globalisation' in the context of HE to "competitiveness", while 'internationalisation' and 'Europeanisation' have been found to be more related to discourses of "collaboration" (Huisman & Van der Wende, 2004). As Brandenburg and De Wit

(2011: 16) reflect, in some sectors "[i]nternationalization is claimed to be the last stand for humanistic ideas against the world of pure economic benefits allegedly represented by the term globalization". Finally, some specialists, like Altbach and Knight (2007), distinguish between "the economic, political, and societal forces pushing 21st century higher education toward greater international involvement" (Altbach & Knight, 2007: 290), namely 'globalisation', and "the policies and practices undertaken by academic systems and institutions—and even individuals—to cope with the global academic environment" (Altbach & Knight, 2007: 290), i.e. 'internationalisation'. In this context, it is imperious to consider the "external forces" that, as Altbach and Knight (2007) noted, are pushing HE institutions towards internationalisation. According to this distinction, "[g]lobalization may be unalterable, but internationalization involves many choices" (Altbach & Knight, 2007: 291).

Despite this polyphony in the literature, it is still to be proven whether the preference between the terms 'international'/'global' in the context of HE is simply arbitrary or might respond to issues of alignment and strategy. Research in this sense is needed. Although I acknowledge the increasing use of both terms interchangeably in the literature – as pointed out by Scott (2000), among others –, for the purposes of this project, the distinction between 'globalisation'-external forces and 'internationalisation'-integration process (by HE institutions) seems the most suitable one. For the sake of simplifying things and avoiding confusion, I will choose the process approach. Therefore, I will use the term 'internationalisation' as a "process" of integration of the international dimension into diverse levels of HE institutions, and other terms, such as "internationalisation activities" and "internationalisation strategies", in other senses, as will be explained in the next subsection. The IoHE will be deemed here a process triggered by agents and their interests, and imposed by means of 'internationalisation policies'.

1.5.3 Form, characteristics, trends and intervening factors in the IoHE

As part of an institution's strategic plan, 'internationalisation' has adopted many forms, which have also evolved from its first introduction into higher education to our days: from changes in the curriculum or mobility of students and staff – the "best known form" (Van Damme, 2001: 418) –, to the cross-border delivery of education, which has been gaining relevance in the last decade (De Wit, 2011a). Some authors have identified new trends in the IoHE considering the strategies and instruments used by institutions. In this line, Van Damme (2001) has distinguished between 'traditional' internationalisation, mainly based on staff and student mobility, and 'current' internationalisation, more focused on exporting education, building up transnational networks, the delivery of virtual training, and the harmonisation of HE systems (e.g. credits and degree recognition). Similarly, Huisman and Van der Wende (2004; 2005) have

recognised the beginning of a 'new phase' in the IoHE, claiming that "[n]o longer is it mainly about student and staff mobility, though these remain important. Rather as a key activity in the knowledge society HE is becoming a key player in a wide range of international relations policies" (Huisman & Van der Wende, 2004: 273). According to them, and as has been already suggested, this new scenario would be characterised by "the trend towards more economically oriented rationales for internationalisation" (Huisman & Van der Wende, 2004: 273), led in Europe by the UK, with the aim of either improving the international competitiveness of the national economy or that of the HE sector as a whole.

Indeed, the activities implemented by higher education institutions in face of internationalisation (e.g mobility programmes, English-medium courses, distance education, etc.) appear as the "peak of the iceberg", being these the most visible part of internationalisation policies. Nonetheless, underlying them there are many elements – drivers, shapers and constraints – that are usually overlooked. Huisman and Van der Wende (2005) indicate that in their processes of profile-building and positioning in the education market, HE institutions seek one or a combination of four main goals, which I would simplify into two goals and three reference frameworks. The two goals would be (a) to enhance their reputation, and/or (b) to survive in the education market. And the three reference frameworks: (1) the global education market, (2) the EU or a cross-border region, and/or (3) the national or the local context. Furthermore, these authors identify three types of factors influencing the strategies adopted to reach these goals: (a) 'regulatory factors' – legal, financial, administrative contexts and attempts to harmonise qualification frameworks; (b) 'normative factors' – institutional autonomy, and depending on whether HE is seen as a public service or a private good; (c) 'cultural-cognitive factors' – characteristics of the disciplines and subject areas, the language, the culture, the region and historical links. Besides these factors, the strategies are defined according to the institution's tradition, history and mission, but ultimately rely upon the decisions of the academics who will put into practice the internationalisation activities.

According to Knight and De Wit (1995) and Knight (1997), in the process approach to the IoHE – the one I will also adopt in the current study – there are two types of strategies traditionally implemented by HE institutions managers to "internationalise" the institution[19]: (a) programme strategies and (b) organisational strategies. Programme strategies refer to those activities and actions "related to the teaching, learning, training, research, advising or supporting activities of

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[19] 'Internationalisation strategies' will be understood here as those planned courses of action with specific aims, which consist of internationalisation activities and other measures that need to be implemented within a given timeframe.

the institution both at home and offshore" (Knight, 1997: 14). The author identifies the following four main categories of programme strategies: (1) "academic programmes" consisting of a wide range of activities that according to Knight (1997) have the main aim of integrating an international and/or intercultural dimension into the curriculum; (2) "research and scholarly collaboration", which includes initiatives related to the integration of the international/intercultural dimension into the nature, the methodology, the actors and/or the distribution of research; (3) "extra-curricular activities", those that bring locals and foreign students together providing a context for interaction besides the academic environment; and finally, (4) "external relations and services" ranging from "internal development activities and bilateral cooperation agreements between institutions" to "commercial activities like contract training and the export of educational products and services to international markets" (Knight, 1997: 16).

Knight lists also several "formal" organisational strategies – "policies, procedures, systems and supporting infrastructures which facilitate and sustain the international dimension of the university or college" (Knight, 1997: 14) –, which contribute to the institutionalisation of the internationalisation dimension through its integration into "the institution's mission statement, planning and review systems, policies and procedures, and hiring and promotion systems" (Knight, 1997: 16). The author classifies organisational strategies into the following four main categories: (a) governance, (b) operations, (c) support services and (d) human resource development. See Knight (1997: 16-17) for examples of all formal strategies.

As noted by this specialist, though, the strategies cited here are of a "formal" kind, and there are some other "informal" aspects of internationalisation strategies worth taking into consideration when studying the IoHE. These are "the patterns of power and influence, personal views of organisational and individual competencies, patterns and groupings of interpersonal relations and communication systems" (Knight, 1997: 17). Communication is therefore an informal aspect of the IoHE, mostly under-researched in relation to this phenomenon. This study hence attempts to contribute to this gap in the literature.

Although communication is an under-explored element within the field of the IoHE, it is an implicit aspect of many internationalisation activities. It is somehow present in activities like student and staff mobility, export of academic systems and cultures, cross-border programme delivery, international networking, international credit recognition and transfer, and curriculum internationalisation, among others. And specifically, scientists' communication may be present in internationalisation activities like research cooperation, cross-border researcher internship, international export of lab culture, international joint projects, international work placements,

etc. Furthermore, the effects of globalisation and HE institutions' 'internationalisation policies' on science have long been documented: the consolidation of an international labour market for scientists, the predominance of English as the "language of science", the formation of multinational research teams and of joint cross-national projects, and the cross-border communication through international conferences and international publications, among others. These have as a result new scenarios with inevitable implications for scientific communication.

In fact, international communication is a basic premise attached nowadays to successful researchers: "They must be active actors within the webs, nodes, and specialized networks and centers of strategic scientific and technological knowledge and information that extend globally across international communication channels" (Maheu *et al.*, 2014: 168). However, besides the recognised attraction force of English-speaking countries, in part due to the presence of this worldwide lingua franca, the effects of communication on the IoHE and vice versa remains unclear. And this is in fact the ultimate aim of the current research project: to unveil in what ways the IoHE is influencing scientists' communication in two multinational research groups, in Catalonia in this case.

In this chapter, literature coming from diverse areas of study but with the common ground of addressing scientists' communication and/or the IoHE has been presented. From the sociology of science, to professional communication, through academic literacies and research on the internationalisation of higher education and the globalisation of science, it has been an exhaustive trip throughout insightful works that frame the current project in different ways and which offer interesting points to support the present study. Here, we have shown how communication is present in scientists' daily endeavour in many different ways. Scientists' communication plays an important role in their daily informal and formal interpersonal interactions in the workplace, in their collective construction of scientific facts, in the rhetoric of scientific discourse (that fosters its mystification, authority and imposition), in scientists' design of (multimodal) scientific presentations, in their simplification of their activity and observations, in the standardised procedures they follow, as well as in the artifacts they use, in their struggle to position themselves in the scientific world, in their publishing practices, and in their use of *linguae francae* (not only English), among many other practices and sites.

We have also made an effort to identify *loci* of interaction between scientists' communication and the IoHE, which remains a rather unexplored issue. Examples of these are the generalisation of protocols and objects, the imposition of standards and of evaluation systems, the international circulation of scientific objects, lab artifacts, scientific discourses and debates, the imposition of discourse styles from central scientists to peripheral scientists, the raise of 'literacy brokers' in

intermediate positions, the imposition of research topics from central to peripheral stakeholders, the emergence of a ruling elite of scientists and institutions and the increasing dependence of others in them, the generalisation of scientific communication genres, the increasing importance of image in science worldwide and the growing intent to counterbalance the democratisation of image-processing technologies through image-processing guidelines. This has thus been an attempt to frame the multiple shapes that scientists' communication may take and to ultimately identify its place within the IoHE. Having set the literature framework, in the next chapter the theoretical framework that determines the collection and analysis of the data will be detailed.

Chapter 2: Theoretical framework

The present chapter will be devoted to the exposition of the theoretical approaches that underlie the design of this project as well as my interpretation of the data gathered. In section 2.1, I will briefly state my ideology as a researcher and explain my personal understanding of sociolinguistic research, which, to my view, needs to be "critical" while it has to be necessarily tied to discourse. In section 2.2, I will summarise the main tenets of Critical Discourse Analysis (Fairclough, 2003; Van Dijk, 2008; Wodak & Meyer, 2001), an approach that will guide my interpretation of the data cross-sectionally, as well as some basic concepts of two macrosociological theories: Bourdieu's (1977) *theory of practice* and Giddens' (1984) *structuration theory*. The following sections will summarise main concepts and tenets of diverse approaches that will help in the analysis of different aspects of the phenomena studied. Section 2.3 will tackle some considerations related to the sociology of language (Fishman, 1968) and the ethnography of communication (Hymes, 1964), which will aid the analysis of phenomena closely (and most explicitly) related with communication. Section 2.4 will be devoted to the explanation of the theory of the community of practice (Lave & Wenger, 1991), which is more centred in processes connected with learning and socialisation in learning communities. In section 2.5, I will explain some main theoretical concepts of multimodal social semiotics (Kress, 2010), also focused on communication in specific communicational instances or 'texts'. And finally, section 2.6 will present the compatibility of the approaches chosen and will illustrate how they may be combined to explore the communication of the research group.

2.1. Research ideology, ethics and my political stance

I believe that any discourse, including – and maybe especially – the academic/scientific[20] discourse, is political[21], not only regarding its aims and effects but also considering its underlying ideology. In the same way that all humans have beliefs about the world surrounding us, every author has an ideology on the topic tackled in her[22] papers, as well as on her texts'

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[20] I will use these terms interchangeably in the present thesis.

[21] I conceive 'politics' in the Aristotelian sense: "an ethical activity concerned with creating a 'just society'" (Heywood, 2013: 5) understanding that 'man is by nature a political animal' (Aristotle, *Politics*). I would also accept Heywood's broad conception of the term: "Politics, in its broadest sense, is the activity through which people make, preserve and amend the general rules under which they live" (Heywood, 2013: 2); and agree with those who believe that 'political' behaviour "can take place in any, and perhaps all, social contexts" (Heywood, 2013: 3).

[22] For political reasons, related to feminism and the counteraction of the predominance of male/masculine discourse in science and more generally in the public sphere, in the present paper the feminine pronoun will be used for generalization, instead of the masculine only, or both.

environment (in terms of production and consumption). This, combined with the constructivist paradigm that underlies qualitative research, for which "there is no universally agreed upon reality or universal 'truth'" (Croker, 2009: 6), makes it indispensable, to my view, that all research reports depart from a statement of the author's ideology and political positioning. The omission of this account would give one's interpretations a pretentious tenor of absolutism and truthfulness, which I believe cannot be tied to human, sociological research: Studying subject(ivitie)s triggers always subjectivity, at most inter-subjectivity, but in no comprehensible way could it generate objectivity. Accordingly, criteria of validity and reliability should be replaced by plausibility – that conclusions are supported by logical arguments and based on data –, accessibility – that findings are accessible and understandable by the implied agents – and above all by honesty and professional ethics[23]. Stating one's (political-ideological) stance should thus be the first step in this direction. Following my firm belief in what has just been claimed, I will try to make clear my own ideology and political stance concerning research, qualitative research, applied sociolinguistics[24], and discourse studies.

As I have already suggested, research, as a form of discourse, responds to political aims and thus is itself ideologically shaped. This, in my opinion, is true for all scientific fields and research types: natural and human sciences, qualitative and quantitative research, and so on. My understanding of human sciences, and especially of the study of sociological issues, is very much influenced by the social constructionist[25] perspective, for which people in their daily

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[23] This idea is also supported by Altheide and Johnson (1994). In this sense, I also agree with Peter Newby's words: "The researcher's ethics are always an issue and should be made explicit. (...) If this is done then the researcher is demonstrating integrity and integrity is the very foundation of research quality. Lack of integrity corrupts an investigation. To demonstrate integrity, we should make everything we do clear, from the values that drive us and the issues that concern us to the rationale for the decisions we take and the argument for the conclusions we reach. Only with this openness will other researchers be able to assess our motives, our methods and our judgements" (Newby, 2014: 131).

[24] Despite not being widely used (being much less common than 'applied linguistics' or 'sociolinguistics' only), this concept has been chosen here to highlight my interest in both, social and communicative-linguistic issues, from a practical/applied approach. For discussions on the use of this concept, see Shuy (1984).

[25] Social Constructionism (SC) is a phenomenological approach to the 'sociology of knowledge' that has its origins in Berger and Luckmann's work: *'The Social Construction of Reality' (1966)*. As its authors state: "The basic contentions of the argument of this book are implicit in its title and sub-title, namely, that reality is socially constructed and that the sociology of knowledge must analyse the process in which this occurs." (Berger & Luckmann, 1966: 13). According to Anthea Irwin, "SC looks beyond, and indeed challenges, taken-for-granted notions (...). SC wants to look back and above and beyond to the processes that have caused these things to become taken-for-granted 'knowledge': Who said what, when, to whom, and how, to get us to where we are on any topic?" (Irwin, 2011: 100). The role of language in SC is that of 'objectifying' (or otherwise 'reifying') reality in a meaningful way: "The reality of everyday life appears already objectified, that is, constituted by an order of objects that have been designated *as* objects before

social activity and through their interaction with one another construct and reconstruct reality. In a similar way as participants' accounts of their experiences, of the world and of themselves are mediated by their ideology – based on their education, culture and values –, researchers' reports are not exempt from theirs; reporting human behaviour is always tied to the researcher's interpretation and, thus, to her own approach to the world. Consequently, in sociology there cannot be an absolute truth regarding right and wrong, good and bad, nor can there be a unique, truthful version of facts.

Due to this relativity and the multi-faceted nature of social research, I believe that qualitative research is most appropriate for the study of human issues, since it allows for the exploration of the complexities of human reason(ing), on the one hand, and for a more emic[26] approach to participants' discourses, through the use of open questions and the observation of natural settings, on the other. It is the inquiry of the qualitative characteristics of discourses[27] that interests me, instead of their amount, score or numeric assessment, which, to my view, is apter for the scrutiny of objects, and has too many drawbacks when used to comprehend human behaviour.

With reference to applied sociolinguistics[28], I understand it as the close, interdisciplinary study of 'real' social issues (grounded in the practice and not in the theory), focusing on their

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my appearance on the scene. The language of everyday life continuously provides me with the necessary objectifications and posits the order within which these make sense and within which everyday life has meaning for me. (...) In this manner, language marks the coordinates of my life in society and fills that life with meaningful objects." (Berger & Luckmann, 1966: 35-36).

[26] I understand 'emic' as described by Robert Croker: "Developing an emic perspective usually means directly interacting with the research participants in the research context, 'in the field, face to face with real people' (Rossman & Rallis, 2003, p.9). It also means using the participants' own terms and concepts to describe their worlds when analyzing data and presenting findings." (Croker, 2009: 8).

[27] This importance of the qualitative approach to discourse in social inquiry is sublimely highlighted by Ben Rampton: "With learning seen as an interactional process and reality viewed as a social construction, the understanding of meaning in interaction becomes a central objective, and the analysis of discourse becomes a potentially vital tool." (Rampton, 1997: 12).

[28] According to Bernard Spolsky, 'sociolinguistics' is "the field that studies the relation between language and society, between the uses of language and the social structures in which the users of language live. It is a field of study that assumes that human society is made up of many related patterns and behaviours, some of which are linguistic." (Spolsky, 1998: 3). The author declares it having been recognised "as a branch of the scientific study of language" (idem) in the 1960s, and distinguishes it from 'applied linguistics', while considering 'sociolinguistics' and the 'sociology of language' as the same thing, even though the latter is more concerned with the macro-domain of language in society. Furthermore, in the figure of Joshua A. Fishman, the "founding father of the Sociology of Language" (García, Schiffman, & Zakharia, 2006: 3), many scholars have also seen a great 'sociolinguist', as recognised by García *et al.* (2006), in their article entitled *'Fishmanian Sociolinguistics'*. For debates on the social dimension inherent in 'Applied Linguistics', see McNamara (2015) and Rampton (1997).

communicative aspects, and generally (though not in the case of the present study) especially in language; it consequently combines interests in society, discourse and language in complex ways though not necessarily in equal proportion or specific form. I am mainly interested in the social dimension of language, or otherwise in the intersection of language and society, seeing them as two inseparable entities. Due to my great interest in language and to my training as a philologist and as a linguist, I prefer to identify myself as a sociolinguist rather than as a sociologist of language[29], although I understand these two as very similar fields − being frequently and for long used interchangeably (Fishman, 1968) −, and many works as overlapping between the two disciplines.

In believing that discourse − of which language is usually a central element − is both shaped in social interaction and shapes society, I conceive of sociolinguistic inquiry as necessarily encompassing the analysis of both, the 'micro' and the 'macro'[30]: textual analyses of form and content, not only as the local, concrete instantiation of discourses, but also in their relation to other texts, to other discourses, to sociological structures and practices, and to ideological trends[31]. Either remaining in the micro domain or in the macro one would neglect an essential aspect of the nature and aim of applied sociolinguistics: solving actual problems (Shuy, 1984). As will be argued later on in this chapter, the present project aims to address the micro and the macro levels, which will be linked through a level in-between these two that I will name the "meso" level.

Ideologically speaking, due to my faith in the problem-solving commitment of applied sociolinguistic research, I tend to adopt a critical view[32] on the issues under study, based on the

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[29] Joshua A. Fishman characterised the sociology of language as inquiring "into the co-variation of diversity and of pattern in these two fields [linguistics and sociology]. Since *languages* normally function in a social matrix and since *societies* depend heavily on language as a medium (if not as a symbol) of interaction it is certainly appropriate to expect that their observable manifestations, language behavior and social behavior, will be appreciably related in many lawful ways." (Fishman, 1968: 6).

[30] On the micro- and macro-dimensions of sociology, sociolinguistics and DA, see Spolsky (1998), Fairclough (2005) and Knorr-Cetina and Cicourel (1981).

[31] This is quite a common claim not only among sociolinguists, but also among social scientists, and particularly also in the field of education, as is patent in Basil Bernstein's quote: "It is a matter of some importance that we develop forms of analysis that can provide a dynamic relationship between 'situated activities of negotiated meanings' and the 'structural' relationships which the former pre-suppose." (Bernstein, 1977: 168).

[32] A description of 'critical research' I like is the following: "...the foundations of all critical research in the social sciences: A systematic account of the way discourse is involved in the reproduction of power abuse (domination) and its social consequences, such as poverty and inequality, as well as the struggle against such domination. Such a study presupposes an explicit ethics, ultimately rooted in universal

deconstruction of the *status quo* − and thus of established structures, usually held by power −, the empathy with sites of struggle, and the spirit of reconstruction of structures and redesign of processes based on ethical values, such as democracy, honesty, opportunity equality, equity and respect. In the conviction that there is no absolute truth, I believe that these values should guide the proposal for improvement that, in my opinion, should always be attached to any applied sociolinguistic research report. The return to society and, very importantly, to the participants that have inspired the research project should be taken as a duty and as the *raison d'être* of the project itself and of the researcher.

My 'critical' view on social issues does have some elements in common with 'critical theory', such as being overtly ideological, seeking change and its interest in power asymmetries (Croker, 2009); however, it does not perfectly fit with it in the sense that I do not intend to empower 'marginalised groups' but to identify any sites of struggle, wherever they come from and whatever form they might take, in order to propose empowering mechanisms for the actors affected. I believe that core or powerful members of certain groups may occupy more peripheral and thus powerless positions in other communities; and it is the identification and empowerment of such peripheral actors what I am interested in. My point of view goes very much in line with the claim made by Norman Denzin and Yvonna Lincoln (2005: 13) that "[w]e want a social science that is committed up front to issues of social justice, equity, nonviolence, peace, and universal human rights. We do not want a social science that says it can address these issues if it wants to. For us, that is no longer an option".

Finally, I think I could trace in my ideological and political research stance some reminiscences of the poststructuralist[33] philosophical thought, which, according to Tim McNamara (2012), has

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human rights and criteria of legitimacy derived from them. Thus, discourses are the object of critical inquiry, when they contribute, directly or indirectly, to the reproduction of illegitimate domination in society, as is the case, for instance, for racist or sexist text and talk, but also for political or corporate manipulation." (Van Dijk, 2011: 36)

[33] For a definition of 'poststructuralism': "Poststructuralism is an outgrowth of structuralism. (...) Structuralism is a mode of inquiry that looks at the phenomena under its scrutiny as made up solely of relations among the entities in question, rather than those entities themselves. In other words, entities themselves are not positively defined, but identified at best as mere place-holders. This has the consequence that all structures are by definition hermetically closed unto themselves. (...) This in turn means that all structures are fully integrated, each with respect to itself, and autonomous with respect to other structures. (...) From a structuralist point of view, all changes were, so to speak, sudden and cataclysmic and, while keeping the overall structure intact, would result in an internal rearrangement of the network of relations within the structure. History, in this world-view, progressed by fits and starts, rather than in a smooth and gradual continuum. (...) In the late 1960s and early 1970s, there was a concerted move among French intellectuals to incorporate into structuralism insights from Marxism and Lacanian psychoanalysis. (...) This then can be pointed out as the hallmark of poststructuralism: the emergence of the historical subject within the very entrails of a structure. This new subject is one who has been empowered to act on his/her own and is endowed with agency. Once the presence of an agent who is

influenced applied linguistics: the social and political engagement; the critical stance towards social, political and cultural issues; an ethical concern in justice; the questioning of absolute 'truths' and of other 'stabilities' and systems; and the rejection of the notion of 'progress'. In this sense, I believe that all policies and politics should be (and actually are) based on social processes, which encompass moral discussions. This idea is very well described by Amitai Etzioni in the following excerpt:

> One main reason a line should be drawn between the social and the political is that there are no political deliberations, decisions, or actions that do not contain a moral dimension. (...) After all is said and done, there can be little doubt that (a) aside from rational deliberations, said to take place within legislative bodies and courts and town meetings, in political bodies, there are significant distinct social processes - moral dialogues - that lead to new or reformulated shared moral understandings; (b) these processes are often best advanced in the social realm, although they can also occur within the political one, and their conclusions often have profound political implications. (...) Although formation and reformation of power relations are at the core of the political, most of its decisions have a moral dimension. (Etzioni, 2004: 151-159)

Furthermore, my scepticism on objectivity in social and human sciences, as well as this very same act of unveiling my own value positions with the aim of making science more honest and democratic, may also be suggestive of poststructuralist ideas (see Agger, 1991). This ideological positioning may be more or less explicitly present in my interpretation of the data, as well as in diverse aspects of the research project's design.

Having summarised here not only 'where I come from' as a researcher, but also 'where I am going' as such, in the following sections I will describe the theoretical approaches that configure the theoretical framework of this project. This responds to the second main objective of this thesis: designing and proving a suitable theoretical framework to study the impact of the IoHE on scientists' communication, holistically. What I propose is an articulated theoretical framework composed of three theoretical layers, coinciding with Fairclough's (1992) three-dimensional model, and a cross-sectional approach which may affect all layers [see figure 1].

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in a position to subvert the order of things, thwarting it from within, is recognised, it is but a short step to reject the existence of all pre-ordained, foundationalist, essentialist and totalising conceptual schemes" (Chapman & Routledge, 2009: 170-172). Although some of them have never shown explicit adscription to poststructuralism, authors that have been attributed such are Jacques Derrida, Michel Foucault, Gilles Deleuze, Judith Butler, Jacques Lacan, Jean Baudrillard, and Julia Kristeva.

Figure 1: The articulated theoretical framework
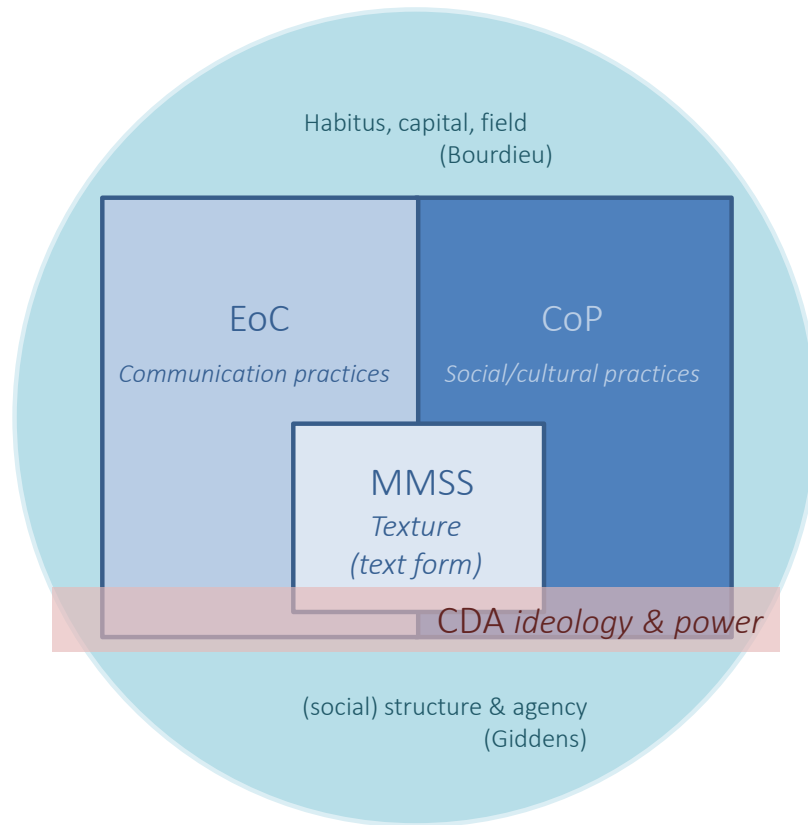
The first layer, that of the micro dimension of discourse and thus of analysis – what Fairclough (1992) defines as 'texture' or text form –, will rely mainly on *multimodal social semiotics* (MMSS) (Kress, 2010). The second layer, which I name 'meso' level/dimension and coincides with Fairclough's second dimension, concerning the production, distribution and consumption of texts, is in itself chiefly articulated by two approaches: the *ethnography of communication* (EoC) and the *community of practice* (CoP). The former may support those aspects of inquiry more strictly related with communication *per se* and the latter may aid the study of related socio-cultural issues at this middle level. This layer may also act as a link between the other two layers and is the main focus of the present project, which centres on the communication of a middle-level social aggregate, as is the research group. The third layer concerns what Fairclough (1992) calls macro dimension, which addresses the 'grand' discourses or broader socio-cultural issues beyond the research group, in this case (e.g. the institution, the national scientific system, international research, global science). Since this level is beyond the scope of this study but inextricable from the other two, it will be approached, though less prominently, to make reference to such macro issues by using concepts from Bourdieu's (1977) *theory of practice* and Giddens' (1984) *structuration theory*. Finally, *Critical Discourse Analysis* (CDA)

is the lens through which all layers will be approached, focusing on ideological stances and power relations across issues and topics.

These diverse theories may provide the concepts and terminology necessary to describe and interpret the observed phenomena, which has been claimed to be indispensable in social research:

> An adequate vocabulary is important because the concepts we use to make sense of the world direct both our perception and our actions. We pay attention to what we expect to see, we hear what we can place in our understanding, and we act according to our world views. (Wenger, 1998: 8)

And this is in fact the purpose of the current chapter: to present and describe the conceptual tools necessary for the analysis of *communication* in the scientific research team. To this end, the theoretical approaches chosen appear to be not only effective, but also highly compatible, as will be argued in the last section of this chapter. The next section will describe the theoretical and ideological underpinnings of the cross-sectional approach adopted here, that is *Critical Discourse Analysis*.

2.2. Cross-sectional Critical Discourse Analysis and the macro dimension

Following the critical approach to social issues I referred to above, and conceiving 'discourse' as a main means for the analysis of such issues, I will adopt in the present study the *Critical Discourse Analysis* approach, which will affect, as I said, not only the analysis of the data, but also the whole methodology of the present study.

Unlike what might be deduced from its nomenclature, *Critical Discourse Analysis*, or otherwise named *Critical Discourse Studies* (CDS), is not a mere method of (qualitative) data analysis nor a theory (Wodak & Meyer, 2009), but rather a 'perspective' or a research 'approach' that relates language and/or communication with discourse and with social and political structures (Fairclough, 1995); or in Ruth Wodak's words: "CDA aims to investigate critically social inequality as it is expressed, signalled, constituted, legitimized and so on by language use (or in discourse)" (Wodak, 2001: 2). It differs from Discourse Studies in CDA's "constitutive problem-oriented, interdisciplinary approach" (Wodak & Meyer, 2009: 1). In adopting this approach, the researcher gives express relevance to notions such as power, resistance, struggle, hierarchy and ideology, and interprets the data according to these. In this sense, CDA is "more akin to a repertoire of political, epistemic stances" (Luke, 2002: 97). Embracing CDA, thus, implies the fact of believing in some assumptions about discourse and power: "that discourse is structured by dominance; that every discourse is historically produced and interpreted, that is, it is situated in time and space; and that dominance structures are legitimised by ideologies of

91

powerful groups" (Wodak, 2001: 3). Therefore, in the study of social processes and structures, the context and thus the historical dimension − how agents and texts relate to contemporary such structures and processes − are indispensable (Meyer, 2001). As a result, elements such as culture, society and ideology need to be considered; and this necessarily entails an interdisciplinary approach (Wodak & Meyer, 2009).

Although some of the principles of CDA are drawn on Critical Theory of the Frankfurt School, CDA is rooted in Critical Linguistics (CL), an approach to texts and discourse developed in the 1970s and 1980s at the University of East Anglia by Roger Fowler, Robert Hodge, Tony Trew and Gunther Kress (see Fowler *et al.*, 1979; Hodge & Kress, 1979), for which Halliday's systemic functional linguistics (e.g. Halliday, 1973) was the main theoretical framework for text analysis (Fairclough, 1992; Van Dijk, 2001). CL viewed texts as the realisation of social processes, thus having an ideological and political role in their context (Fairclough, 1995). However, Norman Fairclough (1992) criticises, on the one hand, CL's excessive focus on text as a product over the processes of production and interpretation of texts; and, on the other hand, its disregard of discourse as a domain of social struggle, and of change in discourse as a 'dimension' of social and cultural change. Yet, both CL and CDA coincide in regarding discourses as ideological, and signs as non-arbitrary (Wodak, 2001).

Due to the wide diversity of definitions in the literature of the main concepts of CDA, as well as the plethora of methodologies used in CDA studies, Ruth Wodak and Michael Meyer suggest "using the notion of a 'school' for CDA, or of a programme, which many researchers find useful and to which they can relate" (Wodak & Meyer, 2009: 5). Indeed, the label 'CDA' comprises studies of very diverse nature, which share common characteristics: "interests in de-mystifying ideologies and power through the systematic and retroductable investigation of semiotic data (written, spoken or visual). CDA researchers also attempt to make their own positions and interests explicit while retaining their respective scientific methodologies and while remaining self-reflective of their own research process." (Wodak & Meyer, 2009: 3). In this sense, CDA implies actively seeking a state of openness and sincerity; in the same way as the researcher tries to unveil the underlying structures and processes of her research object, she intends to keep the research process as open as possible.

The relationship between CDA and linguistics is given by the relationship between language (or semiotic compositions) and social phenomena. In Allan Luke's words:

> CDA involves a principled and transparent shunting back and forth
> between the microanalysis of texts using varied tools of linguistic,

semiotic, and literary analysis and the macroanalysis of social formations, institutions, and power relations that these texts index and construct.

If there is a generalizable approach to CDA, then, it is this orchestrated and recursive analytic movement between text and context. (Luke, 2002: 100)

Regarding language and/or communicative resources as a materialisation of ideologies and social interaction, many CDA studies often investigate linguistic uses and, thus, use linguistic categories in their analyses, many of which come from systemic functional linguistics (Halliday, 1961). The use of pronouns, deixis, verbal tense, mode and time, and transitivity, to name only a few, are very often taken into consideration for data analysis. Indeed, Fairclough, in his work *Discourse and Social Change (1992)*, develops an analytical framework for the interconnections between language, discourse practices and social and political issues such as power and ideology. In particular, this author develops a three-dimensional framework for CDA which I find very inspiring and thus useful for the present study. It consists in the distinction and superposition of three levels of analysis: (1) textual analysis (text), (2) analysis of discursive practices and 'orders of discourse' (discourse practice), and (3) analysis of socio-cultural practices (culture). The first level of analysis consists in focusing on 'texts' as objects of analysis, being these "extraordinarily sensitive indicators of socio-cultural processes, relations and change" (Fairclough, 1995: 4), and basing their analysis on the study of 'texture' – which includes not only the content, but also the form and organisation of texts. The second level of analysis would entail analysing the processes of text production, distribution and consumption. And the third level would involve regarding discursive events as instances of socio-cultural practice.

While CDA's tradition is heavily theory laden, CDA studies, as has been pointed out, use very diverse theories. Among the diverse theoretical levels traditionally reached in CDA-oriented research: epistemology, general social theory, middle-range theories, micro-sociological theories, socio-psychological theories, discourse theories and linguistic theories (Wodak & Meyer, 2009), the present research study seeks to embrace a wide range of such levels, from communication theorisation – in order to understand and explain specific rules of interaction –, to the meso-sociological – to elucidate the social order of a particular social group or community –, and to macro-level theorisation – tackling issues related to a wider socio-political context, such as education and internationalisation, to finally trace some links with other social issues, such as global science and power structures in the production of knowledge, or otherwise link the micro and the macro.

Before moving on to summarising the three theories mentioned, in the following subsections I will define some main concepts related to CDA research, as will be understood and used in the present study: *discourse* and *discourse analysis* (subsection 2.2.1); *text*, *genre*, *intertextuality* and *interdiscursivity* (subsection 2.2.2); *power* (asymmetries) and *ideology* (subsection 2.2.3); and *structure* and *agency* (subsection 2.2.4).

2.2.1. Discourse and discourse analysis

'Discourse' has been differently defined depending on the theoretical perspective taken (e.g. sociocognitive approach, historical approach, etc.) and to the intellectual tradition followed. These diverse definitions can be summarised in the following three categories: "(1) anything beyond the sentence, (2) language use, and (3) a broader range of social practice that includes nonlinguistic and nonspecific instances of language" (Schiffrin, Tannen, & Hamilton, 2003: 1). The definition that best suits my own understanding of discourse and that is the most functional definition for the purposes of the present research study is the following: discourses are "relatively stable uses of language serving the organisation and structuring of social life" (Wodak & Meyer, 2009: 6). However, I look at this notion from a rather "multimodal"[34] perspective than the one reflected in Wodak and Meyer's definition. I share Jan Blommaert's (2005: 3) belief that discourse is "language-in-action" and "comprises all forms of meaningful semiotic human activity seen in connection with social, cultural, and historical patterns and developments of use"; and that "[w]hat is traditionally understood by language is but one manifestation of it". I could not agree more with Blommaert's claim that "all kinds of semiotic 'flagging' performed by means of objects, attributes, or activities can and should also be included for they usually constitute the 'action' part of language-in-action" (Blommaert, 2005: 3). I then consider any type of semiotic composition (being it a designed text or a composition formed by daily objects and environments) as constituent of and containing discourse. In adopting such a multimodal critical perspective on discourse, my study goes in line with the "little critical work done on the way that discourses are communicated, naturalised, and legitimised beyond the linguistic level" (Machin, 2014: 347), and is thus situated within the field of *Multimodal Critical Discourse Studies* (MCDS). Following this, I would rather adapt Wodak and Meyer's (2009) definition, provided above, to include this multimodal dimension; and define 'discourses' as 'relatively stable uses of language *and/or communicative semiotic resources* serving the organisation and structuring of social life'. Nonetheless, such a definition may still seem rather vague and ambiguous. Indeed, discourse is not a concrete entity, but an analytical construct, with fluid boundaries, which is open to reinterpretations (Reisigl & Wodak,

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[34] Meaning that it recognises the use of multiple 'modes' or resources for communication.

2009). The concretion of discourse takes the form of texts. And thus, discourse can be also conceived, to my view, as the common element underlying a specific range of genres and texts.

Related to this latter idea is a definition of 'discourse analysis' (DA) which I find clarifying enough and at the same time broad enough so as to reflect the multiple perspectives to discourse encompassed within DA. It is the definition offered by Christopher Candlin in his preface to Fairclough's work *'Critical Discourse Analysis: The Critical Study of Language'*: "discourse analysis is not a 'level' of analysis as, say, phonology or lexico-grammar, but an exploration of how 'texts' at *all* levels work within sociocultural practices" (Fairclough, 1995: viii-ix; original emphasis). In this definition, there is express reference to the social (and cultural) dimension of texts – and thus of discourse –, which is, to my view, inseparable from sociolinguistic inquiry. Besides adopting this "social" perspective, as has already been explained, in the present study, a critical perspective on DA is also followed. This means that texts and discourses will be considered as pertaining to structures of power and thus contributing to or, on the contrary, resisting the perpetuation of power asymmetries, and consequently being themselves rich and revealing sites for the exploration of such power relations (Blommaert, 2005). Their analysis – the 'A' of (C)DA – will consist in the identification of such structures and their constitutive elements, as well as the explanation of the processes of power imposition and/or resistance in the specific context of research.

2.2.2. Text, genre, intertextuality and interdiscursivity

'Text' is a very relevant concept for CDA, since it is conceived to be the "basic unit of communication" (Wodak, 2001: 2) by scholars working in this field. It is indeed very closely related to the term 'discourse'. As pointed out by Fairclough (1995) and Wodak and Meyer (2009), these two are variably differentiated depending on the tradition followed. On the one hand, some traditions distinguish between these two concepts depending on the medium used: 'discourse' would be the oral communicative instances, and 'text' the written communicative outcomes. However, the border between the two has blurred and 'text' has increasingly been used to refer to both, written and oral compositions (as in the field of discourse analysis). Finally, maybe as a result of the influence of cultural studies, where 'text' may refer to any cultural artefact (a picture, a song, etc.), and due to the increase of multi-semiotic compositions (combining speech, text and even image), 'text' is currently also used by some experts to name any instance of semiotic communication, whatever the communicative resources used (Fairclough, 1995).

On the other hand, other traditions assign a different level of abstractness to these two concepts: in this sense, 'text' would name concrete instances of 'discourse', namely of "what we mean by

saying and doing" (Lemke, 1995: 19) or otherwise of "structured forms of knowledge and the memory of social practices" (Wodak & Meyer, 2009: 6). My own understanding of the term 'text' is a combination of these two approaches: I embrace the view of 'text' as any multi-semiotic composition, comprising not only written or oral linguistic documents, but also objects, spaces, and any "piece" or "section" of the world that can be perceivable by the sense(s); and at the same time, I see this concept as an instantiation or otherwise a perceivable concretion of 'discourses', which to my understanding have a more abstract meaning, which has to do with knowledge, memory and beliefs.

Very closely related to the notion of text are the concepts of 'genre' and 'intertextuality'. The term 'genre' makes reference to a conventionalised "way of acting and interacting linguistically" (Fairclough, 2003: 17) – and I would add 'semiotically' –, such as a letter, a scientific paper and a conference presentation, which determines the structure and form of texts. 'Intertextuality' is a relevant analytical concept for the discourse-historical approach of CDA, and makes reference to the diverse types of relations between texts, or "how texts draw upon, incorporate, recontextualize and dialogue with other texts" (Fairclough, 2003: 17). 'Intertextuality' is different from 'interdiscursivity' in that the latter defines the distinctiveness of texts "in how they draw on and combine together relatively stable and durable discourses" (Fairclough, 2005: 920). The analysis of discourse in such terms entails an analysis of linguistic and semiotic elements, as well as the analysis of social events and practices (Fairclough, 2003, 2005).

2.2.3. Power (asymmetries) and ideology

Following Van Dijk's definition (2001: 354-8), I understand 'power' as the 'control' of individuals over the acts and/or thoughts of another individual or more than one individuals. In fact, Andrew Heywood (2013: 9) identifies three types or 'faces' of power: (a) power as decision-making; (b) power as agenda setting; (c) power as thought control, by which decisions made and prevented as well as thoughts are influenced by means of intimidation, persuasion or indoctrination. Considering power in its social dimension as 'social power' would entail extrapolating patterns of such control to groups of people which share common characteristics in terms of social behaviour: a group of people has control over another group of people (e.g. politicians over the citizenship, general managers of companies over employees, etc.). A basic characteristic of power is that it is usually exerted on the basis of access to resources ('power base' for Van Dijk), such as information, knowledge, money, force, status, authority, dissemination media, etc.

As I suggested in the first section of this chapter, power asymmetries will be regarded as existing in any interaction, and not as always favouring particular social groups (and thus

damaging dominated ones), but as penetrating diverse aspects of every exchange. In this sense, an individual or a group of people are understood to be powerful in certain facets (e.g. gender, status, etc.) and, yet, also powerless in other facets (e.g. access to money, information, etc.), at the same time and depending on the specific situation. Furthermore, power asymmetries are seen in this study as dynamic, changing and evolving in time, even throughout a specific interaction. When analysing power asymmetries, it is not only relevant to observe the behaviour of the powerful ones, but also that of the powerless. Powerless actors might engage in either offering 'resistance', accepting the asymmetric situation, or legitimising the power of the powerful actors, even by regarding it as "natural" and not as an asymmetry. There are diverse ways and means by which power can be legitimised: laws, norms, protocols, "common sense", habits and consensus, which have much to do with discourse practices.

Regarding the connection between power and discourse, Fairclough (1995: 2) defines the "power to control discourse" as "the power to sustain particular discursive practices with particular ideological investments in dominance over other alternative (including oppositional) practices". Two relevant aspects that should be considered in the study of power and discourse are (a) asymmetries between participants in discourse events and (b) asymmetric control capacity of text production, distribution and consumption in particular contexts (Fairclough, 1995). Such control might be 'active', and so imply control over the production of discourse (e.g. in a face-to-face conversation), or 'passive', entailing control over its consumption only (e.g. when reading a newspaper) (Van Dijk, 2001). This author identifies also two main constituents of discourse that might potentially be controlled in power relations: (a) context, consisting of "such categories as the overall definition of the situation, setting (time and place), ongoing actions (including discourses and discourse genres), participants in various communicative, social, or institutional roles, as well as their mental representations: goals, knowledge, opinions, attitudes, and ideologies" (Van Dijk, 2001: 356), and (b) structures of text and talk (e.g. genres, speech acts, topics, meaning, form and style).

Related with 'power' is the concept of 'ideology'. This is a key concept in CDA, and thus in the present study, since it reflects the social dimension of discourse and, for this reason, provides justification for the acts of discourse, namely those actions concerning discourse, such as discourse production, reproduction, consumption, interpretation, imposition, etc. This term, which comes from political science and philosophy, has been defined by Teun Van Dijk as "the underlying frameworks of the socially shared beliefs of group members" (Van Dijk, 1998: 55), which consist of "those general and abstract social beliefs, shared by a group, that control or organize the more specific knowledge and opinions (attitudes) of a group", and continues: "they do not only embody the specific values but also the truth criteria of a group" (Van Dijk, 1998:

49). Such mental frameworks may take form of "the languages, the concepts, categories, imagery of thought, and the systems of representation" (Hall, 1986: 29; in Makus, 1990: 499).

From his socio-cognitive perspective on CDA, Van Dijk (1998) describes the process of ideology formation as corresponding to a process of generalisation of evaluation criteria (or beliefs), which, when they transcend the group and are adopted by society as a whole, acquire the status of 'common ground' - what has been named as the 'ideological moment' (Makus, 1990: 498). These can also be considered 'dominant ideologies', which "appear as 'neutral', holding on to assumptions that stay largely unchallenged" (Wodak & Meyer, 2009: 9). In the process of generalisation of specific ideologies, the social dimension of discourse is key. As Van Dijk puts forward: "In a social sense, this [ideology formation] requires social interaction, sharing, social situations, organisation and often also institutionalization" (Van Dijk, 1998: 51). At this stage, ideologies acquire legitimacy and universal validity, to the point that they are detached from the historical circumstances where they were first coined and are presented as neutral, natural, obvious and true. It is in this status of common ground or common sense when ideologies appear to have the strongest impact, since they adopt the aspect of absolute truth: "Ideologies have often been declared really influential if nobody notices them, and if they define common sense" (Van Dijk, 1998: 50).

The individual is thus caught in this ideological environment, which cannot be escaped. Such 'dominant discourses', which have their origin in the beliefs of the dominant social groups – those with the power to upgrade their beliefs to truth statements –, "constitute the field of meanings within which they [the people] may choose" (Hall, 1977: 343; in Makus, 1990: 502). Ideologies are "resistant to change and thus to the introduction of alternative perspectives (...) to the degree that they may be seen as violating the common sense of a culture" (Makus, 1990: 500). The domination strategy exerted by powerful groups consists in "framing all competing definitions of reality within their range" (Hall, 1977: 333; in Makus, 1990: 502). Anne Makus describes this state of constant dealing with inescapable ideology with a rather illustrative metaphor: "Therefore, ideology is not like a building which one can exit; we are necessarily in the building, and all we can do is choose how to decorate or remodel it" (1990: 500).

This view of ideology as a site of power relations or as a 'modality of power' (Fairclough, 2003: 9) is what makes this concept especially relevant for CDA. From this perspective, as Alastair Pennycook, following Fairclough (1995), signals: "The goal of critical discourse analysis is to denaturalize ideologies that have become naturalized", and follows: "The goal of CDA is to make these ideological systems and representations transparent and to show how they are related to the broader social order" (Pennycook, 2001: 81). Representations of ideology are

98

texts, of which language is usually an important aspect. According to Fairclough (2003: 9), ideologies are not only represented, but also "'enacted' in ways of acting socially, and 'inculcated' in the identities of social agents"; and hence these, the author argues, "can be associated with discourses (as representations), with genres (as enactments), and with styles (as inculcations)".

However, the denaturalisation of ideologies is not an obvious process; as Van Dijk points out, it is only possible when contrast with alternative discourses is feasible:

> …we are only able to understand and analyse common cultural ground as ideological if we have possible alternatives, other examples, other cultures, conflicts between cultures, or when a specific group within a society or culture challenges the social beliefs of the common ground. In other words, again, the relativity principle applies: common cultural ground can only be called ideological at a higher, comparative, universal or historical level of analysis. (Van Dijk, 1998: 50-1)

In this sense, Fairclough argues, "textual analysis needs to be framed in this respect in social analysis which can consider bodies of texts in terms of their effects on power relations" (Fairclough, 2003: 9). Fairclough thus highlights the need for CDA to relate the micro level of textual analysis with the macro level of social (discourse) analysis. In the same vein, Stuart Hall argues that "social ideas arise in the interactive conjunction of rhetorics and social practice", and thus that social knowledge is mainly produced through language, "through the instrumentality of thinking, conceptualization, and symbolization" (Hall, 1977: 327-8; in Makus, 1990: 499). In their status of common sense, ideologies become assumed as culture codes and constrain action and thought as 'structures' - of language, of society and of discourse, in the form of themes and stances - which give meaning to specific events (Makus, 1990). The job of the critical discourse analyst is thus to relate textual analysis and language (or communication) structures with ideologies and social structures. In the next subsection, the concept of 'structure' will be further explained and contrasted with that of 'agency'.

2.2.4. Structure and agency

Structure and *agency* are two sociological concepts that are basic for the understanding of the connections between the micro and the macro dimensions of discourse and/or of the social, which is a main goal of CDA. Structure and agency are two main notions of sociology, departing from a traditional debate – concerning scholars and thinkers such as Émile Durkheim, Karl Marx, Georg Simmel, Norbert Elias, Pierre Bourdieu, Anthony Giddens and Roberto Unger – on the primacy of either of the two to determine human behaviour (for an updated review of this debate applied to the fields of sociolinguistics and intercultural communication,

see Block, 2013). On the one hand, *structure* consists of material (e.g. cities, buildings, jewels, clothes, the body) and non-material (e.g. norms, traditions, ideologies) elements of society that constrain, enable and shape human action. On the other hand, *agency* names the capability of individuals to create and/or influence structure through their action. For the present study, I will follow approaches that try to reconcile these two factions – highlighting structure over agency or vice versa –, understanding that these two elements are mutually constituent and constitutive, such as Anthony Giddens' s*tructuration theory* and Pierre Bourdieu's *theory of practice*, and, more specifically, his constructs of *habitus*, *field* and *capital*.

With reference to *structure*, a basic characteristic of it is that it may design patterns of action and of relations, which are reproduced more or less consciously by actors. Thus structures are not the patterns themselves, but the principles that guide them (Sewell, 1992). According to Giddens, structures are "dual", being "both the medium and the outcome of the practices which constitute social systems" (Giddens, 1981: 27; in Sewell, 1992: 4). Structures may be both rules and resources, either material or immaterial, that facilitate the reproduction of social systems[35]. *Rules*, defined by Giddens as "generalizable procedures applied in the enactment/reproduction of social life" (Giddens, 1984: 21; in Sewell, 1992: 8), do not necessarily make reference to prescriptions, but to informal cultural schemata or assumptions, such as conventions, protocols, principles of action, and habits of speech and gesture. As for *resources*, Sewell, drawing on Giddens (1979), distinguishes between two kinds: nonhuman and human resources; which he describes as follows: "Nonhuman resources are objects, animate or inanimate, naturally occurring or manufactured, that can be used to enhance or maintain power; human resources are physical strength, dexterity, knowledge, and emotional commitments that can be used to enhance or maintain power, including knowledge of the means of gaining, retaining, controlling, and propagating either human or nonhuman resources (Sewell, 1992: 9).

Structures are perceived by social agents, who keep these patterns in their memories, as *knowledge structures*. At the individual domain, Giddens (1984) defends that agents are 'knowledgeable', meaning that they have knowledge about what to do and how to act, by recalling this structured knowledge. Thus *agency* consists in conceiving human beings as agents who are capable of reinterpreting and mobilising resources, as well as transposing and extending (cultural) schemata to new contexts (Sewell, 1992). Power, in this sense, would be determined by the agents' access to resources. Therefore, agents might have control over social relations; have knowledge of schemata; might have access to resources; and are empowered to

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[35] According to Sewell, "[b]y 'social systems' Giddens means empirically observable, intertwining, and relatively bounded social practices that link persons across time and space" (Sewell, 1992: 6).

act in collaboration with or against other agents. Nonetheless, the kind (e.g. desires, intentions, shape of transpositions) and the extent (scope in kinds and amount of resources mobilised) of agency varies from one individual to the other; and its extent, which at the individual domain depends on the agent's position in collective organisations, differs also from one social system to another. Therefore, the form agency takes is determined by the agent's social milieu, and is thus culturally and historically dependent (Sewell, 1992).

As has been already suggested, other relevant constructs for the present study, which are also closely related to the notions of agency and structure, are Bourdieu's concepts of 'habitus', 'field' and 'capital'. Firstly, *habitus* refers to the internal "organising principles" (Bourdieu, 1977: 18) of the agent that are generated out of previous engagement in social practices, and guide (or structure) engagement in new practices and representations, as a result of which those principles might be adapted and modified (Block, 2013). The habitus constitutes, therefore, temporally durable structures, which determine agency.

Secondly, the notion of *field*, in general, identifies "the analytical space defined by the interdependence of the entities that compose a structure of positions among which there are power relations" (Hilgers & Mangez, 2015: 5). The broader *field*, in turn, is composed by subfields – also referred to as *'field'* –, each of which is "a relatively autonomous domain of activity that responds to rules of functioning and institutions that are specific to it and which define the relations among the agents" (Hilgers & Mangez, 2015: 5). Thus, *fields* determine spaces with legitimate forms of acting and thinking (Block, 2013). Narrowly related to the notion of 'field' is the construct 'field of power', namely "the space of relations of force between agents or between institutions having in common the possession of the capital necessary to occupy dominant positions in the different fields" (Bourdieu, 1992: 300; 1996: 215; in Hilgers & Mangez, 2015: 8). The *field of power* is structured by an economic fraction (dominating) and by a cultural fraction (dominated). Depending on the autonomy of the field, it may be more or less influenced by external hierarchisation forces (belonging to the broader field of power), besides the internal ones (exclusive of the specific field).

Finally, *capital* designates "a specific form of accumulated symbolic capital" (Hilgers & Mangez, 2015: 6). As Bourdieu himself defines it:

> Capital is accumulated labor (in its materialized or its 'incorporated', embodied form) which, when appropriated on a private, i.e., exclusive, basis by agents or groups of agents, enables them to appropriate social energy in the form of reified or living labor. It is a *vis insita*, a force inscribed in objective or subjective structures, but it is also a *lex insita*, the principle underlying the immanent regularities of the social world. (Bourdieu, 1986: 46)

101

Bourdieu distinguishes between three types of capital: *economic capital, cultural capital* and *social capital*. On the one hand, the *economic capital* is that accumulative force "immediately and directly convertible into money and may be institutionalized in the form of property rights" (Bourdieu, 1986: 47). On the other hand, the *cultural capital* may take three different forms: it can be embodied, in the form of dispositions of mind and body (or otherwise, culture, cultivation or *Bildung*); objectified, by means of cultural goods (e.g. books, paintings, machines, etc.); and institutionalised, through academic qualifications (which impose long-lasting recognition of cultural capital, external to the agent and more or less independent from her command at a specific moment in time). Lastly, the *social capital*, which is "made up of social obligations ('connections')" (Bourdieu, 1986: 47), makes reference to:

> ...the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in other words, to membership in a group – which provides each of its members with the backing of the collectivity-owned capital, a 'credential' which entitles them to credit, in the various senses of the word. (Bourdieu, 1986: 51)

The *social capital* is "convertible, in certain conditions, into economic capital and may be institutionalized in the form of a title of nobility" (Bourdieu, 1986: 47). The volume of the *social capital* possessed is directly proportional to the size of the social network the agent is capable to mobilise and to the volume of *capital* these connections possess (Bourdieu, 1986).

Additionally, in his work on the scientific field (Bourdieu, 1975), the author makes reference to a fourth type of capital: scientific capital, drawing on Fred Reif (1961). This corresponds to the accumulated scientific authority, which is often reified in the form of academic ranks, posts and awards, and is easily convertible into funding and rewards.

According to Bourdieu (1987), agents take a specific position in the social space according to three variables related to capital: the overall volume of capital they possess, the composition of their capital (volume of each type of capital), and the trajectory of their capital (the evolution of the volume and composition of their capital). Those agents with closer or neighbouring positions in the global social space will tend to have similar properties, interests, or *habitus*, if similar trajectories brought them to those positions. And these neighbour agents will conform a class, a set of agents sharing common conditions of existence, conditioning factors, dispositions, and developing similar practices. Therefore, as the author suggests, the accumulation of capital determines the structure of the social world:

> ...the structure of the distribution of the different types and subtypes of capital at a given moment in time represents the immanent structure of the social world, i.e.,

the set of constraints, inscribed in the very reality of that world, which govern its functioning in a durable way, determining the chances of success for practices. (Bourdieu, 1986: 46)

In this regard, Bourdieu distinguishes between two types of structures: *symbolic structures*, which "order the field (and the social world) by classifying and categorizing it at the level of meaning: how do people think, how do they order the world cognitively within the field, what are their position-takings?", and *social structures*, which "order the world by classifying and categorizing it according to the objective resources, positions and trajectories of individuals and groups" (Hilgers & Mangez, 2015: 11).

By drawing on the concepts above defined and adopting CDA, understood as "the analysis of the dialectical relationships between semiosis (including language) and other elements of social practices" (Wodak & Meyer, 2009: 27), as Fairclough's dialectical-relational approach to CDA does, in the present study I will try to establish connections between micro and macro dimensions of discourse in society, and specifically in the particular domains of my research: science and higher education. Such connections may be drawn by either of the four processes described by Van Dijk (2001: 354): (1) by deeming individuals as members of a certain group or community; (2) by regarding individual actions as part of broader social processes; (3) by viewing particular interaction as part of social structures; and (4) by considering both the personal and the social cognition of actors: individual memories, knowledge and opinions, and also shared 'social representations' that govern actions of groups.

In the next section, I will introduce the approaches of the *sociology of language*, of *linguistic ethnography* and of the *ethnography of communication*, and reflect on their conceptual contributions to the study of language policy – as was the initial objective of my study –, while discussing about their suitability to assist in the data analysis of the present research project. These approaches may be especially useful to tackle the analysis of those semiotic aspects related to the production, distribution and consumption of texts, the meso level of analysis.

2.3. Linguistic ethnography and the ethnography of communication: from language policy to multimodal communication policy

The original objective of this study was to explore and describe the linguistic practices of two groups of scientists in their daily professional activities, with the final aim of unveiling how the groups' language policy was being influenced by the internationalisation policies of the higher education institution where their activity was framed. This sociolinguistically-oriented, initial research question was logically swayed by my linguistic training, the sociolinguistic inquiry I was committed to, and my group's research project, entitled *Intercultural, European citizenship*

and English as a lingua franca: between policy and practice in international higher education mobility programmes, in which my study was set. At this initial stage, Bernard Spolsky's notion of 'language policy' (2004, 2007) was a core concept guiding my research. Following Spolsky, I understood it as consisting of three main elements: (a) language practices, meaning "the habitual pattern of selecting among the varieties that make up its [a speech community's] linguistic repertoire" (Spolsky, 2004: 5); (b) beliefs about language and language use; and (c) language management or planning, namely "any specific efforts to modify or influence that practice by any kind of language intervention" (Spolsky, 2004: 5). Consequently, I considered that language policy should be observed through ethnographic methods, so that I would be able to capture not only actual language practices of participants, by recording spontaneous interactions, but also their ideologies, through interviews, as well as instances of language management, by collecting ethnographic contextual data.

The approach adopted in this study, which is based on the ethnographic study of language in its social context of use, does indeed share some tenets with the work done in the area of *Linguistic Ethnography* (LE), especially in the UK (further explained in Creese, 2008, 2010; Rampton, 2007a; Tusting & Maybin, 2007). Linguistic ethnography is an approach to the study of language and its interplay with the social that follows anthropological linguistic traditions, such as the ethnography of communication (Hymes, 1974, 1977), interactional sociolinguistics (Gumperz, 1964, 1977) and micro-ethnography (Erickson, 1996) (Creese, 2008)[36]. The common grounds between LE and the present study are: (1) the epistemological and methodological orientation towards linguistic-anthropological traditions in the study of the interplay between language use and the social (Creese, 2008); (2) the advocacy for interdisciplinarity, adopting an "eclectic stance of combining different traditions of discourse analysis with ethnography" (Creese, 2010: 138); and (3) the combination of analytical tools traditionally used in linguistics with ethnography, that is, the micro analysis of instances of spontaneous interactions plus the macro-social analysis mediated by field notes, which has been described as resulting in "'tying ethnography down': pushing ethnography towards the analysis of clearly delimitable processes" and "'[o]pening linguistics up': inviting reflexive sensitivity to the processes involved in the production of linguistic claims and to the potential importance of what gets left out" (Rampton *et al.*, 2004: 4).

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[36] It is thus a "theoretical and analytical framework which takes an epistemological position broadly aligned with social constructivist and post-structuralist approaches by critiquing essentialist accounts of social life" (Creese, 2010: 138), and "argues that ethnography can benefit from the analytical frameworks provided by linguistics, while linguistics can benefit from the processes of reflexive sensitivity required in ethnography" (Creese, 2010: 139).

However, despite the reminiscences of this type of research immanent in the current study, adopting linguistic ethnography as a theoretical framework presented two main problems. On the one hand, besides these general parallelisms, LE appears to be a rather broad and thus vague concept – indeed, Ben Rampton refers to it as a "general label" and an "umbrella title" (Rampton, 2007b: 599) –, which does not solve – beyond the coincident poststructuralist and the constructionist perspectives – my need for specific theoretical orientations and models. As pointed out by Alison Sealey, the existing debates around the ontology and the epistemology of LE demonstrate that "the difficult questions of ontology and epistemology are not resolved by adopting an ethnographic – or indeed any other –methodological approach" (Sealey, 2007: 643). On the other hand, after the first few weeks of fieldwork, the linguistic focus I had adopted appeared as too narrow for the "reality" I was observing. I soon realised that my participants' communication was far richer than the mere use of language: images, graphs and actual objects were usually used as communicative resources in their interactions; and my own field notebook was filling up with descriptions of elements which did not have much to do with language, such as participants' gestures, position, movements and clothing, among many others. And thus, focusing on language only would entail obtaining a too partial view of the communication that was taking place there and missing too many elements. Thus, still maintaining the anthropologically-oriented approach to communication, as linguistic ethnography claims, and similar to Hymes' claim that "it is not linguistics, but ethnography, not language, but communication, which must provide the frame of reference within which the place of language in culture and society is to be assessed" (Hymes, 1974: 4), I broadened my focus of inquiry, from language only to communication as a whole, and thus to the broad variety of communicative resources used by my participants in their interactions, though still giving to language a prominent importance. In this sense, ethnography should not only benefit from linguistics but also from semiotics.

At that point, although linguistic ethnography did provide methodological richness to my study and suited its "history" (of me being interested in language practices and in ethnographic research), it seemed an extremely narrow construct. In my need to focus on 'communication' rather than on 'language' only, Dell Hymes' 'ethnography of communication', which linguistic ethnography draws on (Rampton, 2007b; Tusting & Maybin, 2007), appeared as a more suitable approach, given that it would allow me to embrace the wide range of elements activated by my participants for the making of meaning. Indeed, it could be argued that the linguistic dimension of linguistic ethnography encompasses also the semiotic dimension of communication. Yet, to my view, this is not straightforward and, similar to Hymes' realisation of the need to move from talking about 'ethnography of speaking' to 'ethnography of communication', I found that

linguistic ethnography somehow restricted my methodology.

LE is indeed in line with Hymes' aspirations for (socio)linguistic inquiry:

> Most of what can now be sketched is but an outline of a future in which, one can hope, ethnographic studies of communication will be commonplace, and an ethnographic perspective on the engagement of language in human life will be the standard from which more specialized studies depart. (Hymes, 1964: 28)

For these reasons, the *ethnography of communication* was the chosen framework in this study to support the systematised description and interpretation of communicative practices at the meso level of analysis, and its main concepts and tenets will be summarised in the following.

Also categorised as an approach, a framework, a new form of linguistic enquiry, a research paradigm and a theoretical perspective, the ethnography of communication (EoC) has its origins in the work of Dell Hymes, *The Ethnography of Speaking* (1962), and has been defined as a [then] "new synthesizing discipline which focuses on the patterning of communicative behavior as it constitutes one of the systems of culture, as it functions within the holistic context of culture, and as it relates to patterns in other component systems" (Saville-Troike, 2003: 1). Its object of study are, thus, "appropriate" patterns of language use or communication in specific contexts, namely in 'speech communities', and the acquisition process of such 'linguistic/communicative competence' by individuals participating in these contexts; or in Elizabeth Keating's words: "What is of interest to ethnographers of speaking is how speakers use various linguistic resources and how others make sense of or interpret these choices" (Keating, 2001: 289). As put forward by Deborah Schiffrin, from the EoC approach to discourse, communicative patterns are regarded as "part of cultural knowledge and behavior", which "entails a recognition of both the diversity of communicative possibilities and practices (i.e. cultural relativity) and the fact that such practices are an integrated part of what we know and do as members of a particular culture (i.e. a holistic view of human beliefs and actions)" (Schiffrin, 1994: 137). These diverse communicative possibilities and practices are concretised in what Hymes designates the 'communicative economy'[37] of the community (Hymes, 1964). Other objects of study alongside the communicative economy of the group are its cultural values and beliefs, its social institutions and forms, the roles and personalities of its members, and its history and ecology (Hymes, 1964).

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[37] "Hymes' economic analogy is useful: much as individuals use their means of production to produce goods and services, and then exchange these products in an economy, so too do speakers use their means of speech to produce discourse that is exchanged within a speech economy." (Johnstone & Marcellino, 2010: 60)

The objective of the EoC was synthesised by Hymes as follows: "My own purpose with the ethnography of speaking was (...) to show that there was patterned regularity where it had been taken to be absent, in the activity of speaking itself " (Hymes, 2000: 314). The documentation and description of such patterns was ultimately conceived as "a means to the understanding of human purposes and needs, and their satisfaction" (Hymes, 1972a: 70). Therefore, the relation between communicative means and social meaning was brought to the fore.

The EoC thus consists in the following:

> Descriptive and taxonomical ethnographic work that allows for comparison between speech communities allows for systemic classification of ways of speaking in four traditional areas: 'genetic classification' of language descent; 'areal classification' of features spread through an area; 'typological classification' of structural features independent of genetic or areal nature; and usage/role classification (i.e. as a pidgin, trade language, etc). (Johnstone & Marcellino, 2010: 6)

Nonetheless, Hymes did not conceive the EoC as a mere descriptive method, but as a rather holistic programme. It was supposed to serve the elaboration of "models (structural and generative) of sociolinguistic description, formulation of universal sets of features and relations, and explanatory theories" (Hymes, 1972a: 43). Although its taxonomic enterprise as well as its generalisation aims have been questioned (Keating, 2001), and researchers using the EoC have often avoided making general statements and preferred to produce "systematic and comprehensive 'bottom-up' models of specific social interactions" (Kalou & Sadler-Smith, 2015: 651), the EoC has been found especially inspiring for (a) "turning from an investigation of language as a referential code, to an investigation into social meaning, diversity of practices, and actual language use in context" (Keating, 2001) – this was achieved, among other innovations, by the use of non-linguistic units of analysis, such as the 'speech event'; (b) having transcended the description of patterns of language use in interaction by considering them as "embedded in complex cultural processes" (Heller, 2003: 254); and (c) proposing an emic approach to communication, for which etic categories are expectedly modified, complemented or challenged by "culturally defined categories or native taxonomies" (emic categories and descriptions)[38]. For these reasons, the EoC has been deemed an effective tool to achieve a detailed and faithful description – close to the perspective of the implicated individuals – of the

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[38] As reported by Elisabeth Keating, "Hymes utilizes Pike's paradigm of etic and emic analysis (Pike, 1954). (...) An emic account is the ultimate goal, that is, the identification of categories which are meaningful to members of the community. The etic perspective, categories meaningful to the analyst, is considered useful for initial data gathering as well as for cross-cultural comparison" (Keating, 2001: 288).

complexity of elements implicated in human communication, and their relations, seen as cultural artefacts (Kalou & Sadler-Smith, 2015). In fact, the EoC derived from linguistic anthropology and particularly from the work of Franz Boas and Bronisław Malinowsky, from which it took its interest in the context of communicative practices, an indispensable dimension in the study of language.

Some of the main characteristics of the EoC are (a) that it aims at investigating communicative patterns as a whole; (b) that it is focused on communication, including all communicative resources, rather than on language only; (c) that the focus of research is actual communication and that the context of use holds particular importance (Keating, 2001); (d) "a conception of meaning dependent on shared beliefs and values of a community and dependent on social and cultural context" (Keating, 2001: 285); (e) that language (or communication) is seen as a social process and "as a privileged site for the study of society and culture" (Heller, 2003: 254); and (f) that the approach is cross-disciplinary (Keating, 2001).

The present study is likely to benefit from the EoC in some of the ways pointed out by Zoi Kalou and Eugene Sadler-Smith (2015): in that it "offers a lens for bringing into focus micro-level (...) phenomena and macro-level (...) issues within and across social groups"; and that it "affords researchers a systematic rather than ad hoc approach for describing, analyzing, interpreting, and critiquing communicative events, the communicative competence of organisational actors, and its consequences for behaviors and outcome" (Kalou & Sadler-Smith, 2015: 630). It thus seems an appropriate theoretical perspective for the study of a community, such as the research group, in its internal aspects but also as compared to other groups, and specifically for the exploration of the communicative practices of scientists in their daily professional activity, as is the aim of this research. However, as has already been pointed out, the approach adopted in the current study will be that of the exploration of 'communication' in its broadest sense. For this reason, any reference to 'speech' or 'speaking' in Hymes' and other authors' work mentioned in this chapter will be understood as replaceable by the notion of 'communication', which comprises not only language as a code, but also non-linguistic communicative resources, such as gesture and images. In the following subsections, some working concepts used in the EoC will be defined: Speech community and means of speech (subsection 2.3.1); communicative competence, language and linguistic repertoire (subsection 2.3.2); communicative / speech event, communicative / speech situation and communicative /

speech act (subsection 2.3.3); and the SPEAKING grid[39] and its components: setting, participants, ends, act sequence, key, instrumentalities, norms and genres (subsection 2.3.4).

2.3.1. Speech community and means of speech

Speech community is a "socially derived concept" (Jackson, 1989: 55), considered "an important beginning unit of analysis" (Keating, 2001: 288) for the EoC. John Gumperz, reformulating Leonard Bloomfield's construct[40] to "encompass systematic variation and social complexity" (Gal, 2014: 120), defines it as "any human aggregate characterized by regular and frequent interaction by means of a shared body of verbal signs and set off from similar aggregates by significant differences in language usage" (Gumperz, 2009: 66). According to Hymes, the participants in a speech community share "rules for the conduct and interpretation of speech, and rules for the interpretation of at least one linguistic variety" (Hymes, 1972b: 54). Nonetheless, such definitions are not devoid of problems. On the one hand, although it seems to be a common opinion that a speech community cannot be defined only by a shared language variety but according to various criteria − such as the communicative behaviour of its members, relations among them, and their shared knowledge (especially with reference to 'what to say') (Keating, 2001)−, such a contention remains obscure. It seems more plausible to me, as implied by Muriel Saville-Troike (2003), that the definition of a specific speech community as such has usually been mainly based on history, politics, and group identification.

Another important issue related to the characteristics of the speech community that to my view has been usually neglected in the related literature is that of the processes of "participation" and of "membership". It has been frequently stated that an individual might participate in more than one speech community concurrently, which does not imply membership in all of them (Hymes, 1974). Nevertheless, the difference between these two types of bond to the speech community (participation and membership) remains unspecified. Furthermore, the intervention of ICT, increasingly widespread worldwide, not only in terms of users but also of frequency of use, adds new complexities to this issue. In this context, the notion of 'virtual community', understood as

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[39] The SPEAKING grid or model [which will be further described later on in this section] is an etic scheme proposed by Hymes for emic description, analysis and interpretation of local communication of a community. Its main objective is "to force attention to structure and reveal similarities and differences between events and between ways of organizing speaking [or communication]" (Keating, 2001: 290).

[40] Leonard Bloomfield (1887-1949) proposed one of the earliest definitions of 'speech community', viewing it as rather monolingual and homogeneous, as was the paradigm in his time (Morgan, 2014). Following Bloomfiel, a speech community is "a group of people who use the same system of speech-signals" (Bloomfield, 1933: 29) or "a group of people who interact by means of speech" (Bloomfield, 1933: 42).

"a form of community mediated by a highly personalized technology" (Delanty, 2003: 170), has arisen as an adaptation of the 'speech community' to the characteristics of communication through such new technologies. This implies that the speech community, in its facet as a virtual community, might be – nowadays more than ever before – delocalised and devoid of any co-presence of its participants. This has been described by Saville-Troike as follows:

> ...there is no necessary reason for a speech community to be geographically contiguous (...) and (especially with widespread access to telephones and e-mail) individuals and groups who are dispersed may maintain intensive networks of interaction. Largely because of the internet, "virtual" communities of interest have been established world-wide. Even with no face-to-face contact, patterned rules for communication have emerged and become codified (Saville-Troike, 2003: 16-17).

For the present study, I will align with Jef Verschueren's preference for the construct *'community of practice'* (Lave & Wenger, 1991) rather than for *'speech community'*, though for different reasons, understanding that "[t]he concept community of practice is appropriate for talking about much that has been discussed under the label of 'speech community' in the ethnography of speaking" (Verschueren, 2014: 158), and considering that the former offers more adequate tools to the aims of this study. As will be argued in the next section, the orientation of the construct *'community of practice'* towards participation, towards the sense of 'community' over time, towards situated learning and towards patterns of shared practice seems more suitable for the exploration of research groups. In fact, Saville-Troike (2003: 17) indicates that the construct *'community of practice'* "seems especially appropriate for the study of processes in the development of norms of interaction within dynamic groups, involving either enculturation or acculturation and sometimes lengthy periods of apprenticeship", as is the case of the groups observed in this research.

According to Hymes, the 'means of speech', or otherwise 'communicative means', and their meanings are the adequate sphere for the description of speech communities (Hymes, 1980). These make reference to components of languages and/or of communication: "We need to be able to think of languages and personal competencies as specific sets of communicative means, shaped by particular histories and adaptive niches" (Hymes, 1980: iv), as well as to "the features that enter into styles, as well as the styles themselves" (Hymes, 1989: 446; in Johnstone & Marcellino, 2010: 5). The means of communication can be "linguistic", "graphic", "verbal", "phonological" and "other"; they "may include different languages, different regional and social varieties of one or more of the languages, different registers (generally varying on a formal-informal dimension which cross-cuts regional and social dimensions), and different channels of communication (e.g. oral, written, manual)" (Saville-Troike, 2003: 41), depending on the

characteristics of the group members, their interaction goals, the context of the interactions, etc. The aim of the EoC is thus identifying the means of communication of a specific community and their mode of organisation, their uses (who, when, where and why) and the appropriateness of such uses, their accessibility, and the skills they entail (Hymes, 1980).

2.3.2. Communicative competence, language and linguistic repertoire

Communicative competence comprises what speakers need to know to communicate "appropriately" in a particular speech community (in terms of what to say to whom, and how to say it), the skills needed for "adequate" communication, and the ways in which such competence is acquired (Keating, 2001; Saville-Troike, 2003; Kalou & Sadler-Smith, 2015). Therefore, communicative competence encompasses not only rules of language (or communicative means') structure, and of their use and interpretation, but also the necessary cultural knowledge to facilitate interpretation (Keating, 2001). This has been described by Hymes as follows:

> We have then to account for the fact that a normal child acquires knowledge of sentences, not only as grammatical, but also as appropriate. He or she acquires competence as to when to speak, when not, and as to what to talk about with whom, when, where, in what manner. In short, a child becomes able to accomplish a repertoire of speech acts, to take part in speech events, and to evaluate their accomplishment by others. This competence, moreover, is integral with attitudes, values, and motivations concerning language, its features and uses, and integral with competence for, and attitudes toward, the interrelation of language, with the other codes of communicative conduct (Hymes, 1972b: 277-8).

From this excerpt, it may be inferred that the idea of "appropriateness" is directly linked to that of legitimacy and illegitimacy. This implies a hierarchisation of communicative practices and thus the existence of power relations with reference to communication: the practices of some participants in the speech community may be legitimate while those of others may not; access to the skills and communicative resources that make such practices possible may or may not be equal for all participants; all participants may or may not have the power of changing the rules, etc. Power asymmetries are thus present in the 'differential knowledge' or 'differential competence' of participants in a community, for "members of a culture may have available to them different forms, and be differentially competent in, the way they draw upon a communicative repertoire (or parts of the repertoire from which they choose)" (Schiffrin, 1994: 139). The uncovering of such processes of legitimation and delegitimation is one of the aims of the ethnographer, who seems to have, also in the EoC, a critical interest (Kalou & Sadler-Smith, 2015).

From a linguistic-anthropological perspective, *language* can be defined as "a system of use whose rules and norms are an integral part of culture" (Schiffrin, 1994: 139), and *language use* as an activity that "helps realize the cultural norms that underlie the way we act toward one another" (Schiffrin, 1994: 139). Human communication is thus constrained by, but at the same time sustains, culture. In the EoC literature, *language* is sometimes used as a synonym of 'code' (e.g. Hymes, 1964), and sometimes defined broadly to include all forms of communication: speech, writing, song, whistling, drumming, gesturing, etc. (Keating, 2001). In the present paper I will differentiate between these two, naming the former 'language' or 'code' and the latter '(modes of) communication'. Consequently, for the purposes of this study, I will often consider the characterisation of *language* in the related literature as translatable to that of (multimodal) communication. For instance, the assumption of the EoC about the "correlation between the form and content of a language and the beliefs, values, and needs present in the culture of its speakers" (Saville-Troike, 2003: 28) will also be attributed to the form and content of any type of communication; and likewise, considerations in terms of the vocabulary of a given code, for which "speakers categorize experience, and often a record of past contacts and cultural borrowings" (Saville-Troike, 2003: 28) will be associated to any type of communicative code.

Related to the concept of 'language' there is the concept of *linguistic/communicative repertoire*. It has been defined as "all [linguistic] varieties, dialects, or styles used in a particular socially-defined population, and the constraints which govern the choice among them" (Gumperz, 1977: 192), the communicative repertoire of a speech community corresponds to the range of patterned ways of communicating available to its participants. Again from a rather multimodal point of view, it "may also include different occupational codes, specialized religious language, secret codes of various kinds, imitative speech, whistle or drum language, and varieties used for talking to foreigners, young children, and pets", as well as "the variety of possible interaction strategies" available to the community (Saville-Troike, 2003: 41). One of the main objectives of the EoC researcher is to understand and document it.

2.3.3. Communicative/speech event, communicative/speech situation and communicative/speech act

Hymes (1972b) proposed two different units of analysis for the EoC: the 'speech event' and the 'speech situation'; the first referring to those human activities where "speech is crucial and the event would not be said to be taking place without it" (Duranti, 1985: 201), like a telephone conversation or an academic communication, and the second to those 'social occasions' (Schiffrin, 1994: 142) where "speech has a minor role, subordinate to other codes or forms of interaction" (Duranti, 1985: 201), such as a dinner or a trip. While *speech events* are "directly governed by rules or norms for the use of speech" (Hymes, 2005: 8), *speech situations* "are not

in themselves governed by such rules, or one set of such rules throughout", but "enter as contexts (...) as aspects of setting (or of genre)" (Hymes, 2005: 7). Consequently, a *speech situation* may often encompass diverse *speech events*, as for instance diverse conversations (*speech events*) may take place in the same trip (*speech situation*), but, on the contrary, might sometimes coincide with a single event, as in the case of a single-utterance rite. Besides, *speech events* might be discontinuous (e.g. a conversation that is interrupted by a telephone call and resumed afterwards) and/or embedded within other *speech events* (e.g. a video conference taking place at some point of a professional meeting).

These two concepts have evolved over time and have acquired new characteristics, especially when adapted to the perspective of communication instead of speech only. For instance, Saville-Troike describes the *communicative situation* as "the context within which communication occurs", with "a consistent general configuration of activities, [and] the same overall ecology" (Saville-Troike, 2003: 23); and the *communicative event* as defined by a specific and invariable set of components, such as purpose, topic, tone or key, rules of interaction and setting. According to this author, the end of a certain event is marked by "a change in the major participants, their role-relationships, or the focus of attention" (Saville-Troike, 2003: 23). In this sense, *communicative events* will be regarded as "the type of sequences members of societies recognise as routines, [which] are usually named, and are shaped by special rules of language and non-verbal behaviors" (Keating, 2001: 289). Discovering the "local taxonomies" or otherwise the labels used by the members of a community to name *communicative events* is a good first step in order to unveil the whole range of *communicative events* usual in that community. However, it is important to note that not all types of *communicative events* may have a specific label (Keating, 2001).

Although the difference between these two units of analysis may not always be clear-cut, they might be useful to designate two distinct levels of analysis or two perspectives, one (that of the communicative event) more related to communication, and the other one (that of the communicative situation) rather belonging to the domain of social processes. For this reason, despite Alessandro Duranti's proposal of "eliminating the term 'speech situation' and using 'speech event' as a theoretical notion, referring to a perspective of analysis rather than to an inherent property of events" (Duranti, 1985: 201), both concepts may be used, when considered appropriate, in the current study as basic socio-linguistic units of analysis. Moreover, although I understand and acknowledge to some extent Verschueren's (2014) proposal to replace the term 'event' for 'practice', in order to highlight the agentivity involved in it, I prefer to employ the term chosen by Hymes, given that I believe that its agentivity may be indicated otherwise. Yet, I do embrace the practice approach to communication, which Hanks (2005: 191) describes –

regarding 'language' – as "focus[ing] precisely on the relations between verbal action, linguistic and other semiotic systems, and the common-sense ideas that speakers have about language and the social world of which it is a part". I will thus use 'communicative practices' only as an umbrella term to refer to communicative activities in general.

Besides communicative 'situations' and 'events' there are 'communicative acts'. These are components of 'communicative events', and correspond to "a single interactional function" (Saville-Troike, 2003: 24). This notion proceeds from J. L. Austin's speech-act theory (Austin, 1962), but has been expanded to "account for a broader range of phenomena within the ethnography of communication" (Saville-Troike, 2003: 24) and to encompass "a broader notion of context" and "a broader range of acts than speech" (Keating, 2001: 290). The communicative act is community-dependent, conventional and intentional (Saville-Troike, 2003), and thus "implicates both linguistic [or communicative] form and social norms" (Hymes, 2005: 8). Examples of 'communicative acts' are requests, commands, warnings, and invitations.

2.3.4. The SPEAKING grid and its components

The SPEAKING grid is a mnemonic model developed by Hymes on the basis of Roman Jakobson's (1960) model of six constitutive elements of the *speech event*. This was conceived as a universal, etic grid that would serve any ethnographer as a point of departure for the documentation and description of all the elements present in the observed community's communication practices and to facilitate comparison across communities. This initial grid should be modified based on ethnographic work, so that it acquires an emic quality, when adapted to the characteristics of the specific community's communication. Each letter of the acronym SPEAKING is the initial letter of a basic component [see them explained below], and each component may be in turn the representative entry of several components (Duranti, 1985): Situation (comprising 'setting' and 'scene'), Participants (including 'Speaker/sender', 'Addressor', 'Hearer/receiver/audience' and 'Addressee'), Ends (meaning 'Purposes – outcomes' and 'Purposes – goals'), Act sequence ('Message form' and 'Message content'), Key, Instrumentalities (encompassing 'Channel' and 'Forms of speech'), Norms (of interaction and of interpretation), and Genres. This model has been widely used among scholars adopting the EoC, to help in the comparison of communities and the uncovering of the relations between linguistic and social behaviour. In the following I will further describe each component of the SPEAKING grid.

2.3.4.1. Situation

It comprises 'setting' and 'scene'. 'Setting' refers to "the time and place of a speech act and, in general, to the physical circumstances" (Hymes, 2005: 11), encompassing time of day, season,

location and other spatial features (Keating, 2001). It is not only the elements that should be described but also their "social valuing" (Keating, 2001). The 'scene', in turn, is deemed the "psychological setting", and it designates "the cultural definition of an occasion as a certain type of scene" (Hymes, 2005: 11), or said otherwise, "the psychological, culturally bound definition of the setting" (Duranti, 1985: 206). As exemplified by Duranti, the contrast would be that of describing the setting as "10 o'clock in the morning, at the ticket counter of United Airlines at the L.A. airport" and the scene as "buying a plane ticket for a business trip" (Duranti, 1985: 206). As signalled by this author, in the description of setting and scene, it is very important to consider the cultural dimension of the description; for instance, the "morning" might not designate the same part of the day for all cultures and communities, and this must be acknowledged by the ethnographer.

2.3.4.2. Participants

This component makes reference to the identity and characteristics of the individuals participating in the communicative event, including not only "those who participate actively or directly in the communicative event, but also those who may be absent but are in some way involved in the communication processes" (Kalou & Sadler-Smith, 2015: 638). Therefore, Hymes "expands the traditional speaker-hearer dyad to four categories of participants: speaker, addressor, hearer and addressee" (Keating, 2001: 291), of which the *speaker* might instead be a *sender,* and the *hearer*, either a *receiver* or an *audience* (Hymes, 2005), or "other modalities" (Saville-Troike, 2003: 114), depending on other characteristics of the interaction.

The description of participants may include observable traits, background information, their organisation in the event, and their roles in relation to one another (Saville-Troike, 2003). In this case, especially taken in consideration will be, on the one hand, the characteristics as well as the labels the participants themselves attribute to one another and regard as significant; and, on the other hand, the differential characteristics between those participants who are deemed "communicatively competent" by others and those who are not.

2.3.4.3. Ends

With regards to the 'ends' of a communicative event, Hymes distinguishes between 'purposes as outcomes' and 'purposes as goals'. The 'purposes − outcomes' consist in "Conventionally recognised and expected outcomes" (Hymes, 2005: 12), which might determine the rules of participation, the setting, the nature of the event or other characteristics. For example, the characteristics of a certain event may change depending on whether its intended outcome is a decision, a trade, a law, a contract, or a report. And the 'purposes − goals' are "The purpose of an

event from a community standpoint", which "need not be identical to the purposes of those engaged in it" (Hymes, 2005: 12). For instance, a sales agent and her customer participating in a negotiation may have different purposes-goals and thus use different strategies in the communicative event to achieve their own goals. Therefore, it is important to consider the ends and the strategies adopted by participants, for they are determinant of the form of the event.

Furthermore, the ends are closely related to Jakobson's (1960) functions of communication, such as the referential, the phatic, the expressive, the poetic, the metalinguistic and the directive; as well as to notions of pragmatics, such as illocutionary and perlocutionary forces[41] (Saville-Troike, 2003). Consequently, there are many aspects that should be considered in the process of describing them, such as (1) whether they are conventional or situational, personal or communal, explicit or latent, intended or unintended (Hymes, 2005); (2) the fact that "the illocutionary force of an utterance (...) can change during the utterance itself" (Duranti, 1985: 205); and (3) the fact that there might be "differing and distinct ends for different participants" and thus "various motives and intentions" (Kalou & Sadler-Smith, 2015: 639).

2.3.4.4. Act sequence

In Hymes' view, the 'act sequence' integrates the 'message form' and the 'message content', which he regards as "tightly interdependent" (Hymes, 2005: 11), although other authors distinguish them as three different components (e.g. Duranti, 1985; Saville-Troike, 2003). The 'message form' includes the code used and its varieties (e.g. in terms of registers), as well as the channels of communication (e.g. vocal, nonvocal) (Saville-Troike, 2003); and the 'message content', the organisation of communicative acts and sequences of topics. According to Saville-Troike (2003) the function is the primary characteristic of communicative acts to be considered when describing a sequence, but it is also important to illustrate their "typical" form and content with examples. As has already been pointed out, in this study, communicative acts will be considered from a multimodal perspective, and thus not only those verbal acts, but the whole range of modes, codes and resources will be taken into account. This may include laughter, gesture, sounds, and proxemics, among others.

2.3.4.5. Key

The term 'key' stands for the "tone, manner, or spirit in which an act is done" (Hymes, 2005: 12). It may be indicated "by choice of language or language variety, gesture or paralinguistic

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[41] By illocutionary force we may understand the function of language, that is the intent of the speaker; "in which way and in which *sense*" (Austin, 1962: 99) speech is used (e.g. advising, suggesting, ordering). Perlocutionary force is the consequence of the speech act (e.g. someone being convinced of something).

cues such as intonation, laughter, crying" (Keating, 2001: 291). As reported by Hymes, a certain key is usually conventionally linked with specific instances of other components (e.g. the scene *going to the doctor* is attributed a key of *seriousness;* and the genre *joke* is attributed a key of *mockery*) (Hymes, 2005). But also the association between signal − namely the gesture, the tone or the words that index a certain key − and key are conventional, and thus culture-specific: "interpretation of key is culture-specific and must be determined according to indigenous perceptions" (Saville-Troike, 2003: 113). Therefore, the key provides cues for interpretation (Duranti, 1985) and may thus override the conflicting interpretation of other components of the communicative event, such as the message content: "The significance of key is underlined by the fact that, when it is in conflict with the overt content of an act, it often overrides the latter (as in sarcasm)" (Hymes, 2005: 13). For this reason, the key should not be neglected in the ethnographic description of the communicative practices of a community.

2.3.4.6. Instrumentalities

This label comprises two components: 'channels' and 'forms of speech' (Hymes, 2005). The 'channels' are the media of transmission of messages (e.g. oral, written, telegraphic), which are used in diverse 'modes' (e.g. the oral channel might be used to speak, sing, or whistle) (Hymes, 2005). As suggested by Saville-Troike, in every culture, the channels chosen for communication "may depend on environmental conditions" (2003: 43) − such as the materials available, the existing transformation technologies in the community, etc. −, but also on the needs of the participants: e.g. "choosing oral or written channels is usually dependent on distance, or the need for a permanent record" (2003: 43). In contrast, 'forms of speech' refer to "form in terms of language varieties, codes, or registers" (Keating, 2001: 291). Hymes (2005) favors the use of one term over the other, depending on three criteria: (a) the historical provenance of the language resources (for which one may use 'language' and 'dialect'); (b) the presence or absence of mutual intelligibility (which one may refer to as 'code'); and (c) the specialisation in use (named 'varieties' or 'registers') (Hymes, 2005: 13). The register chosen may depend on topic, setting and social distance among participants (Saville-Troike, 2003: 44). There might also be cases where there is specialisation in language use by domain, which may prompt situations of *diglossia*[42] − where "two or more languages (or varieties of the same language) in a speech

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[42] As described by Saville-Troike, "the term 'diglossia' was coined by Charles Ferguson (1959), who used it initially to refer only to the use of two or more varieties of the same language by speakers under different conditions. He exemplified it in the use of classical and colloquial varieties of Arabic, Katharevousa and Demotike varieties of Greek, Haitian Standard French and Creole, and Standard German and Swiss German. In each case, there is a high (H) and low (L) variety of a language used in the same society (...) Diglossia was extended by Fishman (1972) to include the use of more than one language, such as the situation in Paraguay where Spanish is the H language of school and government,

community are allocated to different social functions and contexts" (Saville-Troike, 2003: 45). Consequently, it is crucial to identify the whole range of communicative resources (channels and forms of speech) available for the community before interpreting their social meaning and the appropriateness in a given event (Duranti, 1985). The "interdependence of channels in interaction" and "the relative hierarchy among them" (Hymes, 2005: 13) are two aspects that should also be taken into consideration in an ethnographic description of communication.

2.3.4.7. Norms.

This component comprises the 'norms of interaction' and the 'norms of interpretation'. On the one hand, 'norms of interaction' make reference to "rules" or "specific behaviors and properties" (Hymes, 2005: 14) attached to communication practices, which "implicate analysis of social structure, and social relationships generally, in a community" (Hymes, 2005: 14). In this sense, it is worth noticing that norms of interaction are closely related to communicative competence (Duranti, 1985), and thus to power relations. Following basic norms, for instance, implies their knowledge and the access to the communicative resources that make observing them possible, which is indispensable for the minimal participation in the community, but not always equal for all participants. Moreover, the observance of more complex ones (e.g. the command of diverse registers) might entail the hierarchisation of participants, depending on their access to resources, their abilities to acquire the necessary skills, their opportunities to know the rules, etc. On the other hand, 'norms of interpretation' rule the "interpretation to be placed upon" norms of interaction (Hymes, 2005: 14); and make reference to "the common knowledge, the relevant cultural presuppositions, or shared understandings, which allow particular inferences to be drawn about what is to be taken literally, what discounted, etc." (Saville-Troike, 2003: 110-111). Such norms might vary across communities, for they "implicate the belief system of a community" (Hymes, 2005: 14).

Hymes' EoC assumes that the main task of the researcher in relation to norms is to infer them from the instances of communication observed and by means of techniques such as participation in the community, elicitation of judgements from participants, interviews, and collection of texts (Duranti, 1985). The norms may appear "in the form of aphorisms, proverbs, or even laws, or they may be held unconsciously and require more indirect elicitation and identification" (Saville-Troike, 2003: 123). As this scholar suggests, one good instance that makes norms observable is when they are "violated" and this triggers the censorious reaction of other

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and Guaraní is the L language of home (...) To distinguish societal and individual language distribution, Fishman suggests a four-way designation: both bilingualism and diglossia, diglossia without bilingualism, bilingualism without diglossia, and neither bilingualism nor diglossia" (Saville-Troike, 2003: 45-6).

participants of the community. The description of norms should include "prescriptive statements of behavior, of how people "should" act" as well as the "typical behavior" within the community (Saville-Troike, 2003: 123). Furthermore, "[h]ow, and the degree to which, this ideal is indeed real is part of the information to be collected and analyzed, along with positive and negative sanctions which are applied to their observance or violation" (Saville-Troike, 2003: 123).

2.3.4.8. Genres

Genres are "categories" of communicative practices that have "traditionally recognised" formal characteristics (e.g. lecture, form letter, poem) (Hymes, 2005: 15). They are thus conventionally identifiable by formal markers. However, they cannot always be regarded as "type of events", for genres might sometimes coincide with communicative events (e.g. Power Point presentation), but might also occur as different events (e.g. Power Point presentation as a professional meeting and/or as a conference presentation), or one same genre might recur in several events (e.g. Power Point presentation as part of a lecture and/or as part of a professional meeting); they should thus be regarded as "analytically independent" from events (Hymes, 2005: 15). Saville-Troike (2003) points out that the genre is closely related to other components − such as the topic, the purpose, the setting, the participants, and the message form − and these may thus often influence one another. For instance, joking may not be adequate for certain topics and some topics may only be acceptably tackled in jokes; specific genres may have typical purposes, like fairy tales have the main purpose of entertaining; certain genres may only be adequate in specific settings or inappropriate in others, like joking in a cemetery; some genres may require a specific language variety, like a job interview may require a formal register. The ethnographer should bear in mind such relationships of interdependence among components in her description.

Having all the components of the SPEAKING grid in mind as an etic model which should be adapted to the particularities of the observed community and to the perspective of its participants, the ethnographer's final objective is "the discovery and explication of the rules for contextually appropriate behavior in a community or group; in other words, accounting for what the individual needs to know to be a functional member of the community" (Saville-Troike, 2003: 88). As has been already pointed out, the perspective taken in this study on the analysis of communication will be that of CDA, and, thus, power relations will have prominent importance throughout the data analysis. Indeed, CDA and the EoC have been found to be "potentially compatible or at least complementary approaches to the study of language" (Saville-Troike,

2003: 255), for they share an interest in issues related to power relations, and the EoC has been influenced by Marxism. I thus align with Saville-Troike's belief that:

> the CDA perspective on language and power, in particular, must be represented in any adequate accounts of societal functions and practices of power in language. At the same time, there is need for further understanding of the nature of language and, more broadly, human communication. Functionalist and interactionist perspectives are also fruitful to this end, and may help constrain or at least counterbalance the potential for theoretical bias. While ethnographic accounts are primarily descriptive, critical analysis can add a useful explanatory dimension which problematizes aspects of communication that might otherwise escape attention (Saville-Troike, 2003: 255).

Therefore, following this proposal and Fairclough's (1989; 1995) three-dimensional analysis, which I have presented in section 2.2, the *ethnography of communication* will be the chosen framework (together with the *community of practice* model) to serve as a pivotal approach or a meso level between the micro analysis of communication, that is of the details of particular texts produced within the research groups studied, and that of macro phenomena or broader socio-cultural issues. I thus acknowledge the "necessary complementary relationship" (Saville-Troike, 2003: 106) between ethnography and interaction analysis, which I intend to combine in order to obtain a holistic view of the communication of the research groups studied. This meso level of analysis may solve or at least soften the potential "methodological tensions between a more 'closed' focus on linguistic text and a more 'open' sensitivity to context and to the role of the researcher" (Tusting & Maybin, 2007: 576), as the ones aroused within linguistic ethnography. The next section (section 2.4) will be devoted to the description of the other meso-level approach, the *community of practice* theory, which will guide the description of the social aspects of text production, distribution and consumption within the scientific group.

Before concluding this section though, it is worth noting that the shift in focus from language only to communicative practices as a whole does not only affect the theoretical approach chosen, but also involves redefining the construct serving as object of study. In this case, it thus entails modifying the construct 'language policy' to include the multimodal dimension of communication. The simplest move might be swapping the term 'language' for 'communication'. However, the construct 'communication policy' is not straightforward, since it presents two main complications: first, it does not have a tradition in the field of discourse studies and is undefined in such terms; and second, it is commonly used in the field of media studies (e.g. Just & Puppis, 2012; Mansell & Raboy, 2011), which might generate confusion and interferences. Consequently, in order to avoid such drawbacks, the term 'multimodal communication policy' appears as the most suitable one to synthesize the object of study of this research, because, on

the one hand, the construct 'multimodal communication' has a clear − and increasingly important − tradition in discourse studies, and it clearly dissociates itself from the field of media studies; and on the other hand, it explicitly preserves the focus on the political dimension of communication and the interest in all levels of discourse and the social.

2.4. The 'community of practice' and the scientific group

This section is devoted to the description of the theory of the *community of practice* (CoP) (Jean Lave and Wenger, 1991; Wenger, 1998), which will guide the data analysis, especially in its meso level. Indeed, the CoP theory has been deemed an appropriate linking framework between the micro and the macro levels of discourse and thus of analysis:

> ...the CofP [here CoP] concept offers a potentially productive means of linking micro-level and macro-level analyses. The CofP inevitably involves micro-level analysis of the kind encouraged by a social constructionist approach. It requires detailed ethnographic analysis of discourse in context - to identify significant or representative social interactions, to characterize the processes of negotiating shared goals, and to describe the practices that identify the CofP. A CofP must, however, also be described within a wider context which gives it meaning and distinctiveness. (Holmes & Meyerhoff, 1999: 181)

Moreover, this model has proven to be compatible with theories of language and discourse (see Barton & Tusting, 2005a), and it is thus assumed to be so with approaches to communication. In this section, the *community of practice*, as well as other associated constructs, will be described and related to the study of the research group (also referred to here as 'scientific group' or 'scientific team'), which will be claimed to correspond to such a type of social unit.

The theory of the CoP has been recognised as a social theory of learning (Wenger, 1998; Eckert, 2006). It originated in the work of Jean Lave and Étienne Wenger on situated learning (Lave & Wenger, 1991), rooted in turn in Scribner and Cole's (1981) anthropological approach to literacy, with the aim of "describing and understanding how professional communities (tailors or insurance company employees) induct and train new members, and perpetuate set routines for accomplishing specific tasks" (Meyerhoff, 2004: 528). The CoP thus helps the description and exploration of "a domain defined by a process of social learning" (Meyerhoff, 2004: 528).

Within the CoP theory, a *community of practice* is defined as a group of people "who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger, McDermott & Snyder, 2002: 4); and also as "a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave & Wenger, 1991: 98).

Wenger (1998) attributes three main dimensions or critical characteristics to the CoP: *mutual engagement*, a *joint enterprise* – later on replaced by *domain*, (Wenger, McDermott & Snyder, 2002) –, and a *shared repertoire*, developed as a result of their shared practice over time. Moreover, other three 'fundamental elements' of the CoP model are: "a *domain* of knowledge, which defines a set of issues; a *community* of people who care about this domain; and the shared *practice* that they are developing to be effective in their domain" (Wenger, McDermott & Snyder, 2002: 27).

As listed by Wenger (1998: 125-126), indicators of such a community may be: (1) sustained mutual relationships; (2) shared ways of engaging in doing things together; (3) the rapid flow of information and propagation of innovation; (4) absence of introductory preambles; (5) very quick setup of a problem to be discussed; (6) substantial overlap in the participants' descriptions of who belongs; (7) knowing what others know, what they can do and how they can contribute to an enterprise; (8) mutually defining identities; (9) the ability to assess the appropriateness of actions and products; (10) specific tools, representations, and other artifacts, (11) local lore, shared stories, inside jokes, knowing laughter; (12) jargon and shortcuts to communication as well as the ease of producing new ones; (13) certain styles recognised as displaying membership; (14) a shared discourse reflecting a certain perspective on the world. These need to be externally acknowledged since they might not be so by its members.

As a theory, it is positioned among other theoretical traditions: between those addressing social structure and those highlighting situated experience, and thus, individual agency; and between those tackling identity and those concerned with social practice, that is, "the production and reproduction of specific ways of engaging with the world" (Wenger, 1998: 13). These, Wenger (1998) argues, are necessarily connected with approaches to collectivity and subjectivity, theories of power and theories of meaning.

Acknowledging thus that the *community of practice* is a construct that unites an interest for specific social aggregates of individuals engaged in a common practice with an interest for the ways in which the negotiation of meaning, and hence meaning-making, takes place, the CoP theory has been deemed appropriate here for the exploration of communication in the scientific team. In the following subsections, I will summarise its main concepts and tenets, principally those set out in Wenger's (1998) work *Communities of practice: Learning, meaning, and identity*, which preserves the 'heuristic qualities' (Lea, 2005) of the model designed in Lave and Wenger (1991): practice, participation and reification (subsection 2.4.1); mutual engagement, joint enterprise, domain and shared repertoire (subsection 2.4.2); boundaries, membership and levels of participation (subsection 2.4.3); learning, legitimate peripheral participation, design

and constellations of practices (subsection 2.4.4); identity (subsection 2.4.5), participation, non-participation, modes of belonging [or identification], identification and negotiability (subsection 2.4.6) ; economies of meaning, ownership of meaning and knowledgeability (subsection 2.4.7).

2.4.1. Practice, participation and reification

The term 'practice' in the CoP model "denotes a set of socially defined ways of doing things in a specific domain: a set of common approaches and shared standards that create a basis for action, communication, problem solving, performance, and accountability" (Wenger, McDermott & Snyder, 2002: 38). It is a key concept, since it is what gives coherence to the CoP; it is "a sort of mini-culture that binds the community together" (Wenger, McDermott & Snyder, 2002: 39). A CoP's practice is twofold, it encompasses "what people do together" and "the cultural resources they produce in the process" (Wenger, 1998: 283), in a specific historical and social context. Such context "gives structure and meaning" (Wenger, 1998: 47) to the practice, and thus, from this perspective, practice is always social. Therefore, practice concerns the analytical level of the *social production of meaning*.

Furthermore, practice, which might be either explicit (e.g. codes, machines, stated norms) or implicit (e.g. relations, assumptions, common perspectives), "is, first and foremost, a process by which we can experience the world and our engagement with it as meaningful" (Wenger, 1998: 51). Meaningfulness, this author claims, resides in the production of meaning, in dealing with resistance and malleability in our environment, in affecting and being affected, in handling multiple factors and perspectives, among other sites. Considering this, practice resides in the process of *negotiation*[43] *of meaning*, which consists of the processes of *participation* and *reification*. The first of these, *participation*, refers to a combination of processes of "doing, talking, thinking, feeling, and belonging" (Wenger, 1998: 56); it implies "membership in social communities" and "active involvement in social enterprises" (Wenger, 1998: 55). *Reification*, in turn, means "making into a thing"; or otherwise "the process of giving form to our experience by producing objects that congeal this experience into 'thingness'" (Wenger, 1998: 58); it is both a process and its product. Both reification and participation are presented as a duality of two mutually constitutive elements that are intertwined by complementing one another:

> Indeed, reification always rests on participation: what is said, represented, or otherwise brought into focus always assumes a history of participation as a context for its representation. In turn, participation always organizes itself around reification because it always involves artifacts, words, and concepts that allow it to proceed. (Wenger, 1998: 67)

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[43] The term 'negotiation' here refers to "continuous interaction", "gradual achievement" and "give-and-take" (Wenger, 1998: 53).

These two processes thus offer two types of complementary connection options: *'reificative connections'* and *'participative connections'*, each of which has potentialities and threats (Wenger, 1998). On the one hand, *reificative connections* can move and are more or less perdurable, and thus allow for the transcendence of space and time. This, in turn, might make them flexible in their interpretation and use, but such ambiguity might lead to misinterpretations or misunderstandings. They are paradoxically object of reinterpretations and insignia of a certain *status quo* at the same time. On the other hand, *participative connections* allow for negotiation and potentially give peripheral access to certain practices (in the form of information about, knowledge, and/or representations of those practices). As in the case of *reificative connections*, these are always partial, since they are never the practice itself. Such shortcomings may be compensated when the two connection types are combined (e.g. when objects and people interact). When reified objects appear as too rigid, ambiguous and partial, participation may help repair such drawbacks. And the same applies in the opposite direction: participation might be too informal, loose, ephemeral, local and/or partial, and this may be counteracted by reification. Therefore, their combination needs to be balanced; otherwise, the continuity of meaning could be threatened (Wenger, 1998). However, the transition or translation from participation to reification and vice versa is not exact, but requires a renegotiation of meaning:

> Participating in an activity that has been described is not just translating the description into embodied experience, but renegotiating its meaning in a new context.
> Reification is not a mere articulation of something that already exists. (…) but in fact creating the conditions for new meanings. (Wenger, 1998: 68)

Such renegotiation of meaning is moreover ongoing, since both participation and reification are tied to their ever-changing social contexts: "forms of participation change, our perspectives change, and we experience life in new ways" (Wenger, 1998: 89), and reified objects are subject to reinterpretations over time.

As has been suggested before, the three basic characteristics or dimensions of a CoP's practice are *mutual engagement*, a *joint enterprise* (or a *domain*), and a *shared repertoire*. These will be described in the next subsection.

2.4.2. Mutual engagement, joint enterprise, domain and shared repertoire

Mutual engagement makes reference to the individuals' common engagement in actions with negotiated meanings, and thus to their sustained interaction around a practice. It comprises actions but also relations, knowledge and negotiation. Mutual engagement refers to what one does and knows, but also to one's ability to rely on others to compensate for what one does not

do and does not know (Wenger, 1998). Nonetheless, although mutual engagement unites a CoP's members, since sustained interpersonal relationships are an indispensable characteristic of it, tensions and conflicts, in the form of disagreements, competition and misunderstandings, might arise:

> In real life, mutual relations among participants are complex mixtures of power and dependence, pleasure and pain, expertise and helplessness, success and failure, amassment and deprivation, alliance and competition, ease and struggle, authority and collegiality, resistance and compliance, anger and tenderness, attraction and repugnance, fun and boredom, trust and suspicion, friendship and hatred. (Wenger, 1998: 77)

Far from being a shortcoming, diversity – of roles, of identity, of specialisation, etc. – within a CoP, besides its homogeneity – of purpose, of practices, etc. –, is not only unavoidable but also a fertile trait of it. Yet, "community maintenance" (Wenger, 1998: 74) work is indispensable to harmonise these.

Another paramount dimension of CoPs is the existence of a *joint enterprise* among its members. As Janet Holmes and Miriam Meyerhoff (1999: 175) succinctly defined it, "[t]he joint enterprise is not just a stated shared goal, but a negotiated enterprise, involving the complex relationships of mutual accountability that become part of the practice of the community". The participants' joint enterprise might not be explicit (Meyerhoff, 2004) but "[i]t is defined by the participants in the very process of pursuing it" (Wenger, 1998: 77). It includes "the instrumental, the personal and the interpersonal aspects of our lives" (Wenger, 1998: 78). Examples of joint negotiated enterprises are making money, having fun and making plans. And these need to be accomplished in coexistence and coordination with others.

The CoP's practice is thus a collective response (of the CoP) to external mandates (from the institution or from other external agents); and hence power is not directly exerted onto the CoP but mediated by what the CoP itself, after negotiation, assumes as being its enterprise (Wenger, 1998). The negotiation of a joint enterprise entails dealing with issues such as what is relevant and what is not, what to talk about or not, what to do and what not to do, what is good enough and what needs to be improved, what needs to be justified, what constitutes common sense and what is awkward, which is named by Wenger (1998: 81) as 'relations/regime of mutual accountability'.

Later on, Wenger[-Trayner] replaced the term 'joint enterprise' by 'domain', meaning "the area in which a community claims to have legitimacy to define competence" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 5). This latter term was deemed more efficient to help the distinction between a 'team', which revolves around a common task, and a 'CoP', understood as "a learning

partnership related to a domain of practice" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 5).

The third dimension of a CoP is a *shared repertoire*. The participants' shared repertoire is composed by "resources for negotiating meaning" (Wenger, 1998: 82), such as "routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts" (Wenger, 1998: 83). These are heterogeneous and acquire their status as such because they are constituents of the practice of the CoP. Such a repertoire is accumulated throughout the CoP's history of learning (Wenger, 2010).

As defined by Wenger (1998), for a group of people to constitute a *community of practice* they need to "have a sustained history of mutual engagement" (Wenger, 1998: 123); to negotiate with one another their scope, behaviour, their relation with the institution/company, and the meaning of the resources they use; to "have developed local routines and artifacts to support their work together" (Wenger, 1998: 123); to "know who to ask when they need help" (Wenger, 1998: 123); and to "introduce to their community new trainees who want to become proficient at their practice" (Wenger, 1998: 123). In the next subsection, what constitutes participation in a CoP and what does not will be further described, as well as types ('levels') of participation.

2.4.3. Boundaries, membership and levels of participation

Membership in a CoP is usually not evident, since "[m]ost communities of practice do not have a name and do not issue membership cards" (Wenger, 1998: 7). Not even co-presence is required for the constitution of a CoP, but an 'identity of participation' (Wenger, 1998: 136) is indispensable:

> Nor does the term community imply necessarily co-presence, a well-defined identifiable group, or socially visible boundaries. It does imply participation in an activity system about which participants share understandings concerning what they are doing and what that means in their lives and for their communities. (Lave & Wenger, 1991: 98)

In this vein, membership and the CoP's boundaries "are defined on the basis of criteria that are subjectively salient to the members" (Meyerhoff, 2004: 533) of the CoP. Indeed, practice itself generates bonds and boundaries across its three dimensions: members of the CoP develop "idiosyncratic ways of engaging with one another", a "detailed and complex understanding of their enterprise as they define it" and "a repertoire for which outsiders miss shared references" (Wenger, 1998: 113). These tie participants together within the CoP but detach them from outsiders.

126

Consequently, a CoP's 'boundaries' are comprised by the discontinuities of individuals' practices, those between participation and non-participation. Such boundaries may take diverse shapes and can be reified through membership markers like official categories or titles, assigned tasks, a specific treatment, the clothing, a certain communicative style, etc. And their existence implies, in turn, the existence of positions of peripherality within the CoP. Nevertheless, CoPs also generate bonds, overlaps and connections (continuities) with other CoPs and entities. These, Wenger (1998) explains, are accomplished by the movement of reified entities across CoPs (*boundary objects*[44]) as well as through the individuals' simultaneous participation in several CoPs (*brokering*[45]). Accordingly, on the one hand, objects that move across CoPs are "nexus of perspectives" and "carry the potential of becoming boundary objects if those perspectives need to be coordinated" (Wenger, 1998: 107-8). For such objects to be used, "processes of coordination and translation between each form of partial jurisdiction" (Wenger, 1998: 108) on them are necessary. On the other hand, brokering entails the action of relating the CoP with external entities, of importing and exporting objects, elements and/or ideas; and this again requires translation and coordination of perspectives. It is worth noting that, although "the periphery is a very fertile area for change" (Wenger, 1998: 118) because it is simultaneously inside and outside, and thus facilitates external exchanges and allows for novelties to disseminate internally, brokering "often entails ambivalent relations of multimembership" (Wenger, 1998: 109), which may cause uprootedness of the brokers. As Wenger (1998: 110) puts it, "[b]rokers must often avoid two opposite tendencies: being pulled in to become full members and being rejected as intruders".

A notion that is implicit in the explanation above is the existence of diverse levels or degrees of participation within the CoP, from the periphery to the core, or from being a newcomer to becoming a full member:

> ...a community of practice is a node of mutual engagement that becomes progressively looser at the periphery, with layers going from core membership to extreme peripherality. The interaction of all these levels affords multiple and diverse opportunities for learning. Different participants contribute and benefit differently, depending on their relations to the enterprise and the community. (Wenger, 1998: 118)

What determines the level of participation of the CoP's members is their status as 'competent participants'. It is the CoP itself which "*acts as a locally negotiated regime of competence*"

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[44] This term was first coined by sociologist of science Susan Leigh Star and James R. Griesemer (1989).

[45] Term borrowed from Penelope Eckert who used it to refer to the action of adolescents introducing new elements (ideas, music, styles) into their clique (e.g. Eckert, 1989; Eckert & Wenger, 1994).

(Wenger, 1998: 137; *original emphasis*), and thus establishes what 'being competent' consists in. In this context, 'knowing' would be equal to 'being competent' in the practice of the CoP. These diverse levels of participation act as "generational discontinuities" (Wenger, 1998: 90) which, combined with the CoP's reproduction cycles (for which new members arrive while old members leave the CoP), entails the emergence of new identities: newcomers become relative-newcomers as there are new-newcomers introduced into the CoP.

To sum up, considering what has been explained in this subsection, it can be argued that CoPs "constitute a complex social landscape of shared practices, boundaries, peripheries, overlaps, connections, and encounters" (Wenger, 1998: 118). And practice is precisely the pivotal element around which continuities and discontinuities arrange. Nonetheless, in terms of the applicability of this construct, the ambiguous definition of the socio-spatial delimitation of the CoP has been criticised by some scholars (e.g. Hodkinson & Hodkinson, 2004), since it leaves the responsibility for the definition of the CoP's boundaries on the observer.

2.4.4. Learning, legitimate peripheral participation, design and constellations of practices

The construct of the *community of practice* entailed, in its origins (Lave & Wenger, 1991; Wenger, 1998), a rethinking of the notion of 'learning'. It implied "shifting the analytic focus from the individual as learner to learning as participation in the social world, and from the concept of cognitive process to the more-encompassing view of social practice" (Lave & Wenger, 1991: 43). Following it, learning is understood as "an evolving, continuously renewed set of relations" (Lave & Wenger, 1991: 50); it is unavoidable, it just happens in "the very process of being engaged in, and participating in developing, an ongoing practice" (Wenger, 1998: 118). 'Learning' thus designates the process of "tun[ing] our relations with each other and with the world accordingly" (Wenger, 1998: 45). It partly "implies becoming able to be involved in new activities, to perform new tasks and functions, to master new understandings" which "are part of broader systems of relations in which they have meaning" (Lave & Wenger, 1991: 53). In this sense, participants in a CoP need to be involved in the processes of 'evolving forms of mutual engagement' (establishing relationships and identifying identities), 'understanding and tuning their enterprise' (negotiating it and aligning one's engagement with it) and 'developing their repertoire, styles and discourses' (Wenger, 1998: 95). In this context, learning is conceived as changing participation in a CoP and as identity transformation of its members:

> ...learning – whatever form it takes – changes who we are by changing our ability to participate, to belong, to negotiate meaning. And this ability is configured socially with respect to practices, communities, and economies of meaning where it shapes our identities. (Wenger, 1998: 226)

128

However, Wenger (1998: 138) argues, there is a basic requirement for 'learning in practice' to take place, which is that "an experience of meaning must be in interaction with a regime of competence". Hence, 'learning', in this sense, is the result of the realignment between experience and competence: "learning – taken to be a transformation of knowing – can be characterized as a change in alignment between experience and competence, whichever of the two takes the lead in causing a realignment at any given moment" (Wenger, 1998: 139). And for their interaction to be fruitful, it is indispensable that these two are in constant tension. It is worth noting though that a CoPs' practice does not always require 'knowledge' of its members but may also require their ignorance "as an active principle of their enterprise" (Wenger, 1998: 141).

From this perspective, CoPs are an ideal site for learning, since the CoP is "a context for new insights to be transformed into knowledge"; "a privileged locus for the *acquisition* of knowledge" for newcomers who are given access to competence and can incorporate it into an identity of participation; "a good context to explore radically new insights"; and as long as they provide "a strong bond of communal competence along with a deep respect for the particularity of experience", CoPs are also "a privileged locus for the *creation* of knowledge" (Wenger, 1998: 214). For this to be possible, "encounters between generations" (Wenger, 1998: 99). within the CoP are necessary. Newcomers and older members need to interact so that more expert members induce newcomers into the community and its practice.

In this process, 'legitimate peripheral participation' – which was part of a paradigm shift around the notion of 'situated learning' as opposed to 'school-centric' approaches and formal 'curriculum education' (Hughes, Jewson & Unwin, 2007a) – may be offered by the CoP for the learning of its new members. It consists in the engagement of newcomers in the practice of the CoP through explanations, observation and, above all, through their participation in the three dimensions of practice referred to: mutual engagement, joint enterprise and shared repertoire. As described by Lave and Wenger (1991: 110), "[t]o be able to participate in a legitimately peripheral way entails that newcomers have broad access to arenas of mature practice".

This notion thus rests on two main principles: legitimacy and peripherality. On the one hand, through legitimacy newcomers are "treated as potential members" of the CoP, which is key for their qualitative learning because "[o]nly with enough legitimacy can all their inevitable stumblings and violations become opportunities for learning rather than cause for dismissal, neglect or exclusion" (Wenger, 1998: 101). On the other hand, peripherality designates a given location in the social world; it entails acknowledging the existence of "multiple, varied, more-or less-engaged and -inclusive ways of being located in the fields of participation defined by a community" (Lave & Wenger, 1991: 36). It is the kick off of a 'learning journey' within the CoP,

following a centripetal direction (from the periphery towards the core), which "culminates in the displacement of 'old-timers'" (Fuller, 2007: 21) and thus in 'full participation'. To achieve this, peripherality must consist in "an opening, a way of gaining access to sources for understanding through growing involvement" (Lave & Wenger, 1991: 37). Such a 'journey' may consist in "engaging with the technologies of everyday practice, as well as participating in the social relations, production processes, and other activities" (Lave & Wenger, 1991: 101) of the CoP. However, this location is less demanding (in terms of time, effort and responsibility) than full participation, since "[a] newcomer's tasks are short and simple, the costs of errors are small, the apprentice has little responsibility for the activity as a whole" (Lave & Wenger, 1991: 110). Yet, becoming a full participant not only entails assuming more responsibility in this respect, but mainly "an increasing sense of identity as a master practitioner" (Lave & Wenger, 1991: 111). The journey of newcomers towards full participation is a chief aspect of a CoP, since it is an integral part of the CoP's reproduction: "communities of practice have histories and developmental cycles, and reproduce themselves in such a way that the transformation of newcomers becomes remarkably integral to the practice" (Lave & Wenger, 1991: 98). The opposite of 'peripherality' is not 'full participation' but 'unrelatedness' and 'irrelevance' (Lave & Wenger, 1991: 37).

Despite the situated and hands-on nature of the type of learning that CoPs afford, its *design* is also possible. This concept makes reference to the "systematic, planned, and reflexive colonization of time and space in the service of an undertaking" (Wenger, 1998: 228), which in the case of the CoP corresponds to "the production of artifacts, but also the design of social processes such as organisations or instruction" (Wenger, 1998: 228). From this perspective, design for learning is limited in multiple ways. As Wenger (1998) asserts, while some elements involved in learning through participation are designable (i.e. procedures, policies, systems of accountability individuals' roles, visions, a learning curriculum, etc.), others are not (i.e. the specific practices that individuals engage in, their identities, their allegiance for the visions designed, their actual learning, etc.). In this sense, the author defends that CoPs "can be recognised, supported, encouraged, and nurtured, but they are not reified designable units (…) One can attempt to institutionalize a community of practice, but the community of practice itself will slip through the cracks and remain distinct from its institutionalisation" (Wenger, 1998: 229).

For design in the context of the CoP to be guided, Wenger (1998: 230-5) proposes a 'conceptual architecture for learning', which consists of four basic dimensions (of design for learning) based on four dualities that need to be considered and combined productively, while addressing the inherent tensions between them: participation - reification; designed - emergent; local - global;

identification - negotiability. The author also puts forward four principles on which design decisions need to be based: concerning participation and reification, (1) "[d]esign for practice is always distributed between participation and reification – and its realization depends on how these two sides fit together" (Wenger, 1998: 232; original emphasis). Decisions in this respect concern "what to reify, when, and with respect to what forms of participation; whom to involve, when, and with respect to what forms of reification" (Wenger, 1998: 232). In terms of designed and emergent learning, (2) "[t]here is an inherent uncertainty between design and its realization in practice, since practice is not the result of design but rather a response to it" (Wenger, 1998: 233). Decisions in this respect should consider making the emergent an opportunity, and assessing the benefits and costs of prescription. With regard to the local and the global, as put by the author, (3) "[n]o community can fully design the learning of another" and "[n]o community can fully design its own learning" (Wenger, 1998: 234). Decisions may have to do with the fact of "combin[ing] different kinds of knowledgeability[46] so they inform each other" (Wenger, 1998: 235; original emphasis).

Indeed, the CoPs are the ones "involved in the design of their own learning because ultimately they will decide what they need to learn, what it takes to be a full participant, and how newcomers should be introduced into the community" (Wenger, 1998: 235). In this sense, a design "is not primarily a specification (or even an underspecification) but a boundary object that functions as a communication artifact around which communities of practice can negotiate their contribution, their position, and their alignment" (Wenger, 1998: 235). Consequently, "design will create relations, not between the global and the local, but among localities in their constitution of the global" (Wenger, 1998: 234). Ultimately, design is closely related to relations of power, since inherent in design "is the question of how the power to define, adapt or interpret the design is distributed" (Wenger, 1998: 235).

Finally, it is important to note that in the context of the CoP 'learning' is not only local, but also linked to global aspects, 'macro' issues, or broader 'constellations' of practices:

> What we dare consider knowledge is not just a matter of our own experiences of meaning or even our own regimes of competence. It is also a matter of the positions of our practices with respect to the broader historical, social, and institutional discourses and styles (e.g. scientific, religious, political, artistic) to which we orient our practices in various ways and to which we can thus be more or less accountable. (...) In this regard, knowing in practice involves an interaction between the local and the global. (Wenger, 1998: 141)

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[46] This term is explained later on in this section.

Wenger makes reference to "*constellations* of interconnected practices" (1998: 127; original emphasis) to talk about connected CoPs. This adds notions of "locality, proximity, and distance" (Wenger, 1998: 130) to the construct of the CoP; which gives place to a 'geography of practice'. This term accounts for continuities among CoPs, which "must be understood in terms of interactions among practices" (Wenger, 1998: 129) – such as boundary objects, brokering, boundary practices, styles and discourses. CoPs forming a constellation may relate to one another by one or more of these variables (Wenger, 1998: 127): (1) sharing historical roots; (2) having related enterprises; (3) serving a cause or belonging to an institution; (4) facing similar conditions; (5) having members in common; (6) sharing artifacts; (7) having geographical relations of proximity or interaction; (8) having overlapping styles or discourses; and/or (9) competing for the same resources. Besides, one single CoP can be part of more than one constellation. In consequence, this notion also helps explain how CoPs define their identity, which is "in part by the way they negotiate their place within the various constellations they are involved in" (Wenger, 1998: 128). The idea of *constellations of practices* arguably offers a link between the local and the global:

> There is a widespread assumption – in social theory as well as in more popular writing – that the history of modern times involves a transition from local communities to global societies. From that perspective, the concept of community of practice and the local character of mutual engagement may seem obsolete. By contrast, in the context of constellations of practices, the local and the global are not different historical moments in an expanding world. Instead, they are related levels of participation that always coexist and shape each other. The relevance of communities of practice is therefore not diminished by the formation of broader and broader configurations. (Wenger, 1998: 131)

2.4.5. Identity

The theory of the CoP is also a theory of identity, which is deemed an unavoidable element of the practice in the CoP: "We conceive of identities as long-term, living relations between persons and their place and participation in communities of practice. Thus identity, knowing, and social membership entail one another" (Lave & Wenger, 1991: 53). Accordingly, the CoP may be defined as "a group of people who interact, learn together, build relationships, and in the process develop a sense of belonging and mutual commitment" (Wenger, McDermott & Snyder, 2002: 34). In this context, identity is understood as "a certain way of being part of the whole through mutual engagement" (Wenger, 1998: 152). This includes a participant's "tendency to come up with certain interpretations, to engage in certain actions, to make certain choices, to value certain experiences – all by virtue of participating in certain enterprises" (Wenger, 1998: 153). Wenger (1998: 149) proposes five facets of identity in practice: identity as *negotiated*

experience, identity as *community membership*, identity as *learning trajectory*, identity as *nexus of multimembership*, and identity as *a relation between the local and the global*.

As *negotiated experience*, identity is the result of the participant's negotiation, through practice, of ways of being in the CoP. In this respect, it can be seen as "a personal set of events, references, memories, and experiences that create individual relations of negotiability with respect to the repertoire of a practice" (Wenger, 1998: 153). Wenger (1998: 151) emphasises the expression of identity in practice, as a 'lived experience of participation', besides other representations, or reifications, like 'narratives' and 'categories':

> Identity in practice is defined socially not merely because it is reified in a social discourse of the self and of social categories, but also because it is produced as a lived experience of participation in specific communities. What narratives, categories, roles, and positions come to mean as an experience of participation is something that must be worked out in practice.
> An identity, then, is a layering of events of participation and reification by which our experience and its social interpretation inform each other.

As an experience of *community membership*, identity is chiefly manifested in the forms of competence that membership in a certain CoP involves, besides the reified membership markers (identity as a form of competence):

> An identity in this sense is relating to the world as a particular mix of the familiar and the foreign, the obvious and the mysterious, the transparent and the opaque. We experience and manifest our selves by what we recognise and what we don't, what we grasp immediately and what we can't interpret, what we can appropriate and what alienates us, what we can press into service and what we can't use, what we can negotiate and what remains out of reach. In practice we know who we are by what is familiar, understandable, usable, negotiable; we know who we are not by what is foreign, opaque, unwieldy, unproductive. (Wenger, 1998: 153)

As a *learning trajectory*, identity is a trajectory of "constant becoming" (Wenger, 1998: 154) formed by "a succession of forms of participation" (Wenger, 1998: 154) over time in a certain CoP or across diverse CoPs:

> From this perspective, a community of practice is a field of possible trajectories and thus the proposal of an identity. It is a history and the promise of that history. It is a field of possible pasts and of possible futures, which are all there for participants, not only to witness, hear about, and contemplate, but to engage with. (Wenger, 1998: 156)

In this sense, identity is temporal, ongoing, the result of multiple interwoven trajectories. Such trajectories can be (b) *peripheral trajectories* (never reaching the core), (b) *inbound trajectories* (evolving from the periphery to the core), (c) *insider trajectories* (around the core of full membership), (d) *boundary trajectories* (those focused in the expansion of the CoP's boundaries and its connections with other CoPs) and (e) *outbound trajectories* (leading out of the CoP).

Such an understanding has assets for learning: "A sense of trajectory gives us ways of sorting out what matters and what does not, what contributes to our identity and what remains marginal" (Wenger, 1998: 155); but also limitations, since CoPs provide sets of models for negotiating trajectories (*paradigmatic trajectories*), which shape the learning of newcomers who, however, might provide other models for new ways of participation and find their individual and unique identity.

As a *nexus of multimembership*, identity is conceived as entailing the participation of one individual in diverse CoPs over time, which requires the reconciliation of such multiplicity of ways of participation. It is acknowledged that "[w]e often behave rather differently in each of them, construct different aspects of ourselves, and gain different perspectives" (Wenger, 1998: 159). The notion of *nexus* highlights the convergence of such multiplicity of trajectories in the individual, and hence the need for their reconciliation, not meaning though that they converge in one unique trajectory but in an individual with multiple (histories of) participations and thus trajectories.

As a *relation between the local and the global*, Wenger (1998: 162) acknowledges that part of the "energy" invested on identity in the local site "is directed at global issues":

> More generally, what it means to be left-handed or right-handed, a woman or a man, good-looking or plain, a younger person or an older person, a high-school dropout or the holder of a doctorate, the owner of a BMW or of a beat-up subcompact, literate or illiterate, outcast or successful – these meanings are shaped by the practices where such categories are lived as engaged identities.

Therefore, identity is not just local but an interplay between locality and globality. Consequently, it is important for a CoP "to create a picture of the broader context in which its practice is located" (Wenger, 1998: 161-2) and for its members "to figure out how our engagement fits in the broader scheme of things" (Wenger, 1998: 162).

In brief, for Wenger, identity is a lived experience of participation and reification; an ongoing negotiation; socially shaped, that is, related to one's familiarity with the milieu; a learning trajectory; a nexus of multiple forms of participation in CoPs; and an interplay of local and global references. The construct of 'identity' within the theory of the CoP acts in two directions: it helps narrow its scope onto the individual, and it expands it so it relates to broader notions such as identification and social structures; in this sense, "[t]he concept of identity serves as a pivot between the social and the individual, so that each can be talked about in terms of the other. It avoids a simplistic individual–social dichotomy without doing away with the distinction" (Wenger, 1998: 145). Identity is thus twofold: internal to a practice: "how you negotiate your identity as a participant in a community of practice – how you express your

134

competence in that community, how others recognise you as a member or not" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 7) and also related to one's position and the CoPs' position in broader social structures: "how does your participation in that community enter into the constitution of your identity as a person more generally? How do you inherit some of the identity characteristics that reflect the location of your practice in the broader social landscape?" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 7). In fact, what Wenger (1998: 211) intends to do is define a 'social ecology of identity', the basic constituents of which would be:

1) dimensions of practice as dimensions of identity
2) relations of participation versus non-participation
3) modes of belonging – providing for various forms of social configurations at various levels of aggregation
4) dual processes of identity formation – identification and negotiability
5) dual aspects of social structure – communities and economies of meaning
6) dual aspects of social status – membership and ownership of meaning.

These elements, except for the first one – which has already been explained –, will be described in the next subsections.

2.4.6. Participation and non-participation, modes of belonging, identification and negotiability

The theory of the CoP considers that both *participation* and *non-participation* are equally important for identity formation. Four degrees or forms of participation in the CoP can be distinguished (see Wenger, 1998: 167): full participation (*insider*); full non-participation (*outsider*); peripherality (participation enabled by non-participation); and marginality (participation restricted by non-participation). Such a mix of participation and non-participation denotes "our power as individuals and communities to define and affect our relations to the world" (Wenger, 1998: 167), and determines, according to Wenger (1998: 167-8), six 'fundamental aspects of our lives':

1) how we locate ourselves in a social landscape
2) what we care about and what we neglect
3) what we attempt to know and understand and what we choose to ignore
4) with whom we seek connections and whom we avoid
5) how we engage and direct our energies
6) how we attempt to steer our trajectories.

These aspects are not achieved individually, but negotiated socially in the configuration of social relations, which, as Wenger (1998: 168-9) claims, happens at three levels: (a) at the level of *trajectories with respect to specific communities of practice*; (b) at the level of *boundary relations and the demands of multimembership* (for which communities are defined by contrast to one another, and thus membership in a given CoP means marginalisation in another one); and

(c) at the level of *our position and the position of our communities within broader constellations of practices and broader institutions* (according to which a CoP can be in either a peripheral or a marginal position with respect to a constellation of CoPs and institutional arrangements) (*original emphasis*).

It is worth noting that "relations of non-participation are [often] mediated by institutional arrangements" (Wenger, 1998: 169), such as the job's status, the salary, the encouragement of initiative, standardized procedures, etc., and that these can also have diverse causes and thus tenors: *non-participation as compromise* (for instance when a CoP's members do not involve themselves in the practices of other members), *non-participation as strategy* (when it is deliberately adopted as source of freedom or privacy), *non-participation as cover* (as preventing from conflicts). Finally, non-participation can also be an excuse for disengagement, the resource for individuals who feel powerless in front of certain issues that they assume to be out of their reach (Wenger, 1998).

According to Wenger (1998), participation in a CoP entails three different *modes of belonging*: engagement, imagination, and alignment. Their interplay in diverse degrees results in qualitatively distinct types of communities, regarding identity formation, besides the CoP. Therefore, considering these three modes of belonging helps the understanding of the existent types of community, of their possible transformations over time, and of the kinds of work of belonging these transformations may require.

The first mode, *engagement*, refers to "the ways we engage with others, and the ways these relations reflect who we are" (Wenger, 1998: 189). The *work of engagement* consists in (1) defining and pursuing a common enterprise; (2) engaging mutually in shared practices, (3) accumulating a history of shared experiences; (4) producing a local regime of competence; (5) developing interpersonal relationships; (6) having a sense of interacting trajectories; (7) managing boundaries; and (8) opening peripheries in various degrees of engagement (Wenger, 1998: 184). These processes are limited by time and space. As Wenger (1998: 175) puts it, "there are physiological limits to the complexity that each person can handle, to the scope of activities we can be directly involved in, and to the number of people and artifacts with which we can sustain substantial relationships of engagement". In relation to power, engagement "affords the power to negotiate our enterprises and thus to shape the context in which we can construct and experience an identity of competence" (Wenger, 1998: 175).

The second mode, *imagination*, "refers to a process of expanding our self by transcending our time and space and creating new images of the world and ourselves" (Wenger, 1998: 176). This is a creative process by which we get a sense of the world and of our position in it, and new

136

relations of time and space are generated "that become constitutive of the self" (Wenger, 1998: 177). Such images of the self and of the world transcend engagement, but are "anchored in social interactions and communal experiences" (Wenger, 1998: 178). The *work of imagination* (see Wenger, 1998: 185) requires the ability to disengage, to explore, to take risks, and to create unlikely connections; some degree of playfulness; the ability to dislocate participation and reification, to reinvent ourselves, our enterprises, practices and communities; the willingness, freedom, energy and time to expose ourselves to the exotic, move around, try new identities, and explore new relations. It entails the processes of (1) recognising our experience in others; (2) defining a trajectory that connects what we are doing to an extended identity, and seeing ourselves in new ways; (3) locating our engagement in broader systems in time and space; (4) sharing stories, explanations, descriptions; (5) opening access to distant practices through excursions and fleeting contacts – visiting, talking, observing, meeting; (6) assuming the meaningfulness of foreign artifacts and actions; (7) creating models, reifying patterns, producing representational artifacts; (8) documenting historical developments, events, and transitions; reinterpreting histories and trajectories in new terms, etc.; and (9) generating scenarios, exploring other ways of doing what we are doing, other possible words, and other identities.

Finally, *alignment* is a process that "bridges time and space to form broader enterprises so that participants become connected through the coordination of their energies, actions, and practices" (Wenger, 1998: 179). As this author suggests, the *work of alignment* demands:

> ...the ability to coordinate perspectives and actions in order to direct energies to a common purpose. (...) Alignment requires specific forms of participation and reification to support the required coordination. It requires participation in the form of boundary practices and of people with multimembership who can straddle boundaries and do the work of translation. (Wenger, 1998: 186-7)

Wenger illustrates the idea of alignment through examples like organisations, scientific methods, artistic genres, religions and fashions, which, he states, "propose broad systems of styles and discourses through which we can belong by aligning, for certain purposes, our ability to direct our energy and affect the world" (Wenger, 1998: 180). Since it concerns controlling and directing energy, alignment also concerns power (over one's energy and to inspire or demand alignment from others). Furthermore, alignment has magnifying effects since it "amplifies the ramifications of our actions by coordinating multiple localities, competencies, and viewpoints" (Wenger, 1998: 180). It thus amplifies "our power and our sense of the possible" (Wenger, 1998: 180). Nonetheless, it might also be disempowering when imposed.

Following Wenger, communities of any type (e.g. CoPs, 'imagined communities' (Anderson, 1983), professional communities, 'speech communities' (e.g. Gumperz, 1968), etc.) are the result

of the combination of these three modes of belonging (engagement, imagination, and alignment). It is the predominance of one mode over the others that determines the tenor of the given community: a community where imagination predominates is a group of people who share a common imagined trait; a community driven by alignment is where its members share a common purpose; etc. However, such a combination is also dynamic and thus may change. This has been named 'modulation of identification' (Wenger-Trayner & Wenger-Trayner, 2015). And it also has implications for the learning in a CoP, since "part of a learning community's task is to understand the rhythms of its own learning in order to find optimal opportunities for combining these modes" (Wenger, 1998: 218), which "provides for a degree of agency in the learning theory" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 15).

As Wenger (1998: 188) contends, identity is formed by a tension between "our investment in various forms of belonging and our ability to negotiate meanings that matter in those contexts", and hence, between *identification* and *negotiability*. *Identification* corresponds to "an investment of the self in relations of association and differentiation" (Wenger, 1998: 188). As Wenger puts forth, "[i]dentification is not merely a relation between people, but between participants and the constituents of their social existence, which includes other participants, social configurations, categories, enterprises, actions, artifacts, and so forth" (Wenger, 1998: 192). Identification is thus participative because it entails "'identifying with' something or someone" (Wenger, 1998: 191), and reificative because it entails "'identifying as' (and being identified as) something or someone – a category, a description, a role, or other kinds of reificative characterization" (Wenger, 1998: 191). In this sense, it can be argued that "identification generates the social energy that sustains both our identities and our communities in their mutual constitution" (Wenger, 1998: 192). It is precisely "identification with a mutually negotiated competence around a domain of practice" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 5) what differentiates CoPs from other types of networks.

Negotiability "determines the degree to which we have control over the meanings in which we are invested" (Wenger, 1998: 188). It "refers to the ability, facility, and legitimacy to contribute to, take responsibility for, and shape the meanings that matter within a social configuration" (Wenger, 1998: 197). Among other affordances, "[n]egotiability allows us to make meanings applicable to new circumstances, to enlist the collaboration of others, to make sense of events, or to assert our membership" (Wenger, 1998: 197).

The work of *identification* may be characterized by notions such as "focusing social energy, inclusion and exclusion, commitment, affinity, differentiation, allegiance, solidarity, togetherness, stereotypes, paradigmatic trajectories, trust, shared histories, forgiveness, defining

boundaries, acceptance, inspiration, stories of identity, and so on" (Wenger, 1998: 210). The work of *negotiability*, in turn, consists in processes such as "opening access to information, listening to other perspectives, explaining the reason why, making organisational policies and processes more transparent, seeking control, inviting contributions, defining individual rights, centralizing or distributing authority, negotiation and enforcing shared standards, opening decision processes, argumentation, sharing responsibilities, confrontation, voting, challenging boundaries, and so forth" (Wenger, 1998: 210).

2.4.7. Economies of meaning, ownership of meaning and knowledgeability

According to Wenger (1998: 209), a CoP "is at once both a community and an economy of meaning". This construct underscores the idea that "different meanings are produced in different locations and compete for the definition of certain events, actions or artifacts" (Wenger, 1998: 199). In this context, some meanings may acquire special values/status, and the term 'economy' tries to highlight the following aspects of this process (Wenger, 1998: 199):

> 1) a social system of relative values
> 2) the negotiated character of these values
> 3) the possibility of accumulating "ownership of meaning"
> 4) the constant possibility of such positions being contested
> 5) systems of legitimation that to some extent regulate processes of negotiation

The concept *economy of meaning* alludes to relations of legitimacy and power, and simultaneously acknowledges their fluidity.

Ownership of meaning is "the degree to which we can make use of, affect, control, modify, or in general, assert as ours the meanings that we negotiate" (Wenger, 1998: 200). As Wenger (1998: 200) explains, the term 'ownership' indicates that:

> 1) meanings have various degrees of currency
> 2) participants can have various degrees of control over the meanings that a community produces, and thus differential abilities to make use of them and modify them
> 3) the negotiation of meaning involves bids for ownership, so that the social nature of meaning includes its contestable character as an inherent feature.

Claiming that one owns the meaning of something, the author argues, means "being able to come up with a recognizably competent interpretation of it. (...) but it must have currency within an economy of meaning where it is recognised as a legitimate contender" (Wenger, 1998: 201). And this notion is evidently in direct connection with power relations, since claiming ownership of a widespread style or discourse "becomes a source of power by the very fact that such style or discourse is a source of widespread identification" (Wenger, 1998: 209).

Related with the ownership of meaning and with power is *knowledgeability*. This is also a relevant concept in the CoP model, especially in latter texts (e.g. Wenger, 2010; Wenger-Trayner *et al.*, 2015), though, according to Duguid (2008), it was originally taken from Giddens (1984), who defines it as what actors know about what to do and why in certain contexts, be such knowledge explicit or tacit [see section 2.2 in this chapter]. Within this framework, it refers to "a process of modulating identification across multiple locations of accountability" (Wenger, 2010: 187); "knowledgeability is not just information, but an experience of living in a landscape of practice and negotiating one's position in it" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 4). It is composed of "resources and fragments of experience to be assembled dynamically in moments of engagement in practice" (Wenger-Trayner & Wenger-Trayner, 2015: 23). Knowledgeability is thus what makes participants "recognizable as reliable sources of information or legitimate providers of services" (Wenger-Trayner & Wenger-Trayner, 2015: 23). It is not a characteristic of individuals but "depends on claims to have insights into practices in the landscape and social expectations concerning the value of these practices" (Wenger-Trayner & Wenger-Trayner, 2015: 23).

2.4.8. The adequacy of the CoP construct

As has been made evident in this overview of the theory of the CoP, this construct "is neither a specific, narrowly defined activity or interaction nor a broadly defined aggregate that is abstractly historical and social" (Wenger, 1998: 124-5). And accordingly, Wenger (1998: 124) himself defines it as a 'midlevel category', "between moments of individual experience and broad social structure" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 11). In the case of the present project, the CoP has been chosen to inform and guide the data analysis especially at its 'meso' level. As in the case of Wenger's theory, though, other "abstract historical and social" aspects, as well as issues related to relations of power, may also be addressed in this study. And this is not at odds but, on the contrary, seems to fit very well with our choice of the CoP theory, as a pivotal theory between the micro and the macro levels of analysis; that is, between scientists' daily communication and the internationalisation of higher education.

First, this theory acknowledges that CoPs "develop in larger contexts – historical, social, cultural, institutional – with specific resources and constraints" and that their practice is somehow always "profoundly shaped by conditions outside the control of its members" (Wenger, 1998: 79). Second, the temporal dimension of the CoP's practice necessarily links it to other processes alien to the CoP in a specific space-time:

> We are connected to our histories through the forms of artifacts that are produced, preserved, weathered, reappropriated, and modified through the ages, and also through our experience of participation as our identities are formed, inherited,

rejected, interlocked, and transformed through mutual engagement in practice from generation to generation. (Wenger, 1998: 89)

Third, and connected to this latter argument, reification, which allows for certain durability, is a locus for the convergence of perspectives that might be external to a CoP, that is coming from another space-time. This is explained by Wenger (1998: 89) as follows: "Tools, representational artifacts, concepts, and terms all reflect specific perspectives they tend to reproduce. (...) artifacts tend to perpetuate the repertoires of practices beyond the circumstances that shaped them in the first place". Fourth, the idea of 'constellations' of CoPs adds the spatial dimension to this analytical tool, in the form of "notions of locality, proximity, and distance" (Wenger, 1998: 130), transcending also this way the domain of the CoP. Such 'constellations' designate continuities among CoPs, which "must be understood in terms of interactions among [their] practices" (Wenger, 1998: 129) [see subsection 2.4.4].

The relevance of this construct and the connections of this dimension to 'macro' levels of analysis is claimed by Wenger as follows:

> There is a widespread assumption – in social theory as well as in more popular writing – that the history of modern times involves a transition from local communities to global societies. From that perspective, the concept of community of practice and the local character of mutual engagement may seem obsolete. By contrast, in the context of constellations of practices, the local and the global are not different historical moments in an expanding world. Instead, they are related levels of participation that always coexist and shape each other. The relevance of communities of practice is therefore not diminished by the formation of broader and broader configurations. (Wenger, 1998: 131)

Fifth, 'styles' and 'discourses', Wenger (1998) argues, are elements of the CoP's repertoire that can be exported to other CoPs, and hence, detached from their original enterprise, reinterpreted and adapted in the context of the new CoP. Due to this potential, styles and discourses are forms of continuities across constellations of CoPs and thus "take on a global character" (Wenger, 1998: 129).

In summary, the construct of the CoP is not self-contained not limited to locality – "in the geography of competence" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 11). It indeed places the focus on (local) engagement in practice, but as "ways of participating in the global" (Wenger, 1998: 131), or put differently:

> Focusing on the level of communities of practice is not to glorify the local, but to see these processes – negotiation of meaning, learning, the development of practices, and the formation of identities and social configurations – as involving complex interactions between the local and the global. (Wenger, 1998: 133)

Although we could go beyond the research team in our analysis, and address the institution, the national university system, the European Higher Education Area, among others, the focus here is the scientific team as the relevant social context to be analysed. For this reason, and since "[a]lthough workers may be contractually employed by a large institution, in day-to-day practice they work with – and, in this sense, for – a much smaller set of people and communities" (Wenger, 1998: 6), the research group has been taken to be our "meso" level of analysis, and the CoP theory has been deemed the most adequate perspective to approach its social dimension. Finally, as Tusting (2005) suggests, adopting CDA may permit the link between processes observed at the level of the CoP and other broader phenomena.

Despite having been recognised as "one of the most influential concepts to have emerged within the social sciences during recent years" (Hughes, Jewson & Unwin, 2007b: 1), the CoP is not a perfect nor fully-developed construct. Instead, it has been and still is subject to criticism in diverse respects (see Hughes, Jewson & Unwin, 2007a). It has been criticised, *inter alia*, for not offering a successful conceptualisation of power relations and legitimation processes (e.g. Fuller *et al.*, 2005; Hughes, 2007; Jewson, 2007); for providing ambiguous definitions and operationalisations of *community of practice* and of its boundaries (e.g. Fuller, 2007; Jewson, 2007); for not addressing adequately or for not highlighting the transformative potential of a CoP (e.g. Engeström, 2001; Fuller & Unwin, 2003; Fuller, 2007); for not considering the identity facets of individuals other than as 'participants' (e.g. gender, age, religion, etc.) nor their history (e.g. Hodkinson *et al.*, 2004; Brannan, 2007; Goodwin, 2007; Hughes, 2007; James, 2007); for not giving an exhaustive description of the diverse learning trajectories possible within a CoP (e.g. Fuller & Unwin, 2004, 2005; Fuller, 2007; James, 2007); for oversimplifying the relationships between its members (e.g. Fuller & Unwin, 2004; Goodwin, 2007; Owen-Pugh, 2007); for not tackling sufficiently the relationships among CoPs nor those between the CoP and its socio-political context (e.g. Beck, 2007; Fuller, 2007; James, 2007; Jewson, 2007); for taking on a normative and prescriptive tenor (e.g. Hughes, 2007); and for not adapting effectively to current dynamics of workplaces and/or apprenticeship in advanced industrial societies nor to institutional environments (e.g. Fuller *et al.*, 2005; Unwin, 2007). In fact, some of these drawbacks have been attributed to the neo-liberal tenor that Wenger conferred to the model, for which "the critical edge of earlier work had been lost, (…) the contribution of Jean Lave had been eclipsed and (…) the ideas were being taken over by the certainty and oversimplifications of management training" (Barton & Tusting, 2005b: 6).

Such shortcomings of the CoP theory are conceived here not as insurmountable obstacles, but as evidences of the need for an articulated theoretical framework composed by diverse theoretical standpoints or approaches. To this aim, we will draw on Lave and Wenger's construct, taking

advantage of its strengths, but also considering the criticism it has received in order to adapt it, especially concerning communication, or even improve it in those aspects that need further development, as has been claimed by Lave and Wenger (1991: 42) themselves: "The concept of 'community of practice' is left largely as an intuitive notion, which serves a purpose here but which requires more rigorous treatment".

On the one hand, because I acknowledge the limitations of the CoP theory, like for instance in terms of the theorisation of the full spectrum of the individual's identity and of wider social phenomena, I have relied on other theoretical underpinnings that compensate for this, such as CDA, Bourdieu's (1977) 'theory of practice', Giddens' (1979) 'human agency' – which have also found resonance amongst CoP theorists (Lave & Wenger, 1991; Wenger, McDermott & Snyder, 2002; Wenger, 2010; Wenger-Trayner, 2013). Such a combination of social theories is in fact advocated for by Wenger[-Trayner] himself, who proposes what he calls a 'plug-and-play' approach:

> ...because perspectives can coexist, social theory does not progress in a linear fashion, with one theory replacing another, but by assembling a puzzle of interacting pieces. I propose that theories contribute to this progress by clarifying their location in this puzzle and thus enabling a "plug-and-play" approach to the combination of related theories. (Wenger-Trayner, 2013: 105)

On the other hand, some of the criticism points towards the necessity of more developed theories of learning, which is not however the scope of the present study.

Be that as it may, the CoP, "a rich, useful and potentially fruitful concept" (Hughes, Jewson & Unwin, 2007b: 14) though with shortcomings, is deemed here an a-priori suitable construct to approach the scientific group because it seems to meet the critical characteristics of the CoP defined by Wenger (1998): (1) the research group (as it is known in Spain) is a social aggregate whose main identity marker is a joint enterprise – which is often officially made explicit in accreditation documents, grant applications, etc.; (2) the members of the research team work within an intellectual area of common interest, a domain, and are supposed to jointly develop knowledge relevant to it; (3) although membership in the research group is highly institutionalised and thus does not always correspond to actual mutual engagement among all members, mutual engagement – in the form of sustained mutual relationships and shared ways of engaging in common enterprises – is definitely compulsory among some of its members; (4) finally, regarding the existence of a shared repertoire among the group's members, whilst it is assumed to be indispensable for the effective communication among participants, its assessment and exploration will be the main aim of this study and is thus only an a-priori assumption. In the same way as in a CoP, the research group's members presumably "typically share information,

insight, and advice. They help each other solve problems. They discuss their situations, their aspirations, and their needs. They ponder common issues, explore ideas, and act as sounding boards" (Wenger, McDermott & Snyder, 2002: 4). These connections between the CoP and the scientific group suggest the a-priori suitability of this approach for the current project. Other indicators of the CoP that cannot be taken for granted will need to be confirmed after the analysis of the data. Determining the compatibility between the research group and the construct of the CoP is indeed one of the main objectives of this thesis.

It is worth noting that the CoP model has been widely used from its infancy for the study of learning in higher education, especially suiting a (new) focus "on the autonomous and collaborative learner, operating in an increasingly diverse higher education context" (Lea, 2005: 183). Drawing on Wenger's latter work (e.g. Wenger, McDermott & Snyder, 2002), it has often been approached from a market-oriented perspective, which fits with the marketisation tendency of higher education (Barnet & Griffin, 1997). However, claims have been made to recover the heuristic of the concept:

> ...as a heuristic the concept enables exploration of the ways in which learning does or does not take place and foregrounds not just success but constraints on learning and on full participation in a community's practices. It provides a lens to examine how meanings are contested within a community, to explore the ways in which certain ways of making meaning are privileged to the exclusion of others within the academy, and how some members of a community might, therefore, always find themselves excluded and at the margins, never able to participate fully in the community's practices. (Lea, 2005: 188)

Once the aptness of the CoP theory for approaching the scientific group has been discussed, another major objective is to elucidate the ways in which this learning (and identity) theory can be deemed a good framework for the analysis of (multimodal) *communication*, or in other words, the place and role of (multimodal) *communication* within the CoP and, in this case, within the research team.

Although communication is not in fact a core aspect of the CoP construct, at least explicitly, its presence and relevance to some extent can be deduced "below the surface" in various aspects of this theory, as linguistic anthropologist Williams F. Hanks suggests in his foreword to Lave and Wenger's book (1991: 13). What is more, connections between scientists, communication and the CoP model have been suggested at different points in the main texts of the CoP theory: e.g. "Scientists have long been forming communities of practice by communicating across the globe (once by letter and now by e-mail)" (Wenger, McDermott & Snyder, 2002: 25). Other evidences of the relevance of communication within the CoP model are:

(1) Its emphasis on knowledge transmission and reproduction (Hughes, Jewson & Unwin, 2007a).

(2) The explicit reference to 'language' and to 'communication' not as the main vehicle for knowledge, but as part of the CoP's practice (Lave & Wenger, 1991: 85): "Language is part of practice, and it is in practice that people learn"; "In a theory of practice, cognition and communication in, and with, the social world are situated in the historical development of ongoing activity" (Lave & Wenger, 1991: 51); "The practice is a set of frameworks, ideas, tools, information, styles, language, stories, and documents that community members share" (Wenger, McDermott & Snyder, 2002: 29).

(3) The significance given to communication among co-participants: "sharing a practice requires regular interaction" (Wenger, McDermott & Snyder, 2002: 25); "A strong community fosters interactions and relationships based on mutual respect and trust. It encourages willingness to share ideas, expose one's ignorance, ask difficult questions, and listen carefully" (Wenger, McDermott & Snyder, 2002: 28); "To build a community of practice, members must interact regularly on issues important to their domain" (Wenger, McDermott & Snyder, 2002: 34).

(4) The centrality of the negotiation of meaning, in which communication is inherent: "Participation is always based on situated negotiation and renegotiation of meaning in the world" (Lave & Wenger, 1991: 51); "Apprentice quartermasters not only have access to the physical activities going on around them and to the tools of the trade; they participate in information flows and conversations, in a context in which they can make sense of what they observe and hear" (Lave & Wenger, 1991: 102).

(5) Access to "information" and (communication) "resources" (Lave & Wenger, 1991: 101) is deemed chief for a newcomer to achieve full membership in the CoP.

(6) The important role of language or otherwise of the "acquisition of sociolinguistic competence" (Holmes & Meyerhoff, 1999: 174) to gain legitimacy in the CoP:

> Issues about language (...) may well have more to do with legitimacy of participation and with access to peripherality than they do with knowledge transmission. (...) learning to become a legitimate participant in a community involves learning how to talk (and be silent) in the manner of full participants. (Lave & Wenger, 1991: 105)

(7) Communicative practices are conceived as a support for learning: "apprenticeship learning is supported by conversations and stories about problematic and especially difficult cases" (Lave & Wenger, 1991: 108), and

145

> Talking within itself includes both talking within (e.g., exchanging information necessary to the progress of ongoing activities) and talking about (e.g., stories, community lore). Inside the shared practice, both forms of talk fulfill specific functions: engaging, focusing, and shifting attention, bringing about coordination, etc., on the one hand; and supporting communal forms of memory and reflection, as well as signalling membership, on the other. (Lave & Wenger, 1991: 109)

(8) Communication across boundaries is deemed a site of struggle: "boundaries do have a cost because communication can be difficult across them given the different perspectives and repertoires. And they can limit access to practice and learning resources. Since they are unavoidable, this is something to work with" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 15-6).

(9) Language appears to serve social engagement: "The community of practice takes us away from the community defined by a location or by a population. Instead, it focuses on a community defined by social engagement - after all, it is this engagement that language serves, not the place and not the people as a bunch of individuals" (Eckert & Mcconnell-Ginet, 1992: 7).

(10) Much of the 'reification' participants do is related to communication devices/tools/objects, like standards, manuals, designs, and documents, which serve to manage knowledge (Wenger, McDermott & Snyder, 2002).

(11) The 'domain' appears to determine communication: "Knowing the boundaries and the leading edge of the domain enables members to decide exactly what is worth sharing, how to present their ideas, and which activities to pursue" (Wenger, McDermott & Snyder, 2002: 28).

Hence, this theory allows for a communication-based view but needs further theoretical basis for the full exploration of communication within the CoP.

Such connections between the CoP framework and linguistic/communicative approaches have already been noticed, and even recognised by Wenger[-Tayner] (2013: 111) himself, who asserts that "my theory could be enriched by plug-and-play with theories of discourse because it does not address the use of language and its power in very sophisticated ways". Despite this, the CoP model was brought to the field of sociolinguistics by Penelope Eckert and Sally McConnell-Ginet (1992) to address issues on language and gender, style and language variation and change (e.g. Eckert, 2000). Drawing on this theory, they were able to unveil the links between people's routine practices and language use (Meyerhoff, 2004). The CoP model's value within sociolinguistic and linguistic anthropological research, Eckert (2006: 683) asserts, is "the fact that it identifies a social grouping not in virtue of shared abstract characteristics (e.g., class,

gender) or simple copresence (e.g., neighborhood, workplace), but in virtue of shared practice", such as "a bowling team, a book club, a friendship group, a crack house, a nuclear family, a church congregation". Other contributions of this theory to language and discourse studies are its focus on "individuals' social mobility" and "the negotiated nature of social identities" (Meyerhoff, 2004: 533). As Karin Tusting (2005) contends, the CoP's focus on 'practice', understood as the negotiation of meaning, puts language use (and thus communication) in a central position within this approach. In fact, Wenger (1998: 53) suggests that "[t]he negotiation of meaning may involve language, but is not limited to it", and that 'negotiation' implies "continuous interaction", "gradual achievement", and "give-and-take". And these are evidently linked to communication.

Nevertheless, the CoP theory has been claimed to lack a "fully developed theory of language" (Tusting, 2005: 36). A recursive claim of (socio)linguists in this respect is that "framings provided by theories of language, literacy, discourse and power are central to understandings of the dynamics of communities of practice, but they are not brought out in Wenger's formulations" (Barton and Tusting, 2005b: 6). This fact reveals the importance of combining this larger-level theory with other micro-level approaches to language use, as will be done in this study, though in this case with theories of (multimodal) communication. This has also been noted by some scholars, like Maria Clara Keating, who suggests that

> ...dynamics of participation and reification can be further expanded to include the meaning-making mechanisms that individuals use in the course of their engagement in activities, in continuous, cyclic and dynamic acts of *repetition, recognition, reflection* upon and *recombination* of the resources as they emerge in activity and in the semiotic moment of practice. (Keating, 2005: 127; original emphasis)

Other voices go further in claiming for the need to combine the CoP theory with approaches to language use:

> Any theory of learning based on social practice must, inevitably, involve the ways in which meanings are invented and subtly transformed in interactions between participants in co-ordinated activities in a shared social and material world; and since language and meaning are fundamental to human activity, learning, thinking and knowing can occur only within a world which is socially and culturally structured through language. (Lea, 2005: 191)

This author points out that Lave and Wenger (1991) acknowledge the importance of discourse and 'ways of talking' in the CoP, but this is not developed in their work, which does not comprise theories of language (Lea, 2005). Thus contributing to this gap, which has been partially filled in by work combining both approaches (e.g. Lea & Street, 1998; Lillis & Curry, 2006), is also an objective of the current research study.

147

A connection between the CoP model and communication approaches is the notion of reification, which "offers a specific analytical connection across communities of practice, literacy studies and broader social theory" since reifications "are crucial for interactions across time and space", and they "orchestrate and synchronise people's activities by stabilising meanings" (Barton & Hamilton, 2005: 32). Reification thus "adds to our understanding of the social construction of knowledge, the co-ordination of human activity and the role of institutions and cultural artefacts in these processes" (Barton & Hamilton, 2005: 33). It acts in the local domain, linking localities with one another; it links localities with broader social domains; it gives form to what is moved by participants across CoPs; and it helps contemplate the idea of historical change (through the cultural artefacts that reified objects constitute) (Barton & Hamilton, 2005).

Furthermore, attempts have been made to underscore the communicative elements present in this theory, especially from the perspective of discourse and language use (e.g. Holmes & Meyerhoff, 1999; Barton & Tusting, 2005a). This standpoint brings to the fore "relationships of power, framed within the dynamics of language", that is, "how the linguistic negotiation of meanings within small-scale social interactions generate, communicate and constitute relationships of conflict, rivalry and tension, as well as co-operation, coordination and harmony" (Hughes, Jewson & Unwin, 2007b: 9). An interesting contribution in this direction has been Karin Tusting's (2005) (critical) 'language look' at the CoP theory, which attempted to "demonstrate how paying attention to language use can give us insights into the way in which broader social structures and power relations are played out and maintained within the dynamics of participation and reification in a particular community of practice" (Tusting, 2005: 53).

Tusting (2005) identifies different elements present in Wenger's (1998) work that are relevant for a language-based perspective on such social aggregates. Some of these are: how the beginning of the linguistic/communicative event is signalled; the genre of the activity/event; discourses (how participants are represented); style (of language use or of communication); the function of language [and communication] at any point; how turn-taking decisions are made (whether they are distributed/under control of some, etc.); which the final [communicative] event is; what the conclusion is; the atmosphere; the position of agents; what is acceptable to say; whether there is contribution required from other agents; expectations; dominant values; the setting; management requirements from agents; who holds the decision-making power; how control of the interaction (who speaks, when, about what) is retained; how people are permitted to speak [or to communicate]; who holds control of the agenda of the meeting and how; how hierarchical arrangements are made salient and explicit (or not); how hierarchical power relations are constructed and maintained by the way language [or communication] is used; the

148

demarcation between agents/levels (whether this is clear, explicit, etc.); the existence of positions of superiority; how relations of power are reinforced; the existence of active resistance; contradictions between egalitarian social relationships and hierarchical power relationships; what happens when goals are not achieved; what happens if agents do not improve; characteristics of the context, among others. In fact, these elements concern not only language, but also social issues such as power relations, which, as has been already suggested here, have been found to constitute one of the main gaps of the CoP theory.

Another relevant contribution connected to communication in the CoP comes from the field of literacy studies, which explores "how people act within a textually mediated social world" (Barton & Hamilton, 2005: 24). Within this field, authors have observed direct connections between the notion of *reification* and literacy texts/artefacts: "the concept of reification in the communities of practice work is key to making the link with literacy studies" (Barton & Hamilton, 2005: 14); "nearly all specific examples of reification dealt with by Wenger in his data are in fact literacy artefacts of some kind" (Barton & Hamilton, 2005: 15).

Regarding the list of indicators of a CoP (Wenger, 1998: 125-6), referred to earlier in this section, Holmes and Meyerhoff (1999: 177) deem them useful "for researchers interested in the relationship between language and society, [since] these features provide a basis for exploring the utility of the CofP model in relation to particular communities". From this perspective, Wenger's (1998) 'shared repertoire' may correspond to "shared language and discourse", 'situated learning' and 'legitimate peripheral participation' consist in "access to, and sanctioned membership of, speech communities" (Hughes, Jewson & Unwin, 2007b: 9). In this sense, these authors agree that language – and here also *communication* – is the means by which participants in the CoP code and legitimate their authority; by which hierarchies of cultural capital and moral values are conveyed.

In sum, a main contribution of the CoP theory to a sociolinguistic/communicative approach is that it provides "a framework of definitions within which to examine the ways in which becoming a member of a CofP interacts with the process of gaining control of the discourse appropriate to it" (Holmes & Meyerhoff, 1999: 175). This may act in two directions: it can "be informed by the community of practice framework and it can, in turn, enrich the framework" (Rock, 2005: 77). In order to be able to do a systematic description and interpretation of the social *and* the communicative phenomena observed in the data, the combination of the CoP theory with other theories of communication has been deemed necessary for the purpose of the present project. In the next section, the approach that will guide the micro-level data analysis, *multimodal social semiotics*, will be presented.

2.5. Multimodal social semiotics and the communication practices of scientists

In this section I will introduce the theory which I will mainly draw on for the analysis of the data at the micro level, the level of the 'texture' – content, form and organisation – of texts (Fairclough, 1995) and of meaning-making in particular interactional instances. It is *multimodal social semiotics,* which, similar to linguistic ethnography and discourse analysis, "can be applied to take a detailed look at 'big' issues and questions through specific instances" (Jewitt, 2009a: 27).

The origins of this theoretical stance should be traced back along two lines: (a) the formation of social semiotics and (b) the conformation of multimodality. As regards the former, that is, social semiotics, it stems from the work of Michael Halliday, *Language as Social Semiotic: The Social Interpretation of Language and Meaning* (1978) – where the social and culture-dependent dimension of semiotics was put forward–, and has been strongly influenced by Robert Hodge's and Gunther Kress' book, *Language as Ideology* (1979) – where several key notions of social semiotics were already sketched out (MODE, 2012). As a theory, it started to take shape in *Social Semiotics* (Hodge & Kress, 1988) and in *Reading Images: The Grammar of Visual Design* (Kress & van Leeuwen, 1996); two works where the exploration of other semiotic systems besides language was highlighted.

As claimed by Kress (1993: 171), social semiotics is meant to be "[a] social theory of the production of the sign...the essential underpinning not only of critical theories of text production and reception, but also of any plausible theory of language and text". Its 'central point', the author contends, is that "the social is the motor for communicational/semiotic change; for the constant remaking of cultural semiotic resources; and for the production of the new" (Kress, 2010: 35). This would allow discourse analysts to move away from the traditional logocentrism and consider communicative texts in their most holistic form. The use of this theory, thus, implies not only a change of focus from speech and writing to any kind of verbal or non-verbal communicative resource. This is in fact what is intended here, as has been explained in section 2.3.

Although Van Leeuwen (2005: 1) refers to it as "not 'pure' theory, not a self-contained field", social semiotics is widely recognised today as a theory of, or an approach to, communication that consists in the study of 'semiotics' (of which Ferdinand de Saussure is generally considered the founding father). Consequently, social semiotics centres on the sign-mediated, meaning-making social practices that humans engage in, but with a special focus on the social and culture-specific aspects of such practices of signification and interpretation, such as the characteristics of the communicative situation, the sign-maker's identity, and the historic-

150

cultural context. In this sense, social semiotics is closely related to pragmatics, sociolinguistics, culture studies and critical discourse analysis; and therefore, its interdisciplinarity is a characteristic feature of it (Van Leeuwen, 2005).

In relation to multimodality, in their opus *Multimodal Discourse: The Modes and Media of Contemporary Communication* (2001), Gunther Kress and Theo van Leeuwen explicitly expressed their will to "start a discussion, to open up the question of multimodality" (Kress & Van Leeuwen, 2001: preface), and established the first conceptual tools that would facilitate the analysis of what they called 'multimodal texts': communicative instances that had been produced using diverse sets of meaning-making resources (or 'modes'): speech, writing, image, gesture, music, etc. This way, they intended to "move towards a view of multimodality in which common semiotic principles operate in and across different modes" (Kress & Van Leeuwen, 2001: 2) and "sketch a multimodal theory of communication" (Kress & Van Leeuwen, 2001: 4).

Since then, multimodality has gained adepts and interest until achieving the current status of "a relatively new approach to research" (Jewitt, 2009c: 5), "a field of application rather than a theory" (Jewitt, 2009c: 2), "a domain of inquiry" (Kress, 2009: 54) and a "perspective [that] rejects the traditional almost habitual conjunction of language and communication, for instance with respect to learning or identity formation" (Jewitt, 2009c: 2). Departing from the idea that "all signs are multi-modal, that is, in effect, all signs are complex signs, existing in a number of different semiotic modes" (Kress, 1993: 187), multimodality is, nowadays recognised as the approach to representation and communication that explores the full range of 'modes' for meaning-making used in a specific culture, setting or group. The research group, in the case of the current study, will be the social context framing the exploration of multimodal communication. Therefore, from this perspective, all means should be equally considered in the exploration of the making of meaning.

Instead of aiming at establishing a universal inventory of modes, multimodal research strives to explain the principles of use of the modal resources available in a specific context, providing conceptual and methodological tools for the exploration of such multimodal repertoires and their organisation for the making of meaning (Jewitt, 2009a). However, due to its infancy stage, several tools and procedures of multimodality are yet to be consolidated, or even developed; and this is being undertaken by an increasing number of scholars and from a multiplicity of standpoints. While multimodality has been influenced by linguistics, interactional sociology, semiotics, art history, cultural studies and new media studies − among others −, it has primarily been approached from three perspectives: social semiotic multimodal analysis (e.g. Kress, 2010; Kress & van Leeuwen, 1996; 2001), multimodal discourse analysis (or also a systemic

functional approach) (e.g. O'Halloran, 2008), and multimodal interactional analysis (e.g. LeVine & Scollon, 2004; Norris, 2015) (see Jewitt, 2009b).

Despite such multiplicity of influences and views, Carey Jewitt (2009a) identifies four theoretical assumptions common to all the approaches to multimodality: (1) that language is but only a part of the multimodal ensemble, of which all modes are equally considered in their meaning-making function; (2) that each mode is conceived as contributing differently to the making of meaning, through specific social functions; (3) that the interplay of modes is also significant for the exploration of communication, since it is the result of the orchestration of meaning by the sign-maker; and (4) that the meaning of signs is social, since it is influenced by social norms and by the motivations and interest of the sign-maker acting in a given social context. Moreover, also present in all approaches to multimodality is Halliday's (1978) notion of the three 'metafunctions' (or social functions) of language −ideational, interpersonal and textual−, but in this case applied to all communicative modes and semiotic resources. According to this, modes and semiotic resources are used to represent the world (ideational resources), to establish relationships (interpersonal resources) and to coherently arrange elements in concrete texts (textual resources).

From all the existing approaches to the study of multimodal texts, the strand I will follow in the present study, as has already been noted, is the "one among a number of different frameworks that have been and are now being developed for theorizing multimodality" (Bezemer & Kress, 2016: 12), that of social semiotics, mainly developed by Gunther Kress; especially the theoretical bases reflected in his work *Multimodality: a social semiotic approach to contemporary communication* (Kress, 2010). Following Domingo, Jewitt and Kress (2014) and Kress (2010), I will refer to this approach as 'multimodal social semiotics' (here also MMSS). I will therefore depart from the four assumptions of multimodality above referred to, while adopting the theoretical axioms of social semiotics to inquire into issues such as meaning-making, the resources used for it, sign-makers, their agency, power, and characteristics of the environment of the communicative instance (Bezemer & Kress, 2016), with the final aim of gaining a deep understanding of "how people make signs in the context of interpersonal and institutional power relations to achieve specific aims" (MODE, 2012)[47].

Some of the tenets of social semiotics include (1) its focus on the *sign* and the *mode* as fundamental elements of meaning-making; (2) the assumption that environments affect communication (and learning) in its content (the what) and in its form (the how) (Bezemer &

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[47] MODE (2012). Glossary of multimodal terms. https://multimodalityglossary.wordpress.com/. Retrieved 080217

Kress, 2016); (3) that it is thus necessary to consider (the making of) signs and (the use of) modes in their social, historical and geographical context; and (4) that the sign-maker, similar to Giddens' (1984) 'knowledgeable agent', referred to in section 2.2, is aware of the characteristics of her environment and makes the sign according to her rhetorical assessment of this physical and social milieu (Bezemer & Kress, 2016). Communication, in this sense, is explained by MMSS as follows: in the production of signs, and in the choice of modes for communication, the sign-maker has a range of options, which are not fixed. Instead, these are attached to the changing meaning potentials of the resources available in the context (which is also dynamic) and to their combination. This flexibility of choices and meaning potentials is a key feature that should be explored in any social semiotic analysis of multimodal texts, with a view on the logics underlying the choices of the meaning-maker and their interpretation by the recipient of the message (MODE, 2012). This is what Jeff Bezemer and Gunther Kress (2008: 185) refer to as "the inevitable and motivated partiality of every representation".

Accordingly, a critical view of multimodality (e.g. Machin, 2014) focuses on the ideologies behind the choices of communicative resources, as well as on the control of such resources. In Van Leeuwen's (2005: 5) words, "[i]n social life people constantly try to fix and control the use of semiotic resources – and to justify the rules they make up – although more so in some domains than in others". Such choices, Hodge and Kress explain, are regulated by rules of production and of reception (*production and reception regimes*), which are constituents of a "higher-level control mechanism", the 'logonomic system' (from *logos*, "discourse", and *nomos*, "rule"), defined by Hodge and Kress (1988: 4) as follows:

> A logonomic system is a set of rules prescribing the conditions for production and reception of meanings; which specify who can claim to initiate (produce, communicate) or know (receive, understand) meanings about what topics under what circumstances and with what modalities (how, when, why).

From the MMSS approach, 'rules' are regarded not as universal and static, but as social and dynamic, changing through social interaction. However, it is worth considering that for the rules to be changed, one needs to have power, and that there are different types of rules and diverse ways of changing them – e.g. by imposition, by giving example – more or less explicitly (Van Leeuwen, 2005). For the exploration of rules in a given context, Van Leeuwen (2005) suggests, the researcher must first compose an inventory of rules and afterwards understand how they are accepted and followed. A characteristic evidence of logonomic systems are *genres*, understood as "typical forms of text which link kinds of producer, consumer, topic, medium, manner and occasion" or otherwise as "socially ascribed classifications of semiotic form" (Hodge & Kress, 1988: 7). However, as has already been suggested, not only is the choice of specific resources

153

and modes significant for the analysis of communication, but so is the interplay among them −
the intersemiotic relations. This idea is captured in the concept of 'multimodal cohesion' (Van
Leeuwen, 2005), that is, the integration in a text of diverse semiotic resources through rhythm,
composition, information linking and dialogue.

To conclude, the issues tackled in MMSS are very succinctly summarised by Kress (2010: 59;
original emphasis) as follows:

> *Social semiotics* and the *multimodal* dimension of the theory, tell us about *interest*
> and *agency*; about *meaning*(-*making*); about *processes of sign-making* in social
> environments; about the *resources* for making meaning and their respective
> *potentials* as *signifiers* in the making of *signs-as-metaphors*; about the *meaning
> potentials* of cultural/*semiotic forms*. The theory can describe and analyse all
> signs in all *modes* as well as their interrelation in any one text.

Therefore, in the case of the analysis of the multimodal communication policy of scientific
groups, MMSS may help providing the tools for the exploration of how meaning is 'made' in
particular communicative instances or 'texts', following what rules, involving what agents, with
what interest. And how all or some of these aspects are affected by the internationalisation of
higher education.

In the following subsections, I will describe some of the key concepts conforming MMSS:
(Multimodal) text, medium, entextualisation and recontextualisation (subsection 2.5.1); sign,
sign-maker and semiotic chain (subsection 2.5.2); mode, semiotic reach, semiotic resources,
modal affordances/constraints and transduction (subsection 2.5.3); orchestration (of meaning)
and frame / framing (subsection 2.5.4); genre, discourse and ideology (subsection 2.5.5).

2.5.1. (Multimodal) text, medium, entextualisation and recontextualisation

From a multimodal social semiotics perspective, a *text* can be understood as a multisemiotic
composition, produced using diverse meaning-making resources (or 'modes'), like speech,
writing, image, gesture, or music, among others, and thus comprising not only written or oral
linguistic documents, but also objects, spaces, and any "piece" or "section" of the world that can
be perceivable by the senses. Although some authors emphasise the communicative purpose of
the text as a critical ontological feature of it − e.g. in Kress' definition of this term as
"multimodal combinations of communicatively orientated utterances and actions" (2005a: 19) −,
I understand that the communicability of the sign does not always rest on its producer, the sign-
maker; instead, it might rely on its recipient, the interpreter of the sign. Therefore, any sign,
object or "piece" of the world might be conceived as a text, regardless of the purposes with
which it was first created. This is, in fact, supported by the view of furniture, clothing or
buildings as (multimodal) texts (e.g. Norris, 2004a; O'Toole, 2004). This, however, does not

154

mean that such 'texts' are devoid of purpose or interests; I do embrace Kress' idea that "the text itself is a large, complex sign, in which the interests of a particular producer are realized" (Kress, 1993: 181). Understanding thus that a text is a human product, I consider that it is always the result of human interests, even though communicating them is not always its main purpose but an inherent characteristic of it.

Furthermore, another important, intrinsic characteristic of texts is their dynamicity. Despite the interest of researchers and analysts to regard them as 'punctuations of semiosis' (Kress, 2000), "points of relative stasis and stability in ongoing processes of meaning-making" (MODE, 2012)[48], or as "a trace of discourses, frozen and preserved" (Hodge & Kress, 1988: 12), multimodal texts, which rely on material entities − the media − of our ever-changing world, are also subject to the perishable nature of matter, and are thus also constantly changing. They are therefore communicative instances, regarded, observed and/or captured in their most stable and static form possible in order to be analysed, but which are not the original communicative instance itself but its (as-much-static-as-possible) analysable metaphor − e.g. a film may be analysed as a text but the analysed text may not be the original text-instance that its director recorded, nor even the document that she has saved in her computer, but the form of the film that the analyst has chosen to be her analysed 'text'; hence, a copy, a 'metaphor' of the original document. The stability of the text may depend on the characteristics of its materiality, the *medium* that supports it (e.g. a written text carved on a rock may be more durable than a writing on the sand; but not, however, perennial).

As defined by Kress (2005b: 6), *medium* refers to "the culturally produced means for distribution" of messages. However, nowadays the boundary between the distribution and the production of messages is increasingly blurring. On the one hand, compact multimedia devices are not only in charge of the distribution of messages but also of their production; and on the other hand, new media are increasingly interactive, digital and fast/far-reaching and hence message production and distribution are becoming almost simultaneous. Considering this and also the meaning load of the medium itself, media are not conceived as means "for distribution" only, but as 'media of production and dissemination', and thus also defined as "the technologies for making and distributing meanings as messages" (Kress & Jewitt, 2003: 4).

In MMSS, a medium is regarded as having two facets. It is simultaneously material and social:

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[48] MODE (2012). Glossary of multimodal terms. https://multimodalityglossary.wordpress.com/. Retrieved 200217

> Materially, medium is the substance in and through which meaning is instantiated/realized and through which meaning becomes available to others (cf. "oil on canvas"). (...) Socially, medium is (the result of) semiotic, sociocultural, and technological practices (cf. film, newspaper, billboard, radio, television, theater, a classroom, and so on). (Bezemer & Kress, 2008: 172)

Moreover, as part of its social dimension, the use of media one makes, Kress argues, is a shaper of one's identity, given that "[i]n using such devices we shape *habitus* and the way we approach and conceive of our life-world" (2010: 185). Therefore, the ability in using certain devices, which is to say, certain media, is an aspect of the sign-maker's 'semiotic resourcefulness' – her capacity of selecting, among the options available, the apt signifiers and modes for the specific social context and of exploiting their semiotic potential (Bezemer & Kress, 2016). And this, as these authors suggest, is something that might be valued by the sign-maker's community, or, in Bourdieu's terms, may become part of the social actor's *cultural capital* (Bourdieu, 1986).

As has been suggested, hence, the text is an instance of an ongoing process (of discourse) which can be decontextualised, retrieved from its actual context of production in order to be described, analysed or evaluated. The text is thus the result of *entextualisation*, that is, "the process of rendering discourse extractable, of making a stretch of linguistic production into a unit − a *text* − that can be lifted out of its interactional setting" (Bauman & Briggs, 1990: 73). This term stems from the work of Elinor Ochs (1979), who reflected upon the constraints of a theory-laden transcription of speech in qualitative research. It was later on used among linguistic anthropologists (e.g. Haviland, 1996; Urban, 1996), who supported the idea that speech is often transformed into cultural objects or material 'texts', which can be evaluated. In this sense, this process is comparable to that of *reification*, as has been explained in the previous section of this chapter devoted to the CoP model. Nonetheless, since *culture* is a contested concept, *entextualisation* also presents problems as regards its ontology and its boundaries (Silverstein & Urban, 1996). Despite this controversy, in the present project 'entextualisation' will refer to the action of imposing boundaries and materiality onto discourse, so that it becomes a manipulable artifact (Cramer, 2011), and thus subject to *recontextualisation*, namely, to further interpretation in a new context or setting.

Particularly, in MMSS the term 'recontextualisation' names the process by which changes in the social environment (context) entail changes "in the semiotic materialization of meaning and the representational practices which are deemed appropriate and legitimate" (Sidiropoulou, 2015: 179). Through this process, certain representations and signifiers are selected and re-used in the new context (Kress, 2010) but others are dismissed. This is thus "a process of abstraction, addition, substitution, and deletion" (Machin, 2014: 352). In fact, Bezemer and Kress (2008)

identify four 'rhetorical/semiotic principles' intervening in recontextualisation, which are *selection, arrangement, foregrounding* and *social repositioning* – later replaced by *framing* (Bezemer & Kress, 2016). As these authors explain, *selection* consists in the identification of relevant (meaning) material for the new context among the available resources; *arrangement* encompasses the order and disposition of entities in time and space; *foregrounding* entails assigning salience to certain elements over others (which are 'backgrounded'); *social repositioning* is the reconstruction of social relations among social actors in the new context; and through *framing*, as will be further explained, the sign-maker gives unity and coherence to meaning entities and detach them from others. Nonetheless, these principles are not ruled by the sign-maker's free will, but are guided by issues of aptness, legitimacy, availability, hierarchy and thus also power:

> All signs are made with these two perspectives and interests: *mine* in relation to *my* representation and interests; and *yours* in relation to *communication* and to the need for factoring in your interest and the requirements of power. While power introduces opacity into the world of the signs, it does not disturb the principles of the motivated sign. (Kress, 2010: 72)

In this sense, recontextualisation can be linked to the macro level of analysis and to discourse (see Blommaert, 2005), as it originally was when coined by Basil Bernstein (1996).

2.5.2. Sign, sign-maker and semiotic chain

The *sign* is a basic element/unit of semiotics (from Gk. σημεῖον */semeion/,* 'sign'). It names the conjunction of a signified (meaning) and a signifier (material form). As stated by Kress, "[s]igns can be of any size: a word; a syntactic unit; a clause; a text consisting of many sentences" (Kress, 1993: 175). In MMSS, the sign is conceived as: (1) a motivated construct – not arbitrary but created according to the interest of the sign-maker –, (2) a metaphor – the representation of an object or event and not the object or event itself –, and (3) the result of the process of sign-making, being it a social process (Kress, 1993). The sign is usually part of a coherently organised sign complex (or otherwise 'multimodal ensemble'), and is made – "rather than used" (Kress, 2010: 54) – by means of modal features, each of which has its functions (Bezemer & Kress, 2016). From the social semiotics perspective, the sign has three fundamental characteristics (Bezemer & Kress, 2016): (1) the relation between its form and its meaning is not arbitrary but motivated – its form is purposely chosen by the sign-maker as *apt* to signify its meaning; (2) the environment shapes the sign – the available resources are drawn upon by the sign-maker to make meaning, together with the location of the sign in that environment, which is also significant; and (3) the meaning of the sign depends on the affordances (meaning potentials) of the mode in which it is made. The relation between sign, environment and sign-

157

maker is summarised by Kress as follows: "Signs are *made* in a specific environment according to the sign-*maker*'s need at the moment of sign-making, shaped by the *interest* of the *maker* of the sign in that environment" (Kress, 2010: 62; original emphasis). The sign-maker may prioritise the use of those semiotic resources known and used by those actors in her social environment; however, if she is unfamiliar with them, she may favour signs that she believes are more apt in their form to express the intended meaning (Kress, 2010). Consequently, the characteristics of the sign may be the reflection of the critical features of the signified according to the sign-maker's interpretation and interest; and this is key for the analysis of texts and meaning-making. Kress (2010: 69) elaborates on this as follows:

> In signs, sign-makers mediate their own social history, their present social position, their sense of their social environment in the process of communication; and this becomes tangible in the reshaping of the cultural resources used in representation and communication. The makers of signs 'stamp' present social conditions into the signs they make and make these signs into the bearers of social histories.

The focus is thus on the *sign-maker* and her position in, and interpretation of, the context. Hence, in MMSS the sign-maker is an active agent, a social actor, who 'chooses', according to her interest and rhetorical intentions, some among a range (or a system) of available resources in a specific context to make meaning. This is explained by Kress (2010: 66) in these terms: "I stress the agency of socially formed individuals acting as sign-makers out of socially shaped interest with socially made resources in social interactions in communities". In this view, thus, meaning-making is seen as a social process of choice, dependent, on the one hand, on the resources available for the sign-maker, and, on the other hand, on the discourses that regulate how the diverse communicative modes must be used (Jewitt, 2009a). However, agency is distributed between the sign-maker, who engages in the "semiotic work of *design*" when bringing "together signs in different modes into a semiotically coherent entity" (Kress, 2015: 57), and the recipient of the message, the *re-maker* of the sign, who engages, in turn, in the "semiotic work of *interpretation-as-redesign*" (Kress, 2015: 57):

> Given the theoretically equal status of the interpreter with the initial maker of the message, communication is now more aptly seen as a horizontal and reciprocal relation, one where meaning is made twice: once by the initial maker of the message, and once in the re-making of the transformative engagement by the partner in a dialogic relation... (Kress, 2015: 67)

Moreover, the responsibility of the design might be either individual or assumed by a group of actors. In this latter case, the sign produced may "reflect divisions of labour in a design team, as

well as the power relations between its members" (Bezemer & Kress, 2016: 65), which may be of interest for the critical analyst.

A concept closely related to *sign* is that of *semiotic chain* (or *chain of semiosis*). This names a string of signs related to one another by the sign-maker's desire and interest. Such a relation with one another may be either a common theme, a common set of resources, a common modal configuration, etc. and also a sequentiality. This notion suggests that meaning-making is not a one-time, isolated action but an ongoing process (MODE, 2012). This concept is also related to *creativity*, since the adaptation of the sign to the new context demands the generation of new ideas. Such adaptation might be produced by the variation of any semiotic resources in the making of the sign or by modifying the sign's modal configuration: "By varying different modes, introducing and adding new modes to existing modes in infinite chains, a huge number of variations on a concept are made possible" (Stein, 2003: 135). This way, each new sign or text is a new 'punctuation of semiosis' in the chain (Kress, 2000), which "appears to be a static text, [but] the meanings attached to the text are unstable and fluid within the semiotic chain" (Stein, 2003: 136). The potential exploitation of the sign-maker's creativity resides in her agency, in her confidence, in her flexibility for resource choice and in her knowledge of the specific practice of sign-making (Stein, 2003).

In this study, sign-makers will be the communicating scientists who engage in communicative practices with one another within the research group as well as with external actors. As such, they may design reified texts directed at different interpreters, following their own rhetorical intentions and the regulations of the local context.

2.5.3. Mode, semiotic reach, semiotic resources, modal affordances/constraints and transduction

Mode is a core concept in multimodal analysis and in social semiotics. It has been defined as "a socially and culturally given resource for making meaning" (Kress, 2009: 54); but more concretely as "cultural technologies for making meaning visible or tangible, that is, evident to the senses in some way" (Domingo *et al.*, 2014: 4). The main criterion for something to be deemed a 'mode' is the existence of "a shared cultural sense of a set of resources and how these can be organized to realize meaning" (Jewitt, 2009a: 22). Kress and Bezemer (2008: 172) explain it very illustratively:

> In social semiotics, what is to count as mode is treated as a matter for decision by communities and their social- representational needs. For the "ordinary" user of the mode of writing, *font* is part of that mode. For a typesetter or graphic designer, the meaning potentials—the affordances—of font are such that it can

> be used as mode; that is, meaning can be made through the affordances of font. What counts as mode depends on sign makers acting within the needs and understanding of a particular community and its more or less conventionalized practices.

Consequently, the use of a given communicative resource as a 'mode' is context-dependent − of a 'culture' (Kress, 2009), a 'community' (Bezemer & Kress, 2016), 'institutions and societies' (Jewitt, 2009a) −, and also dynamic (changing over time), in relation to "what they can accomplish socially" (MODE, 2012). Therefore, what is used as a communicative mode in one context, might not be so in another context, or perhaps stop to do so in a different moment within one same context, where new modes are produced. Examples of modes in certain contexts are speech, writing, (still) image, moving image, gesture, body posture and movement, gaze, sound, music, three-dimensional objects, and layout. Nonetheless, in the case of "product[s] of social and cultural work" (Kress, 2009: 54) that have meaning in their socio-cultural context but are not designed for representation and communication purposes, such as furniture, clothing, and food, their conception as modes is debated (see instances of the 'mode of furniture' in Norris, 2004b; and of clothes as 'semiotic media' in Lemke, 2007).

Not only is the use of a resource as a mode context-dependent, but the *semiotic reach* of modes − that is, "what can be expressed readily or at all" (Kress, 2009: 57) by certain modes − is also partial and context-specific. This entails that when the message is shaped through a *modal ensemble* (a combination of modes), each mode may carry part of its meaning in diverse ways. Furthermore, certain meanings can only be realised through a given mode and not through any others, which has been named 'specialisation of modes' (Jewitt, 2009a).

With reference to their relation with the environment, modes are socially and culturally shaped, and also a significant feature of a socio-cultural group. Their characteristics evidence the social needs and interests of a community, since they are the result over time of the semiotic work in the social uses of the modes of the members of that community (Bezemer & Kress, 2016). Being it related to needs and interests, the choice of mode is a central issue in the analysis of ideology in communication.

Moreover, modes "consist of sets of semiotic resources" (Jewitt, 2009c: 2) that help describe their characteristics. The term *semiotic resources* has its origins in Halliday's (1978: 192) words, who referred to the grammar of a language as a 'resource for making meanings' (as cited in Van Leeuwen, 2005: 3). Nevertheless, it takes different nuances in the diverse approaches to multimodality. And even within MMSS, although it is a core concept, this term finds diverse,

160

sometimes too imprecise, (re)definitions, probably due to the ongoing development of this approach.

Semiotic resource(s) has been defined as "a means of meaning making that is simultaneously a material, social and cultural resource" (Jewitt, 2013: 253); as "the connection between representational resources and what people do with them" (Jewitt, 2013: 253); as "resources that people draw on and configure in specific moments and places to represent events and relations" (Jewitt, 2009c: 2); or as "the actions and artefacts we use to communicate, whether they are produced physiologically – with our vocal apparatus; with the muscles we use to create facial expressions and gestures, etc. – or by means of technologies – with pen, ink and paper; with computer hardware and software; with fabrics, scissors and sewing machines, etc." (Van Leeuwen, 2005: 3), to cite only a few examples. Therefore, from the diverse definitions, it can be inferred that semiotic resources are those resources, in the form of material entities, actions or artefacts, used for the making of meaning in specific communicational instances and situated in concrete socio-cultural contexts. In fact, the MMSS perspective focuses on the historical, social and cultural aspects that contributed to a specific use of semiotic resources; that is, the how and the why of semiotic resources in specific texts. In so doing, this approach offers ways to connect the micro level of analysis with the macro level – that of social, cultural and political domains (Jewitt, 2009a).

The 'semiotic potential' or 'meaning potential' of semiotic resources, that is, what they can 'do' or accomplish in terms of meaning, is based on their past uses, on their *affordances* or possible uses, and on the form of the semiotic regime – the rules – of their context of use (Van Leeuwen, 2005). According to this author, two types of 'semiotic potentials' can be distinguished. On the one hand, semiotic resources have 'theoretical' semiotic potential, which is based on the uses they had in the past and their potential uses. On the other hand, they have 'actual' semiotic potential, which is based on the knowledge and awareness of the sign-maker of those past uses and her exploitation of their potential uses. This, explained otherwise, entails that semiotic resources "are the product of the potentials inherent in the material, of a society's selection from these potentials and of social shaping over time of the features which are selected" (Kress, 2009: 55). Consequently, the semiotic resources of a given mode are similar and, at the same time, vary across cultures (Kress, 2009).

Furthermore, semiotic resources can be either material or non-material (conceptual). Material semiotic resources take form of physical actions and material artefacts. Non-material ones consist in concepts or categories that designate diverse aspects of the semiosis – meaning-making – of texts, such as entities, actions, relations, genres, frames, means for cohesion, forms

of coherence, terms to describe time and space, among other aspects (Bezemer & Kress, 2016). Modes themselves can be described in terms of diverse semiotic resources that constitute them. For instance, the mode of *writing* may be described in terms of diverse semiotic resources, such as lexis, syntax, direction, typography, font size, layout and colour. The mode of *speech*, in terms of pitch, tonal quality, intensity, besides again syntax and lexis. The mode of *still image*, in terms of layout, position, orientation, size, colour, shape, among others. These conceptual resources take material shape in the mode used to make a sign, and thus their material form depends on the affordances of the mode chosen (Bezemer & Kress, 2016).

Modal affordance is a contested concept in multimodality, but especially significant in the MMSS approach. The notion of 'affordance' in the area of meaning-making goes back to the work on cognitive perception of the psychologist James Gibson (1977, 1979). This term named the various potential uses of objects, which are defined by their perceivable characteristics (objectivity). According to Gibson, the affordances attributed to objects are also marked by their user's interests and needs, as well as by the characteristics of the situation (subjectivity). Although objects have latent, not-yet-discovered meanings, these are not infinite, but limited by these objective and subjective elements. The first author to apply this concept in the field of object design was Donald Norman (1988, 1990), who considered the material (physical affordances) and the social (cultural) aspects of this notion.

In MMSS, the same idea of 'affordance' is articulated diversely by its two main exponents: Van Leeuwen and Kress. On the one hand, Van Leeuwen takes up Gibson's notion of this term, and simultaneously attributes to the construct 'meaning potential' the material and cultural features of modes and semiotic resources based on their past uses:

> The difference is that the term 'meaning potential' focuses on meanings that have already been introduced into society, whether explicitly recognised or not, whereas 'affordance' also brings in meanings that have not yet been recognised, that lie, as it were, latent in the object, waiting to be discovered (Van Leeuwen, 2005: 5).

On the other hand, Kress does not distinguish between past and future potentialities of modes, but uses the term 'modal affordance' and its opposite 'constraint' to refer respectively to "the potentials and limitations of specific *modes* for the purposes of making *signs* in *representations*" (Kress, 2010: 157); or, to put it differently, "what it is possible to express and represent or communicate easily with the resources of a mode and what is less straightforward or even impossible" (Jewitt, 2013: 254).

Therefore, modal affordances "enable specific semiotic work" (Kress, 2009: 56), but are limited by the modes' *constraints*. The questions around these notions would be "what kinds of things

162

does each mode – image, writing, colour, layout – do well, which things does it do less well, or which not at all?" (Domingo *et al.*, 2014: 4). Due to the subjective aspect of affordance, and to the relation of mode and culture, it is claimed that "not all the potentials inherent in the *materiality* of a mode are used to become affordances of that mode in a particular culture" (Kress, 2009: 56). Modal affordances are thus not universal nor static, but continuously reshaped by societies according to their needs. They are shaped "by how a mode has been used, what it has been repeatedly used to mean and do and the social conventions that inform its use in context" (Jewitt, 2013: 254). It is thus "a complex concept connected to both the material and the cultural, social and historical use of a mode" (Jewitt, 2013: 254).

Furthermore, the idea of modal affordance "suggests all modes are partial in making meaning, so that the designed selection of modes, into multimodal ensembles, allows this partiality to be managed" (Jewitt, 2013: 254). For instance, audiovisual texts integrate the spatiality and simultaneity of still image with the fast sequentiality of sound and moving image, which permits the sign-maker convey different messages from those possible with monomodal texts.

Similar to modes, also *media* have affordances and constraints based on their material characteristics and the social history of their uses (Kress, 2010). For instance, the medium of printed paper affords certain durability and portability but is constrained in terms of dynamicity (its content may remain for long); conversely, the medium of digital screen affords dynamicity (what it projects may vary quickly) but is constrained in terms of durability (which relies on electric power), and its portability depends on the device it is attached to (a personal computer, a laptop, a smartphone). Yet, the main challenge for MMSS analysts nowadays, as Bezemer and Kress (2016) claim, is not only "to understand the affordances, the facilities and the constraints of contemporary media, in all aspects of social action – and the affordances of the modes that appear there" but also to do so within the "mix of sites and media, of the traditional and the contemporary, side by side – each supplying possibilities, all affecting all others" (Bezemer & Kress, 2016: 12) conforming the current 'semiotic world'.

Finally, a very usual process in (multimodal) communication is *transduction*. This notion is very illustratively explained by Kress (2010: 125):

> It names the process of moving meaning-material from one mode to another – from speech to image; from writing to film. As each mode has its specific materiality – sound, movement, graphic 'stuff', stone – and has a different history of social uses, it also has different entities. Speech, for instance, has words, image does not. That process entails a (usually total) re-articulation of meaning from the entities of one mode into the entities of the new mode.

Furthermore, as Bezemer and Mavers (2011: 197) claim for transcriptions (a type of transduction), it can also be argued that any transduction "not only involves re-presenting the world, but also attaching a 'reality status' to those representations". Yet, it is important to notice that transduction can never be perfect and that this process entails always "gains and losses" (Bezemer & Kress, 2008: 175).

In relation to transduction, in MMSS the term 'transformation' names "changes within a mode" (Bezemer & Kress, 2008: 169) entailing mainly changes in its inner structure. Conversely, transduction does not affect structure only, but "brings with it a change of entities. There are no words in image, there are depictions; semiotic/semantic relations that, in speech or writing, are expressed in clauses and as verbs are realized through vectors or lines" (Bezemer & Kress, 2008: 175). Finally, the term 'translation' might also be used in the literature on MMSS as a general synonym of 'transduction'.

2.5.4. Orchestration (of meaning) and frame / framing

A pertinent concept when referring to multimodal ensembles is the *orchestration (of meaning)*. This is the expression used in MMSS to make reference to the design of multimodal ensembles as arrangements of semiotic features – such as layout, colour, font and writing –, "quite as it is in the musical sense" (Kress, 2011: 255), with communicative purposes. It consists not only in choosing the apt semiotic resources, but also in combining them effectively: "people orchestrate meaning through their selection and configuration of modes, foregrounding the significance of the interaction between modes in the production of meaning" (Jewitt *et al.*, 2009: 11). Therefore, this term brings to the fore the "textual or organisational meta-function" (Jewitt, 2013: 258) of communicative resources, the aptness of choice of resources, the interdependence among modes, and the intended harmony of the multimodal ensemble as a whole (Kress, 2010).

The concept of *frame/framing* was introduced by Kress and Van Leeuwen in their book *Reading Images* (1996). As an action, it refers to "the disconnection of the elements of a visual composition, for instance by frame-lines, pictorial framing devices – boundaries formed by the edge of a building, a tree, etc. – empty space between elements, discontinuities of colour, and so on", as well as to "the opposite, the ways in which elements of a composition may be visually connected to each other, through the absence of disconnection devices, through vectors, through similarities of colour, visual shape, and so on" (Van Leeuwen, 2005: 7). The implication of framing, in terms of semiotic potential, is that connected elements may be interpreted as belonging to the same entity, holding a specific relation, and separate or unconnected ones may be regarded as independent. For this reason, frames may also be deemed as signifiers in

themselves (Kress, 2009), which respond to the interest of "those who frame" (Kress, 2010: 149) and are thus a site of ideology and connected to specific societies or cultures.

Applied to all kinds of multimodal texts, 'frame' may be defined as "the formal semiotic resources which separate one semiotic entity from its environment 'pre-frame' or from other semiotic entities" (Kress, 2010: 149). As a provider of unity, relation and coherence, Kress argues, framing is essential in all types of (multimodal) texts:

> *Frame, text, communication* are inextricably interwoven. Without *frame*, no *text*; without *framed entities* no communication (...) To be in a world of meaning is to be in a world of *frames*, of *framing*, of *syntagms*, of *arrangements* and of the constant remaking of all these in transformative representation. (Kress, 2010: 154)

Nonetheless, framing is realised differently in each mode: in writing, framing may be signalled by means of blank space, lines, punctuation marks, etc.; in speech, by pauses, intonation changes, pitch variation, changes in rhythm, etc.; in printed image, by frame-lines, empty space between elements, discontinuities of colour, etc. (see Kress & van Leeuwen, 1996). And these framing resources are differently shaped and used in different cultures (Kress, 2009). Despite being unavoidable, framing is not necessarily static nor opaque, but might be porous, permeable, and/or flexible in different degrees (Van Leeuwen, 2005), just as walls have doors and doors might be open or closed.

Framing is thus a key stage of the broader process of *(multimodal) communication*. This latter is defined by Kress (2010) as being 'semiotic work', but chiefly 'social-semiotic work' and multimodal. It consists, this author explains, of three stages of a cyclical sequence: attention, framing and interpretation. First, the social actor's interest is directed towards a sign of 'the social', which is taken as a message (attention); then, aspects of that message are framed as a prompt (framing); and, finally, the prompt is interpreted, that is, a new 'semiotic entity' is shaped by joining aspects of the prompt with other resources brought by the interpreter (interpretation). As a result of this process, a message may be shaped as a response to the prompt, according to the sign-maker's assessment of the environment, her interest and the semiotic resources available. Hence, two assumptions underlie Kress' model: "that *communication is the response to a prompt*; and that *communication happens only when there is 'interpretation'*" (Kress, 2010: 35; original emphasis).

2.5.5. Genre, discourse and ideology in MMSS

Genre is an especially relevant construct in the field of MMSS but simultaneously a rather complex one, which has been used and defined in many other fields. For these reasons, a brief overview on this concept will be offered here before describing it from the MMSS perspective.

Originally coming from the French word for 'class' or 'kind', this term has been widely drawn on in diverse disciplines, such as literary studies, cultural studies, rhetorical studies and applied linguistics, among many others. Consequently, diverse authors working in diverse fields of interest have defined and characterised this concept differently. For instance, in the field of 'academic literacies', 'genre' makes reference to "types of text, both spoken and written, such as student discussions, written notes, letters, academic essays etc." (Street, 2010: 351-352); within genre theory, genres respond to rhetorical needs and conventions (Abdi, Rizi & Tavakoli, 2010); in particular, John Swales defines 'genre' as follows:

> A genre comprises a class of communicative events, the members of which share some set of communicative purposes. These purposes are recognised by the expert members of the parent discourse community, and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style. (...) In addition to purpose, exemplars of a genre exhibit various patterns of similarity in terms of structure, style, content and intended audience. (Swales, 1990: 58)

Traditional definitions like these ones regard 'genre' as guiding or constraining text design in the sense that it determines the signs and conventions it must encompass: from the specific class or genre type the text subscribes to, the recipient of the text may withdraw the most adequate scheme of interpretation. The genre, therefore, acts as a guiding scheme for the interpreter of the text.

However, claims have been made in relation to the flaws that the construct 'genre' has traditionally had across the diverse fields where it is used; in particular about the rigidness of the concept and the idealisation of certain canonical forms it entails (Bateman, 2008). Some strands within these disciplines have attempted to introduce new dimensions to the traditional, predominant dimensions of *text form, content,* and *intention/purpose*. Some of these are the dimension of *dynamicity* (for which 'genre' designates both, stability and change), that of *social action* (for which genre is the abstraction of recurrent action and thus entails social expectation), and the dimension of *use-value* (for which genres might act as media of transmission or become commodified products) (Miller, 2015). As Bateman (2008) and Miller (2015) suggest, an effective approach to genre would be one that regards it as a multidimensional construct, which

allows for the exploration of multiple and particular aspects of texts that connect them to and/or detach them from one another.

In fact, social semiotics, deriving from systemic functional linguistic theory, accounts for a perspective on genre as "a semiotically constructed social entity" and "a characterisation of a class of identifiable linguistic artefacts" (Bateman, 2008: 184), and thus considers the social aspect of genre, as well as its diverse levels of abstraction (from the level of the artefact to the level of society). Additionally, there has been in recent years an increased tendency for the inclusion of the multimodal dimension into the construct. This entails considering non-verbal features of communication, and thus assuming that "some artefact is subject to similar functional pressures to those that affect language and so will exhibit similar organisational properties" (Bateman, 2008: 197). Furthermore, this new dimension requires the reconsideration of aspects of the theorisation of genre linked to the sequentiality of language, for this needs to be replaced by other perception ways and paths. According to this, "[t]he genre remains a linear, staged-activity, but the stages, rather than being pre-given by the text, are instead constructed by the reading path" (Bateman, 2008: 199). The focus is thus more on the action of the user/recipient and less on the text itself.

Following this trend, within MMSS and especially in the work of Kress, 'genres' have been defined as "canonical forms for interaction" (Kress, 2010: 46); "the 'entexting' of the social relations which obtain in a particular social encounter" (Kress, 2010: 173); "textual forms of social relations and discourses that are the social shaping of content as it appears in texts" (Domingo *et al.*, 2014: 2), among other definitions, all of which highlight aspects of genre such as text form, purpose, content, and social action. A comprehensive and illustrative definition of 'genre' encompassing all these aspects is the following one:

> Texts drive their sense, their order, their coherence, their logic, from the logic, sense, order, of the (structure of the social) environment in which they were produced by one or more speakers, or by a writer who had her or his absent audience nevertheless closely in mind. That order is what I mean by generic form, by genre. (...) All texts are made in social occasions where the participants – if they are 'practised', experienced, competent members of the group – do understand quite clearly what is at issue, what the forms and conventions are, and how much transformative activity is wise or unwise to engage in. (Kress, 1997: 118)

Kress specifies that the 'order' of genres consists of social roles, obligations and rights, conventions and their strength, and the penalties and/or rewards for (not) complying with them (Kress, 1997). Concurrently, though, genres are "one aspect of textual shape" (Kress, 1997: 119), and thus simultaneously social and linguistic (or semiotic). Genres do not only reflect

conventions but create them; they are a set of resources available but may be modified when drawn upon, because, as Kress claims, every textual instance is at the same time similar and different to the generic ideal: "There is nothing that fully predicts my production of a sign. Nor is the textual instantiation of any one generic type ever like that of any previous instantiation, even in conditions of great external constraint" (Kress, 1993: 176).

And it is precisely this twofold potentiality of genre: its structure-building activity, on the one hand, and its transformative capacity, on the other, what has been valued by many scholars so as to deem it an adequate construct to mediate among the diverse levels of concreteness and abstraction in the analysis of communication. In this sense, 'genre' acts as a 'boundary object' (Star & Griesemer, 1989) or an 'explanatory nexus' among these diverse levels – or *strata* in systemic functional linguistics –, mediating between individuality and collectivity and between action and institutions (Miller, 2015). And as such will also be regarded in this thesis.

In fact, the construct 'genre' has already been tackled in section 2.3 of this chapter, devoted to the *ethnography of communication*, being it the eighth and last component of Hymes' SPEAKING grid. Hence, it is a common construct in these two theories: in multimodal social semiotics and also in the ethnography of communication, and thus a logical connection between the micro and the meso levels. It is not, however, our innovation to bring together these two "broad approaches" (Bateman, 2008: 183) to genre in the field of linguistics and of discourse analysis. Precisely, in his work *Multimodality and Genre: A foundation for the systemic analysis of multimodal documents,* John Bateman (2008) attempts to design a model for genre analysis – the 'Genre and Multimodality' model – that combines the *social semiotic* approach and the genre as *social action* approach, deriving this latter from Hymes' (1974) work. As regards the macro level, genre has been claimed to be closely related to ideology and thus culture-dependent (Kress, 1993; Martin, 2009). Therefore, the consideration of genre as a multifaceted semiotic artefact (Bateman, 2008), composed by many dimensions affecting what, following Fairclough (1992, 1995), has been concretised here as the three levels of analysis: the micro level – that of text form –, the meso level – that of communicative practices – and the macro level – that of socio-cultural discourses –, will be key for the conjoining of the theoretical approaches drawn on in the current study.

As in the case of Fairclough's work and in CDA more genearlly, also in MMSS the construct *discourse* is significant. Following CDA, this concept has been defined in section 2.2 as a "relatively stable use of language and/or communicative semiotic resources serving the organisation and structuring of social life". In this section, though, it will be characterised from

the perspective of MMSS. *Discourse* is in fact a very relevant concept within social semiotics, where it has been defined as:

> ...the social process in which texts are embedded (...) Discourse in this sense is the site where social forms of organisation engage with systems of signs in the production of texts, thus reproducing or changing the sets of meanings and values which make up a culture. (Hodge & Kress, 1988: 6)

This construct, however, is less present in multimodal social semiotics, possibly due to the fact that MMSS is less concerned with the "forms of organisation" (maybe rather pertaining to a macro level) and more focused on the "systems of signs" (and thus on the micro level). In fact, Kress (2010: 110) himself points to this "larger level" condition of 'discourse' and characterises it as a rather epistemological construct:

> Discourse deals with the production and organisation of *meaning* about the world from an institutional position. (...) *discourses* are taken to be meaning-resources available in a society to make sense of the world, *social* and *natural*, at a larger level. The term 'discourse' *functions* in the theory as a resource for constructing epistemological coherence in texts and other semiotic objects. *Discourse* refers to institutions and the knowledge they produce about the world which constitutes their domain (Kress, 1984/1989).

Hence, within this theoretical standpoint the concept *discourse* constitutes the underlying 'knowledge' (Van Leeuwen, 2005), 'meaning-resources' and 'ideology' (Kress, 2010), that guide the materialisation of semiotic objects:

> *Semiotic objects*, whether as buildings, written texts, stories casually told, films, gardens and their layout, video games, the layouts and contents of museums and supermarkets are the material sites for the conjoining of discourses and their emergence in material and naturalized form. (Kress, 2010: 113)

In particular, 'normative discourses' regulate "how we use semiotic resources" and act as 'social rules' which refer, for instance, to issues of gender, social class, race, etc. (Jewitt, 2009a: 23). In this sense, it can be stated that "[t]he conjoining of discourses into complexes as *ideology* is neither accidental nor merely contingent; it serves specific, describable social purposes" (Kress, 2010: 113). And this leads us to another significant aspect of social semiotics, coinciding largely with CDA, that of 'ideology'.

The notion of ideology has already arisen in this section, specifically in relation to the non-arbitrariness of sign, and to the sign-maker's choice of mode, frame and genre, according to her interest and to what she regards as 'apt' for the particular communicative context. Within MMSS, ideology takes two different forms: "interest in relation to particular events and objects"

169

and "interest in the relation to the other individual or group" (Kress, 1993: 180). For this reason, this author contends that all signs are deemed ideological, "realiz[ing] the social, cultural and therefore political position of their producer" (Kress, 1993: 174).

Tackling the political position of social actors entails necessarily dealing with power issues; and this is also contemplated within social semiotic theory, as claimed by Kress (1993: 178): "any understanding of the production and reception of signs, that is, a theory of semiosis, has to be set in the context of a social theory of communication in which power is an inevitable component". Particularly, the author argues that power relations are present in any environment and thus that "all sign-making has to be founded on a careful assessment of the social environment and the relations of power in that environment" (Kress, 2010: 72). And it is precisely these power relations that may influence the explicitness of the sign-maker's interest and ideology in the sign:

> Whereas the demands of 'good', efficient communication suggest that the producer of the sign makes the interest which is coded in the sign relation as transparent as possible for the addressee, the presence of power allows her or him to override that consideration (Kress, 1993: 179).

This, in turn, situates the maker of the sign and its "reader" in unequal power positions with regard to the interpretation of the sign/text: "All signs are always transparent to the makers of the sign; and all signs are always opaque to some degree for the readers of signs. The question is: How opaque is this sign for this specific reader, and why?" (Kress, 1993: 180). The interpretation of a sign/text, and especially a 'critical' one, requires thus certain access to, or at least hypothesizing about (Kress, 2010), the sign-maker's interest and ideology: "It is through the two related notions of interest in the production of the sign and the motivated relation of signifier and signified that (critical) readings are made possible" (Kress, 1993: 177).

As has already been claimed in section 2.2, such a critical approach to MMSS that puts special emphasis on the uncovering of ideology and power relations in communication situates the current study within the multimodal critical discourse studies (MCDS) framework. Indeed, the complementarity of MMSS and CDA has already been noted by Kress, chiefly in his work *Against arbitrariness: the social production of the sign as a foundational issue in critical discourse analysis* (1993), where he calls for the combination of CDA and a social semiotic approach:

> CDA needs to produce a clearly articulated theory of the reading of texts as much as a theory of the production of texts, and that such a theory needs, crucially, to be founded on a theory of the social production and reading of signs. As such,

170

> CDA will become, and this too is an essential step, part of that larger enterprise which deals with the production of meaning in any semiotic medium, namely that of social semiotics. That enterprise is one which attempts to account for the making and remaking of meaning in all those semiotic modes which cultures employ, differentially, but as a matter of course. (Kress, 1993: 170)

Here Kress claims for the need for an "articulated theory", as is the case of the one presented in this chapter, and expressly for the need to address the "production and reading of signs" in any (critical) analysis of discourse and thus of communication, as social semiotics does. This entails "go[ing] beyond a concern with the medium of language alone, and insist[ing] that other, visual, semiotic modes are in play" (Kress, 1993: 186). Therefore, considering that "[c]ritical discourse analysis sees texts in the widest social contexts" (Kress, 1993: 186) and that "a social semiotic approach would attempt to dissolve the category of context itself, preferring to speak of series of interrelating semiotic systems" (Kress, 1993: 187), Kress concludes that "[t]his view of signs also permits the move from the micro-histories of semiotic events to the macro-history of semiotic systems" (Kress, 1993: 177). It thus accounts for a critical analysis of communication. Finally, Kress (1993: 189-90) lists the sites of common ground between CDA and MMSS:

> (a) the interest of producers of signs as individuals and as members of social groups;
> (b) the social histories of these individuals and groups;
> (c) the micro-histories of the production of the sign, including the social structures which constituted the relevant contextual features;
> (d) the structurings of power at work in the production of signs;
> (e) the reading/reception regimes in operation at particular points in the reading of signs;
> (f) the interests of readers of signs as individuals and as members of social groups;
> (g) the boundaries of signs in particular, and the degrees of rigidity or fluidity with which these are enforced; and
> (h) the invariable multi-modality of signs.

Therefore, considering that the MMSS perspective accounts for the historical, social and cultural aspects that contribute to a specific use of semiotic resources, that is, the how and the why of semiotic resources' use in specific texts, it is evident that this approach offers ways to connect the micro level of analysis with the macro level – that of social, cultural and political domains (Jewitt, 2009a) – in an articulated theory. As has been pointed out, though, in the present thesis three levels of analysis are distinguished. And indeed Hodge and Kress call for 'mediating categories' between micro and macro levels: "In order to trace the relationship of micro to macro structures we need some mediating categories" (Hodge & Kress, 1988: 7).

MMSS may thus constitute an appropriate approach for zooming in on the issues tackled in the other two levels of analysis (meso and macro), and explore the specificities of texts that reflect the conditions of both, their production and distribution, on the one hand, and the characteristics of their socio-political context, on the other.

The previous two sections have described the theoretical frameworks used to approach the meso level of analysis: the *ethnography of communication* and the *community of practice*. However, although each theoretical approach appears as more suitable to guide one of the levels of analysis, the analysis of any level may also rely on concepts from the other perspectives. To this end, it is necessary to sketch their connections with *multimodal social semiotics*, and hence to show how these three approaches, together with other macro-level concepts, can be combined, as will be done in the next section.

2.6. An articulated framework for a 'holistic' analysis of the multimodal communication policy of a research group

The main aim when designing the theoretical framework of this project was to create a 'holistic' framework to approach the multimodal communication policy of the scientific team. This being a mid-level social aggregate, the theoretical framework revolves around the *community of practice* theory as a mid-level model, constituting here the meso level of analysis. The CoP is thus deemed a useful theory to approach the social aspects of the research group's communication, but needs to be 'plugged' – in Wenger-Trayner's (2013) terms[49] – to other perspectives that account for communication as their core construct. One of these is the *ethnography of communication*, which also offers a mid-level model to approach communication within social aggregates, communities or groups, though in this case with 'communication' as its chief entry point. The other perspective adopted here that centres on communication is *multimodal social semiotics*, which has been chosen to guide the micro level of analysis, that of the content and form of specific communicative 'texts'. Moreover, although the main social unit analysed is the research group, as a community of text production and consumption and as a 'tribe' with its own cultural practices, I recognise that it is not self-sufficient in this respect but highly dependent on the macro-scientific culture, and specifically on the culture of its field of interest and of practice. I will hence try to trace links to broader contextual elements, related to the global scientific community and to the European Higher Education system. For this purpose, I will draw on theoretical concepts from sociological theories, like Giddens' s*tructuration theory* (1984), Bourdieu's *theory of practice* (1977), to address this macro-sociological dimension. Finally, the critical discourse analytical perspective will be adopted across analytical levels as "a 'mode' or 'perspective' of theorizing, analysis and application" (Van Dijk, 2001: 352).

The three main theoretical approaches that guide the current project (*multimodal social semiotics*, the *ethnography of communication* and the *community of practice*), each of which suits better some aspects of our inquiry at the micro and meso level, share indeed common characteristics, such as an interest for meaning-making, a wide perspective of communication that transcends language use, a concern for the social aspects of interaction, and a sensitivity for critical views on communication. Such commonalities have been made evident at different

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[49] Wenger[-Trayner] (2013) proposes the 'plug-and-play principle' for which existing theories can be "run" through each other. The author views it as an enriching way of developing social theory: "What this suggests is a notion of progress for social theory that does not aspire to simple accumulation, but does not entail mere fragmentation either. (...) The plug-and-play principle is an alternative to linear accumulation. It views social theorizing as a puzzle, whose diversity reflects the complexity of human life." (Wenger-Trayner, 2013: 115).

points in the work of experts in these diverse approaches, as will be illustrated in the following subsections: centrality of the subject/individual as communicative/social agent (subsection 2.6.1), negotiation of meaning as core process (subsection 2.6.2), a commitment with learning as a chief social process (subsection 2.6.3), shared repertoire (of resources) as group defining (subsection 2.6.4), (communication) artefacts as having historically-determined affordances and thus as determining participation (subsection 2.6.5), a multimodal view of interaction (subsection 2.6.6), acknowledgement of a social dimension of communication and/or of a macro dimension in general (like 'context', 'culture', etc.) (subsection 2.6.7), presence of a critical perspective or of related notions: CoP (regime of competence, patterns, power relations); EoC (ends, norms); MMSS (interest, production and reception regimes, logonomic system) (subsection 2.6.8), structure and agency in the three theoretical approaches (subsection 2.6.9), and common concepts among theories (subsection 2.6.10).

2.6.1. Centrality of the subject/individual as communicative/social agent

This is an important element in the three theoretical approaches described (the EoC, the CoP, and MMSS). Despite using different terminology to refer to her (e.g. participant, sign-maker, (social) actor), the individual is always a 'knowledgeable agent', in the sense of Giddens' (1984) concept. Within the CoP theory, the full member of a CoP is a participant who shows 'knowledgeability' within a landscape of practice and is hence accountable for certain ways of living and using resources that are perceived as reliable and legitimate. The CoP's practice is the core cohesive element of the community, but, being it a social learning theory, the focus is on the learner who engages in this practice: "participation in social practice – subjective as well as objective – suggests a very explicit focus on the person, but as person-in-the-world, as member of a sociocultural community" (Lave & Wenger, 1991: 52). Her (learning) trajectory is also an identity journey. She is a learner, a participant (in the CoP's practice), a newcomer, an old-timer, a peripheral member, a full member and also an 'agent':

> The person has been correspondingly transformed into a practitioner, a newcomer becoming an old-timer, whose changing knowledge, skill, and discourse are part of a developing identity – in short, a member of a community of practice. This idea of identity/membership is strongly tied to a conception of motivation. If the person is both member of a community and agent of activity, the concept of the person closely links meaning and action in the world. (Lave & Wenger, 1991: 122)

Likewise, within the EoC framework, individuals are also 'participants' in *communicative events* who need to be aware of the communication rules within the community or group in order to be 'functional members' (Saville-Troike, 2003: 88). This perspective is also concerned

with participants' identity, but in terms of their role in the communicative event/act: addressor-addressee, speaker-audience, author, consumer, etc., and also with reference to their 'communicative competence':

> Given the multiple varieties of language available within the communicative repertoire of a community or complex, and the subset of varieties available to its subgroups and individuals, speakers must select the code and interaction strategy to be used in any specific context. Knowing the alternatives and the rules for appropriate choice are part of speakers' communicative competence. (Saville-Troike, 2003: 43)

Similar to the case of the CoP model, in the EoC individuals are participants in the communicative activity and members of a specific communicative culture. In this sense, a key question would be: "How do members of a group use language in order to be taken as a certain kind of person, status, role, or the like?" (Hymes, 1980: x). This is hence a similar argument to that used in order to define the identity of a participant in a CoP but from a different entry point. As Hymes states about 'the role of speaking in socialization', "it is a question of the induction of new recruits into the ongoing adult system. (...) there is far too little attention to it in the study of individual groups; and it presumably underlies much of the variation in individual adult behavior" (Hymes, 1962: 124).

In MMSS, the focus is not so much on the (social) group and hence not on 'participants', but in the particular individual who designs and "makes" the sign, the sign-maker. Again this is a chiefly social perspective, where social actors are mainly seen as sign-makers who act according to their own rhetorical assessment of their social milieu. It is a theory of the sign, but as a result of the sign-maker's interest and choice among a range of socially-made-available resources for communication: "An adequate theory of semiosis must be founded on the recognition of the 'interested action' of socially located, culturally and historically formed individuals, as the remakers, the transformers, and the reshapers of the representational resources available to them" (Kress, 1998: 74).

The three approaches have therefore a focus on the individual who is an active agent in constant relation with her socio-cultural environment.

2.6.2. Negotiation of meaning as core process

The process of negotiation of meaning is again central in the three theoretical frameworks chosen in this study. In MMSS the emphasis is on "understanding the process of meaning making" (Jewitt, 2013: 253) on the part of the sign-maker, but also and very importantly, on its interpretation on the part of the recipient of the sign (e.g. Halliday, 1978; Bezemer *et al.*, 2011):

"The analytical focus is on understanding their interpretative and design patterns and the broader discourses, histories and social factors which shape that" (Jewitt, 2013: 252).

In a similar vein, although not so explicitly – Hymes places emphasis on '(human) meaning' and does not make reference to 'negotiation of meaning' –, the negotiation of meaning is also an important issue in the EoC (see Saville-Troike, 2003). Hymes situates '(creation of) meaning' at the same level as linguistic/communicative form. 'Construction of meaning' (Saville-Troike, 2003: 218) is also a preferred phrase in the EoC. He intends to design a theory for the study of "the means of speech in human communities, and their meanings to those who use them" (Hymes, 1972a: 2). Hymes thus talks about 'meaningful behaviour' and 'meaningful participation' in a community.

Finally, in the CoP theory, the negotiation of meaning is the process by which learning occurs and, at the same time, it corresponds to the process of identity formation:

> The [CoP] theory is an attempt to place the negotiation of meaning at the core of human learning, as opposed to merely the acquisition of information and skills. And for human beings, a central drive for the negotiation of meaning is the process of becoming a certain person in a social context – or more usually a multiplicity of social contexts. That's where the concept of identity comes in. (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 7)

What the CoP perspective and MMSS also have in common is that both deem *participation*, *reification* and *artefacts* in one case, or the corresponding *action*, *artefacts* and *resources*, in the other case, as main elements intervening in the negotiation of meaning or otherwise in the process of meaning making.

2.6.3. A commitment with learning as a chief social process

This is especially true for the CoP framework, which is a social theory of situated learning (Lave & Wenger, 1991; Wenger, 1998), and for MMSS, which positions learning as one of its main entry points to the study of multimodal communication (see Jewitt *et al.*, 2001; Kress, 2005a, 2005b, Bezemer & Kress, 2008, 2016). These two perspectives regard learning as a social process that may happen anywhere, independently from formal education.

The EoC has also been used to approach education and learning issues (see Hornberger, 2009), especially concerning the 'acquisition of communicative competence' – which is the *raison d'être* of the EoC –, 'language learning' and 'cultural learning' (e.g. Saville-Troike, 2003):

> A linguistics that is truly the science of language, linguistics that is truly a foundation for education, will be a linguistics that is part of the study of

communicative interaction. It will understand linguistic competence as part of communicative competence. It will understand the character of competence in relation to the social history and social structure that shape it in a given case. (Hymes, 1979: 10)

In fact, one of Hyme's main concerns was educational linguistics, focusing on "language learning and teaching and the role of language in learning and teaching (...) and addressing (language) educational problems and challenges with a holistic approach integrating theory and practice, research and policy" (Hornberger, 2009: 352-3). He held a "vision of a multilevel ethnography in education, encompassing policy as well as practice" (Hornberger, 2009: 354), which in this project has been resolved by the term *communication policy* (comprising practices also) and by the use of the EoC as a meso-level theory, linking the ''micro-sociological'' and the ''macro-sociological'' spheres, as named by Hymes (cited in Hornberger, 2009: 354).

2.6.4. Shared repertoire (of resources) as group defining

As has already been explained, a CoP is defined, among other elements, by a commonly shared repertoire among its participants, composed of meaning-making resources and configured as a result of the community's practice over time.

Likewise, MMSS places special emphasis on the resources used for communication by cultural groups, which are at the same time defining features of these 'societies': "'a society' is the group that works jointly with resources previously made by the group: with particular purposes, aware of the potentials, meanings, affordances and constraints of the resources/tools used by those" (Kress, 2012: 370).

Similarly, the object of the EoC is to explore "how speakers use various linguistic [or communicative] resources and how others make sense of or interpret these choices" (Keating, 2001: 289). For Hymes (1980) 'speech' – and thus communication – is a learnt pattern that allows individuals to be 'normal participants' in a 'society' or in a 'group within a society':

> In a society speech [or communication] as an activity is not a simple function of the structure and meanings of the language or languages involved. Nor is the speech activity random. Like the languages, it is patterned, governed by rules, and this patterning also must be learned by linguistically normal participants in the society. Moreover, the patterning of speech activity is not the same from society to society or from group to group within societies such as our own. (Hymes, 1980: 2)

This way, from the EoC perspective, the linguistic/communicative repertoire is also a relevant element that characterises a specific 'socially-defined population' and thus a main concern of the communication ethnographer.

177

2.6.5. (Communication) artefacts as having historically-determined affordances and thus as determining participation

The adequate or competent use of artefacts is present in the three main approaches adopted here, and they are theorised in very similar ways. In the CoP theory, 'artefacts' or otherwise 'technology' are objects with a cultural load. They are material instances of the history of the CoP and thus of its past practices:

> Participation involving technology is especially significant because the artifacts used within a cultural practice carry a substantial portion of that practice's heritage. (...) Thus, understanding the technology of practice is more than learning to use tools; it is a way to connect with the history of the practice and to participate more directly in its cultural life. (Lave & Wenger, 1991: 101)

However, the artefacts' relation to such history and thus to the CoP's culture might be either transparent or opaque, according to some motives that may be interesting for the researcher:

> The significance of artifacts in the full complexity of their relations with the practice can be more or less transparent to learners. Transparency in its simplest form may just imply that the inner workings of an artifact are available for the learner's inspection (...) Knowledge within a community of practice and ways of perceiving and manipulating objects characteristic of community practices are encoded in artifacts in ways that can be more or less revealing. Moreover, the activity system and the social world of which an artifact is part are reflected in multiple ways in its design and use and can become further "fields of transparency," just as they can remain opaque. Obviously, the transparency of any technology always exists with respect to some purpose and is intricately tied to the cultural practice and social organisation within which the technology is meant to function… (Lave & Wenger, 1991: 101-2)

In a similar vein, *artefacts* (or otherwise *semiotic/3D objects*), seen as one type of communication *mode* in MMSS (Bezemer & Kress, 2008), are culturally defined and culture-defining. This is intrinsic in the notion of *modal/semiotic affordance* that is socially and historically established:

> The history of semiotic use of a specific materiality produces *semiotic affordances*: what a sign-maker does is shaped by what other sign-makers have done before her or him, in response to similar social and semiotic needs. That prior, socially shaped, semiotic work produces socially organized sets of (material and conceptual) semiotic resources, making distinct semiotic organisational entities for meaning-making available to individual sign-makers. (Bezemer & Kress, 2016: 31)

Although originally the EoC does not refer to 'artefacts' specifically, these are a historical, basic data source for ethnography, and hence for the EoC. Within the SPEAKING model, they are

178

implicit or related to two of its components: *setting* and *instrumentalities*. These are the components most connected to materiality. With reference to the *setting*, it concerns "physical aspects of the situation" (Johnstone & Marcellino, 2010: 7), besides the time dimension. In the case of *instrumentalities*, artefacts or technologies are implicit in the 'physical media', 'means' and some kinds of 'resources' of communication. According to this approach, *instrumentalities* are:

> ...context-specific linguistic [or communicative] resources available for a given speech event and in a speech style selected from available alternatives in relation to the event's purpose (...). Researchers' attention should focus on the means or agencies of speaking, composed of the physical medium of transmission of message (e.g., oral, written, telegraphic, electronic or other medium) and the related ''forms of speech'' such as varieties of a language including dialect and speech styles, and aspects of speech or idioms unique to particular situations, genres or persons. (...) Also, particular forms of speech might be associated with certain organisational settings or cultures (...). Sample questions for the descriptive analysis of instrumentalities might include the following: (a) What linguistic resources are available? (b) What are the styles of speaking (...)? (Kalou & Sadler-Smith, 2015: 640)

Like *artefacts* and *technologies* in the previous two approaches, in the EoC the composition and use of the *setting* and the *instrumentalities* may be specific of a group or community and connected to its culture. It is true though that this perspective does not foreground the 'materiality of communication' (Katriel, 2015), unlike the other two more performative approaches. Nonetheless, later theorisations of the EoC, like that of Saville-Troike (2003), make explicit reference to this material dimension:

> Many of the physical objects which are present in a community are also relevant to understanding patterns of communication, including architecture, signs, and such instruments of communication as telephones, radios, books, television sets, computers, and drums. Data collection begins with observation and may include interviewing with such questions as "What is that used for?" and "What do you use to . . . ?" The classification and labeling of objects using ethnosemantic procedures is an early stage in discovering how a speech community organizes experience in relation to language. (Saville-Troike, 2003: 93)

Consequently, the study of communicative and cultural artefacts are meant to be a substantive aspect of this project.

2.6.6. A multimodal view of interaction

Although with slight differences from MMSS, the multimodal dimension of communication is also implicit in the EoC, and specifically in some of the 'components of communication' it describes, such as the *channels*, which may be oral, written or other types:

> By choice of channel is understood choice of oral, written, telegraphic, semaphore, or other medium of transmission of speech [or communication]. With regard to channels, one must further distinguish modes of use. The oral channel, e.g., may be used to sing, hum, whistle, or chant features of speech as well as to speak them. (Hymes, 2005: 13)

Such channels correspond to something in between *medium* and *mode* in MMSS, and, together with forms of speech/communication, are labelled as 'instrumentalities' in Hymes' SPEAKING model.

In the CoP theory, communication is materialised in the practices of participants and in the reified objects they use for such interactions. These may be seen as 'highly multimodal', especially from the perspective of literacy theory: "The work of claims processing is highly multimodal, involving as it does an ever-shifting combination of speech, visual and numerical information and other symbolic systems" (Barton & Hamilton, 2005: 22). These authors relate reification with the 'materiality of literacy', which they deem 'multimodal'. Also from the standpoint of discourse analysis, social participation is merely a semiotic and thus communicative process:

> Participation can imply actions and doings, as well as linguistic acts of representation of these doings. It thus emerges in the tension between social action and the semiotic mechanisms that bring meaning to (and in a way constitute) this social action. (Keating, 2005: 111)

The semiotic and multimodal dimension of interaction is thus a common underlying characteristic of the three main theoretical approaches used in this thesis.

2.6.7. Acknowledgement of a social dimension of communication and/or of a macro dimension in general (like 'context', 'culture', etc.)

As stated by Wenger[-Trayner] himself, the CoP model does not encompass a macro dimension of analysis as such but is compatible and may be enriched by it. However, to do so, the different dimensions and also the theories on which their analysis relies should be conceived as feeding one another. Wenger[-Trayner], for instance, explains how such 'plug-and-play' combination of the CoP model and Bourdieu's notion of 'field' should be carried out:

> As a practice-oriented learning theory, my theory insists on the negotiation of competence in practice. This implies that structure does not reproduce itself but is reproduced through practice. In this sense, the field is itself constituted by a series of interrelated practices that sustain its existence through local definitions of competence. (...) A field's landscape of practice is textured by a geography of competence. If you are not careful to do this two-way plug-and-play you might end up with a notion of 'learning field' that takes the field as simply a given generalised context rather than a landscape of practices produced and reproduced in specific social spaces for engaging in the negotiation of competence. (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 13-4)

In this sense, the CoP is the (meso-level) 'context' where socio-cultural practices take place and in which newcomers need to engage in order to reach full participation (Lave & Wenger, 1991). The points in common between Bourdieu's theory and the CoP, Wenger[-Trayner] suggests, are that both approaches have a "focus on social practice", "recognise structural power relations", and that "in practice the two perspectives are lived as one" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 14). Indeed, the CoP has been claimed to be a "historical-cultural theory of learning" (Lave & Wenger, 1991: 37). Moreover, the notion of 'history of practice' gives to this theory a dimension beyond the CoP itself:

> ...social reproduction implies the renewed construction of resolutions to underlying conflicts. (...) reproduction cycles are productive as well. They leave a historical trace of artifacts – physical, linguistic, and symbolic – and of social structures, which constitute and reconstitute the practice over time. (Lave & Wenger, 1991: 58)

Another concept that transcends the CoP itself is 'knowledge', which is especially significant when addressing scientific groups, like in the present project: "Though our experience of knowing is individual, knowledge is not. What counts as scientific knowledge, for instance, is the prerogative of scientific communities, which interact to define what facts matter and what theories are valid" (Wenger, McDermott & Snyder, 2002: 10). The collective sense – beyond the CoP – of this term adds a social and macro dimension to it. Finally, the notion of 'identity', like that of 'practice', is also a mediating concept that permits addressing broader social concerns beyond middle-level issues:

> Concepts like practice and identity occupy this middle ground, where the individual and the social are in interplay and learning is theorised to happen as they constitute each other. (Farnsworth *et al.*, 2016: 11)

The EoC also acknowledges the social dimension of communication. In fact, from this perspective, communication is inseparable from the social milieu where it takes place:

> For Hymes, speech cannot be considered separate from the sociological and cultural factors that help shape linguistic form and create meaning, and so the frame he offers in place of grammar gives equal place to both aspects of speech: speech and the entailments that give meaning to speech cannot be considered in isolation. Hymes is thus adamant that any terminology adopted must treat both aspects of speech equally, discarding both 'speech styles and their contexts' and 'means of speech and their meanings' as being insufficient (446). (Johnstone & Marcellino, 2010: 59)

From this theoretical approach, the social dimension of communication is accessed through the analysis of the 'speech event': "In this view, ways of speaking and ways of life are intertwined, and social life can be studied with reference to culturally inflected "speech events" around which social communication is organized" (Katriel, 2015: 454). This connection between the macro and the meso dimensions through communication is underlined by Hanks (2005: 191) as follows:

> The special interest of habitus and field for a theory of deixis and therefore of communicative practice is that both concepts crosscut received divisions between individuals and groups, mental and bodily aspects of language, and agent positions and the encompassing "space of positions" in which they are defined. They are terms in a sociology of large-scale formations, and yet they are precisely applicable to local aspects of communicative practice, including speakers, objects, and the co-engagements they sustain.

Ultimately, 'social structure' is one of the determinants of *communicative competence*, which is "based on language use and socialization within cultures" (Morgan, 2014: 10), in a given social context. The convergence of the micro and the macro levels of discourse and thus of analysis in the EoC can be inferred by Blommaert's (2009: 258) following description of Hymes' understanding of ethnography:

> Ethnography, to Hymes (1986 [1972]), was the study of ''the interaction of language and social life'': an approach in which language and society blended, and which consequently could yield more precise understandings of language and of society.

Though from a micro level of analysis, MMSS is also concerned with social issues, as is made evident in the name of this approach and in its concern for aspects of communication like the characteristics of the communicative situation, and the sign-maker's identity, comparable to Giddens' (1984) 'knowledgeable agent' who is in possession of 'semiotic resourcefulness'. Such 'semiotic resourcefulness' might be regarded as part of her *cultural capital* (Bourdieu, 1986) –, and the historic and cultural context. This theory conceives the making of signs as a merely social practice, since it follows social norms and is influenced by the socio-cultural context

where it takes place, as well as by the history of the making of signs – note here also the presence and significance of the historical dimension. Cultures, communities and societies are relevant constructs affecting communication at its most micro level, and reciprocally specific uses of modes and semiotic resources are distinguishing features of such social and cultural aggregates. Consequently, many concepts of MMSS can be related to other constructs with a broader-reaching scope, beyond the micro level. Examples of such concepts are the *interest* of sign-makers (which can be related to ideology), *genre* (which in itself comprises diverse levels of abstraction and can be linked to the expression of social relations and discourses), and *discourse* (related to social forms of organisation, values and knowledge, this latter coinciding with the CoP model).

2.6.8. Presence of a critical perspective or of related notions: CoP (regime of competence, patterns, power relations); EoC (ends, norms); MMSS (interest, production and reception regimes, logonomic system)

Although the CoP theory "is not critical in the traditional sense" (Wenger-Trayner, 2013: 111), a critical dimension may be identified in it, in which 'participation in practice', besides being an enriching process, has been deemed "a conflicting and problematic process of negotiation of meanings, where mental, psychological, social and discursive aspects are revealed in the person's own process of making signs" (Keating, 2005: 105). Such a critical perspective is implicit in this model's (maybe sometimes too superficial) concern for power relations, tensions and conflict, (in)justice, and legitimacy:

> Claiming that communities of practice are a crucial locus of learning is not to imply that the process is intrinsically benevolent. In this regard, it is worth repeating that communities of practice should not be romanticized: they can reproduce counterproductive patterns, injustices, prejudices, racism, sexism, and abuses of all kinds. In fact, I would argue that they are the very locus of such reproduction. (Wenger, 1998: 132)

> The social structure of this practice, its power relations, and its conditions for legitimacy define possibilities for learning (i.e., for legitimate peripheral participation). (Lave & Wenger, 1991: 98)

Furthermore, Wenger[-Trayner] considers this a "profoundly political theory of learning" (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 13), although power is not its focus:

> Central to the theory is the idea that learning from a social perspective entails the power to define competence. And so when you have a claim to competence in a community, that claim to competence may or may not be accepted. Or it may take work to convince the community to accept it. When the definition of competence is a social process taking place in a community of practice, learning always

183

implies power relations. Inherently. (...) That's not what the theory is about. It is a learning theory, not a theory of power in general. But as I just said, there is a learning-based theorisation of power, which has to do with the definition of competence in social spaces.

Likewise, Jan Blommaert (2009: 257) underscores the "critical and counterhegemonic paradigmatic dimension of ethnography" as configured in Hymes' work, which he characterises as "explicitly political" comparing it with Bourdieu's work among others, and even as "the critical science *par excellence*" (Blommaert, 2009: 258). According to Blommaert (2009), Hymes was concerned with peace, equality, solidarity and ethics, although some of the 'political dimensions' of Hymes' work were mostly implicit. For example, in the EoC, accounting for the rules or system for decision-making is part of the task of describing communication within any group, and of explaining communication more generally (Saville-Troike, 2003). The 'norms' that rule the communicative event are in fact one of the components of Hymes' model. These may be comparable to, or overlapping with, Giddens' (1984) 'rules' that compose 'structure', that is, conventions, protocols, cultural schemata and habits. Besides, the focus on the cultural values and beliefs present in the community constitutes also another strand for a 'critical view' that the EoC offers. And finally, as has been already argued in section 2.3, the concept of 'communicative competence', so relevant in the EoC, is in itself a clear reference to a system of power relations, based on values related to legitimacy, correctness and appropriateness.

With regard to MMSS, although it is not nowadays so explicitly related to critical accounts of communication as it has been in the past (e.g. Kress, 1993), the great influence of critical linguistics in its origins can still be deduced from some of its constructs and terminology. MMSS acknowledges the existence of social norms influencing communication, of rules of production and of reception (*production and reception regimes* and *logonomic system*), of interpersonal and institutional power relations, of issues around the control of semiotic resources, of issues of aptness, legitimacy, availability and hierarchy, and of ideology. Ultimately, the concept of *design*, which is emphasised in this theoretical approach, entails in itself the exploration of agency, of division of labour among design team members, and thus of structure and power. This idea is common in both, MMSS and the CoP, for which "design requires the power to influence the negotiation of meaning" (Wenger, 1998: 235); the author argues that "[i]nherent in the process of design is the question of how the power to define, adapt or interpret the design is distributed". Evidencing the connections between MMSS and a critical view, there is also a critical thread among MMSS scholars, which has been named *multimodal critical discourse studies* (see Machin, 2014).

184

2.6.9. Structure and agency in the three theoretical approaches

According to the EoC, individuals are active agents in interaction with their environment, and 'structure', which is at the centre of this approach, is the expression of social and cultural order, and thus of human beings:

> ...The structuring of social life is a product of the interaction of men and their circumstances, of the human mind and human ecology . . . There is no longer even tactical motivation for denying that some of the determinants of human action and social structure are within human beings . . . [and l]ikewise, it cannot be satisfactory for long to pursue a science of man that . . . satisfies the scientific thirst for uniformity and generality, but that has nothing to say to man's present prospect and social change. The practice of linguistic ethnography can participate in transcending this opposition. It finds structure in the activity of the human mind, conscious as well as unconscious . . . It does not postulate structure as end in itself, but as indispensable means. If it places structure at the center of its work, that is because it believes structure—meaningful structure—to be at the center of human life. If the genesis, maintenance, and change of social and cultural order— their acquisition and meaningfulness in personal life—are to be explained, the nature of the order must be known. [Hymes, 1983/1970: 210–211; in Rampton, 2009: 367-8]

Hymes was hence a pioneer in placing the focus on the ways certain linguistic/communicative structures arise in social interactions, where such structures are "artifacts of the human mind in action in society" (Scollon & Scollon, 2009: 278). And this has consequences for 'agency' and for semiotics:

> ...the position that the structures of human social life—stories, schools, and the rest—are artifacts of human social action, places human action at the center and takes the vast array of material and semiotic resources through which this action is accomplished not as the goals of action but the tools by which action is carried out. (Scollon & Scollon, 2009: 278)

Ben Rampton (2009: 365) in fact contends that Hymes "antedates Bourdieu's praxis (1977) and Giddens's structuration (1976)" in his conception of "social reality as practical activity" (Hymes, 1983/1970: 210–211; in Rampton, 2009: 367). Furthermore, there is from Hymes' perspective an "indissoluble tension between structure and creativity" (Scollon & Scollon, 2009: 277), or in Rampton's (2009: 362) words, between "structure and agency, convention and contingency" that, following Hymes, "should be moved by analysts in the direction of social justice" (Scollon & Scollon, 2009: 277).

Hymes' conception of structure and agency is not too distinct from Wenger's one. In fact, Maria Clara Keating (2005: 110) describes *participation* in the CoP as an 'act of *creativity*' – term also

185

used in the EoC – from the part of the agent: "participation is seen as the extent to which people can use discourses coming from different fields and reproduce them or bring them together in acts of creativity, thus providing openness in the construction of social representations and realities". In a similar vein, Wenger[-Trayner] (2013: 110) reflects upon the presence of the idea of agency in the CoP theory, inherent in the concepts of *competence*, *practice* and *identification*:

> Its focus on learning as a relation between the person and the world, typical of its anthropological roots, rejects a dichotomy between individual and social, but insists on their mutual constitution. In this mutual constitution, the theory affirms agency through engagement in the negotiation of meaning in two ways. At a collective level it theorizes a local definition of competence negotiated by the community through participation. Practice is, in the last analysis, the production of a community, no matter how many external constraints influence this production (Wenger, 1998). At a personal level, the theory embodies agency in processes of identification. While identification with a community entails accountability to its competence, identification is a relationship that can be modulated (Wenger-Trayner & Wenger-Trayner, in preparation).

Practice and participation take place within "broader [beyond the CoP] formations of practice and discourse, immersed in social, structural and historical orders" (Keating, 2005: 106), and thus within the framework of structure[50].

Although with a different nomenclature, MMSS comprises notions related to structure and agency. This is reflected, on the one hand, in its acknowledgement of, and the relevance given to, the socio-cultural context of communication, and on the other hand, in the characterisation of the sign-maker as capable of choosing among a range of resources following her own interest and assessment of the environment: "Multimodality emphasizes situated action – that is, the importance of the social context and the resources available for meaning making, with attention to people's situated choice of resources, rather than emphasizing the system of available resources" (Jewitt, 2013: 250). From Jewitt's words it is deduced that, despite acknowledging both, agency – be it individual or collective, pertaining to the sign-maker or to the interpreter of the sign – is somehow highlighted over structure. In fact, the term 'agency' is present in some

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[50] Wenger-Trayner (2013: 112) indeed acknowledges that Giddens' structuration theory is "highly compatible" with the CoP theory, since "[t]he purposes are complementary, the perspectives are fully compatible, and the languages are quite distinct". In a similar vein, he claims that "a learning theory and a theory of stratification have usefully complementary purposes—they need each other", and that thus Bourdieu's habitus/field theory is also a good companion for the CoP. The author however cautions that "there are some difficulties in the details of plug-and-play due to subtle differences in language generated by the two perspectives" (Wenger-Trayner, 2013: 113). [find in Wenger-Trayner, 2013 a discussion of the compatibility of key concepts in the CoP and Giddens' and Bourdieu's theories]

core works of MMSS (e.g. Kress, 2010; Bezemer & Kress, 2016), while structure is rarely explicitly referred to.

2.6.10. Common concepts among theories

Wenger[-Trayner] (2013: 111) cautions that "the difficulty of the plug-and-play approach is that it requires a deep understanding of the theories involved—their respective focus, stance, and technical language". Concerning language, the author argues that "[p]lug-and-play between theories entails integrating some aspects of their respective technical languages" (Wenger[-Trayner], 2013: 111). In this sense, it may be evident at this point that, besides the commonalities among the diverse theoretical approaches used in this study, that is, the diverse similar notions named by different terms, these also share some conceptual terms, sometimes with different connotations. In the following table, there is a list of key terms used by the diverse perspectives here described to name similar notions:

Table 1: Key terms of the articulated theoretical framework

MICRO	MESO		MACRO	Plug-and-play (Wenger-Trayner, 2013)
MMSS	EoC	CoP	Macro concepts	
Sign-maker	Participants (in the communicative event) Speaker-recipient...	Participant (in the CoP) Newcomer/full participant (identity)	Knowledgeable agent Social actor (identity)	All the approaches put emphasis on the subject-individual but from a different point of reference, be it the sign, the communicative act, participation, or agency. Note that 'identity' is a suitable construct to link the meso and the macro levels.
Sign-maker's 'semiotic resourcefulness'	Communicative competence	Competence Knowledgeability	Knowledgeability Cultural capital	The capabilities of the subject in terms of 'appropriate' and/or 'successful' action are acknowledged in all the approaches.
Semiotic resources Modes	Instrumentalities Communicative repertoire	Shared repertoire	(Cultural, social, economic, symbolic) capital	The means or resources that allow and shape communication are framed differently in

	Communicative means			the approaches used here.
Design & re-design		Design	(Individual/collective) agency	The site for negotiation and decision-making about communication and social practice may be named differently in the theories adopted. 'Design' appears as a good linking concept between the micro and the meso levels.
Interest Motivation Ideology	Ends Patterns	Joint enterprise Learning	(Dominant) ideologies and discourses Habitus	The subject's organising principles of action may be seen as either internal or externally imposed, and as either individual or collective, at different levels of analysis.
(Production and reception) regimes Logonomic system	Norms (of interaction, of interpretation) Patterns	Regime of mutual accountability Learning trajectory	Structure (rules) Field of power	External regimes of governance may take diverse forms across approaches.
Genre	Genre Communicative event	Practice	Structures of text and talk	Conventionalised ways of communicating may be differently named, depending on the perspective adopted. Note that 'genre' is an apt construct to link the micro and the meso levels.
Text (entextualisation)	Communicative act Communicative event	Artifact / Reified objects (reification)	Discourse Socio-cultural practice	The result or output of communicative action and the action itself are present in different theories, which highlight different aspects of

	(communication)			them.
Interrelating semiotic systems, Historic-cultural context	Setting Communicative situation	Landscape of practices Domain Constellations of practices	Socio-cultural context Structure Field	The structure and milieu that influence action are referred to differently, depending on the perspective but also on their scale. The socio-cultural and historic aspects of it are relevant in all the approaches.
Aptness, legitimacy, availability, hierarchy and power	Competence Legitimacy	Competence Legitimacy	Power	'Power' takes the form of 'competence' and 'legitimacy' within mid-level social aggregates.

As can be seen in the previous table, many concepts of one theory find their corresponding terms, though with different nuances, in the other theoretical perspectives used in this thesis. This proves the compatibility of these approaches, each of which contributes its unique combination of point of entry, purpose, focus and scale. The effectiveness of 'plug-and-play' (Wenger-Trayner, 2013) between them is thus evident. Having in mind that "no single theory provides the conceptual tools to tell the full story researchers want to tell" (Wenger-Trayner, 2013: 115), this articulation of theories has been designed to account for a holistic explanation of the multimodal communication policy of a research group, from a particular perspective, this researcher's one.

The aim of this chapter has thus been to describe the articulated theoretical framework that will guide the holistic exploration of the multimodal communication policy of the scientific teams studied in this project, understanding that "[a] perspective is not a recipe; it does not tell you just what to do. Rather, it acts as a guide about what to pay attention to, what difficulties to expect, and how to approach problems" (Wenger, 1998: 9). Inspired by Wenger[-Trayner]'s 'plug-and-play' principle, I have described each approach individually and in relation to each other, drawing parallelisms and commenting on their commonalities, with the conviction that "[p]lug-and-play between theories is useful if the focus of each theory contributes to the focus of the other by enriching and expanding the perspective" (Wenger-Trayner, 2013: 110). The suitability of this framework for the study of communication among scientists in a research group has also been discussed and demonstrated on several occasions throughout the chapter. Here I have

argued that exploring the multimodal communication policy of the research group-CoP in depth and holistically necessarily entails its analysis at three levels, since (communicative) practice and the specificities of communicative instances act at two different planes, and that the mechanisms and discourses of science and of higher education institutions also involve broader-scale elements. It is thus not only aimed at the analysis of multimodal communication, but at (critical) discourse analysis as a whole, understanding it in Fairclough's way as:

> ...concerned with the relationship between processes/events and practices (as well as structures), texts and discourses (as well as genres and styles) (...) analysis of organisational discourse should include detailed analysis of texts, both analysis of linguistic and other semiotic features of texts, and the 'interdiscursive' analysis of texts... (Fairclough, 2005: 919-20)

The present study will thus deal with events, processes, practices, texts, genres, styles, discourses and structures in an ordered way guided by the perspectives summarised here. The use of such theoretical tools may help us "to push our intuitions: to deepen and expand them, to examine and rethink them" (Wenger, 1998: 7), since, as Wenger[-Trayner] (2013: 106) very well describes, it is a fruitful way of 'making sense of the world':

> It allows one to tell certain stories. It enables one to know the world anew by focusing on new aspects, asking new questions, and seeking new observations and interpretations. Whether this counts as producing knowledge is a matter of definition; but it certainly contributes to our ability to make sense of the world.

The next chapter will be devoted to the description of the methodology used in this project for data collection and analysis.

Chapter 3: Methodology

Addressing the issue of the IoHE with reference to actual and concrete communicative practices of practitioners is a challenging endeavour. It is so because the IoHE has been usually tackled at a macro dimension, that of the socio-economic-cultural context, considering discourses of diverse stakeholders, but this phenomenon gets blurred and even lost at other levels of analysis; the more concrete the level is, the subtler it becomes. Therefore, addressing this study's research questions through the analysis of concrete (multimodal) texts is not straightforward. The IoHE in relation to communication is quite evident in the adoption of ELF (English as a Lingua Franca) and of EMI (English as a Medium of Instruction) in campuses around the world, but other than that, there is a gap in the literature with reference to it being addressed from a multimodal perspective and with reference to scientists' daily practices, considering also the micro and the meso dimensions, as has been argued in chapter 1. In this chapter, the main research questions that drive this study will be detailed, as well as the methods for data collection and for the analysis of the data that may lead to the unveiling of the connections between the IoHE and scientists' communication. Section 3.1 will reveal the study's chief research question and will introduce the participants of the study; in section 3.2, the characteristics of case-study research will be described and the selection of the research group as a case will be justified; section 3.3 will present the data collection process, the methods used as well as some difficulties encountered in the process; and in section 3.4, the methods for the analysis of the data will be summarised.

3.1. The main research question and the participants

This study was triggered by an overarching research question, which gradually split into several sub-questions regarding different aspects of the project, which will be addressed in the different chapters of data analysis. The first and foremost research question of the project is the following:

In what ways does the process of the internationalisation of higher education that prevails nowadays influence scientists' daily communication?

The research sub-questions that stemmed from this general one and that have guided each of the chapters of analysis of this thesis are the following:

(1) *In what ways do the RGs studied constitute CoPs?* [Chapter 5]
(2) *What kind of multimodal communication policy does the group abide by?* And *(3) How is this multimodal communication policy influenced by the internationalisation of higher education?* [Chapter 6]

191

(4) What is the influence of the IoHE on scientists' communication at the level of text form? [Chapter 7]

(5) What is the influence of the IoHE on scientists' communication regarded as a socio-cultural practice? [Chapter 8]

In order to address the project's main research question, the perspective adopted was that of qualitative research: an exploratory research methodology that aims to "discover new ideas and insights, or even generate new theories"; it "mostly focuses on understanding the particular and the distinctive, and does not necessarily seek or claim to generalize findings to other contexts" (Croker, 2009: 9). More specifically this study can be framed within (multiple) case-study research, understood as the exploration of one or multiple "bounded systems", in our case research groups, in depth and over a certain time lapse, through the collection of multiple data sources (see Stake, 1995; Creswell, 2013). In multi-case studies the comparison among cases may contribute to the understanding of a general topic or issue (the 'quintain' in Stake, 2013), and this constitutes what this scholar names an 'instrumental case study' – using the cases as tools to apprehend the 'quintain'.

As is common in exploratory studies, I departed from a general research question, with the intention not to impose prejudices onto my observations. This initial research question was refined and split into more concrete questions as the research would proceed and as I would become more familiar with the setting, the participants and the issues at stake (see Croker, 2009). My main aim was to observe scientists' daily communication so as to identify signs of internationalisation in it. To this end, two research groups based at a Catalan university were chosen and invited to participate in the study, for which their members would be observed in their workplace by a researcher throughout a period of 6 months, initially, but which was finally extended to 11 months. The criteria for choosing these research groups among others in the institution were based on the multiplicity of nationalities of their members, the international recognition of their work and their accessibility (due to their predisposition). At that point of the project, the 'multinationality' of the research group seemed a plausible hint of internationalisation, linked to typical academic internationalisation activities like student mobility and the adoption of English for communication (Altbach & Knight, 2007).

Once the two research groups were selected, their respective group leaders were contacted and provided with general information about the project. They were also required to give their permission for the whole group to take part in it. Contacting the group leaders first seemed a necessary step, given that participating in such a study may have been seen as a distracter for scientists, who "feel they have 'no time' to lose" (Knorr-Cetina, 1981: 24), and the group leader is the main responsible for the group's performance and thus its main gatekeeper. After a first

meeting with each group leader, in which both of them showed at first reluctant to participate but ended up by accepting – in October 4th 2013 (for Group A) and October 21st 2013 (for Group B) –, they invited us to visit their laboratories and explain the project to the other members of the groups. Those visits took place in October 24th 2013 (for Group A) and October 21st 2013 (for Group B, after the meeting with the group leader). All the members of both groups accepted to become participants in this project and signed the corresponding consent form whereby they gave their permission for the use of "data obtained through techniques of data collection in ethnographic research: direct observation, audio/video recordings, formal interviews and informal conversations, photographs, etc., in [their] workplace and in other areas and moments [they would] share with the researcher; [their] publications in academic media or in other kinds of media; [their] e-mail communications with the researcher; further data voluntarily provided by [them] to the researcher by other means" (extract from the consent form), only for academic purposes and respecting their anonymity. I was also asked to sign a confidentiality commitment for one of the participant research groups so that details of the studies that the participants were carrying out would not be unveiled.

The participants in this project were thus researchers from two university research groups, working in Catalonia, Spain. Since the groups' area of study was the natural sciences, in both cases most participants used to spend most of their working time in a laboratory. As noted by Collins (1974), also in this case, the "experimental" tenor of the participants' work made it more explicit and thus more easily observable: "because experimental work is involved, so that much tacit knowledge is embodied in visible rather than abstract objects" (Collins, 1974: 182). On the other hand, it is worth noting that the research team, though institutionalised, may be a dynamic entity with a high turnover of members, which may constantly modify its characteristics and urge the research group to adapt quickly to new circumstances. This was the case of the research groups studied here, and any attempt to describe them is most likely to be but a snapshot of a particular moment, as the present study might be.

During the period of data collection, one of the teams was composed of 13-16 members and the other of 12-15 members, variably (due to the group members' turnover referred to above). Their nationalities were Argentinean, Mexican, Indian, Chinese, Bulgarian, French, Greek, Dutch, Cypriot, Italian, Spanish, Basque/Spanish and Catalan/Spanish (with 9 different nationalities in Group A and 5-6 in Group B). Neither the specific national composition of each group nor their specific research area will be unveiled here in order to preserve the anonymity of the participants. See in the table below a list of members that were part of each research group at some point during the data collection, and their rank (names are pseudonyms).

193

Table 2: List of members of the two main research groups

	Group A			Group B	
1	Frank	Group Leader	Pere	Group Leader	
2	Cecília	Senior researcher	Damià	Senior researcher	
3	Hao	Senior researcher	Mila	Senior researcher	
4	Vince	Senior researcher	Neus	Senior researcher	
5	Agus	PhD researcher	Tònia	Senior researcher	
6	Carol	PhD researcher	Montse	PostDoc researcher	
7	Lian	PhD researcher	Dana	PostDoc researcher	
8	Mikela	PhD researcher	Fina	PhD researcher	
9	Tània	PhD researcher	Onofre	PhD researcher	
10	Ainhoa	PhD researcher	Lola	PhD researcher	
11	Mara	PhD researcher	Gina	PhD researcher	
12	Ale	PhD researcher	Yamir	PhD researcher	
13	Navil	PhD researcher	Tira	PhD researcher	
14	Joana	Undergrad. researcher	Alèxia	MA researcher	
15	Lurdes	Undergrad. researcher	Charo	MA researcher	
16	Xènia	Undergrad. researcher	Jetta	Undergrad. researcher	
17	Isabel	Secretary	Bea	Lab assistant	

Both groups were structured hierarchically, at least formally, in three levels: they were led by a group leader, followed in authority by several senior researchers that were accountable to the group leader, and some of which supervised the junior researchers more directly. Also, among the members of this third hierarchical level – junior scientists – there seemed to be a formal hierarchy tied to their training rank (whether they were Postdoc researchers, PhD students, MA students or undergraduates) [see, in figure 2, an illustrative formal hierarchy].

Figure 2: The research group's illustrative formal structure
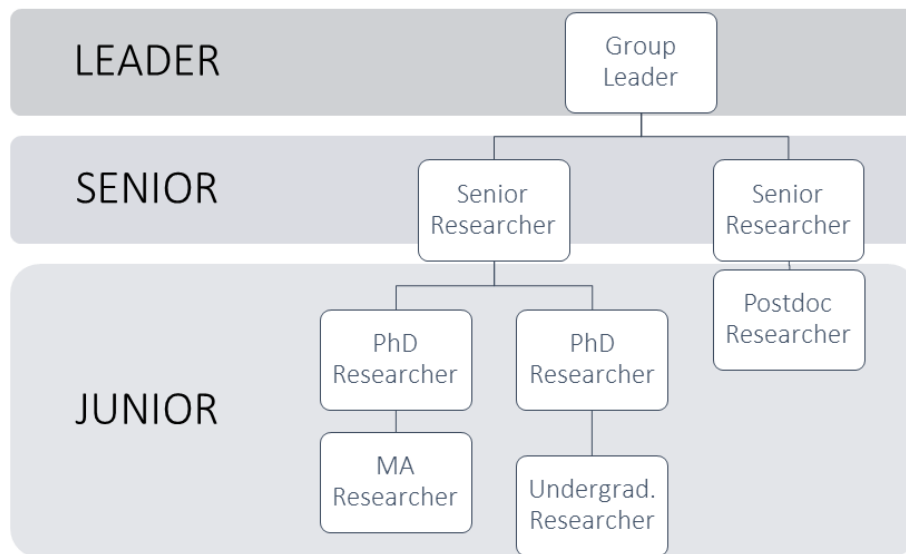
The rank differentiation seemed to correspond to some extent with their assigned workspace. In both cases, the group leaders' working headquarters was their office, while it was junior researchers that spent most of their time working at the lab bench. This feature varied among senior researchers. In Group A, one senior researcher, Cecília, had her office as her headquarters, while Hao had his workspace in the lab (in front of a computer), and Vince used to devote most of his working time to teaching activities (between the classroom, the laboratory and his office). In Group B, all senior researchers were also based in their corresponding offices.

Besides the two main research groups studied, insights from another scientific team will also be contrasted to the core data base. This third group was based in Germany, and its work was also framed in the field of natural sciences, specifically in the same area of Group A. In fact, the group leaders of both research groups were usual collaborators, as had also been other group members in the past. The German group was a very large group compared to Group A and Group B. It consisted of around 50 members; it was involved in more than 15 competitive projects and it was affiliated with an "elite university" in Germany (as stated by its group leader). Data from this group were collected (through interviews and focus groups) during a one-week stay in Germany.

Finally, it must be acknowledged that my own experience as a member of a research group that I had just joined at the time of the data collection should not be underestimated, for it may have influenced my interpretation and take on the data. Despite the lack of data collection in this case, this has commonalities with auto-ethnography. This is an approach to research that acknowledges the self as a participant actor within research and "seeks to describe and

systematically analyze (*graphy*) personal experience (*auto*) in order to understand cultural experience (*ethno*)" (Ellis, Adams & Bochner, 2010: 273). This auto-ethnographic perspective has contributed valuable insights to this study, some of which have been materialised in the research diary I held throughout the data collection period (see more details in section 3.3.1.1).

3.2. Case-study research and the research group as a 'case'

The choice of two research groups to be studied in depth and from a qualitative perspective suits the 'case study research' approach. This was considered to be the most suitable one to the holistic aim of the study and also to its theoretical and ideological underpinnings, as argued in chapter 2. Although the methodology adopted was inspired by ethnography, which, as noted by Creswell (2013: 277), is suitable "when one seeks to study cultural behavior, language or artifacts", the scope of this study is not a whole 'culture' (as the 'academia' or 'science' might be) but the research group, which constitutes a small bounded system within these. Despite its similarities with a microethnography, it may be closer to case study research. It is worth noting though that the boundaries of each case are artificial, imposed by the researcher. It is her endeavour to define them unequivocally so that they are easily identifiable and located in a particular context (Casanave, 2015). Assets of case-study research are that it implies an in-depth understanding of the cases from the part of the researcher, which is presumably conveyed to the reader through the research report; that it relies on multiple data sources; that it implies developing a detailed analysis of the data; and that it is carried out relatively longitudinally and thus may counterbalance to some extent one-shot studies' flaws (see Creswell, 2013).

Typical cases in case-study research are individuals, groups or institutions (Casanave, 2015). The research group has been considered here an entity on its own and thus more comprehensively explorable as such. This was an assumption made previously to the take-off of the study, which needed to be further confirmed (or rejected) after the analysis of the data. Given that in Catalonia research is done in groups (be these 'consolidated groups', 'research projects', or other types of clusters), studying individual scientists seemed *a priori* potentially misleading and partial. Assuming that the scientific team works as a dynamic entity with identifiable boundaries, this was chosen as a significant unit, a 'case', which seemed to be plausibly paralleled to a community of practice (Jean Lave and Wenger, 1991). Despite having chosen it as a significant entity, I acknowledge its problematic nature, as noticed by Rampton *et al.* (2004: 5):

> ...the informants' 'groupness' is itself likely to be treated as a problematic issue, as a category that exists in a much larger ideological field among a range of other claimed, attributed and contested identities, differing in their availability, salience, authority and material consequences for individual lives.

However, limiting the data collection to a physical space like, for instance, a laboratory (e.g. in Latour & Woolgar, 1986 [1979]), may have implied missing strings of acts and thus of communication. Although most participant scientists spent most of their time in the same room (their main lab), all of them needed to work in other rooms and spaces as part of their working routine.

Furthermore, the choice of the research group as a 'case' corresponds to the significance that this construct is given in the specific socio-cultural context of this research study: scientists in Catalonia are almost exclusively attached to a particular research team. This acts as a management unit to which researchers are accountable and from which they receive support of diverse types (financial, material and human). The research group is also officially recognised by the Catalan government through its granting agency (Agència de Gestió d'Ajuts Universitaris i de Recerca, AGAUR), which makes triennial calls for research teams to certify their achievements in order to get funding. As stated in its website:

> The objective of the call is to support groups that carry out research in Catalonia in the different scientific areas with the aim of promoting their activity and the scientific, economic and social impact, as well as promoting the international dissemination of their research.[51]

Belonging to a recognised 'consolidated research group' (*grup de recerca consolidat*) benefits scientists in the sense that the government may contribute to the promotion of their activity, so that it has enhanced scientific, economic and social impact, as well as the endorsement of the international dissemination of their research. Some of the prerequisites for groups to be recognised as such are these: its members need to have a consolidated trajectory of joint work of at least three years (demonstrable through joint publications, joint projects, contracts, joint seminars and meetings); group members can belong to different institutions of Catalonia; groups must be composed by at least five researchers, three of whom must be doctors holding a full-time position in the same university or research centre; researchers from institutions outside Catalonia or linked to companies or public administrations may also be included in the request as external and occasional collaborators of the research group, but not as full members; doctoral researchers can register as group members only if they hold a scholarship or a contract with a university or research centre in Catalonia. This way, the research group is 'reified' through a process of institutionalisation and becomes an identifiable, significant unit. At the time of the data collection, corresponding to the "call for Support to Research Groups of Catalonia (SGR)" for the period 2014-2016, members of the two participant scientific teams were part of

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[51] Generalitat de Catalunya. Agency for Management of University and Research Grants. Retrieved 01/26/2018, from https://agaur.gencat.cat/

recognised 'consolidated research groups' by AGAUR (the Catalan granting agency), though not all scientists working in the labs at that time were included in the official group. Having chosen the research group as a 'case', one of the aims of this project will be to determine to what extent, if so, the two research groups studied correspond to the concept of the community of practice, and therefore how usable this concept is for the study of such a human cohort (see Chapter 5).

As is common in case-study research, my main objective was to gain a deep understanding of the entities studied, the cases, in order to "learn how they function in their ordinary pursuits and milieus" (Stake, 1995: 1). Despite its similarities with laboratory ethnographies, like Latour and Woolgar's (1986 [1979]: 12), whereby "the daily and intimate processes of scientific work" were tracked in order to access "what the scientists do and how and what they think", the focus of the current study was on what they "say" or "communicate" (as well as 'how' they do so), also through their actions.

Although my initial objective was to conduct a balanced study of two cases, the evolution of the data collection forced from very early stages the concentration of efforts in one case over the other. This was due to two main reasons. First, the two cases were being observed at the same time, and thus different phenomena were concurrent; consequently, the researcher had to arbitrarily choose what she considered to be the most productive site, the moment and the length of each observation session, and alternate the observed case. This became an obstacle in order to follow trajectories of phenomena within each research group. Only one researcher observing more than 10 people in two different settings, within multiple physical milieus, and in the same time period implied that many aspects were being left unattended and/or were missed. Second, the specificity of the field of action of the participants: natural sciences, alien to the researcher's area of expertise, required an important effort of comprehension on the part of the researcher, and achieving this with reference to two different subfields within natural sciences, and additionally with reference to more than 20 different projects (approximately one per participant) turned out to be an unmanageable endeavour.

Consequently, I soon decided to concentrate more efforts (in terms of number of visits and their length) in observing one group, which has been named 'Group A', over the other, 'Group B'. The choice of the 'core case', Group A, was based on considerations like the dynamicity of the group (in Group A group meetings were held more often); and the accessibility to data (Group A included the researcher in mailing lists, its members invited the researcher to different kinds of events, and the group leader showed high interest in participating in the study and facilitating different kinds of data). Focusing on Group A entailed that observing Group B became

increasingly difficult because the observed phenomena were more disconnected to one another, trajectories were difficult to track, and participants were less used to the researcher's presence.

For this reason, this may be considered a single case study, of Group A, instead of a 'multiple case study', though with contrasting references from three other cases: Group B, the group observed in Germany (Group G), and the researcher's own research group (Group I). See a representation of the relevance of each research group in the graph below (figure 3).

Figure 3: The cases
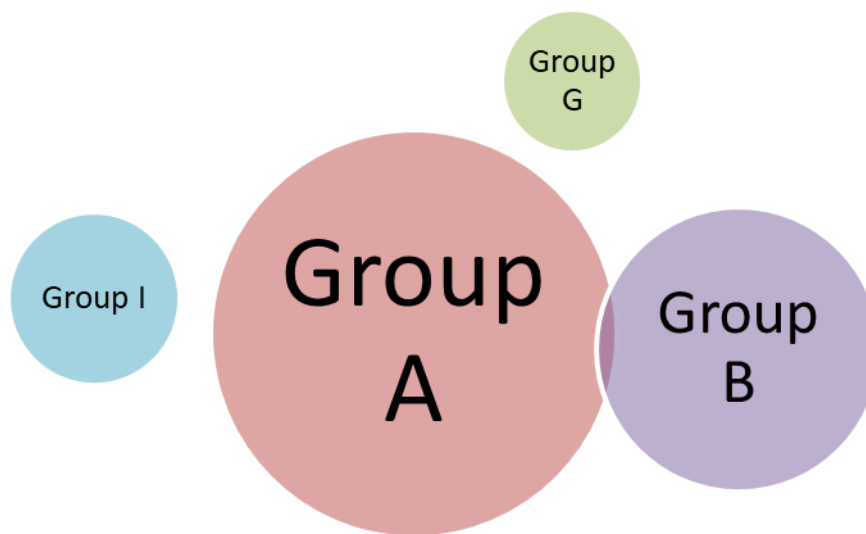
Due to the wide scope of the project, consisting in the longitudinal observation of the activity of multiple individuals, as has already been noted, the starting plan of a six-month data collection had to be finally extended to eleven months. This resulted in an enormous data collection, especially considering that one hour in the field involves six hours of other related activities, like planning, writing, analysing, etc. (Stake, 2013). Details of the data collection, of the database and related issues will be given in the next section.

3.3. The data collection: an ethnographic(-like) methodology

The data collection followed the ethnographic methodology, which usually combines a collection of techniques like direct observation (supported by field notes), interviews, and tape and video recordings, with the aim of "identif(ying) and interpret(ing) regular patterns of action and talk that characterize a group of people in a social context", and to offer "descriptions and perspectives which are not only meaningful to the participants themselves, but also to the researcher" (Creese, 2010: 146). As has been already suggested in chapter 3, these techniques are common in linguistic ethnography (see Maybin & Tusting, 2011; Copland & Creese, 2015), as well as in the EoC, which, as has been noted, also seeks to unveil and explain the community's rules for appropriate behaviour (Saville-Troike, 2003). Following Hymes and the original tradition of ethnography, I have also observed a community, the scientific team, as a 'social unit' or as a 'system' (Blommaert, 2009), and not only individuals. In fact, ethnographic techniques have been used for long in the exploration of scientists' activity (e.g. Knorr-Cetina, 1981, 1999; Lynch, 1985; Latour & Woolgar, 1986 [1979]) for it may be obscure to outsiders, and scientists' reports on their work have been found to be variable (Latour & Woolgar 1986 [1979]: 28). Yet, this study's methodology does not correspond fully with canonical ethnography, in the sense that it was not the researcher's intention to "spend a very considerable time in the field, seeing what happens, doing what the subjects do, reading what the subjects read, eating what the subjects eat" (Rock, 2001: 32), nor to develop a "near-native competence" (Hess, 2001: 239) in the topics dealt with or in the practices performed within the researched community. This would have required more time and resources than I could afford. Although I intended to understand the culture of the scientific groups observed, especially as for their communication policy, I was not taking active part in the community's practices, nor was I full-time engaged in the field. This study may thus be positioned in-between ethnography and case study.

The methods used for the collection of the data are those typical in ethnography and case-study research. Among the most common methods used in this latter type of research, Hartley (2004: 324) mentions "participant observation, direct observation, ethnography, interviews (semi-structured to relatively unstructured), focus groups, documentary analysis, and even questionnaires". Except for questionnaires, the other methods were all used in the present study. 'Documentary analysis' entailed the previous collection of documents like e-mails, reports, and paper drafts, among others. Furthermore, data were recorded through diverse methods, like audio and video recording, photographing and taking hand-written field notes.

Once the cases to be studied had been defined and selected, the data collection was conducted through periodical visits to the participants' workplaces. The first observation visits took place in January 9th 2014 (Group A) and January 23rd 2014 (Group B), although there were some previous pilot visits: two to Group B in November 15th and 21st 2013, and one to Group A in December 17th 2013. The frequency and length of the visits depended on the expected variety of the events that would potentially be taking place in each session (like meetings, seminars, etc.), but they also depended on my availability as a researcher, considering my own commitments as a member of a research team (meetings, courses, conferences, etc.). There was no previous visit programme, but on the contrary visits were random and unforeseen for the participants.

Group A was visited on 43 occasions from January 9th to November 17th 2014. Additionally, I interviewed three of its members in December 4th and 18th 2015, and in February 12th 2016. In May 22nd and 25th 2015, I conducted a 'stimulated recall' with two of its members whereby they were interviewed about some video clips of the database. This data collection gave place to 171 audio recordings (of approximately 6487 minutes of total length), 51 video recordings (of approximately 1286 minutes of total length), 83 photographs, more than 500 emails, around 110 paper drafts with revision comments from four different participants, among other documents, as well as 250,5 pages of field notes (of approximately 80 words per page). Group B was visited on 15 occasions from January 23rd to October 24th 2014. This gave place to 50 audio recordings (of approximately 1918 minutes of total length), 13 video clips (of approximately 363 minutes of total length), 30 photographs and 71 pages of field notes (of approximately 80 words per page). Group G was visited every day between June 10th and 13th 2014, which resulted in 14 audio recordings (of approximately 729 minutes of total length) and 22 photographs. Moreover, the researcher also logged her own reflections throughout the data collection period and after, either written or as audio records. This constitutes a 'research diary' consisting of 60 records (18 audio notes, 4 written notes and 38 diary logs) from October 1st 2013 to July 19th 2015. These documents will be further detailed in the next section.

3.3.1. The database

Observation followed a funnel system whereby attention was broad at the beginning – anything could potentially be interesting to the researcher, who needed to "enter" the community and comprehend what was going on – and it was refined progressively and directed towards specific events and phenomena. The observation sessions ceased when the *data saturation* was reached. This criterion is explained by Fusch and Ness (2015: 1408) as follows: "Data saturation is reached when there is enough information to replicate the study, when the ability to obtain additional new information has been attained, and when further coding is no longer feasible". As

the data collection progressed, some events appeared as similar to previously recorded ones, and there seemed to be no reason why they should be recorded again. Moreover, the interpretation of phenomena seemed little by little more clear-cut, their novelty decreased, and at one point the researcher felt that ordinary events would not provide any new insights to the research. See a calendar of the observation sessions below (figure 4).

Figure 4: Data collection calendar

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
Jan 2014	20	21	22	23	24	25	26
	27	28	29	30	31	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
Feb 2014	17	18	19	20	21	22	23
	24	25	26	27	28	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
Mar 2014	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31	1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
Apr 2014	21	22	23	24	25	26	27
	28	29	30	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
May 2014	19	20	21	22	23	24	25
	26	27	28	29	30	31	1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
Jun 2014	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30						

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
Jul 2014	21	22	23	24	25	26	27
	28	29	30	31	1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
Aug 2014	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
Sep 2014	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
Oct 2014	20	21	22	23	24	25	26
	27	28	29	30	31	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
Nov 2014	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
Dec 2014	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				

Group A ▢   **Group B** ▢   **Group G** ▢

The data were stored in a database. Each file was labelled by date and a brief description of the event and main participant/s. Files collected on a same day were stored in a same folder, labelled by the date and a brief description of the main event logged. See an example below (picture 1):

Picture 1: Data files
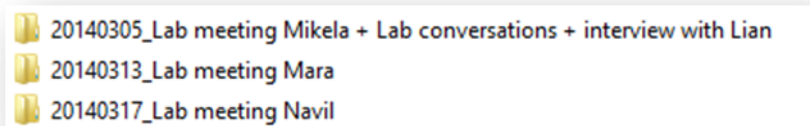
A database description matrix was generated, containing all file labels, the type of document, and the length of audio recordings and video clips or the number of pages of the field notes. See an example below (picture 2):

Picture 2: Database matrix

	A	B	C	D	E	F	G	H
1		Num.	FILE NAME	OBSERVATION LABEL	TYPE	pages	minutes	seconds
2		1	20140123_observació 1_Lab	Field notes	pdf	22		
3				20140123 0858_pre-observació1.m4a	audio		3	34
4				20140123 0914_Lab1_ambient.m4a	audio		3	44
5				20140123 1354_lunchtime_ambient.m4a	audio		6	48
6				20140123 1443_post-observació1.m4a	audio		2	18
7				20140123_1_Lab_conversa Dana i Bea.WMA	audio		1	21
8				20140123_2_Lab_Bea_Dana_Montse_Pere_si l'Helena ens sentís.WMA	audio		28	19
9				20140123_3_Lab_silenci_Yamir_Onofre_música.WMA	audio		5	3

The result were 495 files of 6 types: pdf (written documents), video, audio and image (photo), which will be explained in what follows.

3.3.1.1. Research diary and audio-recorded reflections

A research diary ('RD', henceforth) with periodical reflections and insights into the study was held from October 1st 2013 to April 9th 2015. Besides this, spontaneous reflections were audio recorded or noted down, in the form of audio notes and written notes – the last one dated in July 19th 2015. This resulted in a total of 60 diary entries (18 audio notes, 4 written notes and 38 diary logs) that show the evolution of the researcher's perspective during and after the data collection period, her inner thoughts, doubts, plans and ideas related to what she was observing and experiencing as an active subject. These reflections will be treated as raw data and may be introduced, when appropriate, throughout the thesis. Relevant aspects of audio reflections were summarised in script in order to facilitate their coding. Catalan, the dominant language of the researcher, is the one chosen in all these records, though with some interferences in other

languages used in the research. In this project, both the Catalan version and the English translation of notes will be presented.

3.3.1.2. Field notes

Field notes did not follow a specific observation protocol. They were mainly intuitive and any description of an observed phenomenon, its interpretation, or any thought could be recorded on a same page of the field notebook. At the beginning of the observation session, the date, time and place, and sometimes the 'event' were noted [see an example below, picture 3].

Picture 3: Field notebook page
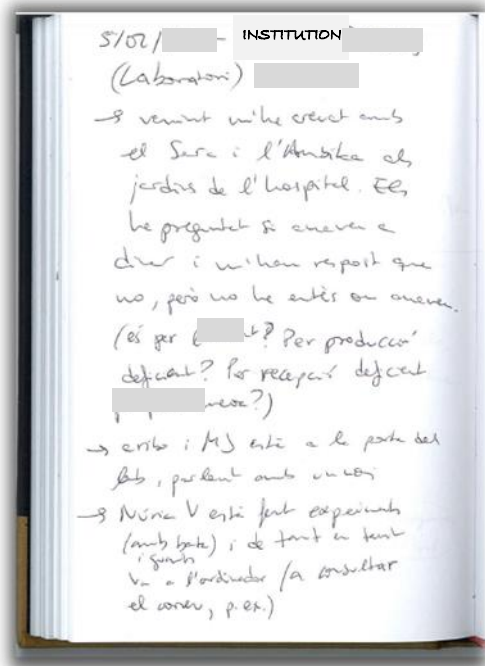
In line with Creese's (2010: 143) claim that field notes should be deemed "primary (and authoritative) data alongside recordings of interactional data", I treated them in the same way as video and audio recordings. This was reflected in my research journal: 'I deem my field notes, as well as my reflections like those I make here, totally legitimate material for investigation and not less than audios or videos' [RD, 18/12/13][52]. Field notes contained my own reflections, questions, sketches of artifacts, lab layouts, etc. [see an example below, picture 4].

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[52] *'... considero les meves notes de camp, així com reflexions com les aquí fetes, un material totalment legítim per a la investigació i no menys que àudios o vídeos.'* [Research Diary, 18/12/13; *original*]

Picture 4: Sketch on a field notebook page
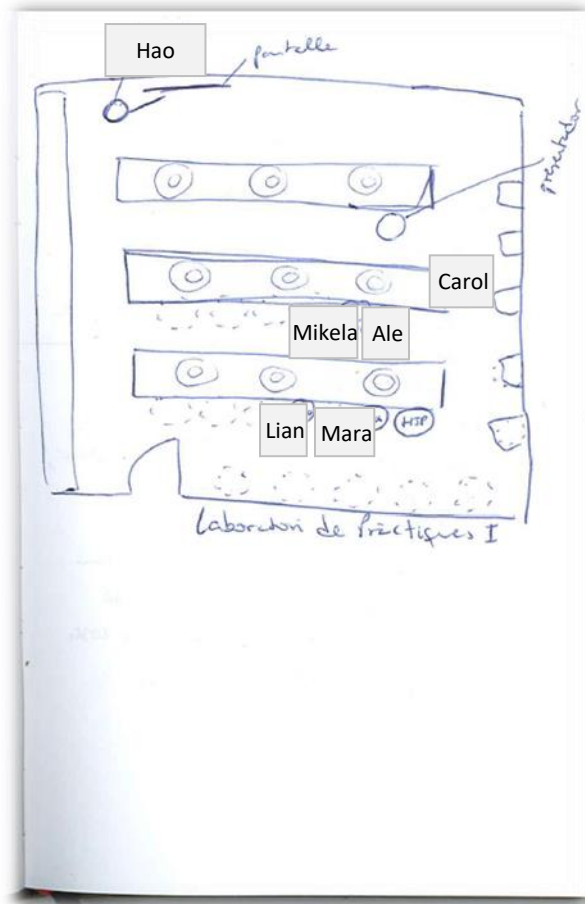
Field notes were not fully transcribed but coded directly, and only some passages were transcribed in order to facilitate data analysis.

3.3.1.3. Field audio recordings

During the observation sessions one or two audio recorders were either placed in diverse locations of the participants' workplace or held by the researcher in order to record her interactions with participants. A total of 210 audio files were collected (apart from semi-formal interviews), 161 files from Group A, 42 from Group B and 7 from Group G, ranging from 5 seconds to 197 minutes. These resulted in more than 7500 minutes recorded, in a variety of situations and communicative events (which will be more precisely categorised in the data analysis chapters), like group meetings, seminars, oral interactions while doing experiments at the experimental bench, lunch conversations and formal presentation rehearsals. Audio recordings were coded directly without previous transcription and only those extracts used in

this report have been transcribed verbatim[53]. Although this is a commonly used method for data collection in ethnography and one with a low level of invasiveness for participants – since audio recorders can be easily concealed –, I soon realised that typical communicative practices in the lab generally draw strongly on visual modes. For this reason, I decided to introduce videotaping as a method for the collection of data at participants' workplace. The first videotaped session took place in January 29th 2014.

3.3.1.4. Interviews

Participants were interviewed at different points throughout the data collection period. Some of these were spontaneous informal interviews that came up during the researcher's visits. All participants in Group A were interviewed individually and 11 members of Group B were interviewed individually or in group, on either a semiformal or an informal interview at least once. Data collection in Group G was mainly based on individual (5) and group interviews (2), for a total of 11 participants.

Informal and semiformal interviews differed in that the first type consisted of fully improvised questions that were more directly connected to what informants were doing while answering. These took place in the laboratory mainly or in other spaces of their workplace. Semiformal interviews were based on open interview outlines, with common or similar questions for all members of a group though adapted to their characteristics, role in the group and answers to previous questions. Questions tackled the topics of group dynamics, communication and learning. More specifically, informants were asked about their training background, their arrival in the group, their role in the group, group hierarchy, group norms, relationships with other group members, their usual communicative interactions, language use, their learning at work, everyday activities, paper writing, preparation of oral presentations, and future expectations, among other topics.

Interviews were held in different languages, depending on the interviewer's and the internviewee's linguistic profile as well as on the preference of the latter. They were held in Catalan with Catalan (L1) speakers and with Vince (French L1), in Spanish with Spanish (L1 speakers) and with Dana (Bulgarian L1), in Greek with Greek (L1) speakers, and in English with the other interviewees. All interviews were transcribed verbatim with the aid of

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[53] The transcription conventions used can be found in Appendix 1.

SoundScriber software[54], including five-minute time indexes so that they could be synchronised with the audio recordings, when necessary.

Picture 5: Soundscriber interface
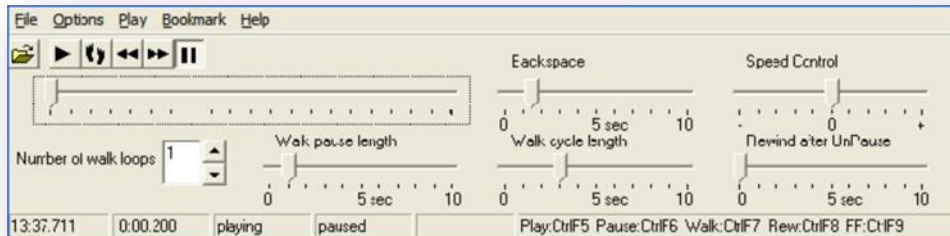
3.3.1.5. Focus group interviews

There were three group interviews that differed from other group interviews in that they were conceived to elicit information from participants but in a way that individual perspectives could be contrasted with others. This was the case of one focus group interview in Group A and two in Group G. In the first case, discussion followed the researcher's presentation of preliminary observations in the field and was video and audio recorded so that speakers could be identified (Duff, 2008). The other two cases were audio recorded only in order not to be too intimidating for participants, who did not know the researcher much and who were not used to her presence, and discussion followed the researcher's direct questions.

The first focus group interview took place in May 27th 2014, lasted around 60 minutes and involved nine members of Group A: the group leader, one senior researcher and seven PhD researchers. Two cameras were placed in two different locations of the room, so that all members present would be visible. The main researcher doing the project presentation was assisted by two fellow researchers. The main researcher made a brief explanation of her project: of the main aspects she had been exploring so far in the participants' workplace, of the foci of interest of her observations, of her hypotheses, etc. And this triggered discussion about communicative resources, communication "spaces", communication tools, and other related issues. Researcher 2 also introduced some comments and questions, and researcher 3 was in charge of one video camera focusing on the speaker whenever possible.

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[54] SoundScriber is a transcription software originally developed for the MICASE project. It is copyright from 1998 at the University of Michigan Regents. It is available for free under the GNU General Public License at http://www-personal.umich.edu/~ebreck/code/sscriber/

Picture 6: Focus group 1

The two focus group interviews in Group G took place in June 11th and 13rd 2014. The first one was held with three junior researchers and lasted 96 minutes, and the second one with three post-doctoral researchers and lasted 160 minutes. The main topics tackled in those interviews were the participants' role in the group, professional identity, daily professional activities, relationships with colleagues, job conditions, learning, self and others' training, and the importance of publishing. Not using video in these two focus groups hampered the identification of speakers, although in this case the participants' personal profiles were irrelevant because they were not members of the main RGs studied, and thus only their discourse – the content of what they were saying – was taken into consideration.

3.3.1.6. Field video clips

Besides speech and sound, there were other visual communication modes upon which participants' daily activity relied. This seemed to naturally emerge through diverse instances. On the one hand, my field notes filled with comments based on visual cues, like participants' location and position, their dressing, objects they used or interacted with, etc. On the other hand, participants themselves deemed visual support indispensable for their professional activity, as evidenced in the discussion that took place among Group A's leader and a PhD researcher during a focus group [see excerpt 1].

Excerpt 1: Focus group [Group A] – 'Without a visual support/'

Researcher: Would you be able to live without pictures/ Would you be able to explain what you are doing without this projector/ Without a visual support/

Agus [PhD res.]: It depends\

Carol [PhD res.]: Yeah, it depends_ on the results you show\ or the_

> **Frank [GLeader]:** Well_ the answer should * I mean_ you should answer with a yes or no\
>
> **Agus [PhD res.]:** No\ It's not possible\
>
> **Frank [GLeader]:** You think it's not possible/
>
> (...)
>
> **Agus [PhD res.]:** Yeah_ but I mean_ it's different if you have to explain +mh+ a simple XX in your results_ and if you have to explain a complicated XX technique with multiple XX_ bla bla bla_ without visual support\
>
> **Frank [GLeader]:** Do you know what the ancient generals used to do before a battle/
>
> **Agus [PhD res.]:** No\ @
>
> **[other people]:** @ @ @
>
> **Frank [GLeader]:** They would get a stick and they would draw battle plans_ very complex battle plans on the sand\
>
> **Agus [PhD res.]:** Yeah_ but we are talking about not having any visual support_ no/ Even without a stick\
>
> **Frank [GLeader]:** You can improvise\

Realising the importance of visual communication entailed a 'multimodal turn' in the research. At that point the multimodal dimension was introduced also into the theoretical perspective adopted.

A total of 64 video clips were collected, 51 from Group A and 13 from Group B. No video clips were collected from Group G. In total, there were more than 1500 minutes videotaped, in a variety of communicative situations, like the ones mentioned in the audio recordings section. As in that case, video clips were also coded directly without previous transcription. Only a few clips were transcribed using multimodal transcription techniques (see Bezemer & Mavers, 2011), and with support of ELAN software[55], in order to carry out detailed micro analysis of specific communicative instances.

Audio-visual transcription was layered. Annotations on the use of each communicative mode were added onto the video clip. Different tiers would encompass the transcript of each participants' speech. Also, the action (gestures and movements) of each participant was annotated in different tiers. Regarding action, however, there were different depths one could annotate: either very concrete movements and gestures, with plain (non-specialised) vocabulary,

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[55] ELAN is a transcription tool that aids complex annotations on video and audio resources. Such annotations can be arranged on multiple layers, named tiers. It is a tool developed by The Language Archive Project of Max Planck Institute for Psycholinguistics and it is available under a GPL 3 license at https://tla.mpi.nl/tools/tla-tools/elan/

as an "outsider" to the community would do – an observer not familiarised with the group nor with natural sciences more generally–, or identifying units of action the same way a member of the group would do, that is, annotating major actions devoted to the execution of protocols and experiments, learning and teaching them, and other major activities belonging to the group's culture. The vocabulary used in this latter tier would be informed, specialised vocabulary and jargon used in the community itself. For the purpose of this study, I decided to annotate both, which I could do only after the 'stimulated recall' sessions with two members of Group A. Therefore, there were two different tiers for action annotations per participant in the video clip: the 'outsider' and the 'insider' description.

Furthermore, regarding action, there is also in the video transcripts a third type of tier: one reflecting the description of the action by the "official" protocol. This one is the most abstract and synthetic one. It may encompass many of the actions described on the other two tiers. A sole "sentence" of the protocol usually encompasses a chain of actions which are not specified on it, but which an experienced scientist should deduce herself.

Finally, there was also one more annotation tier per participant, which indicated their location [see all the annotation tiers described in picture 7].

Picture 7: ELAN annotation tiers

This type of transcription needs to be adapted to the book-page format for the purpose of clear representation, including image (video shots). This has been accomplished in this thesis following the vertical disposition of chronology, as in Sidiropoulou (2015). Two different ways of representing multimodal transcriptions have been used in the present thesis, depending on whether the time and the overlapping of utterances and actions was deemed relevant [picture 8] or not [picture 9].

Picture 8: Vertical multimodal transcription with time

Video shot	Navil's action (by outsider)		Navil's speech		Joana's action (by outsider)		Joana's speech
	00:00:18.2 00:00:19.4	Drops pen onto bench			00:00:00.1	stares at paper reading what Navil writes down	
			00:00:20.2 00:00:20.6	done/			
	00:00:20.7 00:00:21.8 00:00:21.9	picks pen up	00:00:21.4 00:00:21.8	okay\			
			00:00:21.8 00:00:23.4	after this_ the next solution\			
		writes on paper	00:00:23.7 00:00:24.7	What will be			

Picture 9: Vertical multimodal transcription without time

Sign-maker	Speech	Action	Video shot
Joana	**Why can't I** do it with my finger/	Staring at Navil next to him	
Navil	Why you cannot do it with your finger/ **It's not advisable** to do with your finger\	Manipulating objects	
Joana	+Ah+ then why you * what * why you said me to do before/	Staring at Navil next to him	
Navil	What/	Manipulating objects	

3.3.1.7. Stimulated recalls

Micro analyses of participants' (communicative) practices in the lab were not easy for a researcher who was not fully involved in lab work. Even though video images showed familiar people (participants) and objects (the usual objects in the lab), the meaning, significance and rationale of their actions was obscure. This evidenced the need to go back to the field six months after field work had concluded and ask the main actors of those video clips to shed light on those aspects. This has been named here a 'stimulated recall', which typically "involves the use of audiotapes or videotapes of skilled behaviour, which are used to aid a participant's recall of his thought processes at the time of that behavior" (Calderhead, 1981: 212). In this study, the

research participant was shown some video clips in which she appeared and was asked questions about her actions. Two of such individual sessions were held with two members of Group A, Carol and Navil, on May 22nd and 25th 2015. Examples of questions asked in these sessions are:

- What were you doing here?
- When and how did you plan it?
- What experiment did it belong to? What technique? What step was it?
- What were the elements used/needed?
- How is this space called? And what is it for?

Stimulated recalls proved to be an important tool so as to identify major actions relevant for the participants themselves and to name "their world" in the way they would do. These interviews were summarised and the descriptions supplied by the interviewees served to inform the "insider" annotation tier of video transcripts.

Picture 10: Stimulated recall 2

3.3.1.8. Photographs

The need for visual data was fulfilled also by means of photographs. This resource was used to capture the lab landscape, written documents present in the participants' workplace, instances of the participants' lab notebook, etc. [see some examples below]. In total, 135 photographs were taken from the three workplaces, 83 of Group A, 30 of Group B and 22 of Group G.

Picture 11: Lab photographs

3.3.1.9. Collected documents and files

Besides the data collected through eliciting techniques, some documents and evidences were collected from participants in Group A. The researcher was added to the group's mailing list and was also attached as a recipient of some email exchanges between the group leader and other junior researchers. Through this method, evidence of the relationship between the group leader and the junior researchers as well as some paper reviews could be collected. Overall, more than 500 emails were collected, as well as around 110 paper drafts with revision comments from four different participants. Besides these, other documents were collected, such as finished PhD dissertations, PhD defence Power Point presentations, recommended readings, press articles making reference to the researched groups, public interventions of group members, and informal documents (like a Christmas card, a photo log, an autobiographical book, etc.), among others.

The table below summarises the content of the database generated after data collection [table 3].

Table 3: The database

	Group A	Group B	Group G	TOTAL
Research diary	-	-	-	**60 records**
Field notes (80 words/page)	250,5 p.	71 p.	uncount	**321,5 pages**
Audio recordings:	171 (6487 min)	50 (1918 min)	14 (729 min)	**236 (9134 min)**
Field audio recordings & informal interviews	161	42	7	**210**
Semiformal interviews	10	8	5	**23**

Focus group interviews	1	-	2	**3**
Field video clips	51 (1286 min)	13 (363 min)	-	**64 (1649 min)**
Stimulated recall	2	-	-	**2**
Photographs	83	30	22	**135**
Collected documents and files:	610	uncount	uncount	**>610**
emails	>500	uncount	uncount	**>500**
paper drafts	110	-	-	**110**
others	uncount	uncount	uncount	**-**

Managing such a comprehensive database was indeed an overwhelming endeavor. In order to make it more attainable, some data were dismissed, and only those data segments more directly connected with the research questions have been considered. This selection has been aided by the field notes, which pointed at the most relevant events during the data collection.

3.3.2. Issues and difficulties in the data collection process

As noted in the literature, data collection is not an easy process. It involves some issues that need to be handled by the researcher. Burgess (1991), for instance, reflects on ethical dilemmas of field researchers, like trustworthiness, confidentiality and transparency. Hammersley (2006) points out some difficulties for ethnographers related to the definition of boundaries and context, the use of interviews as source of data, the validity of ethnographic reports, and the political and practical intended implications of ethnographic works, among others. Creese (2010) also comments on the complexity of the interdisciplinary requirement of (linguistic) ethnography and the legitimacy of materials collected in the field. Eisenhart (2001) addresses the complexity of the evolving construct 'culture' and ethical issues in the relationship ethnographer-informant. As may be expected, this study was not devoid of such difficulties. In what follows, I will summarise some of the issues I came across during the data collection.

3.3.2.1. What to observe, when and how

Although I did a pilot observation session with Group A and Group B, these were not enough for me to figure out the length and width of the data collection process, nor to be able to identify specific worth-observing events. After my first pilot observations, I already noticed the difficulties that such a data collection entailed, as I reflect in my field notes:

> '...It seems a complex field, with lots of simultaneous actions, semiotic complexities, a lot of individuals; my concern is what to observe, what to note down, whether to record or not, what to record (audio? video?), how should I analyse whatever I observe, would I take interviews? When? About what? How?

[RD, 18/12/2013]'[56]

My first ideas were to 'begin by open questions' to participants and then 'to observe all interactions of one individual throughout a whole working day'; maybe 'to concentrate in two or three individuals per group and observe their interactions, activities and daily language uses more thoroughly'[57]. I was guided by the contrasting phenomena that attracted my attention, what was different to what I was used to seeing or hearing: 'I think I deem relevant, I observe and note down whatever stands out according to my own filter by contrast to other lived situations, observed things, etc.'. Even the fact of observing two *'comparable'* research groups –following my own criterion– 'allow[ed] me to describe them by contrast between them' [RD, 18/12/2013][58].

Little by little, fieldwork allowed me to figure out what was worth recording, considering my research questions:

> '...I discover on the progress interesting aspects, significant themes, spaces, discourses, etc. And I feel I will soon be able to narrow my look down. To do so, it will be important to get to know the groups' dynamics, as well as the stories of their everyday work (discourse plots), the actions and activities that they repeat, the words and terminology, the objects, the spaces, the languages and accents, etc.' [RD, 28/01/2014][59]

But concern about whether I was collecting the most appropriate data was constant throughout the whole data collection process.

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[56] *'Em sembla un camp complex, amb moltes accions simultànies, complexitats semiòtiques, molts individus; La meva preocupació és què observar, què anotar, si gravar, què gravar (àudio? Vídeo?), com analitzar el que observo, fer entrevistes? Quan? Sobre què? Com?'* [Research Diary, 18/12/2013; *original in Catalan*]

[57] *'...penso que potser seria interessant començar per preguntes molt obertes'; 'com a segon pas, podria observar totes les interaccions d'un sol individu en un dia de feina'; 'centrar-me en dos o tres subjectes per grup i realitzar una observació més profunda de les seves interaccions, activitats i usos lingüístics quotidians.'* [Research Diary, 18/12/2013; *original in Catalan*]

[58] *'Penso que considero rellevant, observo i anoto allò que ressalta sota el meu filtre per contrast amb altres situacions viscudes, coses observades, etc. Per tant, el fet d'investigar dos 'grups de recerca científica' com els meus, que jo he etiquetat/categoritzat prèviament com a tals, i per tant com a comparables, per ser semblants i contrastables en tant que pertanyents a la mateixa categoria, em permet descriure'ls per contrast entre ells.'* [Research Diary, 18/12/2013; *original in Catalan*]

[59] *'...vaig descobrint sobre la marxa focus d'interès, temes significatius, espais, discursos, etc. i sento que en poc temps seré capaç d'acotar prou la meva mirada. Serà important per fer-ho conèixer les dinàmiques dels grups, alhora que les històries del seu dia a dia (trames discursives), les accions i activitats que van repetint, les paraules i termes, els objectes, els espais, les llengües i accents, etc.'* [Research Diary, 28/01/2014; *original in Catalan*]

3.3.2.2. Access to data

Although I received consent from all group leaders and consent forms were signed by all group members, access to data depended on a variety of factors. As in Latour and Woolgar (1986 [1979]: 20), also in this case some participants showed bewilderment towards the researcher's activity and her motives and objectives. Some of them opened up earlier and shared their thoughts more easily, while others remained less accessible. This may have influenced also my data collection in the sense that I might have come closer and thus observed more *'those who were more open, closer, who came approached me more'*.[60] Also, role or identity similitude seemed to be a significant element facilitating or hindering data access: I had difficulties in designing and doing interviews with group leaders due to my limited knowledge of their roles and tasks, while it was easier for me to connect with PhD researchers, due to our mutual empathy. This latter difficulty was dealt with by conducting all interviews with group leaders with the assistance of my supervisor, who was also a group leader at that time.

3.3.2.3. How to articulate or describe phenomena

Another issue was also to "understand" what I was observing, especially due to the specialised (professional and communicational) practices of participants:

> '...I don't understand the vocabulary, but I understand the relations between a string of discourse and the following one; a string of discourse and a simultaneous and parallel one (...) Therefore, I see that I understand life stories of the people I observe, at a personal level, trajectories, expectations, deceptions, ... (...). And then, concerning what they deal with, what they do, their object of work and of study, I also see evolutions, contrasts between what some and others do, between what someone does one day and on the following day... It is these contrasts that allow me also to draw my own stories. (...) the contrast between what I know, what I have lived, and what I am seeing, what I don't know, what they know and I don't.' [RD, 04/04/2014][61]

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[60] *'Preguntant-me a quins membres prestar més atenció, ho he fet als més oberts, propers, que se m'han acostat més.'* [Research Diary, 08/05/2014; *original in Catalan*]

[61] *'...no entenc el vocabulari, però entenc relacions entre un discurs i el posterior; un discurs i un altre simultani i paral·lel (...) Així doncs, veig que vaig entenent històries de vida de les persones que observo, a nivell personal, trajectòries, expectatives, decepcions, ... (...). I després a nivell del que tracten, del que fan, del seu objecte de treball i d'estudi, també hi veig evolucions, contrastos entre el que fan uns, el que fan altres, el que fa algú un dia i al dia següent... I són aquests contrastos els que em permeten dibuixar jo també les meves històries. (...) el contrast entre el que jo conec, el que jo he viscut, i lo que estic veient, el que desconec, el que ells coneixen i jo no.'* [Research Diary, 04/04/2014; *original in Catalan*]

These contrasting aspects may encompass the context, the physical site, ideologies, believes, lived experiences, habits, and environment more broadly. What was strange and almost unintelligible to me became progressively somewhat more transparent.

> '...I am starting to be able to formulate my first schemata of what I have observed so far, that is to say, to identify and schematise patterns, to extract symbolic representations of what I have observed. Little by little I capture the dynamics of participants' professional practice and comprehending their actions, the different moments that take place, the requirements of each moment (spare time while waiting for a result, moment of peak activity to prepare an experiment, period of presentations because the group leader is present, etc.). Also as regards language, I increasingly understand the usual dynamics of the groups, as well as their practices and individual habits.' [RD, 30/01/2014][62]

Nonetheless, there are many details of the experiments and the actions of participants that remained alien to my comprehension. In order to counteract this issue, besides the multiple questions I posed to participants during observation sessions, I also had to carry out the two stimulated recall sessions above referred to.

3.3.2.4. My role in the field

The researcher's role in the field is a complicated issue, as posed by Jansson and Nikolaidou (2013: 152):

> ... we found ourselves in constant dialogue with the research participants, and our field roles were continuously shaped and reshaped according to the individuals and the situations in which we became involved. Even aspects of our own identities taken into the field, such as our background and personal qualities, proved to be important in establishing good relations with the care staff.

Also in my case, I was involved in constant identity (re)negotiation in the field, consisting in aligning mine to the participants', creating a member role for myself, moving along the insider-outsider continuum (see Hellawell, 2006; Nakata, 2015), and exploiting whatever might bring me closer to the participants, like "shared features in our personalities and backgrounds..." (Jansson & Nikolaidou, 2013: 162). In my case, my linguistic profile seemed also an element that might have brought me closer to those participants which whom I shared a language (e.g.

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[62] *'... ja començo a ser capaç de formular els primers esquemes del que he observat, és a dir, a identificar i esquematitzar patrons, a extreure representacions simbòliques del que he observat. Poc a poc vaig captant les dinàmiques de la pràctica professional dels informants i comprenent les seves accions, els diferents moments que es donen, els requisits de cada moment (temps lliure per estar esperant un resultat, moment de molta activitat per preparar un experiment, època de presentacions pq està present el líder, etc.). També en qüestió de llengua vaig comprenent les dinàmiques habituals dels grups, així com les pràctiques i costums individuals.'* [Research Diary, 30/01/2014; *original in Catalan*]

the fact that I could speak Greek may have facilitated interactions with Mara, a speaker of Greek, while interactions with those participants who had difficulties with English were difficult and thus scarcer). Other features that might have brought me closer to the participants were: interest for languages, for socialising, for being observed, shared background, living context, habits, hobbies, researcher identity and activities, etc. These might be motives for more or less proximity and interaction frequency of participants not only with me but also among them.

I also had a constant dilemma throughout the data collection: I needed to be accepted as a member in order to have access and to comprehend what was taking place, but I needed also to stay "objective" and emotionally neutral. As explained by Latour and Woolgar (1986 [1979]: 44), "In practice, observers steer a middle path between the two extreme roles of total newcomer (an uttainable ideal) and that of complete participant (who in going native is unable usefully to communicate to his community of fellow observers)". I soon hesitated whether to come close to participants or leave some distance, whether to attach to my 'researcher' identity or to my 'group member' identity. Constant questions came to my mind so as to whom I should talk to, in what terms, in what places, to what extent, etc. Gaining their confidence appeared as something that may help the research – in terms of obtaining more data –, but on the other side, it could be misinterpreted – it could be confused with friendship. This dilemma is summarised by Christine Casanave (2015: 126): "Researchers themselves develop complex and sometimes personal relationships with case study participants and sites and thus need to reflect constantly (e.g. in research memos) on the roles they are playing in their own study".

Finally, I decided to mark my research identity and try not to come too close to participants: this was managed by alternating interviews and observations among participants, not seeking encounters or interactions out of the workplace. This type of encounters took place only on eight occasions and with different participants; in three of them, with the purpose of interviewing the participants; in two occasions, for informal conversations; and in other three occasions, for informal group events that took place out of the workplace, and to which I was kindly invited by group members – one birthday party and two farewell parties.

3.3.2.5. Power relations between the researcher and the research participants

This is also a common issue in the literature. Kvale and Brikmann (2015) address power asymmetries in research interviews; Nunkoosing (2005) tackles power and resistance between interviewer and interviewee; Weis and Fine (2000) show concern for the difficulties in the relationship between the researcher and the participants, among many other scholars. In the case of this study, power was granted to the researcher by the legitimacy of the group leaders' permission to enter the lab, observe, ask, etc. Legitimacy was however not constant; there were

different perceptions of my task as a researcher and thus diverse attitudes towards me: group leaders might see me as a language expert, especially in English, who could help group members in their writing of papers; other participants saw me as a language referee (overseeing their 'correct' language use) [see excerpt 2], as a "spy" of the group leader or as uninteresting.

Excerpt 2: Interview with Pere [Group B's leader] – 'If Helena could hear us_'

Pere: ...we ended up talking about you precisely in the meeting_ because yesterday we started mixing [languages]_ and we said_ If Helena could hear us_ if Helena could hear us_	**Pere:** ...vam sortir a parlar de tu justament per la reunió_ perquè ahir vam començar a barrejar [llengües]\ Dèiem_ si l'Helena ens sentís_ si l'Helena ens sentís_ [original in Catalan]

The participants had the power not to relate with me, to give the depth they desired to their answers, to modify their behaviour in front of me, etc. Nonetheless, being an outsider and having a researcher identity may have aided me gain the participants' confidence for different reasons: because they could identify themselves with me; because I did not have clashing interests with theirs; because I did not depend on their "boss" (their group leader); and because I was not assessing their performance at work. Finally, concern about their answers or behaviours being unveiled to the group leader or to other group members may have also been an inhibiting element.

3.3.2.6. The researcher's impact on the data

My role in the field was mostly that of a 'nonparticipant' or 'observer as participant', as defined by (Creswell, 2013: 167): "The researcher is an outsider of the group under study (...) from a distance (...) without direct involvement with activity or people". I observed their professional practices while recording noticeable events, and only interacted directly with them to ask questions or answer theirs. However, not to influence participants' behaviour is deemed a utopia in the literature. An example of this is the 'observer's paradox' (Labov, 1972) or the 'observer's effect', as Blommaert and Jie (2010: 27) pose it: "you are never observing an event as if you were not there". My impact onto the data was evident in participants' occasional comments in my presence showing their concern about their use of swear words or about their accuracy when using English, which may indicate that my presence raised the participants' awareness of their communication practices.

3.3.2.7. Ethical issues

Other issues that emerged were those related to confidentiality of some aspects of the data like experiment results, and to the participants' anonymity. As has already been noted, the second

aspect has been solved by replacing real names by aliases, not unveiling the name of the universities or research centres and not specifying the area of study of each group. Concerning confidentiality, specific aspects of the data referring to experiment results have been either erased, replaced by a generic (not specialised) term or not included in this report, and interpretations have been generalised instead of offering an individual portrait of a particular, identifiable case (Creswell, 2013). This is not however devoid of dilemmas, as posed by Creese (2010: 145), who summarises this issue as follows: "The tension here lies in protecting those being researched while simultaneously meeting the need for detail and description required in ethnography". Such tension is also manifest in case studies: "The case study is by definition an in-depth study of a particular person, group or program. As the study becomes more and more particularized, it becomes difficult to protect participants' identities and to separate private issues from those that can be written about without risk" (Casanave, 2015: 126). Besides the appointed measures taken, I made the commitment to show all the analyses that might come out from the data to group leaders previous to their publication (see Murphy & Dingwall, 2001, on more 'ethical issues' in ethnographic research). The lack of ethical surveillance in the Catalan-Spanish research system places all responsibility in this respect on the individual researcher. Not putting participants at risk nor herself was also a concern that the researcher had to deal with alone.

Other difficulties with the data collection were technical issues, such as where to place the video camera or the audio recorder, problems with disturbing ambient sounds, the quality of recording devices (one of the audio files was flawed and the recorded event was lost), getting storing devices that could host all data, concerns about backups and safe storing of data, and lost or misplaced data in the database.

All these issues and difficulties may not be avoidable; in this case, I have opted to be transparent in these regards as a way not to counteract them but to be honest about the imperfections that any research study – not only qualitative ones – has.

Having explained the methods for data collection, in the next section I will detail the methodology for data analysis, which is closely connected to them. In line with the principles of linguistic ethnography, "linguistic evidence is ethnographically informed and ethnographic evidence can only be understood as constructed in discourse" (Copland & Creese, 2015: 174). The analysis of the data collected in this study cannot be other than an analysis of discourse. Following the theoretical approaches chosen for this study, the combination of the study of "groups of individuals participating in an event or activity or an organisation", as in case studies, with the exploration of "entire cultural systems or some subcultures of the systems"

(Creswell, 2013: 176), as in ethnographies. This will be accomplished by following the precepts of the ethnography of communication, comprising not only speech or writing but all communicative modes used by participants.

3.4. Data analysis: Multimodal critical discourse analysis and theory-driven thematic analysis

Data analysis in qualitative studies encompasses the processes of data organisation, preliminary read-throughs of the database, data coding and theme organisation, and the interpretive data representation and report (Creswell, 2013: 179). These need to be carried out in the light of the theoretical framework of the study and a specific approach to the analysis. In this section, the connection between these two elements, theoretical framework and approach to analysis, will be made evident and the processes for data analysis, in particular the coding and organisation of themes, explained.

As has been detailed in chapter 2, following Faiclough's 3-D (*three-dimensional*) analysis, the description of cases offered in this thesis will include aspects of the micro, the meso and the macro levels of analysis. I will depart from the analysis and interpretation of ongoing everyday communication, as in Hyme's work (Tusting & Maybin, 2007), analysing speech patterns at an 'interactive' level – the micro level –, as opposed to the level of 'social rules', understood as "a function of macro-social or perhaps economic and political forces" (Gumperz, 1982: 203) – here the macro level –, to which I will end up referring through inferences from the data. I will not however be "missing out the inductive mid-level theory to which ethnography is particularly inclined, working one step at a time from the data bottom-up" (Rampton *et al.* 2004: 10). As in linguistic ethnography, the analysis here will try "to combine close detail of local action and interaction as embedded in a wider social world" (Creese, 2010: 140). Data will be analysed through diverse theoretical lenses: the EoC, the CoP theory, MMSS, and concepts from Bourdieu's (1977) *theory of practice* and Giddens' (1984) *structuration theory*.

Attending the requirement signalled by some scholars of the creation of a 'point of view' or a 'stance' "that signals the interpretive framework" (Creswell, 2013: 180), I have adopted the critical stance. I thus coincide with Creswell (2013: 215) in the conviction that "how we write is a reflection of our own interpretation based on the cultural, social, gender, class, and personal politics that we bring to research. All writing is 'positioned' and within a stance" and I endorse his recommendation to "be open about it" (Creswell, 2013: 215), which he names 'reflexivity' and deems a hallmark of quality in research.

Critical discourse analysis, ethnography and interactional (micro) analysis are compatible approaches that may aid researchers' alienation from the data, as noted by Rampton *et al.* (2004: 6-7):

> ...both critical discourse analysis and conversation analysis provide ways of stepping back from the taken-for-granted in order to uncover the ideological (CDA) or interactional (CA) processes that constitute commonsense and everyday practice (c.f. discursive psychology as well), and this commitment to de-familiarisation can be very well-suited to researchers whose first ethnographic priority is to achieve greater analytic distance on realities that they themselves have lived for a long time.

Such 'de-familiarisation' may be especially difficult with reference to aspects of the research closer to one's own experience, like auto-ethnographic themes, as in the case of this study: "...in the case of ethnographers working in their own speech communities, the development of objectivity and relativity is essential, and at the same time difficult" (Saville-Troike, 2003: 88). This has been a continuous concern for this study's researcher, who despite not being a full member of any participant research group, was a member of a research group as well as of the broader scientific community of Catalonia, and had her own experiences as such.

The good rapport between CDA and ethnography is furthermore evidenced in critical ethnography. Departing from the traditional methodology of ethnography, besides the description of phenomena, it intends the improvement of potential unequal situations they involve; it is especially sensitive to control and oppression; it analyses ideologies; it is purposeful and openly biased in favour of disadvantaged ones (see May, 1997). As in the case of this study, critical ethnography claims that all research is theory laden, including the collection of data. To some extent thus – without claiming it to be a canonical ethnography nor fully committed to critical ethnography's tenets – this study aligns with this approach in its emancipatory aim (see Thomas, 1993) and in its critical gaze at the data.

The first process of data analysis listed by Creswell (2013), 'data organisation', has already been explained in section 3.3.1. With reference to the second process, data coding and theme organisation, it is worth noting that in this study the data have been analysed following the methods of content and thematic analysis. These consist in "classifying material as instances of the categories of a coding frame" (Schreier, 2012: 1) and identifying main ideas or 'themes' in the data (Guest *et al.*, 2012). These may aid mainly the processes of codification and classification of the data. In this regard, many scholars (e.g. Weber, 1990; MacQueen *et al.*, 2009; Drisko & Maschi, 2016) advise to start the coding of data by developing a list of tentative codes, a 'coding frame' (in Schreier, 2012), a 'codebook' (in Guest *et al.*, 2012) or a 'coding scheme' (in Creswell, 2013). This latter author in particular suggests to start with 30 codes. The

codes or dimensions chosen and the structure of the coding scheme may depend on the research questions, which it may help to answer. Considerations regarding codes are that they should be unidimensional – each dimension should fit only one aspect of the data –, mutually exclusive – one data segment cannot be assigned to two subcategories of the same dimension –, and exhaustive – all data segments can be accommodated to at least one subcategory (Schreier, 2012). The tentative codes may need to be reduced later on to themes – broader labels that encompass codes sharing a common idea –, through an 'inductive' process. Creswell (2013) advises synthesising codes into 5 or 6 themes, that is, clustering differently coded data segments into common ideas or patterns. Any previous coding scheme should be open to modification during the coding process through the process of 'data-driven' coding frame building (Schreier, 2012).

The ethnography of communication is a fruitful first source of such etic codes in this study. Following the EoC, the researcher's first step consists in defining the community to be explored; then attaining deep comprehension of it (significant "cultural" characteristics, social organisation, etc.); then formulating hypotheses on its patterns of communication and other socio-cultural phenomena; and finally identifying recurrent events, salient components, and relations among them as well as with other social aspects (Saville-Troike, 2003). This has also been done in the present study. The EoC also points at types of data that any ethnographer should collect (Saville-Troike, 2003: 92-5), which could be assigned codes and organised into themes: (a) background information on the community; (b) material artifacts (e.g. architecture, instruments of communication, etc.); (c) data on the social organisation (e.g. institutions, identity of members, sources of power); (d) legal information (e.g. laws and official regulation concerning language use and communication); (e) artistic data (from literary sources); (f) common knowledge on communication (e.g. in the form of proverbs and aphorisms); (g) beliefs about language use (e.g. taboos, attitudes and values related to communication, etc.); and (h) data on the linguistic code (e.g. in the form of dictionaries and grammars, but also including data on paralinguistic and nonverbal features).

Nonetheless, this list of salient aspects may need to be adapted in the current study to the characteristics of the research group, seen as a community of practice, and thus not corresponding to a speech community, the social unit of analysis that the EoC was originally designed to focus on (Hymes, 1962). Such modifications may consist in considering the historical creation, composition and organisation of the research group, instead of "settlement history" and "sources of population" (Saville-Troike, 2003: 93), or in exploring the specialised literature generated by former members of the group, instead of its "artistic data" (Saville-Troike, 2003: 94).

Aiming at the "ethnographic analysis of the communicative habits of a community" (Hymes, 1964: 13), as in the EoC, my first endeavour, after having identified a specific significant community, was to identify communicative events that the participants would take part in during their daily professional practice. Questions to be asked at that point were: "What are the communicative events, and their components, in a community? What are the relationships among them? What capabilities and states do they have, in general, and in particular cases? How do they work?" (Hymes, 1964: 25). These targeted research sub-questions give place to relevant codes and sub-codes: usual communicative events, their significant components, and relations among them (and between events and social aspects, as noted by Saville-Troike, 2003: 88), etc. Also following Hymes' approach, other relevant codes to analyse communication are: channels and modes, shared codes, settings, forms of messages and their genres (organised routines and styles), topics and comments (from Jakobson, 1953, 1960; in Hymes, 1964: 13) and kinds of participants. The "ultimate criterion for descriptive adequacy" which is "whether someone not acquainted with the speech community might understand how to communicate appropriately in a particular situation" (Saville-Troike, 2003: 88) brings about codes like 'norms of behaviour' and 'appropriateness rules'. This is indeed, as this author explicates, "a major goal of ethnography": "accounting for what the individual needs to know to be a functional member of the community" (Saville-Troike, 2003: 88).

Other such etic codes that can be retrieved from the CoP theory, MMSS, and other theoretical concepts used in this study have been already explained in chapter 2. The CoP theory may trigger research sub-questions like: 'What is newcomers' learning process like and what is the role of communication in it?'; 'How does 'learning' define 'group membership'?'; 'How is identity (and roles) performed through communication in the group?'; 'How does communication contribute to maintain or improve the group's dynamics?'. Multimodal social semiotics imply research sub-questions like 'How do the members of the group manage their (multimodal) communicative repertoires?'; 'How are multimodal communicative resources managed by participants to acquire international success?'; 'What are the hints of international (multimodal) communication in the local context?'.

Bearing all these questions in mind, a coding frame was developed before the analysis of the data. This preliminary coding frame fitted with what Schreier (2012) defines as a 'highly complex' coding frame, since it was formed by four levels of themes and codes. It was structured in two main themes ('communicative events', more focused on communicative aspects, and 'community of practice', rather devoted to social aspects) and more than five sub-themes each (e.g. 'components of the SPEAKING grid', 'communicative modes' and 'discourse trajectory', for the first theme, and 'background info', 'social organisation' and 'role in the

226

macro-scientific culture', for the second theme). These sub-themes were in turn composed of third-level codes or dimensions [See below this project's starting coding frame (or scheme) for data analysis].

Coding frame

Theme1: Communicative events

1.1. Components [SPEAKING grid]

    1.1.1. Situation

    1.1.2. Participants (roles)

    1.1.3. Ends

        1.1.3.1.   Goals

        1.1.3.2.   Outcomes

    1.1.4. (Communicative) Act sequence [form and content]

    1.1.5. Key

    1.1.6. Instrumentalities

        1.1.6.1.   Channels (+interdependence and hierarchy)

        1.1.6.2.   Forms of communication (code, register, etc.)

    1.1.7. Norms (of interaction and of interpretation)

    1.1.8. Genres

1.2. Relation among components

1.3. Communicative modes

    1.3.1. Functions of modes

    1.3.2. Characteristics of modes (affordances, constraints, semiotic reach,

        1.3.2.1.   Explicit characts.

        1.3.2.2.   Implicit characts.

    1.3.3. Mode combination

    1.3.4. Mode Subtypes

    1.3.5. Semiotic resources

    1.3.6. Framing/frames

    1.3.7. Semiotic regime (norms)

    1.3.8. Communicative media

1.4. Discourse (trajectory)

    1.4.1. Texts and entextualisation

    1.4.2. Semiotic chain

    1.4.3. Recontextualisation and creativity

    1.4.4. Transduction mechanisms

    1.4.5. Translation

1.5. Tensions, problems and solutions

1.6. Relations communicative events-society

    1.6.1. Ideologies on Successful (scientific) communication

    1.6.2. Communicative Role in the macro-scientific culture (field)

    1.6.3. Communication as 'capital'

    1.6.4. Imported communicative 'habitus'

    1.6.5. External 'structure' of scientists' communication

Theme 2: Community of practice

2.1. Background info

2.2. Social organisation

    2.2.1.   Mutual relationships (and hierarchy)

    2.2.2. Ways of engaging in doing things together

    2.2.3. Flow of information

    2.2.4. Descriptions of who belongs

    2.2.5. Identity definition of others and the self

    2.2.6. Assessment of action and product appropriateness

    2.2.7. Local lore, shared stories, inside jokes, knowing laughter

    2.2.8. Styles recognised as displaying membership

    2.2.9. Shared discourse reflecting a certain perspective on the world

    2.2.10. Boundary objects

    2.2.11. Brokering

    2.2.12. Learning and 'Legitimate peripheral participation' evidences

2.3. Communication in the group

    2.3.1. Material artifacts (for communication)/reified objects

    2.3.2. Knowledge on communication

    2.3.3. Beliefs about communication and communicative competence

    2.3.4. Linguistic codes, jargon and shortcuts to communication

    2.3.5. Introductory preambles

    2.3.6. Setup of problem to be discussed

2.4. Relations communicative events-society

    2.4.1. Ideologies on scientists' successful practices

    2.4.2. Constellations of practices (with other CoPs)

    2.4.3. Extra-CoP communication

    2.4.4. Power relations/asymmetries

    2.4.5. Dominant ideologies and discourses

    2.4.6. Role in the macro-scientific culture (field)

    2.4.7. Position in the European Higher Education system

The internationalisation of higher education, a core part of this study's main research question, posed at the beginning of this chapter, was supposed to be a cross-thematic element. In order to answer this question, hints of it were searched across codes and themes. The analysis thus had as its ultimate aim the unveiling of the process of integration of the international dimension into diverse aspects of scientists' communication.

Considering the theoretical framework of this study and the ethnographic character of it, the resulting analysis is a combination of etic codes that follow the theoretical perspectives, and an emic approach to the field, which aims to identify phenomena, topics and themes that might "emerge" from the data, that is, that may catch the analyst's attention throughout the data analysis, "with openness to discovery of the way native speakers perceive and structure their communicative experiences" (Saville-Troike, 203: 88). Ways to include an emic approach to the etic codes referred to were identifying communicative events identified by the participants as such, paying attention to what they highlighted as being relevant aspects in these events, posing

open-ended questions and delving into the issues that the participants presented as more important (always in relation to communication and the IoHE). This need for the etic-emic interplay has been also pointed out by Hymes (1980: 109), who warns that "members of a community themselves" may well not "have an adequate model of it, much less an articulated, adequate model".

Despite aiming at an emic approach to data, the role of the researcher as a subjective filter will not be denied here. This consideration has been present throughout the study, as evidenced in my own 'research diary', in which I reflect on how I found myself 'trying not to impose my own perspective, vision, values and interests onto the participants an onto the data', for which a solution might be 'verifying continuously whatever I do, write and think with the participants' [RD, 18/12/2013][63]. I must however acknowledge that 'I am an (influencing) filter' for whatever I observe; to some extent 'I have established the categories, chosen the themes, etc. under my own criteria', and the result may be the result of 'a negotiation of the world, the meanings, of the categories, etc. among the participants, me and my supervisor' [RD, 18/12/2013][64]. It is worth noting at this point that ethnographies entail the ongoing analysis of the data, in a more or less methodical manner, throughout the data collection process and not only after its completion (Hammersley & Atkinson, 2007).

Interpretation of the observed phenomena will be based on the identification of patterns, in the contrast and comparison among the groups observed, and in establishing connections between the communities' behaviour and culture and the theoretical framework, as well as with the related literature. Instead of a detailed description of each case, as is typical in case study research, the final report will offer a generalised explication of events, based on the assumption that commonalities might be established between the communities observed in this study and other similar communities. The voice of the researcher will not be concealed but overtly present throughout the report. The resulting report may be narrated from a combination of a participant understanding and 'anthropological strangeness' (see Latour & Woolgar, 1986 [1979]: 40-1), whereby the research group may be seen as a transparent community and also as a remote culture at the same time.

Once the codes had been defined, the database was scanned, segments of data coded – that is, labelled with any of the existing codes or with a new one –, codes grouped and classified into

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[63] *'...no imposar la meva perspectiva, visió, valors i interessos en els participants i en les dades'; '...corroborar contínuament el que faig, escric i penso amb els informants'* [Research Diary, 18/12/2013; *original*].

[64] *'... JO soc el filtre de la meva investigació' (...) 'JO he establert les categories, triat els temes, etc. segons els MEUS criteris'. '...una negociació del món, dels significats, de les categories, etc. entre els meus informants, jo i el meu tutor...'* [Research Diary, 18/12/2013; *original*]

themes, and the data interpreted. Although the interpretive report was the last step, interpretation of the data took place throughout the whole process and was materialised in the processes of organising data, of transforming them (e.g. through transcription), of coding them, of establishing connections among codes, and in the form of memos, either free or attached to data segments, codes, and files. It is worth noting that the data codification in this study has been supported by Atlas.ti software[65] (see Friese, 2012). Raw data files have been coded directly, except for individual interviews, for which transcripts have been coded. Other video clips and audio recordings have been transcribed partially when required for more in-depth analysis or for their representation in the interpretive report.

Throughout the data collection, which, as has been pointed out, is also a stage of ongoing data analysis, several research sub-questions emerged, from which emic codes (emerging from the observer's interaction with the field) were deduced. For example, a wide range of communicative events was identified and each of them was given a code, using the name the event had for participants whenever possible (not all the communicative events identified were named by the participants). Also, a code was created with the name of each participant, as well as of other actors referred by them at any point. Other 'emic' codes, created during the data analysis were: (a) 'women/woman', to code gender issues that were made relevant by the participants; (b) 'emotions', to code instances in which these were underscored; (c) 'mobility', which was not a key concept in any of the theories used in this thesis, but became relevant in the data; and (d) 'age', which was also referred to once as a significant feature. Also, some codes proved not to be useful, since they were not finally used to code any data segment, probably because they were overlapping with more effective codes or were too concrete to match any data segment. For instance, the codes '1.3.2.1. explicit characts. (of modes)' and '1.3.2.2. implicit characts. (of modes)' were contained in the broader code '1.3.2. characteristics of modes'; and the code '1.1.6. instrumentalities' served to code data segments corresponding to '1.1.6.1. Channels' and '1.1.6.2. forms of communication'. A few codes were merged because they were found to be overlapping (e.g. '2.4. relations communicative events-society' coincided with '1.6.', and the code '1.6.1. ideologies on successful (scientific) communication' was very similar to '2.3.3. beliefs about communication and communicative competence'.

Once all codes had been defined and data segments tagged and classified accordingly, these needed to be organised into a few broader themes or categories. What the researcher did through

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[65] Atlas.ti is a widely used qualitative data analysis software that aids the coding, classification, linking and representation of diverse types of data, like text, image, audio and audiovisual files, among other features.

this process was identifying patterns, similarities among codes and connections. This is also an interpretive process, whereby researchers have been traditionally asked for the validity of their method.

Consequently, this research methodology chapter could not finish without tackling also the 'validity' issue. If this paper is an interpretation of observed phenomena, why should someone trust it? Although a good procedure for the validation of research, as suggested in the literature, is showing the researcher's interpretation to participants, it may be a utopia in studies like this one, which are longitudinal, last several years, involve many people, and where participants are transient individuals, who may be abroad and detached from the researched community for long by the end of the project. My stance on validity is based on an overt commitment to 'ethical validation', that is, to the questioning of my moral assumptions, the ethical implications of my research and to the unveiling of my own political stance, besides other commitments to validity like self-reflection, thoroughness, congruence, and honesty, which is close to Denzin's (1997)[66] poststructural critical perspective. If all research reports are interpretive, scientific honesty involves explaining one's stance and choices. It does not mean, though, intending scientific objectivity.

However, I acknowledge that entering the scientific community implies that one's validity criteria must unavoidably be assessed and accepted by other expert members. In this respect, 'consensual validation' (Eisner, 2017), whereby the study's results are consensually validated by other experts, may act as a sieve and as an external validity indicator for the inexperienced researcher. In the case of the current paper, the director's reviews, comments from colleagues, besides the validation of two external reviewers may act as such.

In the next chapter, devoted to the analysis and discussion of data, this study's main problem and the research context will be presented, salient events described and interpreted, and outcomes commented on, in the light of the relevant literature.

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[66] Denzin (1997) claims for a poststructuralist, critical view on research that breaks with traditional 'post-positivist' validity, which he deems a metaphor for 'authority' and 'power imposition'.

Chapter 4: Contextualising the research

With a view to investigating how the process of the IoHE influences scientists' daily communication practices, the present chapter, which is divided into four sections, contextualises the research project by linking it to the current trend of HE institutions to advocate for internationalisation. Section 4.1 provides an overview of the internationalisation of higher education at a global level. Section 4.2 centres on the European context and on the creation of the European Research Area (ERA). And, finally, sections 4.3 and 4.4 zoom in on the internationalisation of science in the contexts of Spain and Catalonia respectively. Considering the commitment adopted to preserve the anonymity of all the participants in this study, specific information about the research centres and/or institutions will not be provided.

4.1. The internationalisation of higher education as a trade

As has been pointed out, this study is framed within the current trend of HE institutions to advocate for internationalisation. In Spain, the IoHE is a popular issue within the field of HE, present in many policy documents – of universities but also of governments –, acting as a momentum for student mobility programmes, and used as an asset of "competitive" universities. This tendency corresponds to a new era for the university, marked by the increasing hegemony of market laws and the progressive detachment of these institutions from the control of the nation-state (Readings, 1996). The de-nationalising trend of HE institutions may be hence equated with the process of IoHE. The label 'internationalisation' has been used by Western HE institutions to implement aggressive policies in order to attract overseas students (Tilak, 2011) and thus more incomes.

Tilak (2011) in fact attributes the IoHE to market interests, fostered by ministries of trade, commerce and foreign affairs, as well as to 'entrepreneurial groups', that seek same conditions for national and foreign institutions (e.g. in taxes and licences), and no barriers in market access (e.g. prohibitory laws, long-lasting permit procedures, lack of transparency in regulations). In this respect, under the General Agreement of Trade in Services (GATS[67]) of the World Trade Organisation (WTO)[68], which encourages the progressive liberalisation of markets, education

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[67] "The General Agreement on Trade in Services (GATS) is a treaty of the World Trade Organisation (WTO) that entered into force in January 1995 as a result of the Uruguay Round negotiations. The treaty was created to extend the multilateral trading system to service sector..." [Wikipedia, retrieved 10/02/2019]

[68] The WTO has 151 members, accounting for over 97% of world trade and is the only global international organisation dealing with the rules of trade between nations that is the main catalyst of the process of globalization. At its heart are the WTO agreements, negotiated and signed by the bulk of the world's trading nations and ratified in their parliaments. Currently there are WTO agreements on goods, services and intellectual property rights. The GATT is the principle rule-book for trade in goods. The WTO also provides dispute settlement and policy reviews. Main functions of the organisation are as follows:

was included among the tradable service sectors, although only 62 out of the nearly 150 member countries of the WTO had made commitments on education under the GATS framework in 2018. The EU (as one single country) was one of these (OECD, 2018). The means promoted by these actors to achieve their goals, as identified by Tilak (2011), correspond to typical internationalisation policies, such as (1) '*cross-border supply*' like distance training and e-learning, (2) '*consumption abroad*' through mobility students (the most common one), (3) '*commercial presence*', that is, overseas establishment of educational institutions through branch campuses and/or joint ventures, and (4) '*movement of natural persons*' referring to the temporary mobility of education professionals (e.g. teachers and administrators) to establish a service abroad.

However, although the IoHE is an increasing tendency worldwide – e.g. from 2000, when negotiations started, there has been a marked increase in the number of countries making commitments on education under the GATS (Tilak, 2011) –, countries are affected differently by it, depending on their role and capabilities. On the one hand, 'developed countries' – as named by Tilak – look for: (a) financial gains for institutions and other stakeholders through higher fees and other expenses from overseas students, (b) enrichment through diversity, (c) skilled human capital (who would stay in the host country for work) – also called "neo-colonialism of the mind" (Gürüz, 2008: 188), and (d) export of culture (through the export of education) – viewed as a 'new (cultural) imperialism' (Tilak, 2011). On the other hand, for 'developing countries' the claimed assets of trade in education are: (a) resource saving in public investment on education and reduction in unemployment (through student outflow), (b) 'brain gain' through returning skilled nationals, (c) financial gains through foreign investment in education, (d) improved access to and equity in HE through higher offer, (e) 'reverse brain drain' through the arrival of skilled education professionals from developed countries, (f) more quality and efficiency of education through enriched diversity and enhanced competition, and (g) enriched intellectual environment through collaboration, cross-cultural linkages and transfer of knowledge and technology (Tilak, 2011).

This situation has raised concern within the HE community for the potential imposition of trade models onto HE, which would entail the consequent "weakening" of the national systems and/or a decline of quality in HE. In this line, the Association of Universities and Colleges of Canada (AUCC), the American Council on Education (ACE), the European University Association

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Administering trade agreements, Acting as a forum for trade negotiations, Settling trade disputes, Reviewing national trade policies, Assisting developing countries in trade policy issues, through technical assistance and training programs, Cooperating with other international organisations.
As the main purposes of the organisation are to promote freer trade, fair competition and encourage development and economic reform, it is one of the main contributors of the process of economic globalization.

(EUA), and the Council for Higher Education Accreditation (CHEA) signed the *'Joint Declaration on Higher Education and the General Agreement on Trade in Services'* (2001), suggesting that the GATS is not an appropriate framework for HE commitments. These organisations defend that "[h]igher education exists to serve the public interest and is not a 'commodity'", and that "[g]iven this public mandate, authority to regulate higher education must remain in the hands of competent bodies as designated by any given country" (Giroux *et al.*, 2001). Despite this concern, the IoHE is today a reality, increasingly imbuing HE worldwide and becoming the current main university mission, as foreseen by Scott (2006). The next section will illustrate the shape that the IoHE has taken in the European context.

4.2. The internationalisation of HE in Europe and the creation of the European Research Area (ERA)

In the context of European HE, 'internationalisation', or otherwise 'Europeanisation' (Van Damme, 2001; Teichler, 2004; Huisman & Van der Wende, 2005; Knight, 2008), has been gaining relevance in the last 25 years, finally becoming the "mainstreaming of internationalization" (De Wit, 2011b). The term 'Europeanisation' defines the regional 'internationalisation' of higher education at a European level, and is the fruit of policies designed with the objective to secure "stability and economic growth within the region" and to "enhance the global competitiveness" of European HE institutions (Huisman & Van der Wende, 2005: 12).

As Teichler (2004: 22) observes, this perspective remarks the difference of academic relationships within and outside Europe "in terms of less culture contrast and opportunities for horizontal communication, cooperation, and community as well as of potentials of integration and joint action to shape the system". However, the opposition 'Europeanisation' / 'internationalisation' has never been clear-cut. Relations between European institutions and non-European ones existed even before the creation of the EU – e.g. between metropolis and colonies. Thus, institutions and authorities themselves have had to solve the tensions that might have arosen from the integration of a European dimension into their already existing international relations (Callan, 1998).

According to Huisman and Van Vught (2009: 19), the Europeanisation of HE started with "[t]he establishment of the first European community treaties in the 1950s", especially the Treaty of Rome in 1957, which established the European Economic Community. However, HE remained a marginal topic until the 1980s' first programmes (e.g. Comett, Erasmus, Lingua and Tempus), which were strategically designed to foster Europeanisation in a context where the European Comission lacked competencies in education, and the equation of HE structures across states

"with a view towards the common market of 1992" (Van Damme, 2001: 418) was considered too challenging. The Single European Act (1987), the Maastricht Treaty (1992) and the Framework Programmes for Research and Technological Development, instruments for research funding and prioritisation, were relevant frameworks and instruments leading to the creation of the European Research Area (ERA) in 2000, through the Lisbon Strategy (Huisman & Van Vught, 2009). The Sorbonne Joint Declaration (Allegre *et al.*, 1998), announced the creation of a "European area of higher education, where national identities and common interests can interact and strengthen each other for the benefit of Europe, of its students, and more generally of its citizens". This idea was further nuanced in the Bologna Declaration (*The Bologna Declaration of 19 June 1999: Joint declaration of the European Ministers of Education The*, 1999), signed by 29 European ministers, which was supposed to serve "as a key way to promote citizens' mobility and employability and the Continent's overall development". According to this document, the core objective of the European Area of Higher Education (EAHE) was "increasing the international competitiveness of the European system of higher education", following the conviction that "[t]he vitality and efficiency of any civilisation can be measured by the appeal that its culture has for other countries". It thus aimed at achieving "a world-wide degree of attraction". And in order to accomplish this, it was deemed necessary to "construct a European Higher Education Area, to promote mobility and employability and to increase the compatibility and comparability of Europe's higher education systems" (Huisman & Van Vught, 2009: 21), through "compatible degree structures, transferable credits, and equal academic qualifications" (Altbach & Knight, 2007: 293).

Following the Declaration, the Bologna Process – which guided HE institutions in the improvement of the IoHE, e.g. through international degree compatibility and qualification recognition (EC[69]) – involved 46 countries in 2008. By incorporating these two instruments, the 'internationalisation' process in the European context reached its broadest capacity and power, encompassing areas earlier on assigned to mainstream HE policy (Huisman & Van der Wende, 2005). Furthermore, EU internationalisation programmes are still nowadays expanding also geographically, through collaborations and scholarships in Latin-America and Asia-Pacific (Altbach & Knight, 2007; Tobenkin, 2016), which apparently transcends the hypothetical intentions of within-Europe-cooperation and points towards the economic growth in the global market as its (new) rationale.

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[69] EC, The Bologna Process and the European Higher Education Area.
https://ec.europa.eu/education/policies/higher-education/bologna-process-and-european-higher-education-area_en [retrieved 18/01/2019]

Official documents of the EU claim for an internationalism within Europe to face the globalisation of the market; a "Eurocentric" idea of 'internationalisation', where the design and implementation of a common "European area for higher education and research" is presented as the necessary first step before the subsequent competition of European institutions in the global market. Cooperation is apparently required for competition; and the joint enterprise of European nations is to compete against other powers worldwide. Nonetheless, studies analysing what has been actually occurring to HE institutions have found noticeable diversity in the field (Kälvemark & Van der Wende, 1997; Van Vught, Van der Wende & Westerheijden, 2002; Huisman & Van der Wende, 2004, 2005). Besides the variation in approaches and related practices from stakeholders (Kälvemark & Van der Wende, 1997), the combination of cooperation-oriented and competition-focused rationales differs among institutions. While some of them have opted to combine both, others have replaced cooperation with a competition-based paradigm, the national framework being a determining factor in this issue (Huisman & Van der Wende, 2004, 2005).

Regarding research, the EU intends to stimulate cooperation among scientific and technological institutions within Europe through several measures contained in the ERA. The ERA[70] (EC, 2000), defined by the EC as "A European area of free circulation of researchers, knowledge and technology" and "[a] unified area, open to the world, based on the internal market" (EC, 2016: 3), is a policy that aims to promote the interconnection of national research systems within Europe and a European "market" for scientists, in order to increase the competitiveness of European research. It is formed by the European Commission, the member states and several research stakeholder organisations, and involves 60 actions with "concrete objectives", "commitments from each partner", "[f]ollow-up of progress" and "clear deadlines" (EC, 2016: 10).

In particular, the ERA establishes six priorities to be accomplished with reference to research in Europe, of which priorities 2 and 5 are the most related to communication. These priorities are: (1) more effective national research systems, (2) optimal transnational cooperation and competition (to address grand challenges), including research infrastructures, (3) an open labour market for researchers, (4) gender equality and gender mainstreaming in research, (5) optimal circulation, access to and transfer of scientific knowledge including knowledge circulation and open access, and (6) international cooperation[71]. The European Research Area and Innovation

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[70] More information on the ERA here: http://ec.europa.eu/research/era/index_en.htm

[71] Espacio Europeo de Investigación (EEI). Policy initiatives and practices of a unified common European research area, partnership details and progress reports.https://ec.europa.eu/info/research-and-innovation/strategy/european-research-area-era_es [accessed 10/02/2019]

Committee (ERAC Secretariat, 2015) – an advisory committee for EU member states – established several core high-level indicators to monitor progress in achieving the ERA by member states, such as: (a) "the intensity of governmental investment into public R&D and higher education" (EU, 2009: 75), (b) "the level of EU or coordinated research funding", and (c) "the actual involvement of national research institutions in jointly designed projects" (EU, 2009: 76).

Moreover, also in relation to the internationalisation of research, the European Commission (EC) has produced several schemes concerning researchers' mobility and their professional career perspectives and options. EU programmes that promote researcher mobility across national borders are the Marie Curie schemes – a set of mobility fellowships –, the European Charter for Researchers – proposing several principles to guide researchers' roles and relations[72] –, and the scientific visa package – making entrance in Europe easier for non-European researchers.

'Internationalisation' within Europe has the characteristic of having to be developed in "an environment of massive diversity of educational cultures, economic situations, national priorities and professional interests" (Callan, 1998: 54). Besides the complexity of the context, official discourses are not without ambiguities, which in turn puts national governments and institutions in an awkward position. While a case in point is that the structural convergence of national HE systems is intended, official documents advise national governments to take "full respect of the diversity of cultures, languages, national education systems and of university autonomy" (Huisman & Van Vught, 2009: 21-22), without offering the clue as to how to accomplish what these authors call an "organised diversity". As can be seen in such papers, euphemisms and marketing rhetorics are common in official documents of the EU, which make reference to 'a Europe of Knowledge', 'respect of the diversity of cultures, languages, national education systems', 'the challenges of the new millennium' or 'the building of the EU knowledge society' (e.g. Bologna Declaration of 1999 and the Lisbon Strategy of 2000). And the extent to which the European dimension should be integrated into the institutional level remains unclear (Callan, 1998).

The importance of the research dimension in the IoHE lies in the consideration of research success as the primary measure of academic career advancement, which can be found in most countries in Europe. Consequently, international ranking schemes and global markets for researchers, research training and research products have become significant measures of HE

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[72] see: The European Charter for Researchers. https://euraxess.ec.europa.eu/jobs/charter/european-charter [accessed 18/02/2019]

institutions' competitiveness and quality; and success is measured through publications in high-impact journals with international reach (Reichert, 2009). Despite the dangers or disadvantages that the internationalisation of science might entail, international communication (in the shape, for instance, of cross-national partnerships or internationally recognised publications) is a basic premise attached nowadays to successful research. In this endeavour, English is core, for it is becoming the preeminent common 'scientific language' for all experts in a same field (Alastrué & Pérez-Llantada, 2015).

As regards doctoral education, research and innovation are increasingly being regarded as important competitive instruments for national interests in the global market, which has resulted in an enhanced interest in PhD education (Nerad & Evans, 2014). Nowadays, the number of stakeholders involved in doctoral education, all of them with their own interests and goals, is significantly greater than ever: "Now university leaders, governments, business and industry, funding organisations (both governmental and nongovernmental), researchers, quality-assurance agencies, and the community are all players in the enterprise of doctoral education—along with, of course, the graduates themselves (and their parents)" (Evans, 2014: 209). Europe, with the aim to become the centre of the 'knowledge society', is implementing policies to foster HE, not only at an undergraduate level, but also of postgraduate education (e.g. Horizon 2020 PhD research funding; the European Regional Development Fund). Research has been supported through the establishment in 2008 of the supranational European University Association–Council for Doctoral Education (EUA–CDE), whose aims are quality assurance, development of policies, international cooperation and dialogue, monitoring emerging trends worldwide, and positioning the PhD as a key professional qualification in a knowledge-based society (Nerad & Evans, 2014).

Indeed, doctoral education[73] has been regarded as "a key element of the planning of science/technology policies for nation building" (Maheu *et al.*, 2014: 160). On the one hand, doctoral education is locally based but on the other hand it entails the acquisition of "coded skills and knowledge", as well as other "intangible skills" that facilitate the international exploitation of this knowledge: "These collective skills must be recognised, taught and studied, exchanged, and mastered by graduate and doctoral students" (Maheu *et al.*, 2014: 160). Nevertheless, this twofold nature of doctoral education leads to a dilemma, since the "doctoral workforce is not readily contained within national boundaries, and the flows of this workforce

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[73] When dealing with postgraduate education, and in particular with (PhD and post-doctoral) research, the concept "internationalisation" is rarely used. "Globalisation" appears as the main process affecting it, and it is claimed to be doing so unavoidably and enormously.

into and out of the training countries are poorly understood" (Maheu *et al.*, 2014: 160). This mobility trend results in an increased awareness of "global issues" by PhD candidates (Evans, 2014).

The issue of scientists' communication is reduced to a few studies addressing language policy in some scientific communities. In this concern, a trend in Europe is that policy makers think about changing curricula from local languages to ELF, which generates language constraints, as well as cultural and political sensitivity (Kerklaan, Moreira & Boersma, 2008), especially for 'policy makers at local level', because in the creation of the nation-state in Europe, language was a key element used for identity construction and homogenisation. In this sense, it is worth pointing out that:

> The European Union is founded on 'unity in diversity': diversity of cultures, customs and beliefs - and of languages. Besides the 20 official languages of the Union, there are 60 or so other indigenous languages and scores of non-indigenous languages spoken by migrant communities. (Comission of the European Communities, 2005)

The attainment of 'unity in diversity' regarding language may entail a dilemma for policy makers, who, on the one hand, might consider introducing ELF to increase financial income through international competitiveness and the attraction of overseas students and, on the other hand, might aim to protect the interests of their nation-state concerning language management.

And the same tension applies to other aspects of HE management. Despite the intent to transcending national borders, as Huisman and Van der Wende (2004, 2005) point out, the national context still appears as a significant intervening factor in the shaping of the IoHE in Europe: while European regulatory frameworks are common for all member states and pull them towards convergence, their implementation is still influenced by the national context, and diversity and unevenness are still evident. As has been stated, "European universities nowadays are still largely national rather than European institutions" (Huisman & Van Vught, 2009: 18).

Admittedly, science and HE in Europe have undergone a process of "nationalisation" throughout the eighteenth and nineteenth centuries, as a consequence of the rise of nation-states (Huisman & Van Vught, 2009). This consisted in the instrumental use of the university for the dissemination of the new national, cultural identity, in the creation of national regulatory frameworks and the provision of national core funding. In this context, study abroad was usually forbidden and Latin (the language originally used for science in Europe) replaced by national languages as the medium of instruction (De Wit *et al.*, 2015). As a result, universities have evolved ever since being shaped by national political frameworks and as part of national educational and regulatory systems, designed to satisfy national needs (Van Damme, 2001).

239

And the ruling of national governments onto universities is still in force nowadays (e.g. through grant system, scholarships, national accreditation agencies, etc.), although within Europe it is constrained and influenced by EU agreements.

Similar to universities, science, the engine of knowledge production, is also affected by the national-international dilemma. In the case of science, this dilemma, may be especially sharp, given that science is generated and developed in 'knowledge clusters' that are "locally embedded" – acting within nationally configured research centres and universities – (Maheu *et al.*, 2014: 169-70) but which aim at a global outreach of their production, an essential condition for their survival and success. This vicious-circled shape of the internationalisation of science evidences the paradoxes of this issue. The dichotomy national/regional-international is crystallised in the form of twofold influence forces (local and global), which are sometimes contradictory or opposed. On the one hand, research may be regarded as a factor related to 'nation-building', being "at the core of nation-state policies", but on the other hand, "a socially distributed knowledge-production system, extending across multiple countries to large arrays of sites, networks, and webs, paves the way to a globalized world" (Maheu *et al.*, 2014: 163). And the international-to-be university, which is managing the space between local and global, between national and international policies, is the framework in which the cases studied in this project find themselves and carry out their work as scientific actors. In the next section, the status of Spanish science as regards internationalisation will be presented.

4.3. The internationalisation of science in Spain

Science and technology in Spain are regulated by Law 14/2011, of June 1, on Science, Technology and Innovation. The *State Plan for Scientific and Technical Research and Innovation 2013-2016*, in force during the period corresponding to this study's data collection, was designed to facilitate the "achievement of the objectives and priorities included in the *Spanish Science and Technology and Innovation Strategy 2013-2020*" (Ministerio de Economía y Competitividad, MEC, 2012: 6-7). This strategy, in turn, aims at:

> ...boost[ing] the international leadership of the Spanish Science and Technology and Innovation System, ensur[ing] the sustainability of the capabilities of generation of knowledge and boost[ing] the competitiveness of the business fabric of our country [Spain] protected by a solid scientific and technological base and by innovation in all its dimensions" (MEC, 2012: 7; *my translation*).

Both the Strategy and the Plan make explicit reference to "Spain's commitment to participating in joint programming activities linked to the internationalisation of the local R&I system, as well as the identification of societal challenges" (European Union, 2017: 4). In order to achieve these objectives, the Plan is articulated in four *State Programmes* corresponding to one of the

Strategy's goals each: (1) promotion of talent and employability, (2) promotion of excellence, (3) boost of business leadership, (4) promotion of R + D + I oriented challenges of the society.

Regarding the two main topics of this study, the internationalisation of science and scientists' communication, the Plan aims at: (a) "Increas[ing] the quality of scientific and technical research to reach the maximum level of excellence and impact contributing to the international scientific and technological leadership of all the agents of the *Spanish Science, Technology and Innovation System*" (MEC, 2012: 8; *my translation*); (b) "strengthen[ing] the capacities and international leadership of institutions, centers and executing units of scientific and technical research"; (c) "[f]acilitat[ing] access to scientific and technological infrastructures and scientific equipment, with special reference to both national and international large scientific and unique technical facilities" (MEC, 2012: 9; *my translation*); and (d) "[p]romot[ing] the internationalisation of R & D & I activities of agents of the Spanish Science, Technology and Innovation System and their active participation in the European Research Space" (MEC, 2012: 11; *my translation*).

Additionally, the Plan's programmes and sub-programmes include a set of measures like (a) suplementary funding of projects of R+D+I developed in international collaboration (e.g. in the ERANETs and Joint Programming Initiatives (JPIs) of the Framework Program of the European Union), (b) actions to encourage international collaboration of agents of the Spanish Science, Technology and Innovation System and, especially, initiatives within the framework of *Horizon 2020*, and (c) actions involving the Joint International Programming to promote international performances, in particular with countries of the European Union (MEC, 2012: 18).

The internationalisation of (Spanish) science is present throughout the document through terms like 'international impact', 'international collaboration' and 'international leadership', which entail an international dimension of scientific communication. As stated in the document, the ultimate goal of the Plan is "to promote the scientific, technological and business leadership of our System at the international level and to increase the participation of Spanish institutions and companies in the Community initiatives and in programmes of the European Union..." (MEC, 2012: 11; *my translation*). Communication is mentioned in different parts of the strategic plan: (a) "the State Plan contemplates (...) the development of exchange and communication structures that facilitate the effective collaboration between the parties" (MEC, 2012: 10; *my translation*); (b) "The STATE PLAN has among its objectives to encourage and stimulate the rapprochement of science, technology and innovation to the citizens while shortening distances between the scientific and technological world and society in general" (MEC, 2012: 11; *my translation*); and (c) the Plan "will improve the communication and social dissemination

241

channels of existing science and technology and will promote the construction of a collective identity and image of Spain as an innovative country of science" (MEC, 2012: 12; *my translation*). The Plan also establishes the "procedures and channels of communication and information that guarantee adequate representation of the interests of all territories, their institutions and agents" (MEC, 2012: 53; *my translation*).

Besides the aforementioned legal framework, Spain takes part in several international scientific programmes and organisations that support Spanish scientists by making available to them these organisations' facilities for the development of their own projects, and their links with the business sector. The international R+D+I programmes in which Spain participates are usually focused on the European level. Some of these are: (a) the *Framework Programme* of the European Union for the promotion and support of R+D+I, (b) *ERA Nets*, – actions designed to develop a European research area –, (c) collaborative research programmes of the European Science Foundation (ESF) – a non-governmental organisation composed of 76 organisations from 29 European countries –, (d) *Science and Technology for Development (CYTED)* – the Ibero-American Programme on Science and Technology for Development –, (e) *European Cooperation in the Field of Science and Technology (COST)* – a funding organisation that promotes networking in research and innovation –, with the participation of 34 European countries, (f) the *European Conference on Molecular Biology (EMBC),* the *European Molecular Biology Organisation (EMBO),* and the *European Laboratory of Molecular Biology (EMBL)*, (g) the *EUREKA Programme* – an initiative to support international R & D cooperation in Europe, promoted in Spain by the PROFIT Programme –, and (h) the *European Space Agency* – an European organisation for cooperation in space research and technology.

As a result, Spain was in 2011 the 9th world scientific power, with 2.5% of all scientific publications, and above Switzerland and Austria in research quality (The Royal Society, 2011). In terms of scientific productivity, in 2014, Spain produced 3.4% of the world scientific production with 77,013 publications – holding the 10th position in the world ranking –, and 13.4% of excellence rate (FECYT, 2017). International cooperation of Spain is rated 44.7%[74]. At the European level, Spain held in 2012 the 5th position with reference to Government budget appropriations or outlays for research and development (GBAORD) (EC, 2014), with 6185.2 million euro invested, out of 90670.3 million euro in the EU; which in terms of GBAORD per capita corresponded to the 14th position. The number of researchers in Spain in 2011 was 220,254 out of 2,545,544 for the whole EU, which signified the 4th position among EU member states, but the 15th position regarding the number of researchers per 1000 of the active

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[74] The 'international collaboration percentage' indicates the % of published production generated out of cross-national institution collaboration. Source: Elsevier from data of Scopus (nov. 2015)

population. The same year, the number of non-EU doctoral students in Spain was 18% of the total population of doctoral students – the 8th position in the EU. In terms of publications, each researcher in Spain published 2.5 papers between 2000 and 2001, which signified the 16th position of the EU. Each of them published 0.4 itra-EU co-publications – 22nd position – and 0.3 extra-EU co-publications – 13th position. According to the 2016 report, Spain "is making progress in its overall performance towards the achievement of the European Research Area (ERA) but there remains room for improvement" (European Union, 2017: 3). There is still "relatively low participation rate of Spanish research and researchers in EU research programmes" (Perez-Encinas *et al.*, 2017: 66), which may be due to the lack of support instruments available.

Regarding the ERA priorities, reports in 2014 claim that (a) Spain's performance regarding 'An open labour market for researchers' is insufficient, although it had a higher annual growth for this indicator over the 2012- 2014 period than the EU-28 average; (b) in Spain there are low levels of institutional autonomy regarding human resources management in HE institutions; (c) in Spain there are high levels of unemployment affecting researchers (EU, 2017); (d) "there is further room for improvement in knowledge transfer endeavours", which, together with innovation policies, is a "significant policy trend recorded in recent years" (EU, 2017: 6); and (e) regarding 'International cooperation', Spain "showed strong growth over the 2005-2014 period" (EU, 2017: 7).

To revert the low rates in the internationalisation of Spanish science, Martínez Sierra and Álvarez Alonso (2017: 38) point out the need for (a) attraction of "international talent", (b) more "structural access" for researchers to "the world's leading research spaces" and (c) increased access to "sources of inputs for global research projects". Other suggested measures, affecting not only research but the IoHE more broadly, are: (a) strategic investments; (b) expanding and improving services and facilities; (c) focusing on developing relations beyond Europe, the United States and Latin America; (d) promoting Spanish as an academic lingua franca; and (e) insisting on the internationalisation of the curriculum and internationalisation at home (De Wit, Rumbley, & Vélez-Ramírez, 2017: 68). These are, indeed, measures that university managers in Spain are aware of and will probably be present in research policies in the coming years, if not decades. In the next section, the specific phenomenon of communication in science within the context of Catalan higher education, the immediate context of participants in this study, will be presented. Special emphasis will be placed in aspects of communication related to the IoHE. Before addressing this issue, a brief overview of the main characteristics of research in the Catalan HE system will be given.

4.4. Science communication in Catalonia

Catalonia, with a population of 7.5M in 2018, is an autonomous region of Spain, which has a population of 46.6M. Catalonia has seven state universities: the Autonomous University of Barcelona, the Polytechnic University of Catalonia, the Pompeu Fabra University, the University of Barcelona, the University of Girona, the University of Lleida, and the Rovira i Virgili University, besides the Open University of Catalonia – a privately managed online university offering public service –, with a total of 210,870 students overall, 15,363 teaching and research staff and 1,008 consolidated research groups (year 2012-13)[75]. Within Spain, Catalonia was the most funded region of the *Horizon 2020* programme in the period 2014-2016, with 552,2M€ funding, 480 participant entities (311 companies, 86% SMEs) in 1,047 research activities, of which 443 were led by them [76]. Among the 20 most significant funded entities in Spain that achieved the maximum return[77] between 2014 and 2017, there were nine universities, of which four were in Catalonia. The three most relevant universities in Spain according to their return were the Polytechnic University of Catalonia, the Pompeu Fabra University and the Autonomous University of Barcelona [78], all of which are Catalan. Regarding scientific productivity, Catalonia was the most productive region in Spain in 2013 and 2014, with more than the 39% of Spanish publications in both periods, 30,042 publications total in 2014.

The funding obtained in Catalonia in 2014 was distributed among the seven Catalan state universities as follows: University of Barcelona 83,692,224.93€ (28.9%), Autonomous University of Barcelona 60,983,115.25€ (21.1%), Polytechnic University of Catalonia 58,446,463.47€ (20.2%), Pompeu Fabra University 37,912,244.26€ (13.1%), Rovira i Virgili University 21,167,299.33€ (7.3%), University of Lleida 13,953,550.59€ (4.8%) and University of Girona 12,965,327.49€ (4.5%)[79]. In the year 2013-14, Catalonia hosted 15,067 PhD students, of whom 95.3% in state universities[80]. In 2014, there were 9,487 professors working at Catalan universities, 95.7% of whom were Spanish nationals, and 89.4% were working at state

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[75] Associació Catalana d'Universitats Públiques (ACUP). http://www.acup.cat/en/catalan-public-universities. [retrieved 05/03/2019]

[76] Spanish participation in Horizon 2020 (2014-2016). Provisional results from the Autonomous Communities.

[77] 'Return' refers to the budget allocated though competitive calls.

[78] Spanish participation in Horizon 2020. Provisional results (2014-2017)

[79] Source: Universitats i Recerca. Recursos Captats. http://universitatsirecerca.gencat.cat/ca/03_ambits_dactuacio/sur-en-xifres/Recerca/recursos-captats/. [retrieved 12/01/2019]

[80] Source: Universitats i Recerca. Global. http://universitatsirecerca.gencat.cat/ca/03_ambits_dactuacio/sur-en-xifres/Recerca/Doctorats/global/. [retrieved 12/01/2019]

universities[81]. That year, there were 441 senior researchers funded by internationally relevant grants, like ICREA, Beatriu de Pinós, Ramón y Cajal, Marie Curie and Juan de la Cierva.

Considering Readings' (1996) diverse university missions, in Catalan universities the confrontation of two missions of university (the traditional 'propagation of national culture' and the newer 'competition in the global market') is strong, since discourses of national identity are still currently used by many politicians at a national level (Catalonia), especially by those who pursue their aspirations of greater autonomy from the Spanish government. At the same time, universities are increasingly dependent upon sources of funding other than the Catalan-Spanish government to survive, which forces them to compete in the global knowledge market, and thus to focus on missions other than the propagation of national culture, like the pursuit of "excellence" (see Readings, 1996).

Excellence is precisely the main concern of the Agency for the Quality of the University System of Catalonia (AQU). It assesses the merits related to teaching, research and management of teaching and research staff employed and contracted by Catalan public universities, and validates their consequent additional remuneration. This is regulated by Law 1/2003, of February 19, of universities of Catalonia, and Decree 405/2006, of October 24th. This law relates directly HE excellence with the IoHE, by making explicit reference to the relevance of the IoHE for the Catalan university system:

> The internationalisation processes affect fully our university world and require well-defined policies and strategies in areas such as the quality of teaching and research, mobility of students and teachers, or convergence towards the establishment of a European space of higher education. (my translation) [82]

Furthermore, it claims to be founded on three pillars directly connected to the national context, internationalisation and quality and success:

> In the task of facing the new realities, this Law is based on three basic premises. First of all, on the existence of a Catalan university reality, heir to an intellectual, educational and scientific tradition that we own and that we call "university system of Catalonia". Secondly, on the will of this reality to fully integrate itself

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[81] Source: Universitats i Recerca. Global. http://universitatsirecerca.gencat.cat/ca/03_ambits_dactuacio/sur-en-xifres/Personal/PDI-i-Investigadors/global/ [retrieved 12/01/2019]

[82] "Els processos d'internacionalització afecten plenament el nostre món universitari i requereixen polítiques i estratègies ben afinades en àmbits com la qualitat de la docència i la recerca, la mobilitat dels estudiants i del professorat o la convergència cap a la constitució d'un espai europeu d'ensenyament superior". PRESIDÈNCIA DE LA GENERALITAT. LLEI 1/2003, de 19 de febrer, d'universitats de Catalunya. DOGC 3826 – 20.2.2003: 3326

into the European higher education area and to play a leading role in its construction. Finally, on excellence as an indispensable instrument for progress in all areas of university activity and, in particular, on teaching, research and the transfer of technology and knowledge. (my translation) [83]

The main aim of the Law is thus "to contribute to the construction of a deeply universalist university system and, in particular, Europeanist"[84]. With reference to internationalisation and language, the Law states:

> Internationalisation and mobility must be compatible with the maintenance of the presence of the cultural characteristics of Catalonia in the university and, in particular, of its language, which is also the language of Catalan universities. Any culture language needs to be alive and strong in higher education... (my translation) [85]

This fits with one of the 'objectives of the Catalan university system', as stated by the Law, that is, "[t]he incorporation of the Catalan language into all areas of knowledge and contribution to the process of normalising the scientific, cultural and social use of Catalan" (my translation) [86]. Other such objectives, related to the IoHE and/or communication in science, are: (a) "The promotion of scientific research, technological development and innovation", (b) "The promotion and evaluation of quality in teaching, research and the management of university services, in accordance with internationally comparable criteria and methodologies", and (c) "The coordination of actions to achieve the full integration of universities into the European

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[83] "En la tasca d'afrontar les noves realitats, aquesta Llei es fonamenta en tres premisses bàsiques. En primer lloc, en l'existència d'una realitat universitària catalana, hereva d'una tradició intel·lectual, educativa i científica que ens és pròpia i que anomenem "sistema universitari de Catalunya". En segon lloc, en la voluntat d'aquesta realitat d'integrar-se plenament en l'espai europeu d'ensenyament superior i d'assolir un paper protagonista en la seva construcció. Finalment, en l'excel·lència com a instrument indispensable de progrés en tots els àmbits de l'activitat universitària i, en particular, en la docència, en la recerca i en la transferència de tecnologia i de coneixements". PRESIDÈNCIA DE LA GENERALITAT. LLEI 1/2003, de 19 de febrer, d'universitats de Catalunya. DOGC 3826 – 20.2.2003: 3326

[84] "Aquesta Llei pretén contribuir a la construcció d'un sistema universitari profundament universalista i, en particular, europeista." PRESIDÈNCIA DE LA GENERALITAT. LLEI 1/2003, de 19 de febrer, d'universitats de Catalunya. DOGC 3826 – 20.2.2003: 3326

[85] "La internacionalització i la mobilitat han d'ésser compatibles amb el manteniment de la presència de les característiques culturals de Catalunya a la universitat i, en particular, de la llengua pròpia, que és també la llengua pròpia de les universitats catalanes. Tota llengua de cultura necessita ésser viva i forta a l'ensenyament superior..." PRESIDÈNCIA DE LA GENERALITAT. LLEI 1/2003, de 19 de febrer, d'universitats de Catalunya. DOGC 3826 – 20.2.2003: 3327

[86] La incorporació de la llengua catalana a tots els àmbits del coneixement i la contribució al procés de normalització de l'ús científic, cultural i social del català. PRESIDÈNCIA DE LA GENERALITAT. LLEI 1/2003, de 19 de febrer, d'universitats de Catalunya. DOGC 3826 – 20.2.2003: 3328

higher education area and promote the Universities of Catalonia in Europe and in the world" (my translation) [87].

As can be noticed, the presence of the Catalan language in Catalan HE institutions is the most explicit reference to communication in the Law. This aspect, language policy in Catalan universities, is widely addressed by Pons Parera (2015), whose considerations will be summarised in what follows.

As Pons Parera (2015) points out, Catalan universities have autonomy as regards their language policy (language use in internal and external official communication). This is regulated through individual charters of each institution. However, as the author argues, the Spanish language has an advantageous position, due to the control by the central (Spanish) government of the university recruitment system, a centralised student mobility system and a funding system that do not have any deference for minority languages of Spain. Yet, Catalan is the main language used in Catalan universities, and favoured by these institutions, both in administrative and educational activities. The use and protection of Catalan is a concern in these institutions, but any student or citizen has the right to use either of the official languages of Catalonia – Catalan and Spanish – in her communications. There is a third official language in Catalonia since 2010, Aranese, but its presence and status in HE and in Catalonia is still very limited.

Pons Parera (2015) acknowledges that there is also a growing concern in these institutions' language policies as regards internationalisation. This is reflected by some references to the use of third languages in 'international' academic activities. The third language is mostly identified with English and hence the 'multilingual' model for Catalan universities consists in the coexistence of these three languages: Catalan, Spanish and English. This is evidenced, for instance, in some goals for universities established by the Catalan government, like fostering linguistic transparency –e.g. by declaring the language used in classes–, encouraging the learning and use of Catalan by foreign students and academic staff, and of English by academic and administrative staff. Moreover, establishing multilingual plans in Catalan state universities has been a condition for funding allocation by the Catalan government. Pons Parera (2015) remarks that universities' strategies as regards language management are caught between two

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[87] "El foment de la recerca científica, el desenvolupament tecnològic i la innovació", "El foment i l'avaluació de la qualitat en la docència, la recerca i la gestió de serveis universitaris, d'acord amb criteris i metodologies equiparables internacionalment", "La coordinació d'accions per a assolir la plena integració de les universitats a l'espai europeu d'ensenyament superior i promoure les universitats de Catalunya a Europa i al món". PRESIDÈNCIA DE LA GENERALITAT. LLEI 1/2003, de 19 de febrer, d'universitats de Catalunya. DOGC 3826 – 20.2.2003: 3329

aims: (a) fostering Catalan and (b) introducing a multilingual profile to fit with the demands of internationalisation.

As regards research, Pons Parera (2015) identifies two strong factors that condition language use: on the one hand, Spanish centralised institutions and systems –like granting systems, Spanish centralised professional careers, etc.– favour the use of Spanish language; on the other hand, the promotion of European and international engagement of scientists –also through international conferences and transnational research projects– by the Catalan government fosters the use of English. Furthermore, scientists' qualification system in Spain is mainly based on citation index impact factors, which again favours research written in English. The number of doctoral dissertations written in Catalan (25% in 2012) is steadily decreasing, despite the Catalan governments' line of financial support for this type of works, while those written in Spanish stay stable and those written in English are increasing. The Catalan government also supports some Catalan scientific publications and Catalan universities support works written in this language by means of their own publishing services. Despite this, private publishers are more prone to works written in Spanish in pursuit of wider markets of Spain and Latin America.

Regarding language policy in Catalan science, Pons Parera (2015) also cautions about the following problems: (a) within the EAHE, "the messages in favour of multilingualism are often directed to favour the spread of English as a lingua franca which facilitates mobility within the European area" (Pons Parera, 2015: 175); (b) "young researchers conceive as a necessary condition for their academic career a good knowledge of English" (Pons Parera, 2015: 175); (c) English is conceived as "a lingua franca for the dissemination of knowledge in a vast number of scientific communities" (Pons Parera, 2015: 175-6); and (d) "[t]he management of the linguistic impact of EAHE (...) has led to a more central role for linguistic policy in the governance of universities through new instruments of language planning and management through objectives" (Pons Parera, 2015: 177).

Another work dealing with language policy in Catalan research institutions is Vila *et al.* (2012), which provides a report on the languages used in the Scientific Park of Barcelona. The study concludes that (a) Spanish and Catalan are predominant within the Scientific Park; (b) plurilingual practices (Spanish, Catalan, English) are usual; (c) these languages have slightly different uses: Catalan for internal communication, institutional communication and administrative transactions, and external communication with locals, English as an international language for external communication within the scientific domain, and Spanish has a hybrid use, sharing some traits with each of the other two languages –it is used for some external communications, especially within Spain, and internal communications, especially with foreign

researchers, who tend to learn Spanish probably due to the scarce presence of English in the Catalan society–; and (d) English is the preeminent lingua franca in conferences, even in national ones, and in written scientific papers.

The current study is thus framed within the context of Catalan HE institutions, which are increasingly called to meet the requirements of internationalisation, and which, regarding communication in science, have reflected this process through language policy plans that deal with the dilemma of supporting the local language(s) and at the same time embracing multilingualism and especially the preeminent international language: English.

While generalised, the IoHE is not homogeneous. Countries and universities find themselves at different points of this "complex, multidimensional and often fragmented process" (Frolich & Veiga, 2005: 169). And factors such as the foundation context, the maturation, the geographic location and the characteristics of universities still play an important role in this race towards internationalisation (Delgado, 2017). In Spain, the IoHE may be "more of an unintended consequence born of underdeveloped planning, review, and reinforcement activities than a result of purposeful strategies for internationalization" (Rumbley, 2012: 219). In order to shed light on this disorderly phenomenon, and to contribute to its future coherent evolution, research like the current study, coming from multiple places, contexts and institutions, is needed. As regards communication in science, Catalonia may be an interesting setting due to the existing sensitivity for language policy at all levels of higher education, which is explicitly and repeatedly connected with the IoHE, combined with the neglect of other aspects of communication, as will be argued in following chapters of data analysis.

Chapter 5: Analysing the research group (RG) as a community of practice (CoP)[88]

This chapter will tackle some aspects related to what for Fairclough (1989; 1995) constitutes the second dimension of discourse analysis, here the 'meso' level, which focuses on the consumption, production and distribution of texts, in an attempt to answer the following research sub-question: *In what ways do the RGs studied constitute CoPs?* This may validate the theoretical model chosen and provide tools for the analysis of communication within the RG-CoP, if such correspondence is proved. To this end, in this chapter, data will be analysed drawing mainly on the CoP theory. As has been explained in chapter 2, this, together with the EoC, may serve as pivotal approaches, mediating between the micro and the macro dimensions, that is, between the analysis of the form of particular texts produced within the research groups studied (micro dimension), and the analysis of broader socio-cultural issues related to scientists' communication (macro dimension). Ultimately, the analysis of the data at this level should contribute to answering, at least partially, the main research question: «In what ways does the process of the internationalisation of higher education that prevails nowadays influence scientists' daily communication?».

The concept of the *community of practice* allows us to approach the RG as a 'learning community' and to regard communication as one of the mechanisms that a group of people has at its disposal to reproduce itself and to develop its social function. As has been explained in detail in chapter 2, Lave and Wenger's (1991) notion of a CoP identifies a social grouping regarding its members' common practice instead of the shared characteristics of the individuals – like mother tongue, age, nationality, etc. – or their co-presence (Eckert, 2006). Consequently, the CoP perspective allows us to get a holistic idea of communicative and social phenomena taking place in the daily practices of individuals as well as to explore aspects that come up as significant within the group and that are thus shared concerns by its members.

Hence, this theoretical model offers a framework based on collectives whose members are connected by their practice and mutual relations, which fits in the definitions of some institutionally-recognised professional clusters within European HE, like research groups. These collectives, composed of pre- and post-doctoral researchers, constitute a domain of professional and often personal relations, but the extent to which a RG like the ones studied here constitutes

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[88] This chapter has been partially published in Torres-Purroy, H., & Mas-Alcolea, S. (in press). Applying the community of practice theory in higher education: the case of the research group. In J. Huisman & M. Tight (Eds.), *Theory and Method in Higher Education Research* (provisional title). Emerald.

a CoP remains uncertain. For this reason, an effort will be made in this and in the subsequent analytical chapters to, first, check the suitability of the CoP model to study RGs and, secondly, analyse their multimodal communication policy.

Considering the three types of groups of language users identified by Devitt (2004: 42-44): (a) communities – "groups of people who share substantial amounts of time together in common endeavours" –, (b) collectives, – groups that "form around a single repeated interest, without the frequency or intensity of contact of a community" – and (c) social networks – which consist of a person "knowing another person, who knows another person, who knows another person", the RGs studied in the current project correspond to the first one: communities. Most group members, especially those who usually worked in the laboratory, spent a lot of hours in the same space, sharing machinery, tools and materials, as well as conversations and other types of interactions. However, not all 'communities' constitute CoPs. As Wenger (1998: 122) suggests: "Some of these configurations fit the concept of community of practice squarely, some are more or less marginal cases, and some really stretch the idea". The extent to which the two cases studied here match with the CoP model will be discussed in this chapter.

The RG, understood as a group of scientists that relate to one another, communicate and cooperate in the pursuit of the development of a scientific field[89], fits with the definition of a CoP as a cluster of individuals "who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger, McDermott & Snyder, 2002: 4). Furthermore, apart from this general definition, and as has been already pointed out in chapter 2, a set of defining characteristics of CoPs have been proposed, some of which seemed to be met *a priori* by the RGs studied here. It will be our endeavour in the following sections to examine to what extent these characteristics are actually present in the RGs, for which data analysis will be carried out to confirm, qualify or reject the assumption that the CoP theory is a useful construct for the exploration of RGs.

The present chapter is structured in five sections. Sections 5.1 to 5.3 will explore the extent to which three dimensions through which the relationship between 'practice' and 'community' has been established in the CoP theory are present in the participant RGs. These are *mutual engagement* (section 5.1), a *joint enterprise* (and/or a *domain*) (section 5.2) and a *shared repertoire* (section 5.3). Section 5.4 will be devoted to analysing the *practice*, *boundary objects*

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89 AGAUR explicitly supports "groups that carry out research in Catalonia in order to promote their activity and the scientific, economic and social impact, as well as promote the international dissemination of their research". http://agaur.gencat.cat/ca/beques-i-ajuts/convocatories-per-temes/Ajuts-per-donar-suport-a-les-activitats-dels-grups-de-recerca-SGR-00001 [retrieved 20/01/2020]

and *brokering* of the RGs studied. And finally, section 5.5 will present a discussion of the findings in the light of the related literature, as well as some concluding remarks.

5.1. Mutual engagement within the RG-CoP

Mutual engagement designates group members' common engagement in actions with negotiated meanings, including actions, relations, knowledge and negotiation. In the case of RGs, mutual engagement of group members is presupposed from the moment of the inception of the RG. The configuration of a RG implies the existence of sustained mutual relationships and shared ways of engaging in common enterprises, at least among some of its members. There are in the data multiple examples of these regarding the two main cases studied, though with nuances.

Both groups had periodical group meetings where (supposedly) all members shared a space, a common endeavour of sharing their knowledge and solve others' problems or doubts, and thus of making their group, their laboratory and their projects progress. The laboratory was a space where most group members used to spend most of their time at work, and in which they occasionally and mutually engaged in common practices, like doing experiments, solving doubts, teaching techniques to one another, or even chatting while having a coffee. This implied their sustained interaction around a practice, which taken to its simplest form could be formulated as 'doing science'.

However, not all group members used to interact symmetrically: they had specific bonds to one another, not equal with all co-members. Besides the general will of contributing to their field and to the RG, some group members had shared sub-interests that were not shared with others. Within the two RGs studied there were multiple projects in which only some of the members were involved. These projects were related to either a specific object of study, to a specific aim, or to a combination of both [see excerpt 3], and this joined some group members whose project shared some of these aspects.

Excerpt 3: Interview with Hao [Senior researcher – Group A] - 'we have independent projects'

> **Researcher:** What is the group's structure/
>
> **Hao:** We have Frank [Group leader] and Cecília [Senior researcher] and Vince [Senior researcher] and me\ +eh+ we have inde& **we have independent projects**\ you know/ We have projects\ For example_ me * +eh+ me really respond for the·· [object of study 1] and [object of study 2]_ and [object of study 3]_ and [object of study 4]_ and [object of study 5]\ And Cecília mainly responds for the [object of study 6] to neutralise [confidential] and [confidential]\ And Vince is mainly for the [object of study 7]_ And Frank responds for the·· [object of study 8]_ and also for the [object of study 9] for [confidential]_ and also for the·· [confidential]\
>
> **Researcher:** So they are independent projects\
>
> **Hao:** Yeah\ **Independent projects\ But of course the technique is +eh···+ shared\ Some main technique is shared**
>
> **Researcher:** So you can help Cecília_ for instance_ or Frank with a technique you =know better_=
>
> **Hao:** =Yeah\=
>
> **Researcher:** =or something like that\=
>
> **Hao:** =But also= of course Frank mainly knows all the things we always * and we know each other for * fo··r each people's project_ **then for each * each project we have·· one or two or th& th& * or three PhD students to carry out work** Yeah\

This excerpt illustrates how mutual engagement among members of Group A was not homogeneous. They had 'independent projects', among which PhD researchers were distributed, and thus not all activities in the group involved all members and not all members engaged equally in them. Although there were common 'techniques' among lab workers, the existence of common objects of study among some members only but not among all group members triggered selective interactions, usually related to the teaching of such techniques and to problem solving [see excerpt 4].

Excerpt 4: Interview with Tània [PhD researcher – Group A] – 'the doctorate is a very individual thing'

Tània: The period that I have been here doing experiments_ you see_ **the doctorate is a very individual thing**\ I mean_ there are indeed times when they intersect and you can profit from one another_ but **normally everyone has his or her own job**\ I_ since I did not need them_ at any time_ I mean_ from them_ directly_ well_ from Pili_ yes\ but_ no·· (...)	**Tània:** El temps que he estat aquí fent experiments_ ja ho veus_ **el doctorat és una cosa molt individual**\ vull dir_ sí que hi ha vegades que es creuen i es pot aprofitar un de l'altre_ però **normalment cadascú té la seua feina**\ jo_ com que no he necessitat d'ells_ en cap moment_ Vull dir_ així d'ells_ directament_ bueno_ de la Pili_ sí\ però_ no·· (...)
Researcher: Then_ contact at a professional	**Investigadora:** O sigui_ contacte a nivell
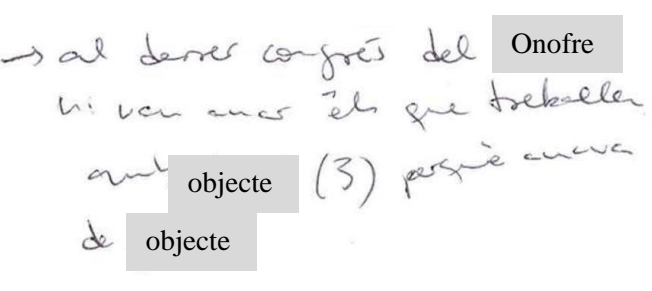
level_ let's say_ you have had it basically with Frank\	professional_ diguéssim_ has tingut bàsicament amb el Frank\
Tània: Professio& * no_ well_ of course_ also * I mean_ **Pili_ for instance_ the chemist of the group_ well she used to help me understand things fro··m [object of study]** she also helped me **do some extractions_ some experiments** to see the levels of [object] in [object]_ of course_ this was also_ a scientific feedback\ what else/ **Diana with the [technique 1]_ Esme_ I also helped her do [technique 1]_** what I had been taught there I taught her_ and what she had been taught in London_ she taught me_(...) **Pili_ with Lian** we had also talked about things\ **we have done some [technique 1] together also_** …	**Tània:** Professio& * no_ a veure_ clar_ també * vull dir_ **la Pili_ per exemple_ la química del grup_ [doncs] m'ajudava a entendre coses de··ls [objecte d'estudi]** ella em va ajudar també **a fer uns * unes extraccions_ uns experiments** per veure el nivells de [objecte] al [objecte]_ clar_ això també_ va ser un feedback per mi científic\ què més/ **la Diana amb els [tècnica 1]_ l'Esme també la vaig ajudar a fer [tècnica 1]_** lo que a mi m'havien ensenyat allí li ensenyava a ella_ i lo que a ella li havien ensenyat a Londres_ m'ho ensenyava a mi_ (...) **la Pili_ amb la Lian** també havíem parlat de coses\ **hem fet algun [tècnica 1] també juntes_** ...
	[original in Catalan]

In this excerpt, Tània justifies the selective interactions among group members attributing them to a shared research topic, and describes how the teaching of techniques and the solving of doubts related to them triggered interactions with specific group members.

Also in Group B the object of study appeared as one reason for particular relationships among group members [see excerpt 5].

Excerpt 5: 20140123_Field notes (Page 8) – 'To Onofre's last conference…' [PhD student - Group B]

«To Onofre's last conference went 'those who work with [object of study]' (3) because it was about [object of study]»	[original in Catalan]

According to this excerpt, having a common object of study facilitated the participants' mutual engagement in attending conferences and the consequent interactions in this event. In this case,

only the three group members who were working on a certain object of study attended the conference.

In both research groups, most group members were PhD students who had an individual PhD project under the supervision of one or two senior researcher/s. In the case of Group A, the group leader was the *de facto* main supervisor of all students. In Group B, all senior researchers were immediate supervisors of some students, and the group leader was also the final supervisor of all projects. Carrying out a successful PhD project was a reason for the mutual engagement of dyads of group members in a relation of supervisor-supervisee [see excerpt 6].

Excerpt 6: Interview with Mara [PhD researcher – Group A] - 'getting adequate results has to do with getting along well with your hirer'

Researcher: Is it a matter of culture/ So to say/	**Ερευνήτρια:** Είναι λόγω της κουλτούρας/ Ας πούμε/
Mara: I don't know if it's in the culture or if it's in whatever else\ But I believe that **a very very important part of getting adequate results has to do with getting along well with your hirer**\ I mean that you have a similar way of thinking\ With my supervisor in the MA we had nothing to do\ (…)	**Μάρα:** Δεν ξέρω αν είναι μέσω κουλτούρας ή αν είναι μέσω οτιδήποτε\ Αλλά πιστεύω **πολύ πολύ σημαντικό μέρος του να έχεις το σωστό αποτέλεσμα είναι το να τα βρίσκεις με τον εργοδότη σου**\ Δηλαδή να σκέφτεστε πάνω κάτω στο ίδιο μήκος σχήματος\ Με τον καθηγητή μου στο μάστερ ήμουνα * ήμασταν άλλα αντ' άλλα\ (...)
Researcher: So from this perspective_ you are satisfied with Frank =since= *	**Ερευνήτρια:** Και από αυτήν την άποψη_ είσαι ευχαριστημένη τότε με τον Φρανκ =επειδή= *
Mara: =Of course\= Of course\	**Μάρα:** =Εννοείται\= εννοείται\
Researcher: What was this chemistry between you and him like/	**Ερευνήτρια:** Πώς ήταν αυτή η χημεία μεταξύ σας/
Mara: If this didn't exist_ I believe I wouldn't have * I don't know whether this existed only with me\ I don't * don't think so\ I can't tell\ but he was there at every step_ a··nd okay_ in the end he was very busy\ he wa··s * he wasn't there for no one\	**Μάρα:** Αν δεν υπήρχε αυτό_ πιστεύω δε θα είχα εγώ * δεν ξέρω αν είναι μόνο σ' εμένα\ Δεν * δε νομίζω\ Δεν μπορώ να το πω αυτό\ Αλλά ήταν εκεί σε κάθε βήμα_ και··· εντάξει_ στο τέλος είχε πολλά πράγματα να κάνει\ ήτανε·· * δεν ήτανε σε κανέναν\
	[original in Greek]

According to Mara, a good relationship between the supervisee and the supervisor was 'important' for results, for which their mutual engagement was needed. The data analysis suggests that mutual engagement may be role dependent. Certain roles probably implied

engaging in common practices with most members (e.g. group leaders regularly interacted with most group members, as did also lab technicians), while others involved mainly individual work (e.g. PhD students devoted most time to their individual PhD project: in the lab when doing experiments, when writing their dissertation, etc.). As a consequence, the dilemma individual-collective work emerged in most participants' interviews, as can be observed in the following excerpts [7, 8, and 9]:

Excerpt 7: Interview with Pere [Group B's leader] – 'each one has been assigned a task'

Researcher: The task is very individual\ there is little ·· (...) = there is not s& = interaction\ right/	**Investigador:** La tasca és molt individual\ hi ha poca·· (…) = no hi ha ta& = interacció\ no/
Pere: Well_ because **each one has been assigned a task_ and a project_ and a thesis or a line of work** somehow\ right/ which can indeed be in combination with the other things_ but +uh+ **it's her work** so_ she goes on with it and has * and has work to do\	**Pere:** A veure_ perquè **cada un té encomanat una tasca_ i té encomanat un projecte_ i té encomanat una tesi o una línia de treball** d'alguna manera\ no/ que sí que pot estar en combinació amb lo altre_ però +eh+ **és la seva feina** [llavors]_ ho tira endavant i té * i té feina a fer\
	[original in Catalan]

Excerpt 8: Interview with Frank [Group A's leader] – 'There is a community'

Researcher: But then_ if you give them this idea of you * you are on your own_ **you work for yourself_** then how do you **create this idea of community/** This idea of being part of a * of a whole_ of a research team/

Frank: Well_ well_ this has two facets\ **There is a community_ but each member of the community has to be an individual as well** Because **they have their own project_** which is independent from everybody else's\ And_ in the end_ even though **they are part of the community_** and they cooperate_ at the same time they compete\ So **they have to compete_ and they have to cooperate at the same time** And it's all a matter of balance\

Excerpt 9: Interview with Vince [Senior researcher – Group A]- 'It's individual but…'

Researcher: So you think that your work_ or the scie& * the work of a scientist_ let's say_ is individual/ or collective/	**Investigadora:** Així tu creus que la teva feina_ o la cie&* la feina del científic_ diguéssim_ és individual/ o col·lectiva/
Vince: No_ I···t's * it's both\ it's both\	**Vince:** No_ És··· * és les dos\ és les dos\
Researcher: +mhm+ so_ why both/ you have like your line or your research_ which is individual_ bu·t	**Investigadora:** +mhm+ o sigui_ per què les dos/ tu tens com la teva línea o la teva investigació_ que és individual_ però·
Vince: Well_ **It's individual but you need**	**Vince:** Aviam_ **És individual però**

others to· * to help I mean_ I··· XXX I have my girlfriend_ who is·· at the [research institute]_ right/ and she works * I mean_ I kno& know the people there very well_ and the world works like this\ they help each other\ this is how it works\ @ @	**necessites els altres per· * per ajudar** Vull dir_ jo··· XXX tinc la meva nòvia_ està·· a [institut de recerca]_ no/ i ella treballa * vull dir_ jo cone& conec molt bé la gent d'allà_ i funciona així el món\ s'ajuden entre ells\ és així\ @ @ [original in Catalan]
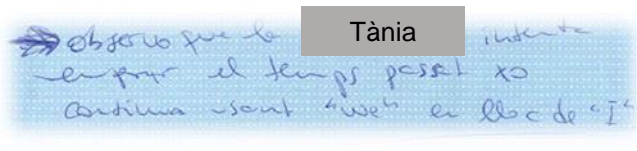
Both group leaders [excerpts 7 and 8] made reference to the individuality of group members' work, marked by an individual project: 'it's her work' (Pere); 'they have their own project' (Frank). But there was also a sense of community or collectivity, as reported by Frank: 'they are part of the community' [excerpt 8]; and Vince: 'you need others to· * to help\' [excerpt 9].

The tension between individuality and collectivity was also made evident by the participants' hesitation between the use of the forms 'I' and 'we' in their reports of past work [see excerpts 10 and 11].

Excerpt 10: Tània's PhD defense rehearsal 1 [PhD researcher – Group A] – 'this is your thesis'

Frank: Just to clear out one thing_ Tània_ Remember_ this is your thesis\ So don't use we\ use I\

Tània: +mhm+

Frank: Okay/ It makes it easier\

Excerpt 11: 20140718_Field notes_Tània's PhD defense rehearsal 1 [PhD researcher – Group A] – 'continues to use "we"'

«I observe that Tània tries to use the past tense but continues to use "we" instead of "I"»	 [original in Catalan]

As can be observed in these excerpts of the first rehearsal of Tània's PhD defense in front of her group peers, mutual engagement emerged unconsciously and seemed to be difficult to erase even when the formality of the communicative event required so and despite the suggestions of

the group leader and of other group peers. Tània could not get rid of the use of 'we' even in her actual PhD defense.

Mutual engagement appeared also to be related to participants' status. Senior researchers had their own meetings [see excerpt 12], and 'lab workers' – mainly PhD students in both RGs – used to engage in lab activities with one another.

Excerpt 12: Interview with Hao [senior researcher – Group A] – 'And sometimes we have informal talks'

> **Researcher:** Do you ever meet the four of you [the three senior researchers and the group leader] to have your own meetings_ to see how you're working_ or how you organise *
>
> **Hao:** Yes\ Yes\ Yes\
>
> **Researcher:** So_ they are different from the other lab meetings\ or * =or seminars\ You have your own=
>
> **Hao:** =Yes\ Yes\ Yes\ That's right\= Yes\ It's very often\ Yes\
>
> **Researcher:** Very often\
>
> **Hao:** Yeah\ Yeah\ Yeah\ Yeah\ Yes\
>
> **Researcher:** How often_ more or less/
>
> **Hao:** +uh+ Every * I think_ **every month_ I think we have** Yeah\ Yeah\
>
> **Researcher:** Once a month\
>
> **Hao: And sometimes we have informal talks** Yeah\ **to discuss**\ Yeah\
>
> **Researcher:** Where do you meet_ usually/ Where/ Here/
>
> **Hao:** Yeah\ In the lab or in the + here * is * in the meeting room\ Yeah\
>
> **Researcher:** +Ah+ Okay\ Because I've never seen so far Cecília and Vince in the * in the lab\ =working in the lab\=
>
> **Hao:** =@@= At the beginning * @@@ =yeah\=
>
> **Researcher:** =nor= Frank\
>
> **Hao:** Yeah\ At the beginning they worked in the lab_ but now Cecília is very busy with a lot of stuff\ For * for example_ for the·· +uh+ project reports_ and also·· +uh··+ the management of the·· financial_ and also·· a lot of stuff for the * like +uh+ * like the foreign students_ for to apply for visa_ and some others\ A lot of work\ And also for the com& com& * +uh+ for the media\ for to· * to· * to· * +uh+ how to say/ to communicate with the public_ and also·· to the government officer_ to * to· explain our projects\ and for * for example_ the people afraid of [confidential]_ and the * maybe to some· * +uh+ maybe to explain our +uh+ +uh+ +uh+ our opinion to make sure to * to·· educate also the high school students or * or some more other [confidential]_ let them know that [confidential] can give us +uh+ very good benefits\ (...) And also Vince now a lot of teaching\ therefore no so many time to work in the lab\ Therefore now_ mainly_ I work with * {(@) in the lab\ and Frank is the manager of things_ and everything_ teaching_ and communication_ and work_ and also Frank has a lot of social activity in * in the world_ and in Europe\

In this excerpt, Hao confirms that Group A's senior researchers and the group leader meet at least monthly, despite the diversity of their tasks. Apart from their status as senior researchers that brought them together in monthly meetings, this task specialisation, as described by Hao, hindered a tighter mutual engagement among them. They worked for the group but separately and in collaboration with one another at the same time. In this vein, Cecília herself draw a

diagram of the RG with four core pillars, each of which was constituted by one senior researcher (Cecília herself, Vince and Hao) and the group leader (Frank) [see picture 1].

Picture 12: Diagram of Group A drawn by Cecília [senior researcher]
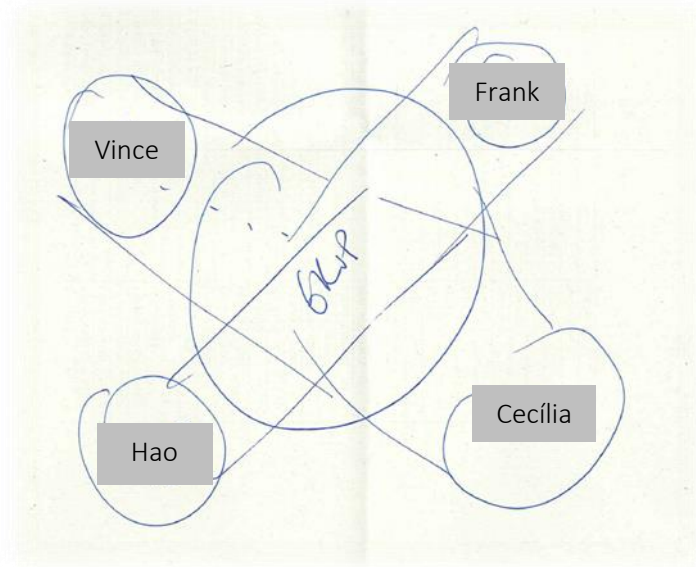
In contrast, mutual engagement seemed to be especially present at the initial stages of individuals' scientific career, during their first induction into laboratory activities and other group events. At this stage old-timers' know-how was transferred to newcomers, and the latter were thus very dependent on the former. In both RGs, the transfer of know-how took place through a mentoring system whereby an old-timer was assigned a newcomer and became her mentor in the lab, as well as in the institution and in the city, if necessary. As the individual scientist became more expert, she was less dependent on mutual engagement in the lab and became autonomous on a daily basis; she was more capable of conducting individual work and expected to do so. This emancipatory process was referred to by Diana [see excerpt 13].

Excerpt 13: Interview with Diana [postdoc, former group member – Group A] – 'you don't know very well what you have to do'

Diana: ... you see in the group that the PhDs there [in the current RG] are not so followed_ they don't have so much the figure of·· * that **they are more controlled_**	**Diana:** ...veus al grup que els PhD allí [al RG actual] no estan tan seguits_ no tenen tant la figura de··l * **que els hi controlin més_**
Researcher: But here [in Group A] did you feel that you were controlled/	**Investigadora:** Però aquí [al Grup A] tu notaves que estaves controlada/
Diana: No\ not controlled\ I mean you can always ask Frank or something\ He'll always help you\	**Diana:** No\ controlada no\ És a dir que sempre pots preguntar al Frank o així\ Sempre t'ajudarà\

Researcher: +mhm+ There not so much\	**Investigadora:** +mhm+ Allà no tant\
Diana: Not so much\	**Diana:** No tant\
Researcher: And that's good or bad/ What do you think/ For them\	**Investigadora:** I això és bo dolent/ tu què creus/ Per ells\
Diana: I think **when you're doing a PhD it's not good\ because since you're starting_ you don't know very well what you have to do** You understand/ You don't know how * I don't know if it's the same with your research_ but in a laboratory you need someone to * guide you_ too\ right/ Obviously_ **when you do a postdoc I guess you don't * you don& * that's not that important**	**Diana:** Jo crec que **quan estàs fent un doctorat no és bo\ perquè com que comences_ no saps molt bé què has de fer** Entens/ No saps com * no sé si amb la teva recerca és el mateix_ però en un laboratori tu necessites algú que et * que et guiï_ també\ no/ Clar_ **quan fas un postdoc suposo que no * no te& * no és tan important això**
	[original in Catalan]

In this excerpt, Diana synthesises the idea that learning in the RG, that is, the evolution from PhD (newcomer) to postdoc (old-timer), goes hand in hand with more or less dependence on guidance. However, in this case, after doing her PhD in Group A, Diana was doing a postdoc abroad, in a different RG. In this case, reduced dependence on guidance was due to the fact that she was an old-timer in her field of study and not in her new RG.

Apart from the mentoring practice, the sharing of a common space, as was the lab for lab workers, facilitated their mutual engagement with one another [see excerpt 14].

Excerpt 14: Interview with Xènia [BA Student – Group A]_ 'being it so small_ you either talk to the one next to you {(@) o··r} [it's too] bad\'

Xènia: Here [in Group A's lab] there are more * that is_ people kind of communicate with each other more\ yes\ (...)	**Xènia:** …que aquí [al lab del Grup A] hi ha més * o sigui_ la gent com a que es relacionen més entre tots\ sí\ (…)
Researcher: Do you think that the space could have anything to do with that? The fact that it's =a bit small=	**Investigadora:** Creus que hi pot tenir a veure l'espai/ que al ser =una mica petit=
Xènia: =Well_I think= so\ I think that **being it so small_ you either talk to the one next to you {(@) o··r} [it's too] bad** Yeah_ there [in her previous lab], the * in fact the computer desks_ there were three of them at one end of the lab_ three at the other_ and they were * they were separated\ you only had one person next to you at the most\ And **the bosses were in * in the same area as the * as the doctoral students_ and so**	**Xènia:** =Home_ jo crec= que sí\ que **al ser tan petit_ o parles amb la del teu costat {(@) o··} o malament** Sí_ allà [al seu anterior lab] la * és que de fet les taules del * així de l'ordinador_ n'hi havia tres en una punta del laboratori_ tres a l'altra_ i estaven * estaven separades\ Només tenies una persona al costat com a molt\ I **els jefes estaven a * a la mateixa zona que el * que els**

on\	**doctorands_ i així**
Researcher: And what difference does it make/	**Investigadora:** I això què fa diferent/
Xènia: I_ for example_ used to have breakfast with my boss\ Every day I used to have coffee with her	**Xènia: Jo_ per exemple_ anava a esmorzar amb la meva jefa\ Cada dia anava a fer el cafè amb ella**
Researcher: This fosters more interaction_ maybe\	**Investigadora:** Això facilita més la interacció_ potser\
Xènia: Yes\ In fact I still meet her having a coffee and we stay there talking\ Yes\ Yes\ It does foster [the interaction] more\ (…) **And [the fact] that from time to time she used to go to the lab and did something** Like Hao_ who from time to time he does something **and is around** Well_ more or less like this\	**Xènia:** Sí\ De fet encara me la trobo pel carrer fent un cafè i ens estem xerrant\ Sí\ Sí\ Facilita més [la interacció]\ (…) **I que també anava al laboratori i feia * de tant en tan feia algo** Tipo el Hao_ que de tant en tant fa algo **i està per aquí** Doncs_ més o menos així\
	[original in Catalan]

In this excerpt, Xènia explicitly attributes her good and close relation with her former boss to their co-presence in the lab. In the case of Group B, the existence of a restroom or lunch area next to the lab facilitated group members' mutual engagement also during breakfast or lunch breaks. In the case of Group A, the lack of such a space and the scarcity of opportunities to mutually engage in such activities among all group members was compensated to some extent by several extra-lab activities, some of which were planned or established by the group leader, while others arose more spontaneously [see excerpts 15 and 16].

Excerpt 15: Interview with Frank [Group A's leader] – 'three times a year I cook for the group'

> **Researcher:** Do you have any other strategies **to keep the group together/** Or do you have either some party_ or some * do you organise things together/
>
> **Frank:** Yes\ Yes\ We do\ +Ehm+ **three times a year I cook for the group** (…) +Ehm+ another occasion is in spring\ When the almonds are in flower_ **we have** a lab seminar in the fields and we have a picnic\ (…) And then in the summer **we have** a barbecue in the fields\ and we do that in probably July_ June or July\

Excerpt 16: Interview with Carol [PhD researcher – Group A] – 'Frank used to organise a lunch with every& everyone twice a year'

Researcher: Are there things * other things that you feel help in the cohesion of the group/	**Investigadora:** Hi ha algunes coses * altres coses que tu sentis que ajuden a cohesionar el grup/
Carol: I don't know\ +uh+ **Before we used to * maybe Frank * Frank used to**	**Carol**: No sé\ +mh+ **Abans fèiem * potser el Frank * el Frank feia un parell de**

organise a lunch with every& everyone twice a year\ we went to the almond [trees]\ or that thing with the turkey @ then * well_ you spend the day together and this unites us\ right/ I think\	**dinars a l'any amb tot& tots\ que anàvem a les ametlles\ o bé lo del pavo** @ I allavors pos bueno_ és un dia que passes tots junts_ i això pos sempre t'uneix més\ no/ penso\
Researcher: But you also do things together outside the laboratory\ don't you/ A dinner_	**Investigadora:** Però també feu coses fora_ no/ del laboratori_ junts/ Algun sopar_
Carol: Yes\ Some\ Yes\ Yes\	**Carol:** Sí\ Algun\ Sí\ Sí\
Researcher: This may also_ and at lunchtime_ I don't know_ if you have lunch together_	**Investigadora:** Això potser també_ i a l'hora de dinar_ jo què sé_ si aneu a dinar junts_
Carol: At lunchtime_ of course_ we go more in groups\	**Carol:** A l'hora de dinar_ clar_ pos anem més per grupets\
	[original in Catalan]

Both, Frank and Carol, coincide in presenting some extra-lab activities as helping the unity of the RG. We can observe, though, through the different use that each of them makes of the verb tense, their different perception of the timeliness of these practices. While Frank constructed them as currently in force, Carol constructed those practices that emanated from the group leader as past, and only those among lab workers as present, though occasional. Some members of Group B also used to engage in spontaneously proposed extra-lab activities, like birthday celebrations, Christmas, welcome and farewell parties, doing sports, etc. [see excerpt 17].

Excerpt 17: Interview with Fina [PhD researcher – Group B] – 'we used to go to the gym together'

Researcher: What else can distinguish you from the other groups and make you feel that you belong to * to * to the same group/	**Investigadora:** Què més us pot diferenciar dels altres grups i fer que sentiu que pertanyeu al * al * al mateix grup/
Fina: That you get on well [with the rest]\ I suppose\	**Fina:** Pues que et portes bé [amb les altres]\ suposo\
Researcher: But with [people from] other floors you can also get on well\	**Investigadora:** Però amb [gent d']altres plantes també et pots portar bé\
Fina: Yes\ I think that **having lunch together and doing * and having breakfast together also helps**\ right/ Because it's a time when you're there a little m& * less overwhelmed_ or whatever\	**Fina:** Sí\ Jo crec que **lo de dinar junts i fer * i esmorzar junts també hi fa\ no/** Perquè és un rato que estàs allí una mica me& * menos atabalat_ o el que vulguis\
Researcher: + mhm + okay\ That is_ space helps a lot\ right/	**Investigadora:** +mhm+ vale\ O sigui_ l'espai hi fa molt\ no/
Fina: And that\ Of course_ if we didn't stay for lunch_ I think things would change a lot\	**Fina:** I això\ Clar_ si no ens quedéssim a dinar_ crec que canviaria molt la cosa\

Because in the end_	Perquè al final_
Researcher: And out of here (…) do you also meet/ Are you_ let's say_ friends outside_	**Investigadora:** I fora d'aquí * també us trobeu/ Sou_ diguéssim_ amics fora de_
Fina: I··· * let's see_ now_ from the group_ of course_ when Lola was here_ yes\ with Ramona too\ with Gina_ I get along very well and **we used to go to the gym together for example**\ but she lives in [city] and she doesn't stay much\ With Onofre_ at the beginning we used to meet more_ but now we meet less\	**Fina:** Jo··· * a vere_ ara_ del grup_ clar_ quan hi havia la Lola_ sí\ amb la Ramona també\ la Gina_ m'hi porto molt bé i **anàvem al gimnàs juntes per exemple**\ però ella viu a [ciutat] i no es queda gaire\ L'Onofre_ al principi quedàvem més_ ara quedem menos\
	[original in Catalan]

In this excerpt, Fina admits that 'having lunch together…and having breakfast together also helps' in generating a sense of togetherness among group members, just like 'go[ing] to the gym together' and meeting out of work. In a similar vein, in the following excerpts we can observe how, besides extra-lab activities, participants pointed at other factors that facilitated or triggered scientists' mutual engagement [see excerpts 18 and 19], such as personality traits, the fact of being part of the same project and of having the same schedule.

Excerpt 18: Interview with Diana [Postdoc researcher, former member of Group A] – 'it's each person's personality'

Researcher: (...) who are the people with whom you interact more at work/ (...)	**Investigadora:** (...) quines són les persones amb qui més interactues a la feina/ (...)
Diana: Well I think that [I interact more] with colleagues\	**Diana:** Pos jo crec que amb els companys de feina\
Researcher: with all your colleagues from the laboratory/	**Investigadora:** Amb tots els del laboratori\
Diana: No\ Not with all of them\ I mean_ I interact more with some than with others\ **It's a matter of affinity_ I guess**\	**Diana:** No\ amb tots no\ Vull dir_ amb gent que et comuniques més que amb una altra\ **per afinitat_ suposo**\
Researcher: Affinity in terms of personality/ or of interests/ or of *	**Investigadora:** Per afinitat de caràcter/ o de gustos/ o de *
Diana: And **of projects** too\ That they are more similar_ o··r **if you do similar techniques_ I guess you will talk more in order to ask more**\	**Diana:** I **de projectes** també\ Més que s'assemblin_ o··· **si feu tècniques similars_ suposo que parlaràs més per preguntar més**\
Researcher: Only for professional matters_ you mean\	**Investigadora:** Purament per motius professionals_ vols dir\
Diana: Well_ and also **because of personality**\ You will like * you will get on	**Diana:** Bueno_ i també **per caràcter personal**\ Tu t'afiniràs * hi ha més afinitat

better with certain people_ of course_ then you will join these a lot more\	per segons quines persones_ clar_ llavors també te fas molt més amb aquestos\
Researcher: It has to do with nationality_ language_	**Investigadora:** Té a veure amb nacionalitat_ llengua_
Diana: No\ (...) I think **it's nothing to do with nationality** because in the end_ when people have already lived abroad_ you are not_ * it's * it depends\ because there are Catalans of all types and Spanish of all types\ there are people who are more extrovert and [others who are] more introvert\ in the end it's nothing to do with nationality\ **it's each person's personality**	**Diana:** No\ (...) Jo crec que **no és la nacionalitat** perquè al final quan la gent ja ha viscut temps a fora_ ja no ets_ * és * depèn\ perquè hi ha catalans de tota manera i castellans de tota manera\ hi ha gent que és més oberta i més tancada\ al final no és la nacionalitat\ **és el caràcter de cada persona** [original in Catalan]

Excerpt 19: Interview with Fina [PhD researcher – Group B] – 'because we had the same schedule'

Fina: Ramona and Antonio because we worked on the same\ Lola because * because we worked together_ {(@) let's say}\ **because we had the same schedule_** we stayed until late_ I mean_ +uh+_ (...) With Antonio I shared\ but we weren't that close friends\ but **that's because of our personality** And then there were Tamara_ Dana_ and Àngela\ and with Àngela I also got on quite well_ **because we used to go to Italian [classes] together** Well_ we went to the Official [language] School\ and then we went to different classes\ And Tamara and Dana_ well_ but I didn't talk to them so much\ However Dana_ I have known her better when she came to our group_ and that's when I've got on very well with her\	**Fina:** La Ramona i l'Antonio perquè treballàvem amb lo mateix\ la Lola perquè t& * perquè treballàvem juntes_ {(@) diguéssim}\ **perquè fèiem els mateixos horaris_** ens quedàvem fins tard_ Vull dir_ +Ehm+_ (…) Amb l'Antonio vaig compartir\ però no em vaig fer tan amiga\ però **això ja per personalitat** I llavors hi havia la Tamara_ la Dana_ i l'Àngela\ que amb l'Àngela també m'hi vaig portar bastant bé_ **perquè anàvem a italià juntes** Bueno_ anàvem a l'Escola Oficial [d'Idiomes]\ després anàvem a classes diferents\ I la Tamara i la Dana_ bé_ però tampoc no hi parlava tant\ En canvi la Dana l'he conegut més quan ha vingut al nostre grup_ que llavors m'hi he fet molt\ [original in Catalan]

In these excerpts, Diana (Group A) and Fina (Group B) reflect on the reasons why they interacted most with certain group peers. Besides the similar-project factor (and common techniques), other reasons were their 'character', because 'we had the same schedule' and 'because we used to go to Italian together'. It is worth noting that both participants accepted the researcher's suggestion that they interacted more with certain group peers than with others without hesitation. Also Agus, when answering the question '*whom did you interact most in the*

laboratory?', pointed at nationality and schedules as some main reasons for interacting with certain group colleagues; besides the teaching and learning of techniques [see excerpt 20].

Excerpt 20: 20140327_Informal interview with Agus [PhD researcher – Group A] – 'maybe Ainhoa_ Ainhoa_ Carol_ and Mikela_ since they're from here'

Researcher: Who are the people you have talked to the most in the laboratory/	**Investigadora:** Qui són les persones amb qui més has parlat al laboratori/
Agus: Who else have I talked to/ Maybe··· * well **maybe Ainhoa_ Ainhoa_ Carol_ and Mikela_ since they're from here_** then maybe··· while having a coffee_ or I don't know_ that_ I tend to talk with them more_ but ··· **with Navil I also talked a lot_ because if we want to stay here until late_** and then_ I do not know_ he tells me about India_ about I don't know what_ and so_ +uh···+ I don't know\ yes\	**Agus:** Amb qui més he parlat/ Poste···r * pos **potser l'Ainhoa_l'Ainhoa_ la Carol_ i la Mikela_ al ser les d'aquí_** doncs potse···r tot fent el cafè_ o no sé què_ tal_ hi tendeixo a parlar més_ però··· **amb el Navil també hi he parlat bastant_ perquè si volem quedar-nos els dos aquí fins tard_** i doncs_ no ho sé_ m'explica de l'Índia_ de no sé què_ i tal_ +eh···+ no ho sé\ sí\
Researcher: And because of labour-related issues/ that is _ of ·· * of work or so/	**Investigadora:** I per temes laborals/ o sigui_ de·· * de feina i així/
Agus: About * +uh···+ well p& * well_ I've talked a lot like that_ but more sometimes in terms of complaining_ of_ {(Sp) wow}_ it hasn't worked out for me either\ I don't know what_ A··nd * and **about like asking for advice_ or things like that_ so maybe with a girl who was here before_ whose name was Simona_** who finished last July_	**Agus:** Així de * +eh···+ doncs p& * bueno_ he parlat bastant així_ però més de vegades de lamentar-nos_ de_ {(Esp) jo}_ a mi tampoc m'ha sortit\ no sé què_ I·· * i **per com demanar consell_ o coses així_ doncs potser amb una noia que hi havia abans_ que es deia Simona_** que va acaba··r al juliol passat_
Researcher: Did she know more because she had more =experience\=	**Investigadora:** En sabia més perquè tenia més =experiència\=
Agus: =Yes_ well_= She started long before I did_ and **she's one of the ones that taught me to * well_ to * to do some of the techniques we do here_** and that_	**Agus:** =Sí_ bueno_= va començar bastant abans que jo_ i **és una de les que em va ensenyar a * doncs a * a fer algunes de les tècniques que fem aquí_** i tal_
Researcher: Did she work with [object of study 1]/ also/	**Investigadora:** Treballava amb [objecte d'estudi 1]/ també/
Agus: Yes\ No\ She didn't_ but they were like very basic [field of study] techniques_ that apply to [object of study 1]_ to [object of study 2]_ to·· anything\ and was here * well_ she used to sit here in Ale's place_ and * I don't know_ and we used to chat a lot_ and I used to ask her_ or_	**Agus:** Sí\ No\ Ella no_ però eren com tècniques de [camp d'estudi] molt bàsiques_ que valen pel [objecte d'estudi 1]_ pel [objecte d'estudi 2]_ per·· qualsevol cosa\ i estava aquí * bueno_ se sentava aquí al lloc de l'Ale_ i * no sé_ i xerràvem bastant_ i jo li preguntava_ o_

	[original in Catalan]

In this excerpt, Agus declares having interacted most with some group colleagues with whom he shares his nationality – and L1 – ('since they're from here'), with whom he stayed late in the lab ('if we both want to stay late here'), and who had taught him to 'do some techniques we do here'.

The sharing of a common working space was a cause for mutual engagement among group members, but also with out-group individuals. Although they shared a headquarter lab, all lab workers in both RGs needed also to use other facilities for some of their experimental activities. These spaces could either be exclusive for the group or shared with members of other groups within the same institution. This fragmented workspace was an opportunity for their mutual engagement with members of other RGs [see excerpt 21].

Excerpt 21: Interview with Fina [PhD researcher – Group B] – 'Then there you work with other people'

Researcher: And how did you get to know people from other floors/	**Investigadora:** I com t'has conegut amb els d'altres plantes/
Fina: Because you move * of course_ because I_ since I work with [object of study]_ which will also happen to Alèxia_ **instead of working in the laboratory_ you spend a lot of time out of it_ in another laboratory_** which is specialised in [object of study]\ **Then there you work with other people**	**Fina:** Per moure't * clar_ perquè jo_ al treballar [objecte d'estudi]_ que és lo que li passarà a l'Alèxia_ **en lloc de treballar dins del laboratori_ estàs molt rato a fora_ que és a un altre laboratori_** especialitzat per treballar amb [objecte d'estudi]\ **Llavors allà treballes amb altra gent**
	[original in Catalan]

In this excerpt, Fina argues that the fact of spending much time in a working space different to her main laboratory facilitated her interaction and acquaintance with other out-group colleagues. This fragmentation of the workplace did not only affect physical settings. Whenever doubts or problems – for instance between supervisee and supervisor – could not be dealt with in person, they were often solved by email through a collection of successive texts. This gave place to a virtual space of mutual engagement, whereby also the time of such engagement was discontinuous.

Apart from the facilitators of or the obstacles for mutual engagement that have been reported here, the fact that doing science, and maybe especially natural sciences, is a chiefly collaborative acitvity was evident in the multiple collaborations it entails. A sign of this is the fact that most published research papers in natural sciences are co-authored by numerous

267

individuals. This is also an opportunity for the formation of online scientific CoPs, which, with the popularisation of communication technologies can nowadays be formed across labs, institutions and countries around the globe. Examples of such collaboration were referenced by Mara and Tània, PhD researchers of Group A [see excerpts 22 and 23].

Excerpt 22: Interview with Mara [PhD researcher - Group A] – 'group [work] out of the lab of course it is'

Researcher: Do you believe your work is individual or group work/ (...) **Mara:** In the group I wouldn't call it {(Eng) group} work\ Because my {(Eng) project} was completely different\ Let's say Michela_ Carol_ or ·· * Ale are collaborating\ Because they have a com& * they have a common [(Eng) project\] Let's say that Navil_ [and] I have a completely different one_ Agus_ Simona some time ago_ were * our {(Eng) project is completely different\ they * it is just us\ Let's say_ I believe that in my {(Eng) lab meetings} no one understands anything\ @@@ Yes\ It was completely out of what the rest did\ But ··· **group work outside the lab_ of course it is**\ Because if I didn't have for instance Luiz_ who was in Brazil_ (...) And he agreed to take my [object] to do the analysis\ Or if I didn't collaborate with John_ or if I didn't collaborate with Lara to accept me a week there\ With Giorgos_ With whom else/ With Damon lastly_ that are the latest and most important results_ **I couldn't do it**	**Ερευνήτρια:** Πιστεύεις ότι η δουλειά σου είναι ατομική ή ομαδική/ (…) **Μάρα:** Μέσα στο {(Eng) γρουπ} δε θα το έλεγα ομαδική\ Γιατί το δικό μου το {(Αγγλ) πρότζεκτ} ήταν τελείως διαφορετικό\ Ας πούμε η Μικέλα_ η Κάρολ_ η·· * η Άλε συνεργάζονται\ Γιατί έχουνε κοιν& * έχουνε κοινό [(Eng) πρότζεκτ\] Ας πούμε ο Ναβίλ_ εγώ έχουμε τελείως διαφορετικό_ ο Άγους_ η Σιμόνα παλιά_ ήτανε * το {(Αγγλ) πρότζεκτ} μας είναι τελείως διαφορετικό\ είναι * είμαστε μόνο εμείς\ Ας πούμε_ Εγώ πιστεύω ότι στα {(Αγγλ) λαμπ μίτιγκ} κανείς δεν καταλαβαίνει τίποτα\ @@@ Ναι\ Ήτανε τελείως έξω από αυτό που κάνανε οι υπόλοιποι\ Αλλά··· **ομαδικό εκτός εργαστηρίου_ εννοείται και πως είναι** Γιατί άμα δεν είχα ας πούμε το Λουίζ_ που ήτανε στη Βραζιλία_ (...) Και δέχτηκε να πάρει τους [αντικείμενο] μου για να κάνει την ανάλυση\ Ή αν δεν συνεργαζόμουνα με τον Τζον_ ή αν δεν συνεργαζόμουνα με την Λάρα να με δεχτεί μια εβδομάδα εκεί πέρα\ Με τον Γιώργο_ Με ποιόν άλλο/ Με τον Ντέημον τελευταία_ που είναι τα τελευταία αποτελέσματα και τα πιο σημαντικά_ **Δεν θα μπορούσα να το κάνω** [original in Greek]

Excerpt 23: Interview with Tània [PhD researcher – Group A] – 'I have collaborated with different groups'

Tània: …and the fact that there have been collaborations has also been positive fo··r * for my thesis_ for the articles that will be	**Tània:** …i **que s'hagin fet col·laboracions també li ha donat un plus al·· * a la meua tesi_** als articles que es publicaran\

published\

Researcher: Yes\ You believe that it's something beneficial\ That adds =value\=

Tània: =Ye··s\ For me it does\= I think so\ Yes\ I mean_ and what's more_ **I have collaborated with different groups_** but now_ among them_ * I mean_ they're·· * how can we say that/ they're mixi··ng topics_ and now I collaborate * I mean_ now I don't have an article with this one_ with this one and with this one\ Now [in] almost all the articles there will appear ones and the others\ you know/

Researcher: And do you like it/

Tània: Yes\ Well_ it's what Frank told me_ +uh+ you could separate things like this_and well_ you would have something\ But when you start mixing is when some really bring a lot to others and these others bring to others\ And all of them bring me a lot\ And I bring them both a lot\ This is what helps\ Yes\ Yes\ Staying in a closed world_ this also happens\ It sometimes happens there\ There are people who isolate themselves and don't realise tha··t probably with a little bit of collaboration with another or something would bring you more\ Not economically\ But at a scientific level\ Or economically_ well_ also maybe\ Bu··t yes\ Yes\ **I think it's very * well_ interesting**

Investigadora: Sí/ Creus que és algo que beneficia\ Que aporta =valor\=

Tània: =Sí··\ Per mi sí\= Jo crec que sí\ Sí\ Vull dir_ I és més_ **jo he fet col·laboracions amb diferents grups_** però ara_ entre ells_ * o sigui, s'estan·· * com diríem/ s'estan barrejant·· temes_ i ara col·laboro * o sigui_ ja no tinc un article amb aquest_ amb aquest i amb aquest\ Ara [a] casi tots els articles sortiran uns i els altres\ Saps/

Investigadora: I t'agrada/

Tània: Sí\ Bueno_ és lo que em va dir el Frank_ +Ehm+ tu podries separar les coses així_ i bueno_ tindries algo\ Però quan ho comences a barrejar és quan realment uns aporten als altres i els altres aporten als altres\ I tots m'aporten a mi\ O jo aporto als dos\ Això és lo que ajuda\ Sí\ Sí\ Quedar-se en un món tancat_ això també passa\ Allà a vegades passa\ Hi ha gent que se tanca en un món i no veu que·· a lo millor amb una mica de col·laboració amb un altre o així t'aportaria algo més\ No econòmicament\ Sinó a nivell científic\ O econòmicament_ pos mira_ també potser\ Però·· sí\ Sí\ **Jo ho trobo molt * vamos_ interessant**

[original in Catalan]

Mara and Tània highlight the importance of group work for their scientific activity, although in both cases out-group collaborations are deemed key. The materialisation of such collaborations in the form of coauthored scientific articles is described by Tània, who finds such collaborations across groups and disciplines 'interesting' for science. Similarly, this relation of collaboration-coauthorship was also reported to the researcher by some members of Group B, as can be seen in excerpt 24.

Excerpt 24: 20140123_Field notes (Page 8) [Group B] – 'collaborations are very usual'

«collaborations are very usual in the case of those who work with [object of study] because [action] takes very long, and if you need a lot of raw material it would take too long; therefore, everyone collaborates preparing the raw material for the rest (and hence they usually appear in the articles of others»	[original in Catalan]

In the case reported in the last excerpt, in-group collaborations within Group B were usual because the generation of some raw materials was time consuming and consequently several members of the RG used to engage in it and help others this way. As has been reported, such collaborations were compensated or gratified through coauthorship in the scientific articles that might result from those experiments.

Besides these types of parallel collaborations, in which scientists contributed to the same projects simultaneously, mutual engagement showed to be also linear, meaning that most participants' projects departed from a previous one, taking into account what previous members of the RG had done and found [see excerpt 25].

Excerpt 25: Interview with Tània [PhD researcher – Group A] – '... you start an [object of study] that some old [group] mates have done here'

Researcher: Who or what is meritorious for having something_ or more or less satisfying results/	**Investigadora:** De què o de qui creus que és mèrit el que tinguis algo_ o resultats més o menys satisfactoris/
Tània: Everyone\ Everyone\ **First because you start an [object of study] that some old [group] colleagues have done here_** my ol& *well_ my directors_ Frank and Cecília_ without this * I wouldn't have been able to do all the rest\ Then_ the design of the	**Tània:** De tots\ De tots\ **Començant perquè se comença un [objecte d'estudi] que han fet aquí antigues companyes meves_** els meus an& *bueno_ els meus directors_ el Frank i la Cecília_ sense això ja * ja no hagués pogut fer tot lo altre\ Després el

experiments_ everything * everything contributes\	disseny d'experiments_ tot * tot contribueix\ [original in Catalan]

In this excerpt, Tània acknowledges her debt to 'all' her group colleagues and to past group members. In fact, teamwork was very present in the participants' discourse. For example, most oral presentations supported by a projected text finished with an acknowledgement to all group members, and often to past group members also. This was a kind of non-explicit norm, which became explicit sometimes [see picture 2 and excerpt 26].

Picture 13: Acknowledgements slide from Lian's PhD defense presentation [PhD researcher – Group A]
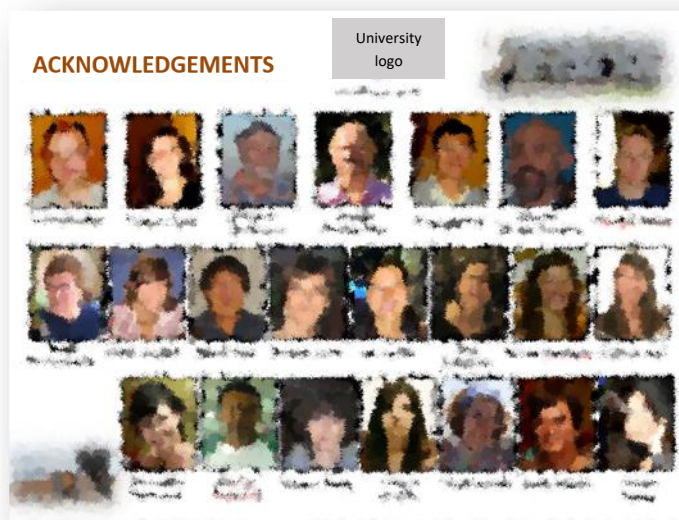
Excerpt 26: Tània's PhD defense rehearsal 1 [PhD researcher – Group A] – 'should I add an acknowledgement'

Tània: And at the end_ +ehm+ **should I add an acknowledgement_**

Frank: Yes\ =XXX=

Tània: =with each= pho& photo/

Frank: Whatever * it doesn't have to be photos\ X **You have to have an acknowledgement**

Tània: Okay\ If I * I don't know if * because I don't know how to include it\ How to i& * I do& * I don't know\ Who I need to include there/

Frank: The people you think helped you in your work In any way\ Either directly or indirectly_ or XXX\

Here, the norm of acknowledging 'The people you think helped you in your work' is transferred to Tània by Frank (Group A's leader), who presents it as an obligation: 'You have to have'.

Apart from members' collective actions, mutual engagement also refers to the members' ability to rely on others to compensate for their own voids (Wenger, 1998). This was also evident in the data, in the way group members relied on each other, to ask for help, solve doubts, etc., on a daily basis [see excerpt 27].

Excerpt 27: Interview with Frank [Group A's leader] and Cecília [senior researcher – Group A] – 'if you have questions_ go to this person'

> **Frank:** She's an Erasmus student\ she's an undergraduate\ So she'll be with us for six months\ So_ Mara is introducing her to the members of the lab_ (…) but tomorrow morning she would have to be in at nine o'clock in the [confidential] department to do her first experiment with techniques she never experienced before\ And the instructions she would receive is that_ okay_ this is the problem_ these are the people you need to go and talk to_ do it\ Then I want to see how she reacts\ And I will tell her_ **if you have questions_ go to this person_ and this person_ to this person_ and if you cannot solve it with this person_ then come to me**\
>
> **Cecília:** But this is going to * **going to happen anywhere around the world**\ I arrived to England and they told me_ this is your lab_ do\
>
> **Frank:** Yes\
>
> **Cecília:** I mean_ you have to be * people will help you\ but you have to initiate the process of * of asking for help\

In the excerpt below, Frank (Group A's leader) and Cecília (senior researcher) describe the induction process of a newcomer's first day in the lab as consisting in systematically engaging with other scientists in solving her doubts. This, they argue, is the way Cecília was also induced to the scientific practice in a former RG and is assumed by her to be a norm that applies 'anywhere around the world'.

The data analysis has shown that, on the one hand, group members' mutual engagement entailed the establishment of bonds among them, their sense of mutual belonging, but on the other hand, it also gave way to tensions and conflicts, involving competition for resources and misunderstandings of different sorts. However, as was suggested earlier, mutual engagement was not homogeneous and, in fact, as can be seen in excerpt 28, the lack of it among group members generated a sense of isolation from their peers.

Excerpt 28: Interview with Mara [PhD researcher – Group A] – 'But ever since she left I'm in a vacuum'

Mara: Bef& before I had a girl who·· we were [working] in the same object_ She was in the [object] _ and I was in the [object]\ But more or less we he& * we worked with the same [object]_ So more or less I saw what she did in the {(Eng) lab meeting}_ she saw what I do_ we did the same things more or less * the same combinations in the different [object]_ Theoretically in principle we could compare our results\ **But ever since she left I'm in a vacuum** @ **Researcher:** I see\ So you are a bit isolated\ **Mara:** I am\ I am\	**Μάρα:** Πρι& πριν είχα μια κοπελιά που·· ήμασταν στο ίδιο αντικείμενο_ Αυτή ήτανε στο [αντικείμενο]_ κι εγώ ήμουνα στο [αντικείμενο]\ Αλλά πάνω κάτω είχαμ& δουλεύαμε με τα ίδια [αντικείμενο]_ Άρα πάνω κάτω έβλεπα τι κάνει αυτή στο {(Αγγ) λαμπ μίτιγκ}_ έβλεπε αυτή τι κάνω εγώ_ ψιλοκάναμε τα ίδια * τους ίδιους συνδυασμούς στα διαφορετικά [αντικείμενο]_ Θεωρητικά σε βάση μπορούσαμε να συγκρίνουμε τα αποτελέσματά μας\ **Αλλά αφού έφυγε είμαι στο κενό** @ **Ερευνήτρια:** Κατάλαβα\ Οπότε είσαι λίγο απομονωμένη\ **Μάρα:** Είμαι\ Είμαι\ [original in Greek]

Despite belonging to Group A and sharing a workplace and some events with her group colleagues, Mara declared feeling 'in a vacuum' because she did not share daily procedures and the object of study with any other group peer. But the lack of shared daily processes and object of study were not the only factors rising a sense of loneliness within the RG. In Group B, language use was pointed out as a cause for individuals' isolation. Some group members who could not understand nor speak the Catalan language evaluated it as important for engaging in activities with group peers, both in the lab and out of it. This is the case, for instance, of Yamir and Tira who, as illustrated in excerpt 29, expressed the importance of (not) knowing or of (not) having learnt the local language.

Excerpt 29: Interview with Tira and Yamir [PhD researcher – Group B] – 'I didn't know that this is that much important to have a a * a·· language for the communication'

Researcher: …but do you think it * it would * I mean_ if you went back two years ago_ would you take a course [of Catalan]/

Yamir: Yeah\

Resarcher: Okay\ You too/

Tira: Yeah\ Because by the beginning **I didn't know that this is that much important to have a * a·· language for the communication**\ But the time I was like I came to lab and going home_ **I didn't interact much with the people**\ **But if I learnt the language before_ no/ It would be more im& +uh+ like useful for me**\

(…)

Researcher: You miss some =information=

Yamir: =because= +Uh+ {(?) Yeah_ you miss} some expression\ Expression they will say_ and you cannot translate to my la& * in * in the English\ Even if I used to talk_ but when I translate the meaning will change\ There are some local thing you * you * you still have\ no/

Tira: Yeah\ It won't be the typical\ Sometimes you have an expression in Catalan that you cannot translate it very clearly\ no/ **And also when we are +uhm+ +uhm+ in a common place like coffee or something_ sometimes if they have said something funny we couldn't get it clearly**\

Researcher: Yeah\ +mhm+ It's a problem\

Yamir: We used to have coffee before X in other building {(?) itself}_ then X we used to come here\ Because you can see a lot of people_ and we know the other people will come here also\ So sort of interaction\

In this excerpt, the two Indian members of Group B expressed their regret for not having arrived in Catalonia with a certain proficiency in Catalan, which they believed hindered their participation in coffee conversations to the point that they stopped sharing coffee time with their lab peers in the 'other building' and preferred to go to a different cafeteria.

Besides lack of competence in the local language, lack of competence in the 'scientific language' itself showed to be an obstacle for mutual engagement, whenever group members did not share a research topic nor procedures [see excerpt 30].

Excerpt 30: Interview with Mara [PhD researcher – Group A] – 'I'm the only one who does this in the laboratory'

Researcher: The rest all [work] with [object of study]\	**Ερευνήτρια:** Οι υπόλοιποι όλοι με [αντικείμενο] [δουλεύουν]\
Mara: Yeah\ (…) **I don't understand it so**	**Μάρα:** Ναι\ (...) **Εγώ ας πούμε δεν τα**

274

to say\ I have seen * for three years I have been seeing that this goes there_ (…) But I * I don't like it\ **It's something I cannot understand_** a···nd I don't even want\ I don't * I'm not interested in it\ (...) I believe that [with them] like with me\ Because· **I'm the only one who does this in the laboratory** So with p& * everyone listens to it_ no one asks me anything because they don't * **they don't understand much/** Or they don't want to understand/ I don't know\ But it's a bit_ (...) Few times they ask me like general things in the [object]_ basics\	**καταλαβαίνω** Έχω δει * τρία χρόνια βλέπω ότι αυτό πάει εκεί_ (...) Αλλά δεν * δεν μ'αρέσει\ **Είναι κάτι το οποίο δεν μπορώ να το καταλάβω_** και··· δε θέλω κιόλας\ Δεν * δε μ'απασχολεί\ (...) Πιστεύω όπως και μ'εμένα\ Γιατί· **είμαι η μοναδική που κάνω αυτό μέσα στο εργαστήριο** Άρα με το π& * όλοι το ακούνε_ κανείς δε με ρωτάει τίποτα γιατί δ& δεν * **δεν καταλαβαίνουν και πολλά/** Ή δε θέλουν να καταλάβουν/ Δεν ξέρω\ Αλλά είναι λίγο_ (...) Λίγες φορές με ρωτάνε έτσι γενικά πράγματα στο [αντικείμενο]_ βασικά\

[original in Greek] |

In this excerpt, Mara confesses her difficulty in understanding her group peers' explanations about their work, which she believes is reciprocal. As this excerpt suggests, mutual engagement was not always possible among all group members since there were multiple elements that conditioned it. They interacted with each other to some extent and they contributed to each other's learning and expertise acquisition, but this was not always perceived by participants as the mutual engagement of all group members in a common endeavour. The rigidity and institutionalisation of the RG prevented individuals from joining one another purely for their interests, since even if their interests or topics were moving away, they had to continue to work together and meet each other (aside from the external contacts they had).

A CoP has been defined as "a group of people who interact, learn together, build relationships, and in the process develop a sense of belonging and mutual commitment" (Wenger, McDermott & Snyder, 2002: 34). In the two cases studied, mutual engagement was not a homogeneous and stable activity among all members of a group. Shared traits (role, status, etc.) and activities among some group members were usually an initial motive for interaction which sometimes triggered further selective mutual engagement. As has been shown in the data analysis, science was perceived by participants as both, individual and collaborative, and the community with which the participants engaged in a shared practice did not always correspond with the RG to which they were affiliated.

The analysis of the data thus suggests that the studied RGs may correspond to CoPs in their mutual engagement in the macro dimension (regarding the nominative general endeavour of the group), but it became less mutual as we approached the meso level (e.g. one group may have diverse projects with different aims, different objects of study, and involving only some group

members) and the micro level (that of daily practices, where mostly one-to-one interactions occur and where individual work prevails). The induction to the RG started by a prescribed belonging: a statement of group membership, either in the form of the group leader's acceptance, or in the form of a joint project with another group member. The RG as a community was hence primarily based on affiliation and shared physical space for work purposes, as well as on shared presence in professional events such as meetings, and on the distribution of tasks for the common benefit. Outside the working context, the community seemed to fade out: having lunch could be a shared practice among group members or not; personal space or leisure activities could involve several group members or not, etc. Moreover, these sites were often shared with other related CoPs, including members of other RGs, like neighbouring laboratories or collaborating teams.

Since daily practices were sometimes shared with out-group individuals, participants' sense of mutual engagement could involve members of other RGs. However, despite the potential feeling of detachment from the RG by group members that these practices could entail, extra-group or extra-institutional collaborations were also denoted as desirable by policy makers of the research institute of Group B. In a presentation about institutional future strategies that took place in February 26th 2014, one of the institution's core future scope was boosting this type of collaboration, which was named 'aggregate research' ('investigació agregativa') and which was supposed to transcend 'collaborative research' ('investigació col·laborativa'). The consequences of these dynamics at a large scale may be still unknown, but promoting this type of research might generate cross-group atomist networks of individualist workers at the local level, working in disrupted and virtual spaces throughout disconnected time slots (see Snyder, 2016). In this case, mutual engagement might be replaced or at least eclipsed by the existence of a joint enterprise only. In the next section, this key element of CoPs, a joint enterprise, will be analysed in relation to the RGs studied.

5.2. Joint enterprise and 'domain' in the RG-CoP

A CoP's joint enterprise includes a stated shared goal, a negotiated enterprise of the members of the CoP, as well as relationships of mutual accountability among them (Holmes & Meyerhoff, 1999). Such joint enterprise might be explicit or implicit in individuals' pursuit of it (Meyerhoff, 2004). Accordingly, a joint enterprise seems to be an identity marker of the RGs studied, and this needs to be stated in official documents like accreditation forms and grant applications. While in the previous section we have argued that group members mutually engaged in 'doing science', the data analysis suggests that 'advancing their (research) field' was

the main joint enterprise uniting all members of the RGs studied. This was not made explicit, but inferred from their daily practices and interactions, as will be shown in what follows.

For the two RGs, the existence of a joint enterprise among all group members was especially evident in group meetings (or 'seminars'), where group members met to jointly help one another solve a problem or doubt or to aid them in their projects. The existence of a joint enterprise in these events was never made explicit, since group meetings were a usual group practice to which newcomers were not introduced but were given access to directly engage in them. The fact that these meetings were a practice in the pursuit of the group's joint enterprise was expressed by the group leader of Group B [see excerpt 31].

Excerpt 31: Interview with Pere [Group B's leader] – 'the seminars of the week_ many times are for this\'
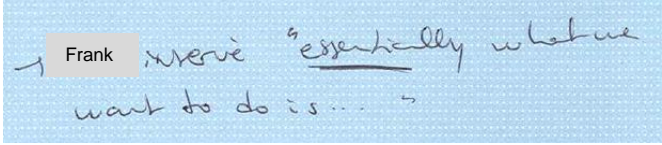
Researcher: And you can also recommend them at some point that * that they offer each other advice or that they help each other with a technique_ **Pere:** Yes\ of course\ of course\ that is * that is_ **the weekly [group] seminars_ many times are for this\ Right/ Because if someone gets stuck somewhere and the other says look_ I read it_ or I tried this\ Do this** It's for this as well\ right/ the seminars on Friday of the [research institute] are theoretically for this also\ Right/ I mean_ Yes\ Yes\ **Researcher:** And within the group they also learn from each other/ **Pere:** Oh_ of course\ Of course_ of course\ Obviously\ Yes\ Yes\ Yes\ Yes\ Yes\ and * and * and they exchange information\ of course\	**Investigadora:** I també els hi pots recomanar en un moment donat que * que s'aconsellin entre ells o que s'ajudin en una tècnica_ **Pere:** sí\ i tant i tant\ És dir * és dir_ **els seminaris de la setmana_ moltes vegades és per això\ +Eh+/ Perquè algú s'encalla en algun lloc i l'altre diu hosti_ jo ho he llegit_ o jo ho he provat\ Fes-ho** És per això també\ +Eh+/ Els seminaris dels divendres de [institut de recerca] també teòricament són per això +eh+/ Vull dir_ Sí\ Sí\ **Investigadora:** I dins del grup també aprenen els uns dels altres\ **Pere:** oh_ clar\ Clar_ Clar\ Evidentment\ Sí\ Sí\ Sí\ Sí\ Sí\ i * i * i s'intercanvien informació\ I tant\ [original in Catalan]

In this excerpt, Pere states that the aim of the 'weekly [group] seminars' is to solve group members' problems whenever 'someone gets stuck somewhere'. In these occasions, other group peers can contribute by explaining what they have 'read' or 'tried' themselves.

The sense of a general common endeavour or joint enterprise among group members can be deduced also from Frank's [leader of Group A] use of the first-person plural pronoun 'we' when explaining the objective of a given task [see excerpt 32].

Excerpt 32: 20140321_Field notes_Intergroup seminar (Page 5)- 'what we want to do is'

«Frank speaks: "Essentially what **we** want to do is..."»	
	[original in Catalan & English]

As in Frank's utterance, the first person plural pronoun was very present in the participants' discourse when they reported on their scientific work. It could be the case, though, that the 'we' used by participants referred to out-group collaborators and not only or not mainly to group members. For instance, Mara acknowledged having worked more with out-group colleagues than with her lab mates (as shown in excerpt 22). Therefore, in the following excerpt, her use of the first-person plural pronoun 'we' could be interpreted as referring to herself together with her out-group collaborators instead of her group colleagues [see excerpt 33].

Excerpt 33: 20140313_Lab meeting Mara_ Recording – 'we found one protocol'

> **Mara:** For the [object] **we found** one protocol_ I have to say_ It's almost * this week it's first (…) and then **I have to proceed** with the XXXXX because …

Note here that Mara uses the plural form of the pronoun with reference to the finding of a protocol and the singular for other procedures. In this case, the joint enterprise might define a CoP not corresponding exactly with the RG. In the same line, some group members expressed a sense of a joint enterprise with out-group collaborators. This was Navil's case also, who, in an interview some days after his PhD defence, contended that the people from whom he had learnt most were his collaborators based in other two Spanish cities, besides other people from his own lab [unrecorded interview].

Moreover, as has been shown in the previous section regarding mutual engagement, the joint negotiated enterprises that define the RG-CoP were not shared equally by all group members. Some of them involved the collaboration of multiple members, but others required a more individual implication. The two RGs studied were carrying out diverse research projects for which specific aims had been established. Each of them involved only some group members and not all of them, although the projects' success might be beneficial for all members of the group [see excerpt 34].

Excerpt 34: Interview with Tània [PhD researcher – Group A] - 'also because the topic'

... also because the topic_ * of course_ we are like_ **the group that does [topic 1]\ The**	... també perquè el tema_ * clar_ nosaltres som com una mica_ e**l grup que fa pues**

group * well_ for instance_ Mara_ Esme_ Nàdia_ were more into [topic 1]\ We are like * well_ I consider myself of the group doing [topic 2]\ With Hao_ Carol_ Mikela_ Diana was here_ Simona_ now there's Ale_ and me (...) That is_ Deshi_ for instance_ which was the line [of research] that Ainhoa is following_ not_ because it had nothing to do\ Navil neither\ The part abou··t [topic 3]_ Navil and Agus didn't * well_ you always_ * you always make comments\ Because with Mikela_ with Agus_ we've talked_ * Agus has nothing to do\ But_ about a technique_ **about the [technique]\ This you talk about_ how have you done this/ +Oh+ this like this\ Yes**	**[tema 1]\ El grup * bueno_ per exemple_ la Mara_ la Esme_ la Nàdia_ feien més [tema 1]\ [Nosaltres] som com * bueno_ jo me considero del grup del [tema 2]\ Que està el Hao_ la Carol_ la Mikela_ la Diana estava_ la Simona_ ara està l'Ale_ i jo** (...) O sigui_ el Deshi_ per exemple_ que era la línia que segueix l'Ainhoa_ no_ perquè no tenia res a veure\ El Navil tampoc\ La part més així de·· [tema 3]_ el Navil i l'Agus tampoc no·· * home_ sempre_ * sempre fas comentaris\ Perquè amb la Mikela_ l'Agus_ hem parlat_ * l'Agus no té res a veure\ Però_ **d'una tècnica_ de la [tècnica]\ Això ho parles_ com ho heu fet vosaltres/ +Ah+ això així\ Sí**
	[original in Catalan]

In this excerpt, Tània asserts that hers is a divided group according to its members' research topic or object. Tània clearly groups her peers accordingly. This triggered discussions among group peers who were working on the same topic and hindered the participation of other group members in them. See in the figure below the schema of Group A, as described by Tània in the previous excerpt [figure 1].

Figure 1: Diagram of Group A according to Tània [PhD researcher]
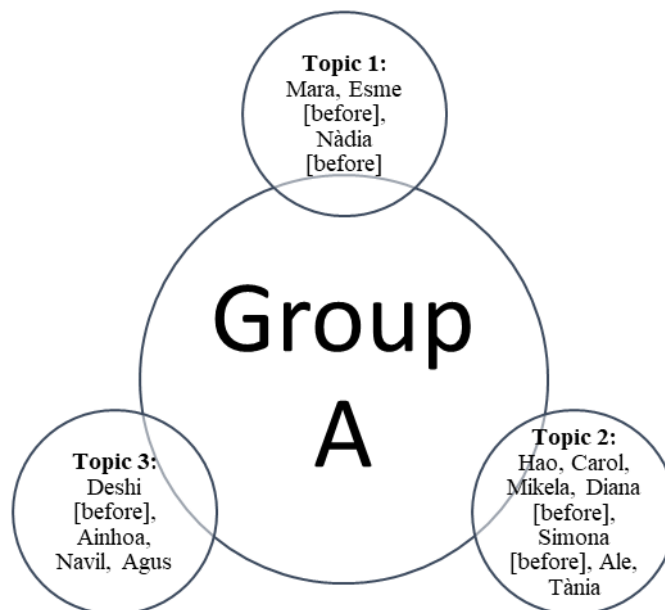
The tension between individuality and collectivity that appeared in the participants' discourse about their daily activity affected not only their mutual engagement (as described in section 5.1), but also their sense of a joint enterprise among all the members of the RG. To counteract this, assuming the collective aim, in this case the RG's general enterprise, as one's individual goal was deemed the best practice by Group A's leader [see excerpts 35 and 36].

Excerpt 35: Interview with Frank [Group A's leader] – 'The PhD positions are associated with a project'

> **Researcher:** And most of your PhD positions are for specific tasks that you want to carry out within your project/
>
> **Frank:** No\ Well_ No\ **The PhD positions are associated with a project**\
>
> **Researcher:** Yes\
>
> **Frank:** And is * th& th& the project is not task-oriented\ **It's concept-oriented**\ So there are many multiple and distinct tasks within a project\

Excerpt 36: Interview with Frank 2 [Group A's leader] – 'the group's goal ... should be their own personal goal'
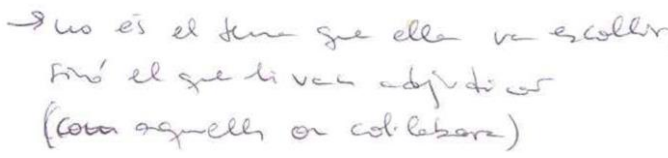
> **Researcher:** So_ going back to what you said_ you think that the key element is to make sure that everybody has a goal\ An individual goal\
>
> **Frank:** And * and be * and * and understand that that is * while that is **the group's goal_ equally importantly it should be their own personal goal**\ Not only for while they are here_ but also when they leave and go somewhere else\ And establish their own lab at some point\

In these excerpts, Frank suggests the existence of different PhD projects defined by a 'concept', which coexist with a 'group's goal' that should be equated with 'their own personal goal'. His words denote a prescriptive stance whereby he shows his conviction that group members 'should' consider individual and collective aims as 'equally important'.

Nonetheless, the individuals' assumption of the RG's joint enterprise as their own might be hindered by the way it was conceived. Both, group goals and individual aims were often perceived as imposed on them by some participants, instead of "the result of a collective process of negotiation" that emanates from the practice itself, as described by Wenger (1998: 77). It was the group leader, possibly in coordination with other senior researchers, who decided on the strategic aims of the group's projects, and other junior researchers had not chosen them freely [see excerpts 37 and 38].

Excerpt 37: 20131217_Field notes_Pilot observation in Group A (Page 06) – Carol's research topic [PhD researcher]

«It is not the topic she chose but the one that was assigned to her (like the ones she collaborates with)»	→ uo és el tema que ella va escollir, Finó el que li van adjudicar (com aquells on col·labora)
	[original in Catalan]
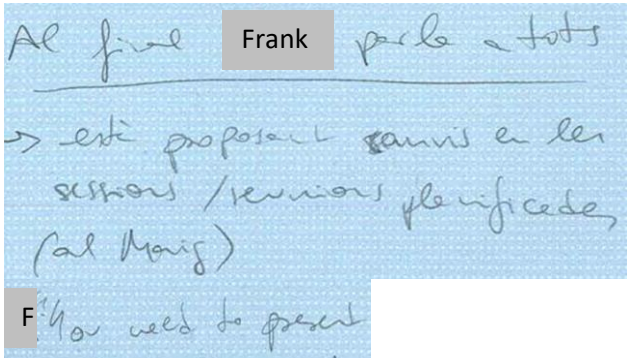
Excerpt 38: 20140630_Informal interview with Joana on experiments and expectations [BA researcher – Group A]

Researcher: Did you choose the topic or was it assigned to you/	**Investigadora:** el tema el vas triar tu o te'l van assignar/
Joana: It was assigned to me\ I met the professor_ and he told me_ what do you want to do/ When you have an [object of study] until it grows you need to do different experiments\ The more different things the better\ Well then\ We'll see it\	**Joana:** Me'l van assignar\ Jo vaig anar al professor_ i em va dir_ tu què vols fer/ Quan tens una [objecte d'estudi] fins que es fa gran necessites diferents proves\ Com més coses diferents millor\ Pues vale\ Ja ho mirarem\
Researcher: Are you happy/	**Investigadora:** Estàs contenta/
Joana: Yes\ Sure\ Well_ it's the first day\	**Joana:** Sí\ Sí\ Bueno_ és el primer dia\
Researcher: But were you assigned more or less what you were looking for/	**Investigadora:** Però t'ha tocat més o menys el que buscaves\
Joana: Yes\ I think so\	**Joana:** Sí\ Jo crec que sí\
	[original in Catalan]

In the two excerpts above, Carol and Joana coincide in asserting that their research topic was chosen by other group members. Joana, however, implies that her agency was considered to some extent by her professor in the decision of what type of daily tasks she would engage in. Due to her status as a newcomer and temporary member of the RG (as an apprentice), we must assume that she was not in a position to decide what her research topic would be. At that point her interest was doing 'as many different things as possible'.

Although choice or attribution of a research topic used to take place in private meetings, to which I did not have access, the directive role and style of group leaders could be observed in the data. The RG's joint enterprise was mainly set by the group leader, following a history of strategical decisions, and conveyed to the RG's members directly through the imposition of (explicit or implicit) norms [see excerpt 39].
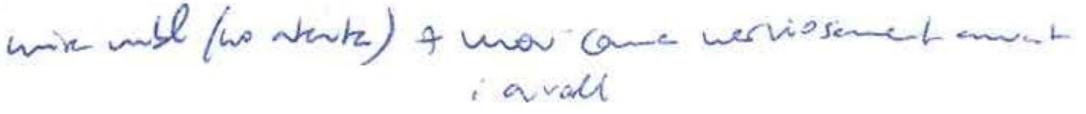
Excerpt 39: 20140313_Field notes from Mara's Lab Meeting (Page 02) – 'You need to present...'

«At the end Frank talks to eveyone. → He's proposing changes in the sessions/meetings planned (for May) (...) F: "You need to present...»	[handwritten note with "Frank" and "F" labels] [original in Catalan & English]
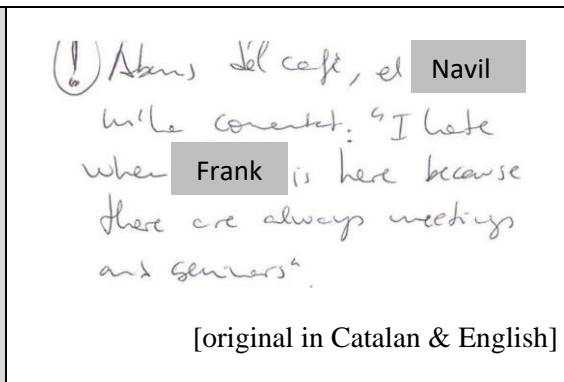
As can be seen in the previous excerpt, Frank makes statements about what needs to be done, without further justifications. The 'joint' enterprise is stated and conveyed, not negotiated nor discussed.

The imposition of a "topic" or a project's aim onto newcomers could generate a certain alienation of the individual, that is, that she perceived it as not her own (Korman, Wittig-Berman and Lang, 1981). It may require a big effort on her part to accommodate to this alien endeavour and to find (or generate) the motivation to make it her own. Individual alienation was also evident in relation to some events that involved all group members but were not perceived by all of them as part of "their" individual enterprise. It was the case of department meetings or group meetings [see excerpts 40, 41 and 42].
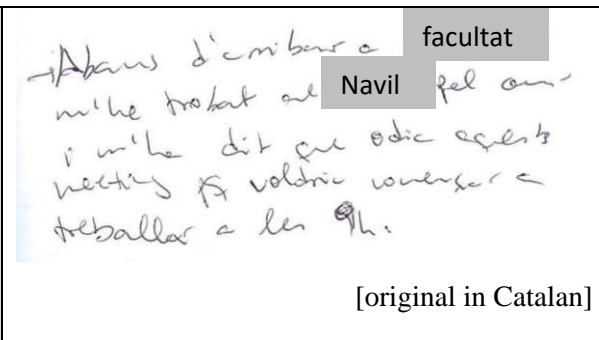
Excerpt 40: 20140109_Field notes_Observation Group A_Hao's Department Seminar (Page 2) – 'M[ara] looks at mbl'

«M[ara] looks at mbl [mobile phone] (not attentive) + moves leg nervously up and down»
[handwritten note with "M" label] [original in Catalan]

Excerpt 41: 20140129_Field notes_ Observation Group A_Group Meeting (Page 4) – 'I hate it when'

«Before having a coffee, Navil has commented: "I hate it when Frank is here because there are always meetings and seminars".»	[original in Catalan & English]

Excerpt 42: 20140210_ Fieldnote_ Observation Group A_Lab meeting Ainhoa (Page 4) – 'he told me that he hates these meetings'

«Before getting to the [faculty], I met Navil on my way and he told me that he hates these meetings because he would like to start work at 9 a.m.»	[original in Catalan]

These excerpts evidence the discomfort of some participants in some group events like group and department meetings, which they deemed distracting and hindering their aim or individual enterprise. Note that Navil implies that such meetings are not his individual enterprise; and that Mara showed anxiety during the department seminar perhaps due to her frustration at not being engaging in her individual project.

However, in the process of accommodation to the RG's joint enterprise some group members may go through diverse phases and different degrees of self-identification with the imposed enterprise. Moreover, even though individual enterprises might coincide with the enterprise of the RG, as set or formulated by the group leader, both could change across time, for multiple reasons. The group leader, on the one hand, might have diverse individual objectives throughout her career, as was expressed by Frank (Group A): 'I had different motivations at different stages of my life' [see excerpt 43].

Excerpt 43: Interview with Frank [Group A's leader] – 'I had different motivations at different stages of my life'

> **Researcher:** What is your motivation in doing your job/
>
> **Frank:** Okay_ **I had different motivations at different stages of my life**\ Right now_ my motivation is to see if at least one of my students can stand out of the rest and be a world-leading scientist\

On the other hand, also junior or senior researchers could change their priorities as a result of experiencing the practice of 'doing science' [see excerpt 44].

Excerpt 44: Interview with Agus [PhD researcher] – 'I have realised that I like the job but it's not my passion'

Agus: … If I have to give up all this all my life_ well I don't know if I like science so much as to give up all this\ (...) I mean_ **the PhD has helped me realise that_ hey_ I'm very interested in many things_ and tha··t * and that they are * I mean_ they will probably be necessary for me to be happy_** or for whatever_	**Agus:** … Si tota la vida he d'estar renunciant a tot això_ doncs no sé si m'agrada tant la ciència com per renunciar a tot això\ (...) Vull dir_ **el doctorat m'ha servit per adonar-me que_ coi_ que hi ha moltes coses que m'interessen molt_ i que·· * i que són * vull dir_ segurament seran necessàries per a que jo sigui feliç_** o per a que tal_
Researcher: So_ you have realised what you lacked maybe\	**Investigadora:** O sigui_ te n'has adonat del que et faltava potser\
Agus: Yes_ yes_ **I have realised how precious free time is**\ **And the importance of the time you spend on yourself and on the things that you're really interested in**\ (...) What I think I have also realised is that_ when I finished the degree_ I was completely sure that * well_ I wanted to be a scientist_ a··nd that it wa··s * And **I have realised that I like the job but it's not my passion**\ I'm not passionate about it_ a··nd then_ * I don't know\	**Agus:** Sí_ sí_ **m'he adonat del valor del temps lliure**\ **I del valor del temps que et dediques a tu i a les coses que t'interessen de veritat**\ (…) Jo el que me sembla que també m'he adonat_ és que jo tenia claríssim_ al sortir de la carrera_ que * bueno_ volia ser científic_ i·· que era·· * I **m'he adonat que m'agrada l'ofici però no és la meva passió**\ No m'apassiona_ i·· aleshores_ * no ho sé\
	[original in Catalan]

In this latter case, an (existential) crisis arose when Agus, after considering pros and cons, started to wonder whether the RG's enterprise was also his own. It could also be the case that changes in imposed enterprises hindered individuals' accommodation to it and hence generated frustration [see excerpt 45].

Excerpt 45: Interview with Carol [PhD researcher – Group A] – 'the project is not mine'

Carol: (...) Of course_ at the beginning_ when you start the thesis_ you * I don't know\ Right/ But_ **you** maybe **have some goals that you have to·· achieve**_ then the means through which you do it * maybe you do a little bit what you want\ Or not\ Or * but you have a& some guidelines\ I_ with what I started_ my thesis topic_ well_ the 50% are things that I'm not doing anymore\ Either because they haven't turned up and so **we've left this**_ or because something else has appeared which **they find more interesting** and this has been put aside\

Researcher: Okay\ So * but they find more interesting\ I mean_ they gave you a topic_ they are also deciding whether what you're doing is worth or not\ I mean_ it's not your decision\

Carol: No\ Because of course_ I * **the project is not mine**\ (…) There comes a moment when they have new projects and they have to consider [them]\ So as to say_ when * to what extent is worth continuing to invest in older things_ that didn't give you good results either_ even though you want to improve it now_ compared to_ * I don't know\

Researcher: Of course_ but **this is a bit frustrating\ Isn't it/**

Carol: Of course_ **because you may be doing a lot of work_ one year working on one thing_ and then they finish\ @ And it doesn't get anywhere** And that's it\ You say_ well_ the work is there\ It's done\ And it won't_ it won't get anywhere\ It will stay there\ @@

Researcher: How do you deal with this/ this moment/

Carol: At the beginning very bad_ @ and then_ you know_

Carol: (...) Clar_ al començament_ quan comences la tesi_ tu su& * no ho sé\ +Eh+/ Però_ igual **tu tens uns objectius que has de·· fer**_ llavors els mitjans de com ho facis * pos igual vas una mica més al teu aire\ O no\ O el q& * però tu tens un& unes pautes\ Jo_ amb lo que vaig començar_ el meu tema de tema de tesi_ pues_ el 50% són coses que ja no estic fent\ Bé perquè· no han sortit i llavors **ho hem deixat**_ o perquè ha aparegut una altra cosa que **els interessa més** i això ha quedat aparcat\

Investigadora: Vale\ O sigui * però els interessa a ells\ O sigui_ ells te van donar un tema_ ells també van decidint si lo que estàs fent val o no val\ O sigui_ no és decisió teva\

Carol: No\ Perquè clar_ jo * **el projecte no és meu**\ (...) Arriba un moment que ells tenen projectes nous i han de valorar\ Pos de dir_ quan * fins quan val la pena continuar invertint amb coses més antigues_ que tampoc no t'han donat un resultat_ per molt que tu ara ho vulguis millorar_ a comparació de_ * no sé\

Investigadora: Clar_ **però això és una mica frustrant\ No/**

Carol: Clar_ **Perquè tu pots estar fent un munt de feina_ un any treballant amb una cosa_ i llavors ells acaben\ @ I no va a cap lloc** I és això\ Dius_ ostres_ la feina hi és\ Està feta\ I no_ n& no nirà a cap lloc\ Es quedarà allí\ @@

Investigadora: Com ho afrontes això/ Aquest moment/

Carol: Al principi molt malament_ @ i després_ pos mira_

[original in Catalan]

Carol's words show her detachment from the 'project' she is contributing to, about which she states 'is not mine'. The multiple changes in her enterprise that had been imposed on her generated her frustration at the beginning, as she explicitly frames it in this excerpt, a situation she seems to have been resigned herself to.

Since enterprises are dynamic, it is worth considering that such variation might give place to convergences but also to divergences among group members. The modification of initially coinciding enterprises between the one set by the group leader and those of other group members might generate at some point contrasting or incompatible enterprises within the RG [see excerpt 46].

Excerpt 46: Interview with Frank [Group A's leader] – '...not to have them graduate and become unemployed'

> **Frank:** Any member of the group who graduated_ and wished to go for a postdoc anywhere in the world_ they were able to do so\ And secure excellent postdocs\ Now_ two individuals_ whom you haven't met_ had opportunities to go for a postdoc\ But they elected not to go out of Spain\ They said_ I don't want to go out of Spain\ Well_ they are both unemployed right now\ So in my mind that is a waste of my time_ in training them_ and very selfish on their part because for four years they deprived an opportunity for somebody else who truly wanted to do research and embark on a scientific career\ I * **my idea of giving somebody an opportunity to· do research is not to have them graduate and become unemployed**\

In this excerpt, Frank shows his disapproval at past group members' decision of not accepting a postdoc position abroad. He represents his agency in accepting new members into the RG ('giving somebody an opportunity to do research') and implies his expectation that newcomers will accept becoming mobile scientists after their 'training' in the RG. Whenever this expectation is not fulfilled by a group member, he deems it 'a waste of time'.

The data analysed in this section so far show the existence of asymmetries in members' involvement in joint enterprises, as they were recognised or set by the group leaders. The existence of different individual projects defined by their aim, of subgroup projects, and of group activities, placed group members in a position of ambivalence, where the individual interest and the collective benefit could be perceived as clashing at some points.
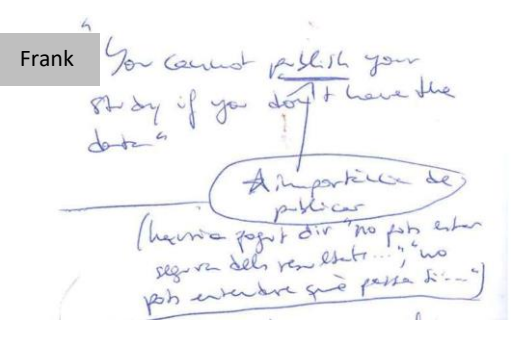
There was however an enterprise that could sometimes be 'joint' among some group members, but not necessarily among all of them: "publishing" their research results [see excerpt 47].

Excerpt 47 Interview with Pere [Group B's leader] – 'results in science are publications'
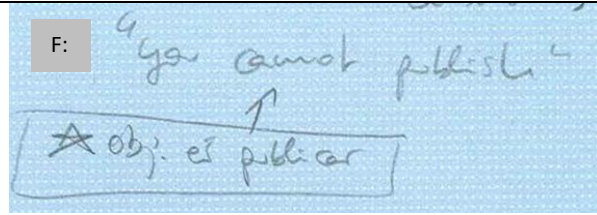
They [group members] are very special_ but_ let's see_ +uh+_ in the projects_ every year we have to report on what we have done\ Right/ And on the results we have obtained\ **And you know perfectly well that results in science are publications**\ If three years after the project_ there are no publications_ +uh+ it will be very difficult that they give you an extension for the project\ Because it says_ you have spent one hundred thousand euros and you haven't done anything\	[Els membres del grup] són molt especials_ però_ a veure_ +eh+_ en els projectes_ nosaltres cada any hem de donar comptes del que hem fet\ Vale/ I quins resultats hem obtingut\ **I tu saps perfectament que els resultats en ciència són publicacions**\ Si al cap dels tres anys del projecte_ no hi ha publicacions_ +mm+ costarà molt que quan intentis renovar el projecte_ te'l donin\ Perquè diu_ vostè s'ha gastat cent mil euros i no ha fet res\ [original in Catalan]

In this excerpt, Pere presents the fact that scientific publications are the way in which results are reified as general knowledge ('you know perfectly well…'), at least among researchers. The idea of publishing as an established goal was made explicit in other conversations with and among participants, although it was usually accepted as an implicit aim for all participants. It was deemed very important and obvious, and was frequently recalled by the group leader as a taken-for-granted final aim of all group members' activity [see excerpts 48 and 49].

Excerpt 48: 20140305_Field notes_Lab meeting Mikela + lab conversations (Page 3) – 'You cannot publish your study if...'

«Frank: "You cannot <u>publish</u> your study if you don't have the data" *Importance of publishing (He could have said "you cannot be sure of the results…", "you cannot understand what's going on if…")»	 [original in English & Catalan]

Excerpt 49: 20140313_Field notes_Lab meeting Mara (Page 2) [Group A] – 'Frank: You cannot publish'

«F[rank]: "You cannot publish" *obj[ective] is publishing	

	[original in English & Catalan]

In these excerpts, the objective of publishing is presupposed by Frank (Group A's leader) as taken for granted and also deemed as a final criterion to assess the quality of scientists' work, in this case Mikela's and Mara's (PhD researchers). As implied here, in the case that they did not 'have the data', their work would not be acceptable since it would not be possible to publish it.

Despite it being a structural, imposed aim in the scientific domain, publishing was often assumed as an individual responsibility. Individual scientists had to take the leading role for a certain potential publication, in which others might collaborate diversely, either as supervisors, as suppliers of partial results, as reviewers, etc. These roles were reified in terms of the position that each individual would occupy in the authorship line of the future scientific paper. Publishing was thus again an individual and a collective enterprise for the participants in this study.

Although publishing was a core practice and a goal in science, the 'structure' (as opposed to 'agency') (Giddens, 1984), in this case in the form of institutional norms, could be found to incentivate or on the contrary to hinder the groups' enterprise of publishing, as was implied by a member of Group G [see excerpt 50].

Excerpt 50: 20140613_Focus group with Postdocs [Group G] – 'in Sweden we have to publish'

Sonja: … And one thing that is totally different in my education in my PhD education_ compared to this institute in Germany_ is that here people write a monograph\ one big thesis\ That usually ends up in some library_ and is not read\ While **in Sweden we have to publish**\ (…) So **there was always a lot of pressure to write this manuscript and to improve on manuscript writing and to improve on the results**\ The research for the manuscripts\ (…) Because then you would say * as I say_ it's very * it puts a lot of stress on the students\ But it gives them a clear aim\

Researcher: So you would prefer that publications are given more importance\

Rita: Yeah\ From the beginning\ The students **from the beginning they have to know what is expected from them**\ (…)

Sonja: But I think it's not only the students\ Also the supervisors * also **in Sweden there was also a lot of stress on the supervisor**\ Because he knew that if * for example the task he gave to a PhD student has to produce so much data that he can publish\ Otherwise the student would not have the chance\ And also you have to supervise\ you have to see_ does the student go in the right direction/ Does he or she learn how to treat the results or how to write up/ Or start writing up/

In this excerpt, Sonja implies that there was a structural 'publishing norm' that affected all doctoral students in Sweden, the country where she did her PhD. The fact that the 'pressure to write this manuscript' existed in her environment is indicated by the impersonal expression 'there was'. Again, as in Pere's words [excerpt 47], publishing is directly related to 'results'. Sonja compares the Swedish and the German systems, and values the former as more effective in stressing the importance of publishing. In that system, 'supervisors' play a mediator role between the institution and doctoral researchers, and are given responsibility in students' success in their publishing endeavour. This feature was observed in Group A and Group B, where group leaders were the final supervisors of all group members' work. They seemed to act as a filter, translating the general purpose of their field of expertise or scientific domain into the RG's joint enterprise, and accommodating their guidelines also to the structural norms of their local environment (institutional, national, etc.).

Instead of the CoP's 'joint enterprise', which has been analysed in this section, the concept of 'domain' was proposed as a defining feature of CoPs by Farnsworth *et al.* (2016: 5). It named "the area in which a community claims to have legitimacy to define competence". Feldman, Divoll and Rogan-Klyve (2013: 238) asserted that the RGs of their study, whose members' were devoted to 'the practice of science', coincided with a CoP in that they had a 'shared domain of interest', defined generally by their scientific discipline and more specifically by their own research questions, as well as in the mutual engagement of their members in research activities which entailed "helping each other, and sharing information about their research interests". In the two core RGs of this study, all group members' work was framed within a specific intellectual or scientific domain, a field, and they were required to contribute jointly to the field's developement. The 'domain' thus was their field of specialisation or the specific area within this field in which the RG's members, especially the group leader, were recognised specialists. But also their institution and their lab constituted a 'domain' in which group members had legitimacy to define competence.

The idea of a common 'domain of knowledge' is linked in the CoP theory with two fundamental elements: a community of people who care about this domain, and a shared practice that is developed by CoP members "to be effective in their domain" (Wenger, McDermott & Snyder, 2002: 27). This shared practice implies a "mutually negotiated competence" around the domain (Farnsworth, Kleanthous & Wenger-Trayner, 2016: 5). In this sense, the RGs studied acted as a community of people who showed concern in mutual interactions about a shared domain. And most of their (professional) interactions had to do with their competence as scientists in different facets: doing experiments properly, writing reports effectively, presenting results adequately, etc.

As has been shown, it could be the case in our RGs that each group member had her own motivations and goals, some of which did or did not coincide with those of others. For instance, a common enterprise of group members was *making science advance* in their common scientific field. Another shared enterprise among group members may have been *becoming competent scientists*, although it could be the case that it were a coinciding individual goal, rather than a joint enterprise. Other examples of individual enterprises suggested by the data analysis were: *becoming a full member of the CoP-RG*, *becoming a legitimate scientist*, *becoming a successful researcher*, *earning money*, *completing the PhD, postdoc or practicum*, and *making relevant discoveries*, which could be coexisting in one same RG, and which needed to be pursued in coordination among group members. When it was not the case (as showed in excerpts 44 and 45, for example), clashes and frustration appeared. The RGs studied hence acted as collective enablers of these individual enterprises but, as has been shown, these were not always deemed compatible with group norms and priorities. Not all members of a same group shared always exactly the same field of interest, nor the same research topic. Not all participants needed to cooperate with the same intensity with the rest, besides the 'obligatory' meetings and the accidental sharing of information. Considering this, the RGs at some points ressembled a CoP composed of sub-CoPs and also of parts of CoPs that transcended the RG (for instance, composed of group members and their out-group collaborators).

The CoP model, which describes the CoP's joint enterprise as one and singular, homogeneously shared by all CoP members, does not seem 100% suitable with the two cases studied here. Although there may be a shared enterprise for all members of the CoP, like the advancing of science, this needs to be stated in very general terms in order to embrace all the diverse individual goals and motivations of group members, some of which were also shared among them, but not necessarily among all of them. It was apparently also difficult for them to share joint enterprises with other group members, because professional interactions were mostly transactional (they implied asking for advice, favours, help, asking doubts, etc.) and did not revolve around philosophical considerations like group mission or the management of in-group cooperation. The lack of negotiation in the setting of a joint enterprise could have generated alienation and frustration when individuals did not identify or accommodate to the imposed enterprise. This could have led to rejection of the leadership and/or of acts that in the end could make the RG advance and make it more competitive in the global scientific domain. Some group members did not see direct benefits of the imposed joint enterprise, especially when these were not explained to them.

Considering that a joint enterprise may shape group members' 'identity of participation' (Wenger, 1998) in the CoP, in our RGs such identity showed to be influenced by powerful

members, like group leaders, in asymmetrical relations, for they defined what is relevant and what is not, what to talk about or not, what to do and what not to do, what is good enough and what needs to be improved, what needs to be justified, what constitutes common sense and what is awkward in multiple ways, through interactions. These considerations shaped group members' shared understandings of what they were doing and of the significance of their acts in their professional lives and for their professional community (Lave & Wenger, 1991). Group members had a clear commitment to their joint accommodation to a shared sense of appropriateness, to common quality standards and to common norms. Their accommodation to such "relations/regime of mutual accountability" (Wenger, 1998: 81) constituted a core task for newcomers, a chief aspect of their learning trajectory in the RG-CoP. This enculturation process was evident in a multiplicity of group members' daily interactions, like mentoring in the lab, written correcting feedback from supervisor/s, and one-to-one meetings between supervisor and supervisee, among others.

In the next section, the third chief characteristic of CoPs, the development of a shared repertoire, will be analysed with reference to the RGs studied.

5.3. Shared repertoire of the RG-CoP

As has been expounded in chapter 2, the shared repertoire among a CoP's members, generated throughout a sustained shared practice, may include manifold meaning-making resources, like habits, language, artifacts, symbols, etc. There are in the data multiple elements that constituted the repertoire shared by the members of the two RGs studied. This repertoire encompassed elements of diverse nature, as will be described here.

To begin with, from the moment they entered the group, participants with a lab-worker status (all newly arrived participants started with this status) had a space assigned in the shared main laboratory, the headquarters of the RG [see exceerpt 51].

Excerpt 51: 20140508_Field notes_Observation Group B (Page 3) – 'everyone has her own assigned place'

«Especially the CoP is officially joined by the laboratory, but it is at the same time a divided space depending on the functionality of each area, as well as on the individuals' ownership (**everyone has her own assigned place** at the bench and at the computers), but within this space the official divisions blur, like the fact that there are 3 subgroups in 1 (in Group B). There is not in the lab (I think) a division of the space according to the official subgroups. Similarly, there are a lot of spaces, rooms, etc. in the building that are shared by all groups ('common spaces') and they are distributed according to their functionality, the practices that take place in them, the machines they have, their conditions (e.g. sterilisation, non-contamination, security…)»	 (in Group B) [original in Catalan]

From their arrival to the RG, this space, the main laboratory, became their reference place, where most of them would spend most of their working hours. As described in excerpt 51, in both labs, the space was divided into experimental benches, machine areas, and computer areas, according to the kind of practice these were devoted to instead of following project divisions. Although it was a reference space, the participants needed to use other spaces besides their main lab for special purposes, which were not necessarily the same spaces for all members of the RG [see excerpt 52].

Excerpt 52: 20140630_Informal interview with Joana (1st day in the lab) [BA researcher – Group A] – 'there are a lot of rooms'

Researcher: And regarding space_ you know the lab_ that room where we were today_ and anything else/	**Investigadora:** I d'espai_ coneixes el laboratori_ la sala aquella on hem estat avui_ i algo més/
Joana: Yes\ They showed this to me the first	**Joana:** Sí\ això m'ho van ensenyar el
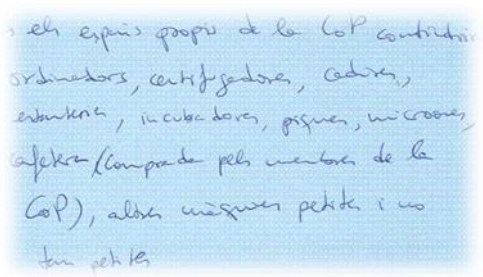
day that I came_ two months ago\ That room over there_ then there's another downstairs\ Do you know the study room/	primer dia que vaig vindre_ fa dos mesos\ Aquella sala d'allà_ llavors n'hi ha una a baix\ Saps a la sala d'estudi/
Researcher: +mhm+	**Investigadora:** +mhm+
Joana: Well then_ if you go to the toilets_ there's a door in front of them_ a black door_ there also\ Then there's another room_ further from that lab we went to * well_ **from that room where we went where there are the leaves_** there is another one * there are two more_ **one that is to take the ice_** and the other that is to * **where there·'s a heater that reaches one hundred and something degrees** a···nd there are a lot of rooms\	**Joana:** Doncs anant cap als lavabos_ queda una porta en frente_ negra_ allà també\ Després hi ha una sala més_ més cap allà del laboratori aquell que hem anat a * Bueno_ **de la sala aquella que hem anat on hi ha les fulles_** n'hi ha un altre * n'hi ha dos més_ **una que és per agafar gel_ i una altra** que és per * **que hi ha una· estufa que arriba a cent i pico graus\ i···hi ha moltes sales**
	[original in Catalan]

In this excerpt, Tània makes reference to some spaces that have been shown to her for they are deemed relevant for her work, apart from her headquarter laboratory. Some such spaces are the room 'where there are the leaves', 'one that is to take the ice' and a room 'where there·'s a heater that reaches one hundred and something degrees'. As can be observed, these rooms are specialised since they contain certain machines or materials that enable specific tasks.

These spaces could be exclusive for the group members or shared with members of other RGs in the same institution. The sharing of a same space involved the sharing of the elements that were present in this environment, like computers, machines, furniture, tools, materials, etc. [see excerpt 53 and picture 3].

Excerpt 53: 20140508_Observation 7 (Page 4) [Group B] – 'the spaces typical of the CoP contain...'

«the spaces typical of the CoP contain computers, centrifuges, chairs, shelves, incubators, sinks, a microwave oven, a coffee machine (bought by the CoP members), other small machines and not so small ones»	
	[original in Catalan]

Picture 14: Materials found in Group A's lab_IMG_0380

Regarding materials, machines and tools, the fact of constituting a shared repertoire among group members implied not only that they were recognised or named, but also that they were used in a certain way, which needed to be learned by newcomers [see pictures 15, 16 and 17, and excerpt 54].

Picture 15: Message on wall in Group A's lab_IMG_0380

Picture 16: Message on machine in Group A's lab_IMG_0398

Picture 17: Message on machine in Group A's lab_IMG_0376

Excerpt 54: 20140630_Interview with Joana [BA Researcher - Group A] – 'you don't know how to use them well until you actually use them'

Researcher: And do you still have any doubt/ What a particular machine is used for_	**Investigadora:** I tens algun dubte encara/ Per a què serveix alguna màquina_
Joana: Yes_ sure\ I'm sure there are a lot of them which I don't * Yes\ Yes\ Of course\ I guess you don't know how to use them well until you actually use them\	**Joana:** Segur que sí\ Segur que n'hi ha moltes que no * Sí\ Sí\ Clar\ Suposo que fins que no les fas anar_ no saps ben bé com utilitzar-les\
Researcher: How to use them\	**Investigadora:** Com utilizar-les\
Joana: Yes\	**Joana:** Sí\
Researcher: But you do know what they are used for\ Or you haven't seen all of them/	**Investigadora:** Però sí que saps per a què serveixen\ O tampoc les has vist totes/
Joana: No\ I haven't seen all of them\ No\ No\ Of course_ I guess that_ as we use them then we know what they are and how to use them\ I mean_ this with the ones that we've used i·n class\	**Joana:** No\ Totes no les he vist\ No\ No\ Clar_ és que suposo que_ a mesura que les fem anar doncs sabem què són i com s'utilitzen\ Vull dir_ això les que hem fet a· classe\
	[original in Catalan]

In picture 14 the 'autoclave tape' was named. This object was very commonly used and found in the lab, but not usually found out of the laboratory context. Moreover, pictures 13, 14 and 15 illustrate the existence of norms of use for objects and machines, which were written in these

cases, but most often they were passed on from old-timers to newcomers through oral commands, corrective feedback, embodied exemplification or through a combination of these means. Excerpt 54 shows that newcomers' learning trajectory in the RG, like Joana's, implied becoming familiar with the way lab machines were used, which could not be done 'until you don't use them'. This shows the hands-on nature of their learning.

Besides machines, materials and scientific objects, lab-workers' shared repertoire included also books and other artifacts present in the lab, as well as their names [see picture 18].

Picture 18: Dossiers and files in Group A's lab_IMG_0420

Apart from the laboratory, which appeared to be a collective identity marker, often identified with the RG itself [see excerpts 55 and 56], also a range of shared working techniques seemed to act as such [see excerpts 57 and 58].

Excerpt 55: Interview with Frank [Group A's leader] – 'the university PhD program does not like our lab at all'

> **Researcher:** Is that why many PhD students have different supervisors/ Because they have more than one\
>
> **Frank:** (…) To the day **the university PhD program does not like our lab at all**\ Because my principle is to have multiple PhD supervisors for our students_ because a lot of our students have PhD programs which span many different areas\

Excerpt 56: Interview with Agus [PhD researcher - Goup A] – 'I probably was more aligned with the ideas of the lab'

Researcher: @@ How different is the Agus at the beginning from Doctor Agus/	**Investigadora:** @@ En què ha canviat l'Agus del principi a l'Agus doctor/
Agus: (…) and I also realised that at the	**Agus:** (…) i també m'he adonat que doncs al

beginning I probably was more aligned with **the ideas of the laboratory_** or of my boss_ or of my bosses\ And in the end I realised that I didn't agree at all with those\ That is to say_ I have also evolved in this sense\	principi potser estava més alineat amb **les idees del laboratori_** o del meu cap_ o dels meus caps\ I al final me n'adonava que no·· hi estava gens d'acord\ És a dir_ també com que he evolucionat en aquest sentit\
	[original in Catalan]

Note in these excerpts how Frank and Agus use the term "laboratory" to make reference to the RG (Group A). The RG and thus the 'lab' were also identified and distinguished from others in terms of the 'techniques' they used (see excerpts 57 and 58).

Excerpt 57: Interview with Vince [Senior researcher - Group A] – 'Some have more experience than others_ but yes'

Researcher: And within the group_ **do you all know how to do the same techniques/**	**Investigadora:** I dins del grup_ **tots sabeu fer les mateixes tècniques/**
Vince: +Uh+ yes\ Quite a lot\ **More or less yes\ Yes\ Yes\ Some have more experience than others_ but yes** Everyone has *	**Vince:** +Eh+ sí\ Bastant\ **Més o menys sí\ Sí\ Sí\ Alguns tenen més experiència que els altres_ però sí** Tothom té *
Researcher: Because that's a little bit what is learnt_ isn't it/ **When people join this group_ they learn the techniques that the group knows**	**Investigadora:** Perquè és una mica lo que s'aprèn_ no/ **Quan s'arriba a aquest grup_ s'aprenen les tècniques que sap fer el grup**
Vince: Not all at once\ But little by little\ Right/ It depends on * on * it depends on the·· * on the * on the experiment that you have to do\ Right/	**Vince:** Tot d'un cop no\ Però a poc a poc\ no/ Depèn de * de * depèn de la·· * de la * de l'experiment que has de fer\ No/
Researcher: +Mhm+ Of course\	**Investigadora:** +Mhm+ Clar\
Vince: It's not that you now learn one thing * For instance Navil won't teach Joana one thing she's not interested in at the moment\	**Vince:** No que ara aprens una cosa * Per exemple el Navil no li ensenyarà a·· la Joana una cosa que no li interessa ara mateix\
Researcher: +Mhm+ And maybe Navil doesn't know how to do things that other people that work with the * with the * what's the name_ that don't work with [object of study]\ That work with the *	**Investigadora:** +Mhm+ I potser el Navil no sap fer coses que fa altra gent que treballa amb el * amb el * com se diu_ Que no treballa amb [objecte d'estudi]\ Que treballa amb el *
Vince: No\ But ev& everyone has a little bit of experience in everything\ (...) There may be expe& esp& * maybe for instance microscopy_ right_ this is not the * the * the * the* the most	**Vince:** No\ Però tot& tothom té una mica d'experiència en tot\ (...) Potser hi ha expe& esp& * potser per exemple microscòpia_ vale_ això no és el * la * la

297

important technique that we use\ I don't talk * the main techniques_ yes\ But the secondary_ no\	* la * la tècnica més· important que utilitzem\ Tot no parlo * les tècniques principals_ sí\ Però les secundàries_ no\ [original in Catalan]

Excerpt 58: Interview with Hao [Senior researcher – Group A] – 'of course the technique is shared'
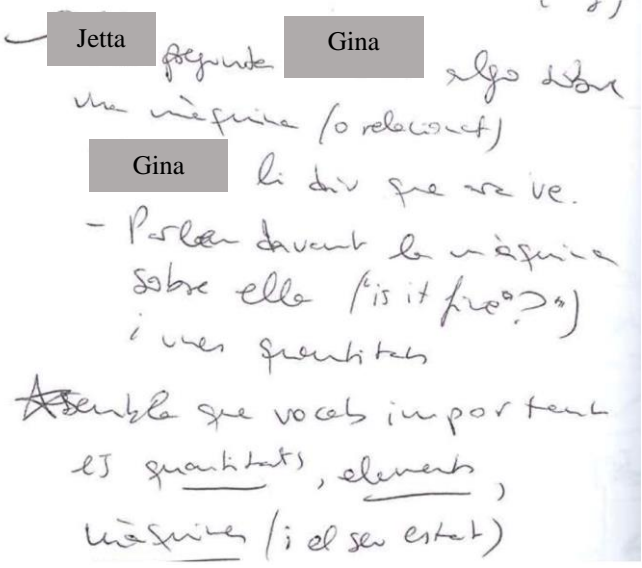
Researcher: What is the group's structure/

Hao: We have Frank and Cecília, Vince and me\ We have independent projects\ I respond for (…) Independent projects\ But **of course the technique is shared\ Some main technique is shared**

In these excerpts, Vince and Hao coincide in asserting that the 'main techniques' used by group members in the lab are 'shared'. This common repertoire transcended 'independent projects' and thus united group members.

We have shown so far that the specialised use of artifacts, machines and materials was very important for the scientists investigated. And besides these, communication around their practices and findings was also paramount. Members of the two RGs shared a specialised linguistic repertoire that they used on a daily basis, within the lab, in group meetings, in reports, etc. This specialised vocabulary could make reference either to elements of their object of study, to experimental techniques and protocols, to machines and their outputs, or to aspects of the texts they generated to report on their work (like graphs, images, symbols, etc.), among others [see excerpt 59 and picture 19].

Excerpt 59: 20140123_Field notes (Page 5) – Jetta [MA resarcher – Group B] and Gina [PhD researcher – Group B] – 'Jetta asks Gina something about a machine'

«Jetta asks Gina something about a machine (or related). Gina tells her she's coming.
They talk in front of the machine about it ("is it fine?") and some quantities
*It seems that important vocab are quantities, elements, machines (and their state)»

[original in Catalan]
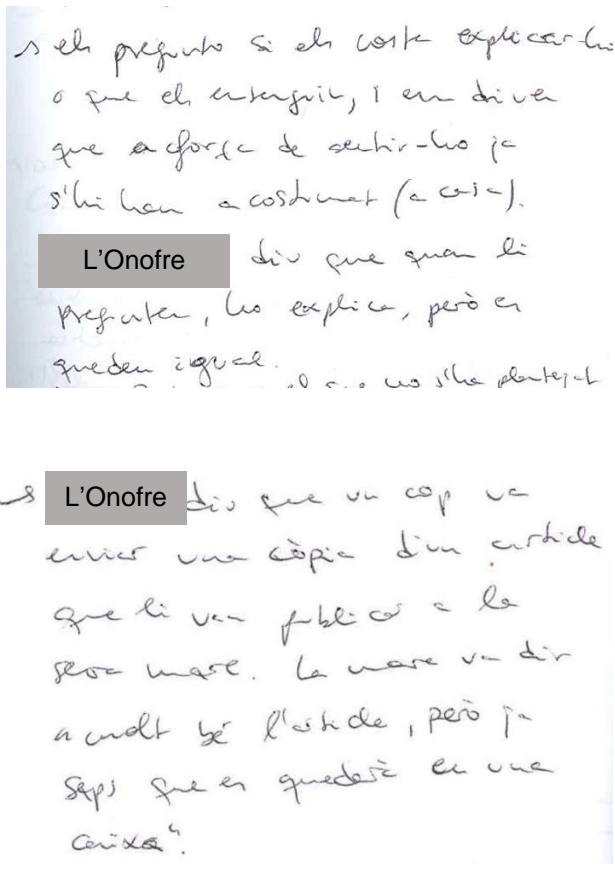
Picture 19: Diagrams on the wall [Group B's lab]_IMG_0433
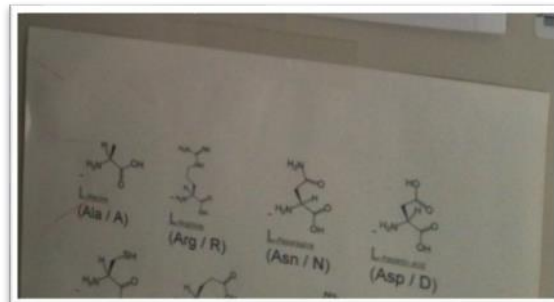
In excerpt 59, Jetta asks Gina about a machine and they engage in a conversation about the machine and some quantities. Following this and other similar instances, I deduced that typical vocabulary of the RG encompassed 'quantities, elements, machines (and their state)'. Picture 19 shows some diagrams that were commonly found in Group B's laboratory in the form of signs, notes in a lab notebook, and slides of a Power Point presentation, among others.

These specialised terms and expressions were a clear sign of participants' membership in their RG because they determined individuals' capacity to fully participate in all the usual communicative events of the RG. These constituted a group jargon which was strange and incomprehensible to out-group individuals, like the participants' relatives or myself [see excerpt 60], to a lesser degree was it strange to scientists of other scientific domains and also, though less, to members of other RGs within the same domain [see exerpts 61 and 62].

Excerpt 60: 20140123_Field notes (Page 7) [PhD researcher – Group B] – 'you know that it will stay in a box'

«I ask them if it is difficult for them to explain it [their work] or that others understand them, and they tell me that after hearing it many times they became used to it (at home).

Onofre says that whenever they ask him, he explains it, but they stay the same [don't understand].

(...)

Onofre says that once he sent a copy of an article he got published to his mother. His mother said to him: "well done with the article, but you know that it will stay in a box".»

L'Onofre

L'Onofre

[original in Catalan]

Excerpt 61: 20140508_Informal interview with Dana [Senior researcher – Group B] – 'for the external world it's unknown'

Dana: ... yes\ But what do you mean/ That we_ within the lab we have our own language\

Researcher: = for instance| XXX=

Dana: = it's a way of * this also= it's true\ Because they way you express yourself and everything_ despite not being only through [technical] terms_ and [despite] simply using abbreviations or whatever_ for the external world it's unknown\ (…) Even scientists but from another field\ My boyfriend is an agronomist\ And I talk to him @ about XXX from here_ it doesn't * it doesn't ring him a bell at all\ @

Dana: …sí\ Pero qué quieres decir/ que nosotros_ dentro del laboratorio tenemos un propio lenguaje\

Investigadora: =Por ejemplo\ XXX=

Dana: =es una manera de * eso también= es verdad\ Porque la manera que te expresas y todo_ aunque no sea solamente con términos_ y simplemente uses abreviaturas o lo que sea_ para el mundo externo es desconocido\ (…) Incluso científicos pero de otro campo\ Mi novio es agrónomo\ Y yo le hablo @ del XXX de aquí_ no * no le suena para nada\ @

[original in Spanish]

Excerpt 62: Interview with Tània [PhD researcher – Group A] – 'they wouldn't understand things from there either'

Researcher: And are there any words you don't know/ When you come here_ for instance_o·r =XX= there/

Tània: =Yes\= I told you_ things related to·· botany_ or plant physiology_ or * or very * very specific\ Because here they use a m& a·· * I don't know\ A·· medium with an antibiotic_ o··r a medium that is called that\ Sometimes I didn't didn't know tha··t when they talked this made reference to this\ Then they tell you_ +oh+ no_ this is a medium\ I say_ +oh+ okay\ okay\ Well_ so·· that's it\ You know/ Well_ at the beginning yes\ At the beginning I did find everything a little more difficult\ Now it's just some details probably\

Researcher: And you've also had this learning of the vocabulary =that you didn't know=

Tània: =Yes\ Yes\= For instance_ they said callus\ I didn't know what Callus was\ Of course_ it's the embryos\ But I * you either told her embryos_ because you had been explained embryos_ but you had never been told about callus during the degree\ This like this and more experimental things\ Right/ What might this be/ or what is that/ Parts of the plants\ In English\ Of course_ I'd never done it\ But no\ I mean_ apart from this_ because it's a different topic * totally different_ they wouldn't understand things from there either\ Probably\ Of course\ But well_

Researcher: Because of the vocabulary =mainly\=

Tània: =Yes\= Things related to illnesses_ which means that it's * I don't know\ Yes\ Of course\ Things related to illnesses they would ask probably\

Investigadora: I hi ha paraules que no coneguis/ Quan vens aquí_ per exemple_ o· =XX= allà/

Tània: =Sí\= Ja et dic_ coses de mo··lt o botànica_ o fisiologia vegetal_ o * o molt * molt concrets\ Perquè aquí utilitzen un ma& * un·· * jo què sé\ Un·· medi amb un antibiòtic_ o·· un medi que es diu tal\ A vegades no sabia que·· quan parlaven això se referia a això\ Després te diuen_ +ah+ no_ això és un medi\ Dic_ +ah+ vale\ vale\ Bueno_ pos·· ja està\ Ho entens\ Home_ Al principi sí\ Al principi sí que em va costar tot una mica més\ Ara ja potser detalls\

Investigadora: I has tingut també aquest aprenentatge del vocabulari =que no coneixies=

Tània: =Sí\ Sí\= Per exemple_ deien callus\ Callus no sabia el que era\ Clar_ són els embrions\ Però jo * o li deies embrions_ perquè t'havien explicat embrió_ però callus no t'ho havien dit mai a la carrera\ Coses així i de més experimentals\ +Eh+/ Això què deu ser/ O allò què és/ Parts de les plantes\ En anglès\ Clar_ no ho havia fet mai\ Però no\ Vull dir_ a part d'això_ perquè és un tema diferent * totalment diferent_ ells tampoc entendrien coses d'allí\ Segurament\ Clar\ Però bueno_

Investigadora: Pel vocabulari =més aviat\=

Tània: =Sí\= Coses de malalties_ que vol dir que està·· * no sé\ Sí\ Clar\ Coses de malalties segurament preguntarien\

[original in Catalan]

Excerpt 60 reflects Onofre's feeling that his work is not fully understood by his family, which he exemplifies through the description of his mother's reaction when receiving one of his

published works: she has no other option but to leave it 'in a box' for it does not constitute a feasible reading for her. In excerpt 61, Dana aligns with the idea that there may be some vocabulary and expressions used by her group peers and herself which might be strange or unknown by external individuals. She exemplifies this phenomenon through her conversations with her own boyfriend, also a scientist but from a different field, who does not understand some things she explains about her work. In excerpt 62, Tània, a PhD researcher of Group A who had to do experiments in different labs, explains how there are words normally used by other group peers she did not know at some point due to the fact that her object of study is a bit different to that of her group peers, and conversely there are words or concepts that she believes would need to be clarified when addressing someone of her RG.

In terms of language choice, both RGs worked in a multilingual environment, although with a different linguistic repertoire and different proportions of each language [see pictures 20, 21, 22, 23, 24, 25 and 26].

Picture 20: Notes in multiple languages - Group A's lab_ IMG_0411
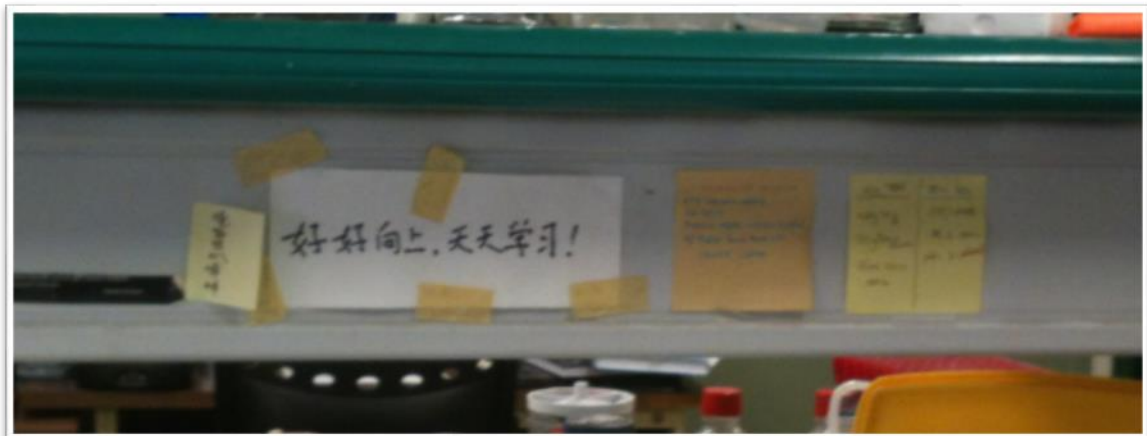
Picture 21: Same sign in two languages – 'Danger, do not touch' – Group A's lab_ IMG_0401

Picture 22: Multilingual Christmas card - Group A

Picture 23: Note in Catalan – 'The last one to use the coffee machine, please turn it off!!' - Group B's lab_ IMG_0439

Picture 24: Note in English - Group B's lab_ IMG_0450

Picture 25: Multilingual repertoire in Group B's lab_ IMG_0460

In the case of Group A, Most objects and artifacts were named in English and, thus, it was their English naming (and not their naming in the participants' L1) that was part of the RG's shared repertoire. In contrast, in Group B, the Catalan or Spanish name of artifacts was most often used in the laboratory. Therefore, participation in Group A entailed learning the English name

304

of all tools and materials used in the lab and/or referred to in group meetings [see picture 26 and excerpts 63 and 64].

Picture 26: Poster with the English name of the parts of a plant – Group A's lab
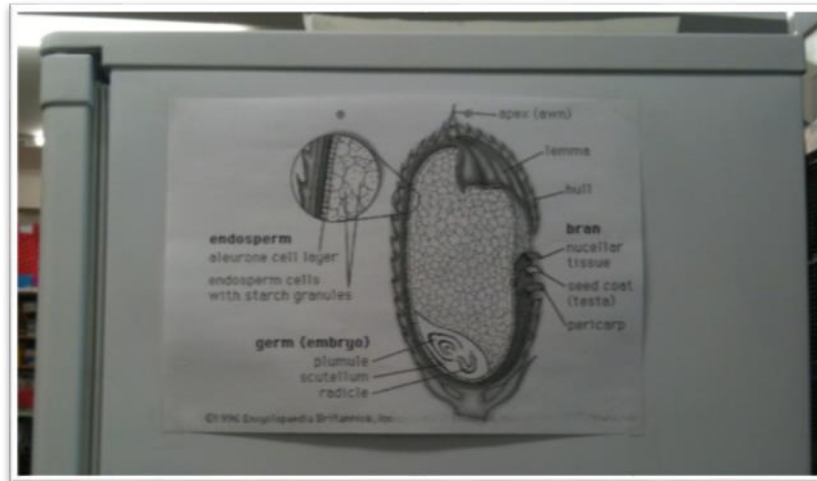
Excerpt 63: 20140630_Field notes (Page 4) – [PhD researcher] and Joana [BA researcher] – Group A – 'Navil looks up the word on the Internet'

«Navil tells Joana something about "foil" {(Cat) foil}; she does not understand and Navil looks up the word on the Internet - Oxford dictionary online»	[original in Catalan]

Excerpt 64: 20140630_Navil [PhD researcher] and Joana [BA researcher] doing experiments – Group A – 'In English_ it's spray squeezer'

Participant	Speech	Action	Video shot
Navil	Use the alcohol\		
Joana		Looks into the vacuum doubting.	
Navil	Alcohol\	Points somewhere in front of him.	

305

Joana		Assents and walks towards the area Navil had pointed at.	
(...)			
Joana		Comes back with a bottle and leaves it on the bench.	
Navil	How do you say from this bottle this/	Points at the atomiser of the bottle.	
Joana		Shrinks her shoulders (meaning 'I don't know')	
Navil	In English_ it's spray squeezer\		
Joana	Squeezer/	Moves head closer to Navil.	
Navil	Squeeze\	Squeezes bottle	
Joana	Spray/		
Navil	Yeah_ Spray\ Yeah\	Assents	

In picture 26, the English name of different parts of a plant are written and superposed to an image, a drawing of these parts. The fact that this document was exposed in a central part of Group A's lab may indicate that this vocabulary was commonly needed in daily interactions within the lab. Excerpts 63 and 64 illustrate how this specialised vocabulary in English was negotiated among group members who did not share their L1 and it was learned through the practice in the laboratory. In the first of the two excerpts, Navil (Kannada L1), an oldtimer who is mentoring Joana (Catalan L1), a newcomer, says the name of a material they are going to use in English, and given that Joana does not recognise this word, Navil looks up its definition on

306

the Internet. This type of interaction was usual between Navil and Joana during Joana's internship in Group A's lab, especially at the beginning. This is also evidenced in the second excerpt of the two [excerpt 64], which shows the moment when Navil teaches Joana the term 'spray squeezer'. Little by little Joana got used to the English name of the objects she and Navil were using in the lab and to other recurrent expressions in their interactions. In this sense, Navil acted as a mentor in lab activity and also a teacher of English language, in particular in relation to the linguistic repertoire related to the lab and to his scientific practice.

In both groups, English was the chosen lingua franca, common to *all* members of the group. The sharing of this lingua franca entailed also getting used to all group members' speaking style and accent in English, which also required the individuals' accommodation effort [see excerpt 65].

Excerpt 65: Interview with Carol [PhD researcher – Group A] – 'I've got used to it now\'

Researcher: And the communication with Hao_what's it like/ Because I don't know_ I also guess he may +uh+ understand things quite differently from the way we understand here_ right/ =us\=	**Investigadora:** I la comunicació amb el Hao_ què tal/ Perquè no sé_ també suposo que pot +eh+ entendre les coses bastant diferent de com entenem aquí_ no/ =nosaltres\=
Carol: +mh+ I don't know_ **I've got used to it now** @ (...) **At the beginning I found it very hard** From what he wanted to say to the way he said it_ But *	**Carol:** +mh+ No sé_ **ara m'hi he acostumat** @ (...) **Al principi em costava molt** Del que ell volia dir al que ell com ho deia_ Però *
Researcher: Because of the language/ Or because of how he understood things/	**Investigadora:** Per la llengua/ o per com entenia les coses/
Carol: Because of everything\ Because he didn't speak very well @_ Because he skips words\ And then you don't know what he wants to say_ a··nd * that is_ it's a little more XXX\	**Carol:** Per un tot\ Perquè entre que no acaba de parlar molt bé @_ Perquè es menja paraules\ I després que no ho saps el que vol dir_ i·· * o sigui_ que és una mica com més XXX\
(…)	(…)
Researcher: And what about the other way round/ Do you feel that you u& * that he understands you/	**Investigadora:** I al revés/ Notes que tu t& * que ell t'entèn a tu/
Carol: I think he does\ He probably found it more difficult before\	**Carol:** Jo crec que sí\ També abans li devia costar més\
	[original in Catalan]

In this excerpt, Carol (Catalan L1) confesses the difficulties she used to have initially when interacting in English with Hao (Chinese L1), one of her supervisors. After some time

interacting with him, she believes that their speaking style in English is now more intelligible to one another than 'at the beginning'.

Besides special scientific terms, not usually used in other contexts, there were also some ordinary words used with a specialised meaning within the RGs, like 'line', 'band, 'culture' and 'tissue' [see excerpts 66 and 67].

Excerpt 66: 20140709_Meeting Hao (senior res.), Carol (PhD res.), Lurdes (BA res.), Xènia (BA res.) and Frank (group leader) – Group A – 'each line we have three independent'

Hao: …you have* you will do six different [object of study 1] expressing in [object of study 2]\ Xènia_ you will do the [experiment]\ is the * the one key is +uh+ XXX XXX\ and have* in [object of study 2] * have three different +uh+ +uh+ [object of study 1]\ and +uh+ for +uh+ for [object of study 2] we're growing the +uh+ X [confidential] **bands** with +uh+ the XXX X and [material]\ each **line** we have three independent +uh+ * each [confidential] we have three independent [confidential]\ Right/ and +uh+ can you contact the XXX to see whether we can get the kit/

Excerpt 67: From protocol followed in Group A – 'transfer the tissue'

> D. **Regeneration**
>
> After another two weeks of **culture** on [confidential], transfer the healthy [object of study 1] on to a MSR plate for regeneration (Remove dried portion (brownish) of the [object of study 1] and then transfer the **tissue** to MSR. If the **tissue** is large, then make it into two or three pieces.

The shared repertoire among group members of the two RGs studied hence consisted of artifacts, machines, techniques and words, but also of a wide range of specialised images, graphs and symbols that were commonly used among group members [see pictures 27, 28, 29 and 30].

Picture 28: Machine output – Group A_ IMG_0389

Picture 29: Sign on autoclave tape_ IMG_0407
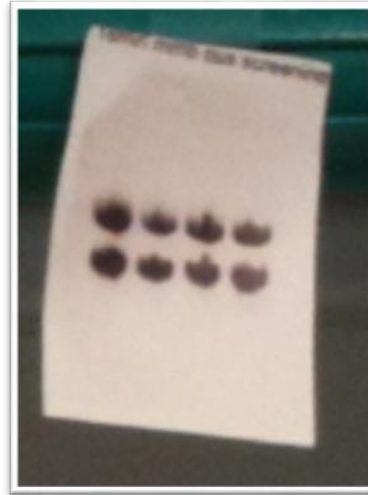
Picture 30: Schemes – Group B_ IMG_0397
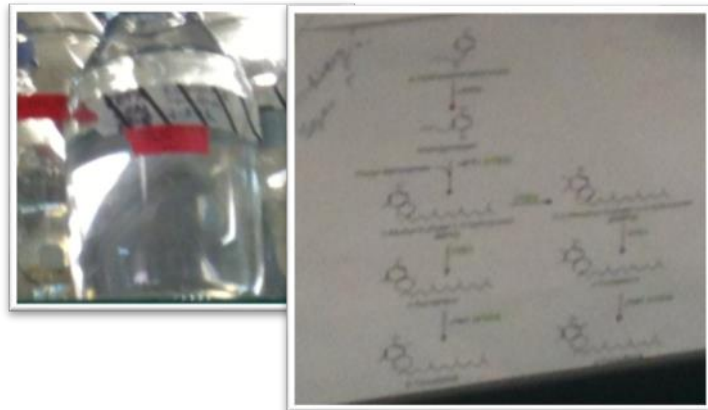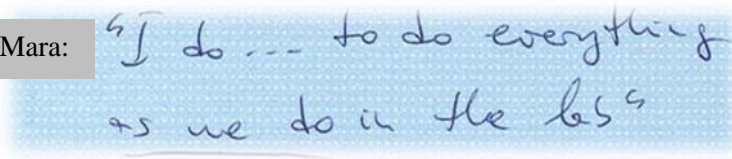
All elements shown in these pictures were very commonly found in either of the two RGs' labs, and also these images or similar ones were often used in presentations and reports of different kinds. Mastering this type of shared repertoire implied not only understanding the words, the symbols, the colours in images, the forms of the figures, and all the communicative resources, but also that all group members interpreted them in the same way. The shared repertoire thus

entailed shared ways of interpreting texts and also shared ways of doing things, marked by a shared system of norms [see excerpts 68, 69 and 70].

Excerpt 68: 20140530_Lab meeting Mara 2 (Page 2) [PhD researcher – Group A] – 'everything as we do it in the lab'

«Mara: "I do...to do everything as we do it in the lab."»	Mara: [original in English]

In this excerpt, where the RG is equated with 'the lab', Mara expresses her will to act 'as we do it in the lab', and thus proceed in a standard way, common for all lab-workers of her RG.
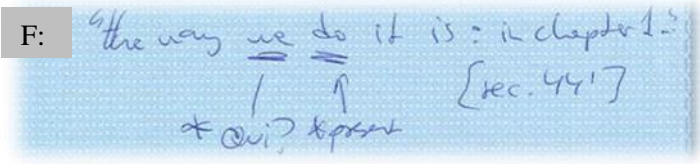
The idea of a shared repertoire within the RG can be extended to the adoption of specific textual genres to report on research outputs, which seemed to affect all the RG's reports of one same kind, like the PhD thesis [see excerpt 69].

Excerpt 69: Interview with Tània (PhD researcher – Group A) – 'this is how it has always been done here in the group'

| **Tània:** ... The structure of the thesis_ to say something_ has been defined by Frank and Cecília\ Well_ defined_ **this is how it has always been done here in the group**\ I follow this model\ Yes\ (...) Because if not_ in the end_ you don't know_ * there are thesis that are very * there mainly in medicine_ very long\ a very very_ * of two hundred pages maybe\ and here the idea is_ well yes_ it's_ the introduction_ general_ that it can include everything_ but not very long_ after each chapter_ this thing with chapters is not something many people do either\ well_ they do it * they do it or they don't do it\ But there are groups in medicine that don't_ that do thesis o··f five hundred pages_ explaining point by point each * how they made the materials and methods_ **and here it's not common**\ **And here in English_ there [in medicine] they do it in Catalan**\ | **Tània:** ... L'estructura de la tesi_ per dir algo_ ho ha organitzat el Frank i la Cecília\ Bueno_ organitzat_ **és com s'ha fet aquí al grup sempre**\ Segueixo aquest model\ Sí\ (...) Perquè si no_ al final_ no saps ja_ * que hi ha tesis que són molt * allà sobretot a medicina_ molt llargues\ una introducció molt molt_ * de dos-centes pàgines potser\ i aquí la idea és_ pos sí_ és_ introducció_ general_ que una mica ho pugui englobar tot_ però no molt llarga_ després cada capítol_ * que això de capítols tampoc no ho fa gaire gent\ Bueno_ ho fan * ho fan o no ho fan\ Però hi ha grups a medicina que no_ que fan tesis de·· cinc-centes pàgines_ explicant-te fil per randa cada * com han fet els materials i mètodes_ **i aquí no s'estila**\ **I aquí en anglès_ i allà [a medicina] ho** |

	fan en català
	[original in Catalan]

Excerpt 70: 20140718_Tània's PhD defense rehearsal 1 (Page 3) (Group A) – 'The way <u>we</u> [who?] <u>do</u> [present] it is...'

F[rank]: The way <u>we</u> [who?] <u>do</u> [present] it is: in chapter 1... [rec. 44']	F: *the way we do it is: in chapter 1...* [rec. 44'] [original in English]

In excerpt 69, Tània describes briefly the structure of her dissertation, which follows the group leaders' indications, as had 'always been done here in the group'. In this excerpt, Tània constantly compares her RG's 'model' for a PhD thesis with the style she has seen in the other RGs with which she had collaborated and other groups in that faculty. She points at differences like the structure, the length and the language used 'here in English and there [in medicine] they do it in Catalan\'. Excerpt 70 illustrates how the group leader, in this case Frank, gives instructions to Tània on her oral defense, during a rehearsal. Note that the group leader's statement is constructed with a first-person plural pronoun and with the verb in the present tense, as if it were a convention or habit, a usual practice among group members, instead of a request.

Also Diana, a former member of Group A, after spending some time abroad as part of her postdoc realised that her writing style was marked by the general normative style that was usual in her former RG [see excerpt 71].

Excerpt 71: Interview with Diana [Postdoc – former member of Group A] - 'it's the style that I've been developing during these four years of the PhD'

Researcher: And when you wrote something there_ a supervisor also corrected it_ or_	**Investigadora:** I quan has escrit allà algo_ també t'ho han corregit algun supervisor_ o_
Diana: Yes\ Yes\	**Diana:** Sí\ Sí\
Researcher: Yes\ The·· team leader/ O··r	**Investigadora:** Sí\ El·· {(Eng) team leader}/ O··
Diana: Yes\ Like Frank\	**Diana:** Sí\ Tipo Frank\
Researcher: Like Frank\	**Investigadora:** Tipo Frank\
Diana: But of course_ the difference is	

there\ Each of them writes differently\ And at the beginning when I wrote with her I also didn't know how she wrote\ Then of course_ well then the feedback_ but not a feedback about spelling mistakes or something like this\ It was more about writing style\

Researcher: +Mh+ Of course_ everyone has =a little bit her own\=

Diana: =Everyone= Exactly_ she adapts that according to her style\ Which doesn't mean that there is a grammatical or spelling mistake\ It has to do more with styles\ That **everyone has her own style_ and likes things to be written in her own style**

Researcher: So you may write the same thing here_ and they wouldn't =correct it\=

Diana: =Yes\= He [Frank] wouldn't correct it_ probably_ **because it's the style that I've been developing during these four years of the PhD_** But if you send the same style to her_ she changes it\

(...)

Researcher: +Mhm+ And * and what does this style change/ Does it change the structure of the sentence_ the words you use in the same sentence_

Diana: The structure and she often starts with for instance {(Eng) and}\ (...) And this is something that we had never done here\ I guess it's the style that she has\ Or for instance we often use the passive voice when we write\ Passives or pasts\ Right/ I did whatever\ And she also uses the present tense a lot\

Diana: Però clar_ la diferència hi és\ Cada un d'ells escriu diferent\ I jo al principi quan vaig escriure amb ella no sabia tampoc com escrivia ella\ Llavors clar_ Pos llavors les correccions_ però no les correccions que tu fas errors d'ortografia o així\ Eren més correccions de l'estil d'escriure\

Investigadora: +Mh+ Clar_ això és cadascú =una mica té el seu\=

Diana: =Cada u= Clar_ ella s'ho adapta al seu estil\ Que no vol dir que hi hagi un error gramatical o d'ortografia\ És més d'estils\ **Que cadascú té el seu estil_ i li agrada que li escriguis al seu estil**

Investigadora: O sigui que tu potser escriuràs lo mateix aquí_ i no t'ho =corregirien\=

Diana: =Sí\= Ell [el Frank] no m'ho corregiria_ segurament_ **perquè ja és l'estil que he anat agafant durant tots aquests quatre anys de doctorat_** Però a l'enviar-li el mateix estil a ella_ ho canvia\

(...)

Investigadora: +Mhm+ I * i aquest estil què canvia/ Canvia l'estructura de la frase_ les paraules que utilitzes dins la mateixa frase_

Diana: L'estructura i comença molt també per exemple amb {(Eng) and}\ (...) I és algo que aquí mai ho havíem fet\ Suposo que és l'estil d'ella que té\ O per exemple nosaltres fem servir molt les passives quan escrivim\ Passives o passats\ No/ He fet no sé què\ I ella també fa servir molt present\

[original in Catalan]

In this excerpt, Diana remarks that some features of her writing style, which she had learned or acquired during her PhD in Group A, did not fit in with her new supervisor's style, and that thus she had to adapt to this new style. She gives examples, like the use of 'and' at the beginning of the sentences, and the predilection for past or present tenses, or for the passive or the active voice, which she deems a matter of taste.

Besides artifacts, their nomenclature, linguistic elements and genre norms, the shared repertoire of the RGs studied included also some jokes and anecdotes, like the ones that decorated their working space [see pictures 31, 32, 33 and 34].

Picture 32: Group A – 'A highly dangerous virus'_ IMG_0417a

«A highly dangerous virus called "Weekly Overload Recreational Killer" (WORK) is currently going around. If you come in contact with this WORK virus, you should immediately go to the nearest "Biological Anxiety Relief" (BAR) center to take antidotes known as "Work Isolating Neutralizer Extract" (WINE), "Radioactive UnWORK Medicine" (RUM), "Bothersome Employer Elimination Rebooter" (BEER) or "Vaccine Official Depression Killing Antigen (VODKA)»
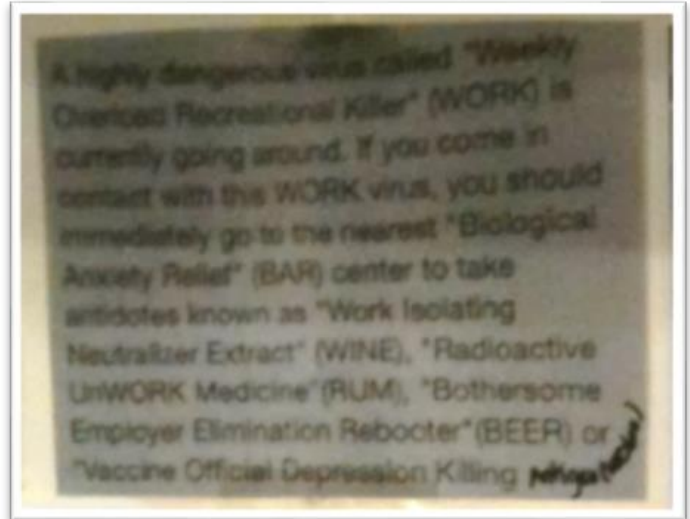
Picture 31: Group A - 'Western blot'_ IMG_0417b

«WESTERN BLOT!»*

Analytical technique used in molecular biology.

Picture 33: Group A - 'All work and no play'_ IMG_0417c
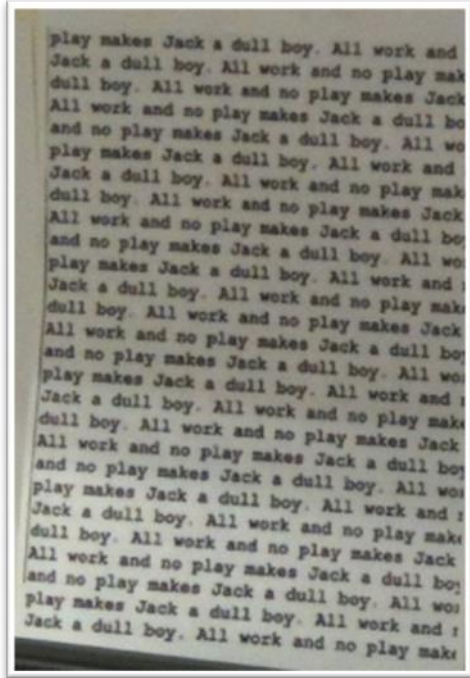
«All work and no play makes Jack a dull boy. All work and no play makes Jack a dull boy. All work and no play makes Jack a dull boy. All work and no play makes Jack a dull boy...»
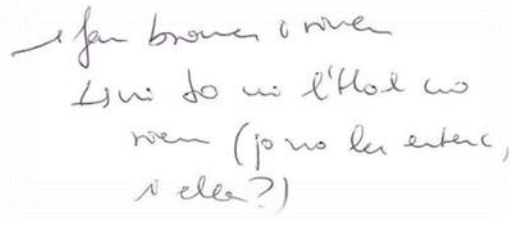
Picture 34: Group A 'Tips'_ IMG_0413

As shown in pictures 31, 32, 33 and 34, jokes were usually the result of combining scientific and non-scientific references giving place to paradoxes or absurd. The combination of these two worlds appealed to participants in a special manner. Such jokes seemed a metaphor of the ambivalence of their daily activities, between the scientific and the non-scientific worlds. In-group jokes probably required also a period of accommodation to common references and group

jargon from the part of newcomers, and hence they were probably ineffective with or alien to peripheral members [see excerpt 72].
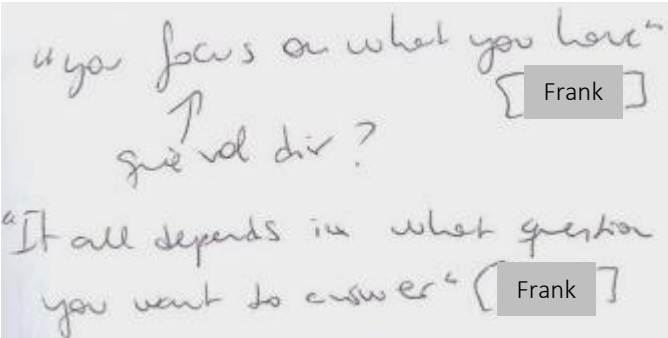
Excerpt 72: 20140129_Field notes_Gina's Group seminar (Page 3) [PhD researcher Group B] – 'They make jokes and laugh'

«They make jokes and laugh. Neither I nor Jetta laugh (I don't get them, does she?)»	[original in Catalan]

As was gathered in this fieldnote, Jetta and I, as newcomers to Group B, lacked the common references necessary to participate in group members' jokes. In this case, since the participants were using English – which was not Jetta's L1 –, the linguistic factor could also play a role in Jetta's limited participation in this kind of interactions.

Finally, the RG's shared repertoire included also a shared discourse reflecting certain perspectives on the world among group members, like empiricism, materialism, naturalism and a hierarchical worldview based on publications, impact factors, and popularity. From the moment when new members entered the RG, they started to be surrounded by discourses reflecting these perspectives and to be trained to accommodate to them [see excerpt 73].

Excerpt 73: 20140120_Field notes_Observation Group A's lab (Page 06) – 'You focus on what you have'

« "You focus on what you have" [Frank] 　　　What does it mean? "It all depends in what question you want to answer" [Frank]»	[original in English]

This excerpt reflects how Frank passed on his perspective in a subtle way, that is through a speaking style characterised by the use of the present tense, like in 'focus' and 'depends', which denoted absolute certainty about a general norm.

As has been exposed in this section, in both cases studied, there was a shared repertoire among group members which developed as a result of the participants' practice in the RG-CoP. The setting of the lab as a core, pivotal space conformed a complex multimodal milieu with a wide range of resources not commonly found in non-specialised environments. It conformed "a repertoire for which outsiders miss shared references" (Wenger, 1998: 113) and newcomers had to get used to it. It consisted of specialised linguistic resources, shared communicative resources of other types, shared information about their field of practice, shared working techniques, common materials, tools, machines, etc. Yet, while shared by most group members, a great deal of it was not shared by all of them. It was mostly shared by group members working with the same object of study, in the same project, by same-status members (e.g. lab-workers versus office-workers), etc. Besides mutual engagement, a joint enterprise and a shared repertoire, also a shared practice is a core element of CoPs, as described in the literature. The next section will revolve around the existence of a shared practice among group members in the RGs studied, which implies also the existence of boundary positions and objects and brokering practices.

5.4. Practice, brokering and boundary objects in the RG-CoP

As is underscored in the theory's name itself, a shared practice is a defining characteristic of a CoP. Its members interact frequently in order to expand their skills around a topic, as a result of which they develop common know-how or ways of doing and communicating things. In the case of the two RGs studied here, their central practice could be summarised as 'doing science'. As noted in chapter 2, the CoP's practice encompasses a series of actions and the objects that derive from those actions, that is, *participation* and *reification*. CoPs develop their practice through a variety of activities, like 'problem solving', 'requests for information', 'seeking experience', 'coordination and synergy', 'discussing developments', 'visits', etc. (Wenger-Trayner & Wenger-Trayner, 2015). Examples of these were observed in Group A and Group B, and were central activities of their daily work, which undoubtedly required effective communication.

However, a practice entails the existence of connections or continuities at multiple levels and these, in turn, imply discontinuities. The conformation of a CoP centripetally joined around a core practice involves the existence of boundaries around it. Participation is hence a continuum

from the core to the extreme periphery, and non-participation corresponds to unrelated and irrelevant practice (Lave & Wenger, 1991). Among the diverse shapes that a CoP's boundaries may take, some of these that have been identified in the cases studied are: official documents certifying membership, group members' official categories or titles (like group leader, senior researcher, PhD researcher, etc.), assigned spaces – especially in the RGs' main laboratory –, mailing lists, group meetings, research projects with an assigned PR (or more), assigned tasks – like doing experiments in the lab or taking care of the lab materials –, and an in-group communicative style, among others.

Around the CoP's defining practice, there are diverse degrees of centrality and thus of peripherality. Centrality designates a position of 'full participation' in the CoP's practice, of responsibility on this practice and an identity of "master practitioner" (Lave & Wenger, 1991: 111). As described by Wenger (1998: 152), central participation or full membership entails feeling "in familiar territory", "experience[ing] competence" and being "recognised as competent", understanding others' actions, what their enterprise is and knowing the norms for engaging with others and the shared resources used for communication and for performing the CoP's practice. In the case of the two core RGs studied, the data analysis suggests that centrality in the RG-CoP might not coincide with official positions of power. In both cases, there was a task specialisation among group members depending on their status. Newcomers who had a student status (from BA and MA to PhD) engaged in lab-work specialisation and had to follow a certain non-explicit curriculum of techniques and protocols in the RG's lab. The subsequent statuses in the hierarchy (from postdoc and senior researcher to group leader), as I explained in section 5.1, implied a progressive dettachment from the experimental bench and an engagement in office work, like project proposals, grant applications, and supervision of other group members' reports [see excerpts 74 and 75].

Excerpt 74: Interview with Cecília [senior researcher - Group A] – 'all the students have a series of documents and papers that I always deal with first'

Researcher: To start with_ for instance_ I would like to know which are your daily tasks\ What do you do/ (...) **Cecília: Administration**\ Well_ for instance_ we [the group] have students\ Right/ Well_ **all the students have a series of documents and papers that I always deal with first**\ Then we fill them out and we do it together\ Then we have what is related to invoices_ the money\ We have to decide how to spend it\ What projects you assign it and how it fits with what objectives\ (...) Then I also start all the forms if we have to ask for projects\ (...) This let's say would be in the morning\ (...) In the morning nor& normally we solve everything related to the press\ If someone calls_ if they want interviews_ if we have to go somewhere_ if we have to make a programme_ (...) And then in the afternoon I try to do my research\ In the afternoon I try to do my * to write if I have a publication waiting_ I try it\	**Investigadora:** Per començar_ per exemple_ volia saber quines són les teves tasques diàries\ Què és el que tu fas\ (…) **Cecília: L'administració**\ A vere_ Per exemple_ lo grup tenim estudiants\ No/ Pos_ tots **los estudiants tenen una sèrie de documents i papers que sempre primer passen per mi**\ I a llavons els omplenem junts i ho fem junts\ Després tenim tot lo que és la facturació_ los diners\ S'han de distribuir com se gasten\ A quins projectes se posen i amb a quins objectius encaixen\ (…) Llavorens jo també començo tots los formularis de si hem de demanar projectes\ (…) Això diguessam que seria al matí\ (…) Al matí nor& normalment solucionem tot lo que és premsa\ Si truca algú_ si volen entrevistes_ si hem de sortir a algun puesto_ si hem de fer algun programa_ (…) I llavons a la tarda intento fer la meua recerca\ (…) A la tarda intento fer el meu * escriure_ si tinc alguna publicació pendent_ Ho intento\ [original in Catalan]

Excerpt 75: Interview with Pere [Group B's leader] – 'you keep separating from the [experimental] bench more and more\'

Researcher: Of course\ And [you] the senior don't sit here [in the lab]\	**Investigador:** Clar\ I els sèniors no us asseieu aquí [al laboratori]\
Pere: Very little\ Very little\	**Pere:** Molt poc\ Molt poc\
Researcher: You don't have many opportunities\	**Investigador:** No teniu gaire oportunitat\
Pere: Very little\	**Pere:** Molt poc\
Researcher: We make doctoral students transcribe things_ and so\ @@@ =here they are the ones who make you the experiments_ right/=	**Investigador:** Nosaltres als doctorands els fem transcriure coses_ i així\ @@@ =Aquí són els que us fan experiments_ no/=
	Pere: Ja\ Ja\ Ja\ Aquí molt poc\ Aquí molt

Pere: I see\ I see\ I see\ Here very little\ Here very little\ I * I mean_ I already * that is_ **you notice +uh+ that you keep getting away from the [experimental] bench more and more** **Researcher:** And therefore_ at some point_ **as regards the use of machines they can be more expert than you** **Pere:** In some aspects for sure\	poc\ Jo * vull dir_ jo ja vaig * és dir_ **vas notant +eh+ de que et vas separant de la poiata cada vegada més** **Investigador:** I per tant_ **en algun moment_ pel que fa a la utilització de màquines poden ser més experts ells que vosaltres** **Pere:** Amb alguns aspectes segur\ [original in Catalan]

In these excerpts we see how Cecília, a senior researcher of Group A, describes her daily practice as a member of her RG as consisting of paper work mainly, and how Pere, the group leader of Group B, declares that indeed 'you keep getting away from the [experimental] bench more and more' as you progress in your career as a scientist. He describes this phenomenon as something 'you notice' as opposed to something you decide or you do, and thus as something inherent in the practice and hence out of one's control. This aligns with Wenger's (1998: 150) view that CoP members' status or rank is a reification of their competence which "comes with certain responsibilities and privileges". In this case, Cecília and Pere not only hold a position within their RG or take on a label as a senior researcher or as the group leader, but they also *perform* that position/label through their daily engagement in their RG-CoP, which implies some privileges as old-timers but also corresponding responsibilities like office work.

Changes in members' identity, roles, knowledge and skills as part of their trajectories within the CoP have been pointed out in the literature (Feldman, Divoll and Rogan-Klyve, 2013). The task specialisation of the members of the two RGs hinders the definition of the 'master practitioner' that defines centrality in the CoP, for it could be the case that certain junior members mastered lab work more than senior members. This is shown in Pere's words [excerpt 75] regarding PhD researchers' mastery of 'some aspects', about which he agrees with the researcher's assertion that 'they can be more expert' than the group leader. While in both RGs the group leader had the power to define practices and activities, assign tasks, accept or reject group members, among other decisions, the core practice took place in the lab, where most group members usually interacted. Centrality, in practice, lied in PhD researchers doing experiments, reporting to their supervisor/s and interacting with one another to ask for help, for information, to mutually engage in doing expeiments together, etc. Doing experiments could be argued to be the central activity of 'doing science', and experiment results and procedures, the main topic around which interactions and discussions took place. If this were the case, the CoP's periphery would be constituted by individuals newly arrived in the group/lab, who were not yet master

practitioners, outgoing individuals, who were engaging in brokering practices with prospective CoPs, temporary practitioners, who had been given peripheral access to some of the practices, and even group leaders, who did not spend much time in the lab, as will be suggested in what follows.

Beyond the CoP's periphery, there are discontinuities of practice that help us define the CoP's limits. These are compensated by *brokering*, either between CoPs or with external entities, through the negotiation of meaning with external individuals for an effective export and import of knowledge, ideas or objects. Throughout the data collection, diverse communicative events took place between members of the RGs studied and other out-group individuals around their identity practice. These 'boundary practices' (Wenger, 1998) provided evident examples of brokering, as illustrated in the following excerpt, retrieved from Hao's speech for other department colleagues (officially named 'department seminar') [see excerpt 76].

Excerpt 76: 20140109_Hao's department seminar [senior researcher – Group A] – 'I don't understand'

> **Out-group interlocutor 1:** For questions/
>
> [silence]
>
> **Out-group interlocutor 1:** I have a question\ How is the performance of these +eh+ [confidential] lines in front of pests and diseases/
>
> **Hao:** +uh+ Sorry/
>
> **Out-group interlocutor 1:** How is the performance_
>
> **Hao:** Yeah\
>
> **Out-group interlocutor 1:** +eh···+ the behaviour of these +eh···+ [confidential] lines_ in front of pests and diseases/ In * in * in {(?)countries}\ I mean_ If they have more or less +eh+ quantity of +eh+ pest incidents\
>
> **Hao:** What incident/ I * **I don't understand**\
>
> **Out-group interlocutor 1:** Quantity of diseases X\ It's higher/ Or_ normal/
>
> **Hao:** For what/
>
> **Out-group interlocutor 1:** Diseases_ of plants_ I mean_ [object of study]_ =XX_=
>
> **Hao:** +Uh+ The same\ The same\
>
> **Out-group interlocutor 1:** +Ah+ The same\ Okay\
>
> **Hao:** Yeah\
>
> **Out-group interlocutor 2:** =But now to the X=
>
> **Out-group interlocutor 3:** =XXX=
>
> **Out-group interlocutor 2:** Now to the X_ it just be to eat some·· insects_ there will be more [substance]\
>
> **Out -group interlocutor 1:** Yeah\
>
> **Hao:** But the * the * the raw * the * the raw performance is the same\ Yeah/ Yeah\
>
> **Carol: Yeah_ But he's asking about** the diseases\ The insects_ or these =X=
>
> **Hao:** =That= **I don't know**\ I think that now we are working on it\

 In this excerpt, we can observe some comprehension difficulties between Hao and a member of the audience (named here 'Out-group interlocutor 1') who was not a member of Hao's RG. This individual had to repeat his question three times until he received a satisfactory answer from Hao. However, after a subsequent question from 'Out-group interlocutor 2', Hao's answer was not deemed adequate by Carol, Hao's PhD researcher, who had to broker between both. Indeed the fact that Carol shared her first language with Hao's interlocutors and that she had some years of experience working with Hao may have qualified her as a perfect broker in that situation. At that time, Carol mastered the comprehension of the Spanish accent in English as

well as of Hao's accent, and she also had common (cultural) referents with both, the out-group interlocutors and Hao. This example of brokering illustrates how Carol collaborated with Hao "in placing themselves as a group with respect to the world around them", in this case with respect to members of other RGs, through offering a joint interpretation "of their own practice with respect to those communities, and ultimately with the development of a style – including a linguistic style – that embodies these interpretations" (Eckert, 2006: 683).

The following usual (communicative) events in the daily professional practice of which participants constituted *boundary practices*, provided brokering opportunities between group members and out-group individuals were: (1) department seminars (like the one illustrated in the previous excerpt), which included a member of the department explaining her professional activity and recent findings in front of other colleagues from the same department; (2) formal seminars with out-group interlocutors, which consisted of a bilateral meeting between group members and members of another RG in which possible inter-group collaborations were discussed; (3) out-group individual collaborations, with group members asking external partners to help them in doing a certain experiment or teaching them a certain technique, etc., or vice versa [see excerpt 77]; (4) extra-lab internship, in which a group member worked temporarily in an external lab (of the same institution or not, even abroad) [see excerpt 78]; (5) co-supervised projects involving an outsider supervisor besides the in-group supervisor [see excerpt 79]; (6) inter-lab or international working experience, whereby group members coming from other (foreign) labs had to negotiate their working style and daily activities [see excerpt 80]; and (7) international conferences, which entailed communication and the negotiation of meaning and of value system with other scientists of their same domain [see excerpt 81]. See a few excerpts [77-81] illustrating some of these events.

Excerpt 77: Interview with Tània [PhD researcher – Group A] – 'There was the option to send it to Frankfurt'

Researcher: But you have not had the need to collaborate wi·th * with someone from outside\ From another city_ or from another country_ **Tània:** +Mm···+ That is_ I did need it_ for instance with * some experiments that I did_ nothing_ I still haven't finished_I will finish now\ **There was the option to send it to Frankfurt_ that they do it for you_** or there was * and * well I asked for this option_ and they said no because we went * of course_ they * **they are collaborators with Frank's group**	**Investigadora:** Però no has necessitat col·laborar amb· * amb algú de fora\ D'alguna altra ciutat_ o d'un altre país_ **Tània:** +Mm···+ O sigui_ ho he necessitat_ per exemple en el cas d'una * uns experiments que he fet_ re_ encara no he acabat_ acabo ja\ **Hi havia l'opció d'enviar-ho a Frankfurt_ que t'ho facin ells_** o hi havia * i * bueno ho vaig preguntar aquesta opció_ i em van dir que no perquè anàvem * clar_ ells * **ells sí que són col·laboradors d'aquí del grup del**

here_ they work with [object of study]_ **they also work with Hao's things_** and things like that_ and they've already done_ I mean_ they are already overwhelmed by this\ And they told me_ no_ maybe we can help you from June onwards\ From June onwards it was useless for me\ And then I talked to the people in the [local research centre]_ with the people of this group o··f [topic]_ and they have some knowledge about * well_ no\ They had knowledge about this_ I have to somehow tune the technique_ in my case_ but we did it_ and I did it\ In the end\ So_ the possible collaboration that I could have done with that group [from Frankfurt]_ I ended up doing it myself\ Well_ me with the people of that group [of the local research centre]\	**Frank_** treballen amb lo dels [objecte d'estudi]_ **també treballen amb coses del Hao_** i coses així_ i ja han fet_ vull dir ja * ja estan saturats d'això\ I em van dir_ no_ si un cas a partir del juny podríem ajudar-te\ Jo a partir del juny no em servia de re\ I llavors vam parlar allí amb els de l'[centre de recerca local]_ amb els del grup aquest que et dic de·· [tema]_ i ells tenen una mica de coneixement de * bueno_ no\ Tenien coneixements en això_ He de ficar una mica la técnica a punt_ en el meu cas_ però ho vam fer_ i ho he fet jo\ Al final\ O sigui_ la possible col·laboració que podia haver fet amb aquell grup [de Frankfurt]_ l'he acabat fet jo\ Bueno_ jo amb els del grup aquell [del centre de recerca local]\ [original in Catalan]

In this excerpt, Tània describes a situation in which she needed a collaboration with some external partners so that they could carry out certain experiments that neither she nor anyone in her RG knew how to do, and which she finally learnt thanks to a collaboration with a local partner group.

The following excerpt illustrates how and why extra-lab internships were requested.

Excerpt 78: Interview with Frank [Group A's leader] – 'I send PhD students to other labs of other colleagues'

Researcher: So_ How do you diversify this kind of =+uh+ training/=

Frank: =Training\= Training\ Training\

Researcher: Yes\

Frank: I send *

Researcher: =So you make=

Frank: =I send= **PhD students to·· other labs of other colleagues who·· have expertise we don't have in the lab** I invest money to send PhD students to spend anything from two weeks to two months all over the world\ to learn_ acquire skills_ and bring those skills to the lab\ So this is how we operate\

In this excerpt, Frank declares that he intentionally 'send[s]' PhD students of his RG to other labs so that they are trained in skills not present in Group A's lab. According to this practice, PhD students acted as brokers between their lab's/RG's culture and the culture of another lab/RG. This was acknowledged as an asset for Group A by its group leader to the extent that he invested some of the RG's resources on this. At the time of the data collection, both Group A and Group B were hosting also temporary interns from other RGs, so that they would learn from some of the practices being carried out by group members. This was the case of Rober [Group A] and Jetta [Group B].

Brokering among scientific domains was fostered by Group A's leader also. He admitted his preference for co-supervised projects for his students, which he saw as benefitting both the students and the RG by enhancing the students' productivity [see excerpt 79].

Excerpt 79: Interview with Frank [Group A's leader] – 'my principle is to have multiple PhD supervisors for our students'

Researcher: Is that why many PhD students have different supervisors/ Because they have more than one\

Frank: Yeah\ And in our lab_ I mean_ This is something that we are fighting with the university\ To the day_ the university PhD programme does not like our lab at all\ Because **my principle is to have multiple PhD supervisors for our students\ Because a lot of our students have PhD programmes which span many different areas\ So_ in my mind_ that is great training\ Because they learn many different things_ and their average output is four times higher** than the avera& average output of any science PhD student at the [University]\

In this excerpt, Frank admits his preference for multi-supervisor PhD projects, which he considers more successful than others. This kind of boundary practice that entails brokering is thus also deemed an asset by Frank.

Mobility was considered as intrinsic to scientific practice in both RGs. Both included members of different nationalities and hence many of them had had to broker between their former lab/s (inter-lab brokering) sometimes located in other national systems and their current lab (international brokering) [see excerpt 80].

Excerpt 80: Interview with Frank 2 [Group A's leader] – 'I'm going to bring her back to the lab as a postdoc'

Frank: … And_ you met Diana/

Researcher: Diana_

Frank: Who is now a postdoc at [research institute] in [foreign city] (…) She graduated with seven first-author publications\ and another twelve papers where she's a less senior author\ She got the [name] fellowship\ She came * She came_ I learnt_ she got the top mark throughout Europe\ She had to pick up the place to go_ and **she went to the [research institute]** And she works in the top lab in the world in [research field]_ **and then when she finishes_ I'm going to bring her back to the lab as a postdoc**

This excerpt exemplifies the mobile nature of scientists' activity, in this case through Diana's career story, who did her PhD in Group A, was doing a postdoc abroad during the data collection period, but was still sporadically doing some experiments in Group A's lab, where she was expected to go back as a senior researcher.

As has been pointed out, international conferences were also a site that facilitated boundary practices and brokering [see excerpt 81].

Excerpt 81: Interview with Pere [Group B's leader] – 'the group must be very well represented when one goes somewhere'

Pere: … You asked me if the level of involvement is the same when there are the weekly seminars or when we have to go to a conference\ I don't know if that was clear\ But it has nothing to do\ Right/ I mean_ one ting is that they do what they want_ the other is that **the group must be very well represented when one goes somewhere**\ Therefore_ there·· * I mean_ there **you do it_ and you revise it_ and if necessary you do it three times**\	**Pere:** … M'heu preguntat si el grau d'implicació quan hi ha els seminaris aquests de la setmana o quan s'ha d'anar a un congrés és el mateix\ No sé si ha quedat clar això\ Però no té res a veure\ +Eh+/ Vull dir_ una cosa és que facin el que vulguin_ i l'altra és que **el grup ha de quedar molt ben representat quan va a un lloc** Per lo tant_ allí·· * és dir_ **allí es passa_ i es repassa_ i si convé tres**

(…)	**vegades**
Researcher 2: =And you do= rehearsals\	(…)
Pere: Ye··s\ Ye··s\ Yes\ Yes\ Rehearsals and questions\ Hypothetical\ That she can be asked in a conference\ Of course\ And normally these rehearsals_ **since they are conferences_ they are rehearsals in English_** questions in English_ answers in English\	**Investigador 2:** =I feu= assajos\
	Pere: Sí··\ Sí··\ Sí\ Sí\ Assajos i preguntes\ Hipotètiques\ Que li poden fer al congrés\ Clar\ **I normalment aquests assajos_ com que són congressos_ són assajos en anglès_** preguntes en anglès_ respostes en anglès\
(…)	(…)
Researcher 2: Because do you make them go to conferences before_ only as unregistered students/	**Investigador 2:** Perquè els feu anar a congressos abans_ només d'oients/
Pere: Yes\ Yes\ No\ No\ No\ When we go to conferences_ they normally come\ We don't go to all the conferences_ nor do all of us go to all of them\ Okay/ But **during the year they do go to one_ two\ Each of them\ Then they see it** At the weekly seminars it's a little presentation\ Informal\ **But it's a little presentation\ Which then has to become something much more concrete_ much more formal_ and better presented\ There are many images that are presented in the seminars * the weekly meetings_ that you wouldn't be able to present in a confernece** This is clear\ =And this goes=	**Pere:** Sí\ Sí\ No\ No\ No\ Quan anem a congressos_ normalment venen ells\ No anem a tots els congressos_ ni tots anem a tots\ vale/ Però sí que **al llarg de l'any van a un_ dos\ Cada un d'ells\ Llavors veuen** Als seminaris de les setmanes és una mini presentació\ Informal\ **Però és una mini presentació\ Que després s'ha de traduir en una cosa molt més concreta_ molt més formal_ i més ben presentada\ Hi ha moltes imatges que es presenten als seminaris * les reunions de la setmana_ que no podries presentar en un congrés** Això està claríssim\ =I això va=
Researcher 1: =Why/=	**Investigadora 1:** =Per què/=
Pere: Well_ **because of_ because of quality_ because of * for the transmission of the information_ for_** (…) very little images_ or putting very little text and very little image_ +uh+ well_ +mm+ or putting **an image that says nothing_** (…) **If you want to communicate something_ choose the image that perfectly shows what you want to communicate** +Uh+/ So_ put the emphasis on what is important\ And choose the one that is of quality\	**Pere:** Bueno_ Per * **per qualitat_** Per * **per transmissió de la informació_ Per_** (…) imatges molt petites_ o posar molt text i poca imatge_ +eh+ en fi_ +mm+ o posar **una imatge de la qual no diu res_** (…) **Si tu vols comunicar alguna cosa_ escull la imatge que reflecteixi perfectament allò que vols comunicar** +Eh+/ Per tant_ fot l'èmfasi en allò que és important\ I tria la que sigui una imatge de qualitat\
	[original in Catalan]

In this excerpt, Pere explains how all group members normally go to one or two international conferences every year and what adjustments this entails regarding communication resources,

like language, register and images. Pere stresses the formality and importance of these boundary practices in which, he asserts, 'the group must be very well represented'. Being it a boundary practice, group members must acquire certain skills through diverse rehearsals, in which they receive correcting feedback from other group peers, so that they 'translate' their usual presentations 'into something a lot more concrete_ much more formal_ and better presented'. This process coincides with Wenger's (1998: 109) description of "brokering", as entailing "processes of translation, coordination, and alignment between perspectives". As reported by Pere, in this case, the acquisition of brokering skills was mediated by senior group members who had more experience in such practices, and who thus had a greater insight into the different perspectives that might be negotiated.

Besides those entailing interaction between group members and out-group individuals, intra-group brokering was also observed in the two RGs. In particular, three kinds of such events were observed: (1) group meetings, whereby individual projects were explained to the rest of group members and thus entailed the brokering among group members who worked in different projects and/or subfields [see excerpt 82]; (2) spontaneous interactions between group members around their experimental projects [see excerpt 83]; and (3) meetings with the supervisor, in which brokering took place between individuals with different involvement and perspectives around the same project [see excerpt 84]. See below some data segments illustrating these events.

Excerpt 82: Interview with Tània [PhD researcher – Group A] – 'we have various seminars in every month'

Researcher: … You are a bit between the two groups_ aren't you/	**Investigadora:** … Tu estàs una mica entre els dos grups_ no/
Tània: +Mhm+ yes\	**Tània:** +Mhm+ sí\
Researcher: What's it like to be between one place and the other/	**Investigadora:** Com és això d'estar entre un lloc i l'altre/
Tània: Well_ then_ +mh+ I mean_ the good thing is tha··t * that is_ **imagine that it was a group where we didn't have these seminars_ these {(Eng) lab meetings}_ that we didn't do presentations_ and no talks that we sometimes make_** it would be harder\ Because of course_ here at [the faculty] I wouldn't have to come for anything\ I have come to do * to lyophilise_ with some experiments_ that I needed the [object]_ o * o I needed something from	**Tània:** Bueno_ pues_ +mh+ o sigui_ lo bo que té és que·· * o sigui_ **imagina't que ara fos un grup que no tinguéssim aquestos seminaris_ aquestos {(Eng) lab meetings}_ que no féssim presentacions_ i no xerrades a vegades que fem_** seria més dur\ Perquè clar_ jo aquí a [facultat] pràcticament no hauria de venir per res\ Sí que he vingut a fer_ * a liofilitzar_ amb alguns experiments_ que he necessitat la [objecte]_ o * o he necessitat d'ells alguna cosa_ venir a buscar

them_ come here to take [object of study]_ and this_ Bu··t I mean_ experiements_ there ha& I've made some experiments of [confidential] here\ But daily experiments_ I haven't had to do here\ **Then the good thing is this_ that more or less_ we··ll that_ * I don't know_ we have various seminars every month\ And I come for this_ I get in touch with the directors_ well_ with Frank_ Cecília_ I··t's * it's the good thing about it**	[objecte d'estudi]_ i això_ Però·· o sigui_ experiments_ ha hagu& * alguns experiments de [confidencial] n'he fet aquí i tot\ Però experiments experiments del dia a dia_ no m'ha tocat fer aquí\ **Llavors lo bo és això_ pos que més o menys_ pos·· que_ * pos no sé_ al mes tenim vàrios seminaris\ I vinc per això_ em poso en contacte amb els directors_ bueno_ amb el Frank_ la Cecília_ És·· * és la gràcia que té**
Researcher: So_ the seminar thing helps you keep in =touch=/	**Investigadora:** O sigui_ lo dels seminaris t'ajuda a mantenir el =contacte=/
Tània: = Yes\= Yes\	**Tània:** =Sí\= Sí\
	[original in Catalan]

In this excerpt, Tània expresses her satisfaction at the existence of periodical group meetings and seminars in her RG that provide her with opportunities to contact her main supervisor and other group peers in person, which otherwise would be difficult for her. Note that despite not spending much time in the RG's main lab, she feels that she belongs to Frank's RG 'because it is officially' her RG. See below an example of the brokering practice in spontaneous interactions among group members.
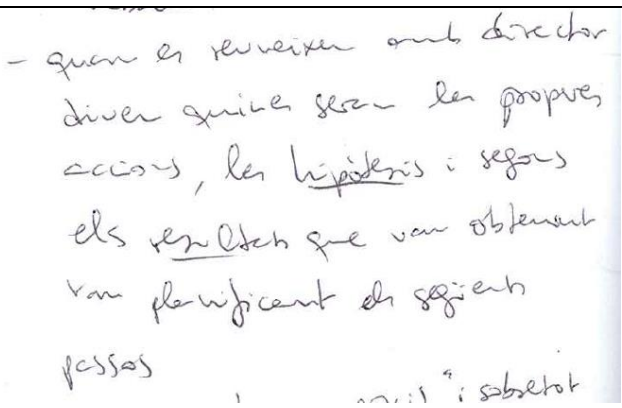
Excerpt 83: 20140123_Observation Group B – Spontaneous professional conversation between Lola and Dana [Senior researchers] – 'My concentration is poor'

Lola: …X I don't have it\ I have microlitres\ How stupid\ **My concentration is poor_**	**Lola:** …X no lo tengo\ Tengo microlitros\ Que tonta\ **Tengo mal la concentración_**
Dana: XXXXX	**Dana:** XXXXX
Lola: But here it's not that it tells you_ put this much and this much\ You know/	**Lola: Pero acá no es que te dice_ pon un tanto y tanto\ Sabes**
Dana: Yes\ Yes\	**Dana:** Sí\ Sí\
Lola: But I can look it up\ On the internet {(?) it should be there}	**Lola: Pero lo puedo buscar\ En Internet {(?)debe estar}**
Dana: Yes\ Yes\ In * like what you have looked up XXX\	**Dana:** Sí\ Sí\ En * en plan de lo que has buscado XXX\
Lola: What happens is that maybe it's a little bit tight on time\ Because if we do it tomorrow_ that is_ we have to divide them today_	**Lola:** Lo que pasa que igual es un poco justo\ Porque si nos ponemos mañana_ O sea_ hay que dividirlos hoy_
Dana: +mh+\	**Dana:** +mh+\
	Lola: Sí/ La dividimos otr& * claro_ si la

Lola: Yes/ We divide ano& * of course: if we divide one into four_ {(?) then it's} one in two\ And at the weekend_ Monday_ XX this sheet for XX\ XX we won't even be able to see them\ XX XX XX\ And no_ because when it's XX the sheet_ also * that is XX which are transfected_ you see it well let's say· in one day_ two_

Dana: It really takes three days for the virus\ XX

Lola: But the XX of three_ grow very fast\

Dana: I know they grow very fast\ But we can't reduce the·· * the serum\ That's it\ Maybe they live in zero twenty * twenty-five\ XX XX\ XX XXX\ We stop and that's it\

Lola: Well_ look at the protocol_ and XX complicate_ the =XX XXX=\

Dana: =By * by= ten per cent\ I am sure they resist well\

Lola: Don't * don't worry about this because what we're going to do is leave it there_ and leave it until Monday\ **But I will look at a protocol** that XX XX\

dividimos uno en cuatro_ {(?) luego está} uno en dos\ Y el fin de semana_ lunes_ XX esta placa para XX\ XX no vamos ni a poder verlas\ XX XX XX\ Y no_ porque cuando está XX la placa_ también * o sea XX que se transfectan_ la ves bien suponte· en un día_ dos_

Dana: Realmente el virus son tres días\ XX

Lola: Pero el XX de tres_ crecen muy rápido\

Dana: Ya sé que crecen muy rápido\ pero podemos bajar la·· * el suero\ Ya está\ Igual viven en cero veinte * veinticinco\ XX XX\ XX XXX\ Paramos y ya está\

Lola: Bueno_ mírame el protocolo_ y se XX complican_ las =XX XXX=\

Dana: =Por * por= diez porciento\ Yo estoy segura que aguantan y aguantan bien\ (…)

Lola: No * no te preocupes de esto porque lo que vamos a hacer es dejarlo aparcado_ y dejarlo para el lunes\ **Pero voy a mirar un protocolo** que XX XX\

[original in Spanish]

The excerpt above is an example of the types of spontaneous professional conversations that used to take place among group members in the two RGs studied. In this case, Lola and Dana were negotiating how to follow a protocol properly after they realised they had done something wrong. To do so, they needed to share with each other their views on the topic and their interpretation of the protocol they were using, a boundary object that required such negotiation of meaning. Commonly, such spontaneous conversations used to revolve around doubts and problems, the teaching and learning of techniques and experiments among group members, and the coordination in the use of machines, materials or the like. See below another instance of intra-group brokering, in this case with reference meetings with the supervisor/s [excerpt 84].

Excerpt 84: 20140123_Field notes_Observation Group B – 'When they meet their supervisor'

«When they meet their supervisor they establish what the next actions will be, the hypotheses and depending on the results they obtain they plan the next steps»	[original in Catalan]

Since meetings with supervisors used to be private, I did not have direct access to them, but only some indirect references, like the one reflected in the excerpt above. In them, the supervisor and the supervisee brought their perspectives and knowledge, on the basis of which they had to negotiate future trajectories for their experiments.

Apart from specific events and circumstances that involved brokering, there were some members of the RG whose daily tasks entailed continuous out-group brokering. This signals the peripherality of these group members, at the boundaries between the RG-CoP and other CoPs or entities. One of these was the group leader [see excerpts 85 and 86].

Excerpt 85: Interview with Frank 2 [Group A's leader] – 'I'm involved in a number of international committees'

You asked what is the purpose of my travel\ Multiple\ +Uhm+ One reason is go to targeted meetings which are more in the area of scientific policy_ at an international level\ I'm involved in a number of **international committees_** and I'm also part of the [name] Foundation's **think-tank** on [topic]\ (…) Another function is to * +uh+ I'm invited to give many lectures at **international meetings**\ And I mean I would not * I normally I don't go to scientific meetings\ Whenever I get an invitation to go to a scientific meeting_ +uh+ I don't go\ I send Hao\ Or other senior members when we had senior members in the lab\ (…) So it's good for him because he gets exposure_ he needs it * he needs it a lot more than I do\ (…) I'm involved in the [country] department of [field] **policy group_** (…) I'm involved in a **programme** run by the [country] department of [topic]_ and that takes me to [country 1] twice a year\ +Uh+ And then I have similar programmes which get me to countries like [country 2]_ [country 3]_ [country 4]_ [country 5]_ and a number of European countries\ (…) Another part of my travel_ which I would say may be six to ten times a year_ is to be in **evaluation panels_** either to evaluate institutes or in {(?) **grant} X panels**\ Either at the European Union_ or Horizon_ now Horizon 2020_ or Inepsar_ or in other international +uh+ fora_ and linked to that +uh+ I'm involved in·· the scientific **advisory work** of four institutes\ (…) So that takes me to these places once a year\ Each for XXX\ +Uhm+ then I'm invited to **teach short courses**\ (…) So this is why I travel\

Excerpt 86: Interview with Frank 2 [Group A's leader] – 'I'm chief editor of two journals'

…I'm chief editor of two journals\ So that's another aspect of my job\ So that's my third job\ And what that means is that every week I get about thirty or forty manuscripts admitted to the journal_ and I have to screen them and send them to **members of the editorial board**\

As can be observed in these excerpts, a central part of Frank's endeavour consisted in interacting with external individuals, different stakeholders and institution managers, and brokering between his and their perspectives and opinions. He used to take part in international committees, think-tanks, international meetings, policy groups, scientific programmes, evaluation panels, advisory groups and editorial boards, which might constitute other CoPs of which he was also a member. He showed to be at the periphery of Group A while being its leader, brokering as a policy maker with members of powerful CoPs in the same field.

Junior researchers with multiple supervisors (from different RGs) occupied also a periphral position since, although they officially belonged to one RG only, they had to broker among the RGs of each of their supervisors, that is, among the practices of each lab they worked in, among all their supervisors' perspectives and opinions, and among the diverse (sub)fields of knowledge

of each RG and thus among the diverse perspectives and knowledge of their workmates [see excerpt 87].

Excerpt 87: Interview with Tània [PhD researcher – Group A] – 'All this I've had to look up'

Tània: ...Hao's topic_ i··s * is * that is_ it's very [subfield 1], it's very [subfield 2] very [subfield 3]\ Yes\ About [subfield 3]\ Then it's different\ For instance_ I remember things that I did in my degree and I can understand it but now·· following exactly_ for instance the technique that he has commented on_ the [technique]_ **I did learn it in my degree_ but I w& wouldn't know where to start from\ I don't know * I don't know * I don't know how to do it** And things that they see a lot_ XX_ yes_ this we * we already tried\ You put it here_ of course_ **you miss these things** And this is something that I remember talking with Pili_ who was like me_ but she was a the department of chemistry\ Instead of the medicine department\ And she came to the seminars_ she was a little like me\ **The boss * the codirector was Frank_ but he was a little like me\ And he said_ the thing is that I sometimes_ Tània_ {(@) I don't understand anything}** That there are things_ mainly Hao's things_ that are more of [subfield 1]_ I didn't know wha··t * I mean_ I didn't kn& know * I don't understand\ **I have had to read about it_ I have had to look it up** And I say_ Maybe because I have a ki& * background more of [subfield 1]_ but you also have to understand very specific things of [object of study] o··r +mh+ * **There are things that I looked up\ There are things that I've had to manage by myself** Because mainly when we've done {(Eng) reviews} together_ they take it for granted that you know_ we·ll_ I don't know_ techniques to transform [object of study]_ I didn't know\ I mean_ you did do it in your degree_ but I didn't know if they went perfectly well_ or wrong_ models to study [object of study]\ **All this I've had to look up\ Mainly when doing the [(Eng) reviews} together**	**Tània:**...El tema del Hao_ és·· * és * o sigui_ és molt [sub-tema 1]\ és molt·· [sub-tema 2]_ molt [sub-tema 3]\ Sí\ De [sub-tema 3]\ Llavors és diferent\ Per exemple_ me'n recordo coses que havia fet a la carrera i puc entendre-ho_ però ara·· seguir exactament_ per exemple la tècnica que ha comentat_ el [tècnica]_ **sí que ho he après a la carrera_ però jo n& no sabria ni per on començar\ No sé * no sé * no sé com se fa** I ells coses que veuen molt_ XX_ sí_ això ho vam * ja ho havíem provat\ El fiques aquí_ clar_ **te perds amb aquestes coses** I això és una cosa que me'n recordo que parlava amb la Pili_ (...) que era com jo_ però estava al departament de química\ En canvi del de medicina\ I venia als seminaris_ era una mica com jo\ **Sí que el jefe * el codirector era el Frank_ però era una mica com jo\ I deia_ és que jo a vegades_ Tània_ {(@) no entenc res}** Diu que hi ha coses_ sobretot coses així del Hao_ que són més [tema 1]_ no sabia lo que·· * vull dir_ no n& sé * no entenc\ **Ho he hagut de llegir_ ho he hagut de buscar** I dic_ Jo potser perquè tinc una me& * una base més [tema 1]_ però també has d'entendre coses molt concretes de [objecte d'estudi]_ o·· +mh+ * **Hi ha coses que he buscat\ Hi ha coses que m'he espavilat** Perquè sobretot quan hem fet {(Eng) reviews} junts_ ja donen per sobreentès que tu saps_ pues·_ no sé_ tècniques per transformar [objecte d'estudi]_ no ho sabia\ Vull dir_ sí ho has fet a la carrera_ però profundament no sé si anaven bé_ o malament_ Models per estudiar [objecte d'estudi]\ **Tot això ho he hagut de buscar\ Sobretot al fer els {(Eng) reviews} junts**
	[original in Catalan]

In this excerpt, Tània, who had multiple supervisors from different departments, expresses her struggle to understand the work of other group peers. Although she confesses having studied something about their research topics, she lacked core information and knowledge that she had to look up in order to be able to work with them. This boundary position, Tània states, was shared with a former group mate, Pili, who had also multiple supervisors from different departments. These differences in their expertise, which were anecdotal in the course of their daily work, used to become especially relevant whenever group members engaged in a joint enterprise as was 'doing a review' of the literature.

There was also in both RGs another actor in a peripheral position: the group's scientific writer, who took part in the RG's practice of 'doing science' as a contributor, but did not engage in the majority of in-group activities, to the extent that in both cases this person was living abroad [see excerpt 88].

Excerpt 88: Interview with Cecília [senior researcher - Group A] – 'we need one only for us'

Cecília: …Then we have Tim_ who is the {(Eng) scientific writer}_ who in the end is the one * first there's always this up and down with Frank\ But then it's Tim_ even after Frank_ and Tim is when he does the * this final homogenisation of a good publication\ (…) But this_ he takes it_ he closes it_ and he does it well\	**Cecília:** …Nantres a llavorens tenim al Tim_ que és lo {(Eng) scientific writer}_ que al final és ell * primer sempre hi ha el amunt i avall entre el Frank\ Però llavons ho agafa el Tim_ inclús després del Frank_ i el Tim és quan fa la * aquesta homogeneïtzació final de qualitat de publicació\ (…) Però aquest_ ho agafa_ ho tanca_ i ho fa bé\
(…)	(…)
Cecília: … we were at the [research institute]_ and then we already had twenty people_ and all of them foreigners\ And Frank couldn't keep up with correcting\ And he thought * that this in England is normal_ **having a {(Eng) scientific writer} at the institutes * at the research institutes** He thought_ **we need one only for us** And he laucnhed a call_ and Tim sent the papers_ they got on well with each other_ and since then **he works for us\ It's been twenty years already**	**Cecília:** … nantres érem al [institut de recerca]_ i a llavontes ja teníem vint persones_ i tots estrangers\ I el Frank no donava l'abast a corregir\ I va pensar * que això a Inglaterra és normal_ **tindre un {(Eng) scientific writer} als instituts * als centros de recerca** Va pensar_ **nantres necessitem un només per nosaltres** I va obrir una convocatoria_ i el Tim va enviar els papers_ se van avindre_ i des de llavors **treballa per nantres\ Ja fa vint anys**
Researcher 2: Very good\	**Investigador 2:** Molt bé\
Cecília: And then **twice a year he comes here_** you will meet him\ And he meets all the students_ and all the manuscripts that	**Cecília:** I llavorens ja **dos vegades a l'any ve aquí_** ja el coneixeràs\ I es reunix amb tots los estudiants_ i tots los manuscrits que tenen entre mig_ **pos ho parlen_ los hi**

they have half done_ **well they talk about it_ he shows it to them_ and they just learn**\ (…) **Researcher 2: Where does he live/ In the UK/** **Cecília: Yes**\ Wait_ in [city]\	**ensenya_ i ells ja aprenen**\ (…) **Investigador 2: On viu ell/ Al Regne Unit/** **Cecília: Sí**\ Espera_ a [ciutat]\ [original in Catalan]

In this excerpt, Cecília summarises the story of how her RG in the past ended up hiring a scientific writer, Tim, who was still collaborating with her RG at the time of the data collection, after twenty years. As stated by Cecília, he used to work remotely except for 'twice a year' when he would meet the other group members in person. Although Tim had started working 'exclusively' for Frank's and Cecília's RG, at the time of the data collection he was collaborating as a scientific writer with other RGs around the world, like Group G. Tim thus occupied a rather peripheral position in the RG-CoP, to the extent that it was not clear wether he was actually a member of the RG – he was actually not an official member for the institution – or an external collaborator – he used to be a co-author in the RG's publications. His role and tasks were also quite different to that of other group members, for his work was specialised in language: he did not do experimental work, but only linguistic corrections and courses on writing for publication. His position may thus be that of "being neither in nor out" which required "yielding enough distance to bring a different perspective, but also enough legitimacy to be listened to" (Wenger, 1998: 110). In this case, Tim's legitimacy was assured by Frank and Cecília, as well as by his identity as a 'native' 'scientific writer', but it was sometimes also questioned by other group members [see excerpt 89].

Excerpt 89: 20140327_Informal interview with Agus [PhD researcher – Group A] – 'I don't have a good command so as to complain about English'

Researcher: Of course_ what I would like to know is what type of corrections\ To what extent the c& * the language has somethi·ng =to do=\ **Agus:** =Normally_= +uh+ normally the language_ unless it's something very flagrant_ which then he [Frank] writes a comment saying {(Eng) this is not English}_ or something like this_ he leaves it to the end_ fo··r * for this reviewer of texts_ who is a colleague of him_ and I don't know_ that then he changes it to * to refined English\	**Investigadora:** Clar_ a mi lo que m'agradaria saber és quin tipus de correccions\ Fins a quin punt la c& * la llengua hi té algo· =a veure=\ **Agus:** =Normalment_= +eh+ normalment la llengua_ a no ser que sigui algo molt flagrant_ que llavors [el Frank] fica un comentari de {(Eng) this is not English}_ o algo així_ la deixa pel final_ pel·· * pel revisor de textos aquest_ que és col·lega seu_ i no sé què_ que llavors ell ho transforma en * en anglès pulit\ **De vegades**

Sometimes you say_ Damn it_ but here {(@) there's no * there's not a single comma of what I wrote\ What the hell is this/}

Researcher: @@@

Agus: Bu⋯t * it enrages me a little bit also_ because_ =damn it_=

Researcher: =Of course\=

Agus: Afterwards you see your name there published_ and you say well_ I don't know\ (…) **But I see the correction_ like his alternative_ and I think_ well_ this is a matter of taste** Sometimes\ But_ well_ * I mean_ this guy is a native English speaker_ and besides he has a very good command\ Right/ And then I won't co& complain about anything\ Bu⋅⋅t sometimes I think_ * sometimes they are things that they do look much better_ and som& * but sometimes I think_ I don't know to what extent this is a correction_ or a⋅⋅ +uh+ well that this style_ you like it more_ and_ but well\

Researcher: Of course\ You can't complain_ either\ Right/

Agus: No\ No\ No\ No\ Well_ **I don't have a good command so as to complain about English to an expert of the English [language]\ Right/**

dius_ hòstia_ però si aquí {(@) no hi ha * no hi ha ni una coma de lo que vaig escriure jo\ Què punyetes és això/}

Investigadora: @@@

Agus: Però⋯ * a mi em fa una mica de ràbia també_ perquè_ =hòstia_=

Investigadora: =Clar\=

Agus: Después veus el teu nom allí publicat_ i dius_ bueno_ no sé\ (…) **Però jo veig la correcció_ com la seva alternativa_ i penso_ bueno_ pues això és una qüestió de gustos** De vegades\ Però_ bueno_ * o sigui_ aquest tio és anglès nadiu_ i a part domina molt\ No/ I llavors tampoc li re& reclamaré res\ Però⋅⋅ a vegades penso_ * a vegades sí que són coses que queden molt millor_ i a ve& * però a vegades penso_ no sé fins a quin punt és una correcció_ o un⋅⋅ +eh+ pos que aquest estil_ t'agrada més a tu_ i_ però bueno\

Investigadora: Claro\ No pots reclamar_ tampoc\ no/

Agus: No\ No\ No\ No\ Bueno_ **tampoc tinc molta base per reclamar amb anglès a un erudit de l'anglès\ no/**

[original in Catalan]

In this excerpt, Agus describes the contradictory situation he finds himself in when dealing with Tim's revisions of his writings. On the one hand, Agus is not completely satisfied with all the corrections and modifications proposed by Tim, which he deems sometimes excessive to the extent that he recognises 'not a single comma' of his original text, and also 'a matter of taste'. And on the other hand, he acknowledges Tim's authority as a native English speaker, in Agus' words: 'an expert of English', and as the RG's scientific writer, legitimised by the group leader. In this sense, Agus feels he is in an unequal power position that prevents him from 'complain[ing] about English' and that forces him to accept any changes in his texts even when he does not like them.

Besides the group leader, researchers with in-group and out-group supervisors and the scientific writer, experienced senior researchers also used to engage in inter-group brokering since they had the knowledge and skills that other RGs occasionally required. And for this reason they used to establish bonds with members of other RGs and also with institution managers [see excerpt 90].

Excerpt 90: Interview with Vince [senior researcher – Group A] – 'they ask for quite a lot of help in these groups'

Researcher: From outside the group_ who do you communicate with/	**Investigadora:** De fora del grup_ amb qui tens comunicació/
Vince: Of the department_ you mean/	**Vince:** Del departament_ vols dir/
Researcher: For instance\	**Investigadora:** Per exemple\
Vince: +Mm+ +Bah+ There are quite a lot of people\ From the group of * from the group of Jorge Bosque_ I don't know if you know him/	**Vince:** +Mm+ +Bah+ Hi ha bastanta gent\ Del grup del * del grup del Jorge Bosque_ no sé si els coneixes/
Researcher: No\ But it's another group\ Right/	**Investigadora:** No\ Però és un altre grup\ No/
Vince: Another group_ +uh+ yes_ other groups\	**Vince:** Un altre grup_ +eh+ sí_ altres grups\
Researcher: And what's the reason why you =communicate=/	**Investigadora:** I per quin motiu =tens comunicació=/
Vince: =Other teachers= also +uh+ for collaborations_ for instance\	**Vince:** =Altres profes= també_ +Ah+ per col·laboracions_ per exemple\
Researcher: +Mhm+ You do experiments_	**Investigadora:** +Mhm+ que fas experiments_
Vince: Yes\ For help\ Right/ **They ask for quite a lot of help in these groups** =also=\ (…) Because they don't have know& I mean_ now yes\ Better\ But at the beginning they didn't have practice or enough knowledge about [discipline]_ for instance_ about the things that we do_ tools that they can use_ that we use_ (…) And then_ they often ask me for help\ @	**Vince:** Sí\ Per ajudes\ No/ E**m denanen bastanta ajuda en aquests grups** =també=\ (…) Perquè no tenen coneixem& * vull dir_ ara sí\ Millor\ Però al principi no tenien pràctiques o coneixement prou en [disciplina]_ per exemple_ en les coses que fem_ eines que poden utilitzar ells_ que nosaltres utilitzem_ (…) I doncs_ sovint em demanen ajuda\ @
Researcher: +Mhm+ so_ you're like one of the experts_ aren't you/ Of the house/ In_	**Investigadora:** +Mhm+ o sigui_ que ets com un dels experts_ no/ De la casa/ en_
Vince: Expert_ no_ but {(?) already}\	**Vince:** E**x**pert_ no_ però {(?) ja}\
Researcher: But you know more * you know more about it than them\	**Investigadora:** Però en sap més * en saps més que ells\
	Vince: Dels altres grups_ d'aquest tema_ sí\

Vince: Than the other groups_ about this topic_ yes\ Of course\ And also than other technicians of the department_ (…)	Clar\ I també d'altres tècnics del departament_ altres profes també del departament_ (…)
Researcher: (…) I want to know what's the reason why you communicate\	**Investigadora:** (…) Vull saber quin motiu hi ha per comunicar-te\
Vince: +Oh+ yes\ Yes\ It's for +uh+ * XX groups it's more collaborations_ for help_ then_ with the others it's for things related to material of the department_ (…) other teachers of the department_ it's more for * also for help_ a···nd workshop planning_ planning * problems with materials_ @ (…) problems with shared material_ (...) @@ there always are\ (…) And they also come to take advantage of our material_ also_	**Vince:** +Ah+ sí\ Sí\ És per +eh+ * XX grups és més col·laboracions_ per ajuda_ després_ amb els altres per tema de material del departament_ (…) altres profes del departament_ sí és més per * també per ajuda_ i··· planificació de pràctiques_ planificació * problemes amb material_ @ (…) problemes amb material comú_ (...) @@ s'empre n'hi ha\ (…) I ells també venen per aprofitar també el nostre material_ també_
	[original in Catalan]

In this excerpt, Vince declares that his help is often required by another RG in his institution and department, for he has some knowledge that the other RG lacks. Other factors that might trigger inter-group brokering, as reported by Vince, are the lending of materials, the common use of machines, and the planning of workshops.

Apart from that, Vince's peripheral position as a lecturer – besides scientist – facilitated his task as a broker between BA students and his RG in orther to recruit new members [see excerpt 91].

Excerpt 91: Interview with Vince [senior researcher – Group A] – 'I'm the intermediary'

Vince: … in general there are always one or two students interested\ (…) in coming to the lab\ Yes\ Every year\ Yes\	**Vince:** …en general sempre hi ha un o dos alumnes interessats\ (…) Per venir al laboratori\ Sí\ Cada any\ Sí\
Researcher: And this is good for the lab/ You think/	**Investigadora:** I això és bo pel laboratori/ Tu creus/
Vince: Yes_ because it he···lps * I mean_ it's * it's * I mean_ it's * for them it's good because they learn good things\ Right/ (…) And for the people they work with it's a help\ Isn't it/ (…) it's the double {(Fr) sens}\ Right/	**Vince:** Sí_ perquè ajuda··· * vull dir_ és * és * vull dir_ és * per ells està bé perquè aprenen coses noves\ No/ (…) I per a la gent amb qui treballen és una ajuda\ No/ (…) És el doble {(Fr) sens}\ No/
Researcher: And who decided who they would have * as supervisor_ so to speak\ right/ Because Joana is with Navil_	**Investigadora:** I qui va decidir qui tindrien de * de tutor_ entre cometes\ No/ Perquè la Joana està amb el Navil_
Vince: +Bah+ **I for ins& * for instance_ in**	**Vince:** +Bah+ **jo per exem& * per exemple_ en aquest cas_ +eh···+ estic**
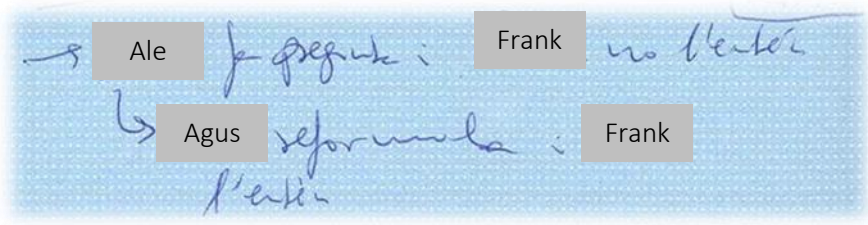
this case_ +u···h+ I'm the intermediary right/ I ask\ (…) I ask people [in the lab]\ +U··h+ do you need help/ Wouldn't you like a student for the summer/ (…) **I ask the people_ who would be interested in having a student as an assitant**

(…)

Researcher: And after it could be that these continue in the lab/

Vince: Yes\ Look_ Mikela_ for instance\ **She was also a student of mine\ She was with Agust in the same year\ Look_ who do we have_ Agus_ Mikela_ +u··h+ Carol_** +u···h+ not Ainhoa_ Ainhoa was also a student here\ She did her +uh+ master in [Spanish city]_ and then he went * he did some internships here_ in the department_ and she actually stayed here\

(…)

Researcher: And when it comes to accepting people at the lab for internship_ do you look at the marks/ or is there any requirement/

Vince: No\ It's not * Yes_ **during the year_ I have a year to right/ * to look a little bit a···t * what they are like_ how they do * how they behave during the workshops_ the motivation_ the marks_** of course\ But the marks don't mean XX that * it's a selection criterion\ (…) It's a little how * how they behave\ And the motivation\ Important\ Very important the motivation\ (…) And since I have them one whole week +uh+ of workshops_

Researcher: You have them in class\

Vince: Yes\ At the lab\ We have a * workshop pe groups of ten people +uh+ of workshop in the lab\ **During this week I have time to assess the people**

d'intermediari No/ Pregunto\ (…) Pregunto a la gent\ +Eh··+ necessites ajuda/ No voldries un alumne per a l'estiu/ (…) **Pregunto la gent [del lab]_ qui podria ser interessat a tenir un alumne com ajudant**

(…)

Investigadora: I després aquests pot ser que continuïn al laboratori/

Vince: Sí\ Mira_ la Mikela_ per exemple\ **també era una alumna meva\ Que estava amb l'Agus a la mateixa promoció\ Mira_ qui ens queda_ l'Agus_ la Mikela_ +eh··+ la Carol_** +eh···+ l'Ainhoa no_ l'Ainhoa també era alumna d'aquí\ Que va fer el seu +eh+ màster a [ciutat d'Espanya]_ I després va passar * va fer unes pràctiques aquí_ al departament_ i ja es va quedar aquí\

(…)

Investigadora: I a l'hora d'acceptar gent al laboratori de pràctiques_ tu mires les notes/ O hi ha algun requeriment/

Vince: No\ No és * sí_ **jo durant l'any_ tinc un any per no/ * per mirar una mica el··· * com són_ com fan * com es comporten durant les practiques_ la motivació_ les notes_** clar\ Però les notes no vol dir XX que * que és un criteri de selecció\ (…) És una mica com * com es comporten\ I la motivació\ Important\ Molt important la motivació\ (…) I com que els tinc una setmana sencera +eh+ de practiques_

Investigadora: Els tens tu a clase\

Vince: Sí\ Al laboratori\ Al laboratori\ Tenim un * pràctiques per grups de deu persones +eh+ de practiques al laboratori\ **Durant aquesta semana tinc temps per avaluar la gent**

[original in Catalan]

In this excerpt, Vince explicitly describes himself as a 'broker', a liaison between BA students that he has 'time to evaluate' as a lecturer and then 'ask people [in the lab] who would be interested in having a student as an assistant'. Vince describes lab internship as a helpful

practice for both, BA and MA students (trainees), on the one hand, and for lab workers (mentors), on the other. These temporary apprentices were given full access to certain practices and spaces as legitimate peripheral participants (Lave & Wenger, 1991), but "without subjecting them to the demands of full membership" (Wenger, 1998: 117), which corresponds with what Wenger (1998: 117) calls "the opening of a periphery" and which gives place to "multiple levels of involvement" with the RG-CoP. This, Wenger (1998: 117) claims, is "an important characteristic of communities of practice, one that presents opportunities for learning both for outsiders and for communities". And the learning of trainees was exactly the main objective of such internships.

Apart from inter-group brokering between members of the RG-CoP and external individuals, intra-group brokering, within the RG-CoP itself, was sometimes also necessary depending on group members' status. Senior researchers-old-timers occasionally brokered between junior-newcomers and more senior-old-timer researchers or even with group leaders [see excerpt 92].

Excerpt 92: 20140514_Field notes_strategy seminars (Page 5)

«Ale asks a question and Frank doesn't understand. Agus reformulates it and Frank does understand.»

[original in Catalan]

This example of generational brokering between a more junior PhD researcher (Ale) and the group leader (Frank) by a less junior PhD researcher (Agus) was possible because it had to do with problems of how something was formulated in relation to their field of knowledge and in terms of their field jargon, and also because Ale and Agus might share knowledge about junior researchers' practice that Frank lacked or that was too remote to him. In such *generational encounters,* as described by Wenger (1998: 157), "[d]ifferent generations bring different perspectives to their encounter because their identities are invested in different moments of that history". Even among same-role members, like PhD researchers, more experienced ones used to broker between more experienced and junior researchers. Within the RG-CoP, brokering was needed for a variety of reasons like language, expression style and knowledge.

As has been shown so far, brokering (negotiation of meaning) was not only a usual practice for some peripheral group members, but all members at some point had to carry it out as part of their professional activity which required also some dissemination and discussions, and which implied brokering between groups, fields, perspectives, countries, etc. Brokering might even constitute a requirement and a skill that all participants were forced to develop and master. The aims and outcomes of such brokering practices for the RGs are the acquisition of know-how or knowledge (whenever advice or help was required), networking (getting to know individuals from other RGs, fields, etc.), exchange of favours (in terms of experiment results), and co-authorship in prospective publications (which was a common compensation for the favours done). This brokering practice may derive into boundary or peripheral identities, ambivalent relations of multimembership and a certain sense of uprootedness on the part of the brokers. In order to counteract this, in-group events, such as formal or informal meetings, were deemed useful by some participants, like Tània as shown in excerpt 82, in which she claims that intra-group events contribute to group cohesion and reinforce her sense of belonging to her official RG, which was especially important for her as a peripheral member.

However, brokering involved not only benefits for, but also requirements from group members. One of these was the requirement of sharing some information about their field of practice, which could make communication feasible. This was especially evident in relation to peripheral positions, that is, when participants who had connections with different RGs had to communicate with some group members about research done with out-group individuals, like Tània, who was working in different labs, and had to report on her work to her colleagues in Group A [see excerpt 93].

Excerpt 93: Interview with Tània [PhD researcher - Group A] – 'I can't speak the same way with someone from there'

Researcher: This has helped you mainly as regards the level of anxiety_ =to··=	**Investigadora:** Això t'ha ajudat sobretot a nivell de nervis_ =a··=
Tània: =Yes\ Yes\=	**Tània:** =Sí\ Sí\=
Researcher: To deal with this differently\	**Investigadora:** Gestionar-ho diferent\
Tània: And to be able to talk_ and * yes\ Yes\ to talk in public\ And **to know how to explain myself_** It's also been di& well_ I found it very difficult_ of course_ **I can't speak the same way with someone from there** [the other lab]_ about the specific topic_ this way_ * Well_ this [object of study] in particular_ **Here** [in Group A] **I**	**Tània:** I poder parlar_ i * sí\ Sí\ Parlar en públic\ **I saber-me explicar_** També m'ha cos& * bueno m'ha costat molt_ Clar_ **no puc parlar igual amb un d'allí** [de l'altre laboratori]_ del tema en concret_ d'aquesta via_ * Bueno_ d'aquesta [objecte d'estudi] en concret_ **Aquí** [al Grup A] **els he d'obrir una mica des del principi** Saps/ Faig

have to broaden [the explanation] from the beginning a little bit\ You know/ I do this [object of study]_ that there is this_ **then keep_ you know_ explaining/**	aquesta [objecte d'estudi]_ que hi ha això_ després anar_ saps_ explicant/
Researcher: Here at the [faculty]\	**Investigadora:** Aquí al [facultat]\
Tània: Here when I do the seminars here\ **Yes**\ **Well_ focusing everything a little more**\	**Tània: Aquí quan faig seminaris aquí\ Sí\ Bueno_ una mica el centrar-ho tot una mica més**
Researcher: When you do it for the very same group/	**Investigadora:** Quan ho fas pel gup mateix/
Tània: Yes\ Yes\	**Tània:** Sí\ Sí\
Researcher: Because you deal with topics that they don't know that much\	**Investigadora:** perquè toques temes que ells no coneixen tant\
Tània: I think * Well_ They don't _ **Of course they don't know that much**\ I mean_ I mean_ maybe they know_ +uh+\ But I * I mean_ I have to * I think that in order to understand it * I mean **it's helped me** explain myself as well\ To know how to teach_ no\ But to * yes_ to **make myself understood**\	**Tània:** Crec * Bueno_ No··_ **Clar que no coneixen tant**\ Vull dir_ Vull dir_ a lo millor ho saben_ +eh+\ Però jo * vull dir_ els he de * jo crec que per entendre-ho * vull dir **m'ha ajudat** a fer-me explicar també\ A saber ensenyar_ no\ però a * sí_ a **fer-me entendre**\
	[original in Catalan]

In this excerpt, Tània declares she 'can't speak the same way' with all her interlocutors, because she needs to adapt her speech depending on the lab, the RG or the persons in the audience. She specifies that whenever she presents her work in front of her peers of Group A, she has to 'broaden [the explanation] from the beginning a little bit' and 'focus[ing] everything', for they might lack some basic knowledge. Tània believes that in the course of her doctoral research she has developed the necessary skills to 'know how to explain [herself]', in this case with different audiences.

As commented by Tània, the information conveyed must be first selected according to the audience. The speakers need to consider the level of implication of the audience in their field of expertise in order to modulate both, the content of their message and the text form [see excerpt 94].

Excerpt 94: Interview with Tània [PhD researcher - Group A] – 'when I come here I try to make myself understood'

Researcher: Then you·· the process is that you put yourself in their shoes_ a little_ =and you try to=	**Investigadora:** Llavors tu·· el procés és que et fiques en la seva pell_ una mica_ =i intentes=

Tània: =+mh+ +mh+=	**Tània:** =+mh+ +mh+=
Researcher: =think like they think_=	**Investigadora:** =pensar com =pensen ells_=
Tània: =Yes\ Yes\=	**Tània:** =Sí\ Sí\=
Researcher: or see what things they don't deal with = to * to adapt= a little_	**Investigadora:** o veure quines coses ells no toquen =per * per adaptar= una mica_
Tània: =Yes\ Yes\= Clar\ Clar\ And with Frank I also do it\	**Tània:** =Sí\ Sí\= Clar\ Clar\ I amb el Frank també ho faig\
Researcher: With Frank too\	**Investigadora:** Amb el Frank també\
Tània: Yes\ Yes\ That is_ it's not the same * well_ it's not that I know a lot about every topic_ because I have also come across many different topics_ and I can't explain you exactly how one pathway works_ and what molecules are there exactly\ But when I talk to the people there [in the other RG] I am the one who doesn't understand_ maybe_ where this can come from_ tha⋯t * that **when I come here I try to make myself understood\ Because there they are all more focused\ And of course_ I go to a group that collaborates and only knows about this** And I find it hard to a& adapt to them\ But they have to explain it to me as it is\ Because it's me who has to learn\ no⋯ * it's not like here_ that they don't need to know if one thing is another thing_ because it's * it's * **they have to understand the concept\ No * they don't need to go in depth\ And I do have to go in depth there\ And of course_ I also find this hard there**	**Tània:** Sí\ Sí\ O sigui_ no és lo mateix * a vere_ no és que jo sapigui molt de cada tema_ perquè també m'han tocat molts temes diferents_ i jo no te puc explicar exactament com va una via_ i quines mol·lècules hi ha exactament allí\ Però quan jo parlo amb els d'allà [de l'altre grup] soc més jo la que no pilla_ potser_ d'on pot venir això_ que⋯ * que **jo quan vinc aquí [al group A] intento que se m'entengui\ Perquè allí estan molt més ficats\ I clar_ jo vaig a un grup que col·labora i sol sap d'això** I a mi em costa a& adaptar-me a ells\ Però ells m'ho han d'explicar a mi tal com és\ Perquè soc jo la que ho ha d'aprendre\ no⋯ * no és com aquí_ que no cal que sapiguin si una cosa és una altra_ perquè és * és * **han d'entendre el concepte\ No * no cal aprofundir\ I jo allí sí que he d'aprofundir\ I clar_ això també em costa allà**
	[original in Catalan]

In this excerpt, Tània shows her concern about adapting her speech and making herself understood in the two environments she usually works in: 'here' (in Group A) and 'there' (in the collaborating group/lab). As Tània notes, in the first environment 'they need to understand the concept' superficially, while in the second one 'I do have to go in depth'. An example of how Tània adapted her speech can be observed in excerpt 95.

Excerpt 95: Interview with Tània [PhD researcher - Group A] – 'there I say steatosis'

Researcher: So_ you have the need to adapt your speech somehow_ when you come here_ and when you give * well_ =when you do a conference_ and so/=	**Investigadora:** Llavors_ tu has necessitat adaptar el teu discurs d'alguna manera_ quan vens aquí_ i quan dones * bueno_ =quan fas conferències_ i així/=

Tània: =Yes\ Yes\= Yes\ Yes\ For instance_ fatty liver_ I can say fatty liver_ or steatosis\ Here I don't say * +oh+ **there I say steatosis_ and everybody understands me_ and here I say fatty liver\ Fatty liver everybody understands it** O···r (…) parts of the colon_ o let's see_ parts of the colon that you may also know_ but **instead of saying this part_ I say_ the colon\ or I say··_ the part below the colon_ o···r * you know/ things like that\ The last part\ I drew a colon_ what it was like_** and of course_ to say_ yes\

Researcher: Have they every asked you something that they didn't understand of what you say_

Tània: Yes\ Yes\ Well_ Yes\ In the presentations (…) Maybe there are more questions during the··· presentation than to others\ I don't know_ +uh+\ It's the * the feeling that I have_ I don't make a talk and m& * and that's it_ and I finish_ which never happens_ +uh+ because there are always questions in the middle_ But **maybe people interrupt me more_** maybe +eh+_ now if I compare with some others_ maybe not\ But_ maybe for this_ because they do··n't * o_ and why do you do this/ **Maybe out of curiosity_** +uh+\ And why do you have these animals separated from the others/ And why do you * are they male or female/ Are they together/ Things like this_ **I probably take it for granted** that males and females have to be separated_ But they say_ how do * how do you have it/ **O·r they cannot imagine it_** you know/ What's the cage like/ Or things like this\

Tània: =Sí\ Sí\= Sí\ Sí\ Per exemple_ fetge gras_ Jo puc dir fetge gras_ o hesteatosis\ Aquí no dic * +ai+ **allí dic esteatosis_ i tothom m'entén_ i aquí dic fetge gras\ Fetge gras ho entèn tothom** O··· (…) parts del colon_ o a vere_ parts del colon potser també potser les pots saber_ però **jo en canvi de dir aquesta part_ dic_ el colon\ o di··c_ la part descendent del colon_ o··· * saps/ coses així\ La última part\ Els vaig fer el dibuixet del colon_ com era_** i clar_ per dir_ sí\

Investigadora: T'han preguntat alguna vegada alguna cosa així que no entenguin del que dius_

Tània: Sí\ Sí\ Bueno_ Sí\ A les presentacions (…) Potser hi ha més preguntes durant la··· presentació que potser a altres\ No sé_ +eh+\ És la * la sensació que tinc_ Jo no faig una xerrada i m& * i ja està_ i acabo_ que no passa mai_ +eh+_ perquè sempre hi ha preguntes entremig_ Però **potser la gent m'interromp més_** potser +eh+_ ara si comparo amb uns altres_ potser no\ Però_ a lo millor per això_ perquè no·· * o_ i això per què ho fas/ **Potser per curiositat_** +eh+\ I per què tens aquests animals separats dels altres/ I per què tens * són mascles o femelles/ Estan junts/ Coses així_ més que **jo a lo millo ho dono per suposat** que els mascles i les femelles s'han de separar_ Però ells diuen_ com ho * com ho tens/ **O· no s'ho imaginen_** saps/ La gàbia com és/ O coses així\

[original in Catalan]

In this excerpt, Tània describes some reflections and considerations she makes whenever she presents her research to her group peers. These events require that she anticipates the knowledge her colleagues may have on her research topic, and that she adapts the vocabulary she uses to that imagined shared repertoire. She gives the example of using the word 'hesteatosis' in one RG while 'fatty liver' in Group A, and also using supporting images of the parts of the colon so that her group peers can understand exactly what she is referring to. Tània has the impression

that her presentations generate more questions than those of others, which she hypothesises might be due to the lack of common knowledge, curiosity or because 'they cannot imagine' what the things she refers to look like.

Besides participants' requirement to adapt by using certain vocabulary and by providing extra information on some aspects, individual projects forced group members' adaptation also in terms of text consumption (reception) by proactively filling in one's voids. They were continuously adapting to communication with one another in order to make interactions possible and effective [see excerpt 96].

Excerpt 96: Interview with Tània [PhD researcher - Group A] – 'I may ask you a very absurd question'

Researcher: But then_ this introductory chapter_ let's say_ you have missed it in their * in their *

Tània: but you manage\ =@ @=

Researcher: =talks\ Right/=

Tània: Yes\ Yes\ Since you have done it * you have seen it from a lot of people and everything_ Of course_ for instance I_ at the beginning I sometimes tell them_ **I may ask you a very absurd question_ but I don't know what this is\ And then they explain it to you_** and that's it\ This after the seminar\ But you see that everybody understands it_ For instance_ parts of the [object of study] the other day_ or I don't know what it was\ **I do··n't * I do··n't * I don't use it\ Of course\ And I except i& * well in English_ not even in Catalan\ And_ well then_ you ask_ and that's it\ The same with the way things are done_ which sometimes they really take for granted_ they_** and I sometimes tell them_ hey_ how do you do this/ +U··h+ you know/ +U··h+ How do you do [an action]/ That is_ from this medium_ you go to this one_ to this one_ to this one_ why/ I don't know what/ Of course_ this I have had to ask them\

Investigadora: Però llavors_ aquest capítol introductori_ diguéssim_ a tu t'ha faltat als seus * a les seves *

Tània: però ja t'espaviles\ =@ @=

Investigadora: =xerrades\ no/=

Tània: Sí\ Sí\ Com que ho has fet * ho has vist de molta gent i tot_ Clar_ jo per exemple_ al principi jo a vegades els hi dic_ **potser us faré una pregunta molt absurda_ però jo no sé el que és això\ I llavors t'ho expliquen_** i ja està\ Això després del seminari\ Però ja veus que tots ho entenen_ Per exemple_ parts de la [objecte d'estudi]_ l'altre dia_ O no sé què era\ **Jo no·· * no·· * no ho utilitzo\ Clar\ I menos a& * bueno en anglès_ ni potser en català\ I_ pos bueno_ ho preguntes_ i ja està\ Igual que la manera de fer les coses_ que a vegades ho obvien molt_ ells_** i jo a vegades els hi dic_ a vere_ això com ho feu/ +eh··+ saps/ +eh··+ Com [feu una acció]/ O sigui_ d'aquest medi_ passeu a aquest_ a aquest_ a aquest_ per què/ No sé què/ Clar_ això els ho he hagut de preguntar\

[original in Catalan]

Following the excerpt above, adaptating one's communication involved managing the in-group jargon and shared vocabulary, as well as common information about know-how, usual practices,

etc. In this sense, due to her peripheral position, Tània had to do an extra effort in in-group communicative events by actively asking questions, in order to fill in her voids in the shared repertoire of her RG.

As has been pointed out at the beginning of this section, the CoP's practice encompasses both, participation and reification, that is, the objectification of abstract entities. In our RGs, the outcomes of reification used to take diverse shapes, like concepts, materials, scientific objects, protocols, machine outputs, documents, etc. And similar to brokering, discountinuities of practice can be dealt with through the use of boundary objects, that is, reified entities resulting from the CoP's practice that transcend the CoP.

The participants in this study used boundary objects continuously, for they were an integral part of their practice. They used scientific concepts to explain their activity; they used imported materials and scientific objects that had been used by others to do experiments, by following protocols that had been designed by extra-CoP individuals; they generated machine outputs to show the results of their experiments; they created documents to disseminate their findings; they read publications to learn about others' findings; they did extra-lab collaborations to use a machine or a technology inexistent in their own lab.

The participants' work was based on materiality, and thus on reified entities, to a great degree. Their central activity, doing experiments, consited in the manipulation of imported machines, materials and artifacts. And their final aim was generating objects, in the form of written and oral texts (i.e. scientific articles and conference presentations), that would transcend their RG-CoP and be relevant for external individuals working in their same field. As Wenger (1998: 235) notes, such boundary objects acted as "communication artifacts" that served and triggered the negotiation of the CoP's contribution to and position in its field, and its alignment or disalignment with other CoPs in it. This was the case, for example, of the PhD dissertation and of other products like those addressed to industry [see excerpts 97 and 98].

Excerpt 97: Interview with Mara [PhD researcher - Group A] – 'you should write your dissertation as if you were explaining it for the first time'

Mara: You must think that those who will se& * let's say_ as usual_ one of the * from the trib& * from your {(Eng) panel}_ will know more or less what you are doing\ The other two will have no idea\	**Μάρα:** ...Πρέπει να σκεφτείς ότι αυτοί που θα το δουν& * ας πούμε_ ως συνήθως_ ένας από το * από τη τριβη& * από το {(Eng) panel} σου_ θα ξέρει πάνω κάτω με τι ασχολείσαι\ Οι άλλοι δύο θα είναι άσχετοι\
(...)	(...)
That is_ you should write your dissertation as	Δηλαδή_ θα πρέπει να γράψεις τη διατριβή

if you were explaining it for the first time\ That * let's say_ your nephew that he takes it_ opens it_ and that he ca& * that he can understand that the {(Eng) introduction} is this_ I mean_ that it goes somewhat like this\ But don't make it incomprehensible\ Because +m+ now if someone calls me and tells me about some {(Eng) possible interview} or anything_ they will bring this too\ I'll have to make a presentation_ and even take it with me to show them what I've done\ Until all this is published\ So_ it's good_ my dear_ also for your future\ To have it as what you have done_ and that it is as much {(Eng) clea&} * {(Eng) as clear as possible}\	σου σαν να την εξηγείς για την πρώτη φορά\ Να * ας πούμε_ ο ανιψιός σου να το πάρει_ να το ανοίξει_ και να μπ& * να μπορεί να καταλάβει ότι το {(Eng) introduction} είναι αυτό_ Δηλαδή_ κάπως έτσι να πάει\ Μα μην την κάνεις ακαταλαβίστικη\ Γιατί +μ+ τώρα αν κάποιος με φωνάξει και να μου πει για κάποιο {(Eng) possible interview} ή οτιδήποτε_ θα φέρουνε κι αυτό\ Θα πρέπει να κάνω μια παρουσίαση_ και να το πάρω και μαζί μου για να τους δείξω τι έχω κάνει\ μέχρι να γίνουνε {(Eng) published} όλα αυτά\ Άρα_ είναι καλό_ ρε παιδί μου_ και για το μέλλον σου\ Να το έχεις σαν τι έχεις κάνει_ και ότι να είναι και όσο γίνεται πιο {(Eng) clea&} * {(Eng) as clear as possible}\
	[original in Greek]

Excerpt 98 Interview with Hanns [Group G's leader] – 'the way from starting research to product'

> …It's also very difficult in life sciences_ and especially in biology_ because_ looking to pharmaceuticals_ for example_ yeah/ +Uh+ the way from starting research to product is * is fifteen years\ And * and one billion\ Yeah/ Of * of money is that you need\ So you cannot do that as a research organisation\ Yeah/

In excerpt 97, Mara insists on the importance of writing one's PhD dissertation 'as if you were explaining it for the first time' because it is meant to be read by people external to one's RG and who may lack some contextual an/or background information. In excerpt 98, Hanns makes reference to another boundary object, pharmaceutical products, which are the result of the reification of research; a process that according to him may take 'fifteen years', 'one billion' euro, and the implication of other organisations, different from 'research organisation[s]'.

Therefore, reified objects or "reificative connections" (Wenger, 1998) were both the tools that enabled scientists' daily practice as well as the final outcomes of their practice, which would transcend the RG-CoP, so that they contribute to the specific field of research and be valued by other individuals in their field. These *objects* "connected" the RG-CoP with external knowledge and practices, for they are the materialisation of these two in more or less perdurable and manageable entities.

However, as nexes of different contexts and perspectives, for they can transcend time and space, the use of boundary objects has also requirements so that these perspectives are coordinated (Wenger, 1998). Since they are partial and interpretable, devoid of the context in which they were conceived, they may require supplementary explanations, clarifications and negotiations of their meaning through diverse means. This was the case, for example, of experimental protocols, which the participants had to interpret and execute following certain steps, like a recipe, and in case of failure or of unexpected outcomes, they needed to find out what the errors or problems had been [see excerpt 99 and picture 35].

Excerpt 99 20140327_ Interview with Frank [Group A's leader] and Cecília [senior researcher] – 'just drive them through the protocols'

Researcher: So_ going to the issue of measures_ +uh+ How much time would you say that a Ph& * a regular PhD student would need to spend reading_ struggling with +uh+ English texts_ =in their= training period/

Frank: =+uh··+= I'll say_ =reading=

Researcher: =Roughly\=

Frank: following the literature_ a lot\

Cecília: But * but_ to read is not for the experiments\ To read is to =interpret the results= of the experiments\

Frank: =Exact\ Yes\ Yes\= It's to be aware of what others are doing\ Because the techniques are standard\

Cecília: Yeah\ To design the experiment_ the key is to have some X the experience\ Showing you the steps\

Researcher: Your experience\ =You tell them\=

Cecília: =No\ No\ No\=

Frank: =Or * or * or= other colleagues\ =This is why we se&=

Cecília: =Hao_ Vince_= or **a more experienced PhD students_ just drive them through the protocols\ And once they see the whole thing once_ they can do it themselves** They don't need to read anything\ **The problem is when they are getting the results_ they need to know how to interpret the results\ And the other * the only way is reading other publications** The way they did similar experiments_ and comparing\ But not to set up the experiments\ The experiments in [research field] and [research topic] they are always very repetitive\

Picture 35: Lurdes' lab notebook (page 37) – Protocol with annotations
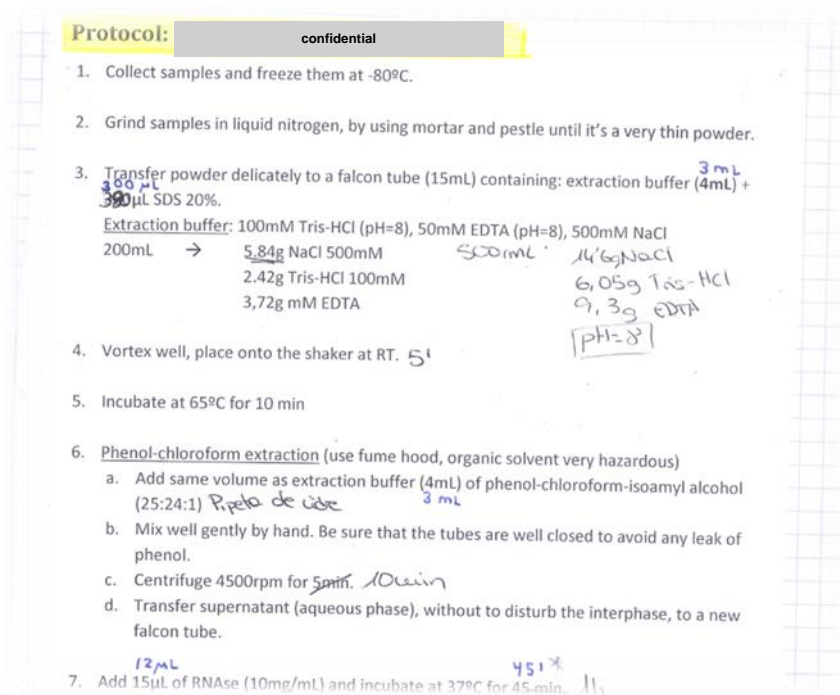
In excerpt 99, Cecília describes experimental protocols as 'standard', as a collection of 'steps' that can be easily followed after they have been shown 'once' by a colleague. However, they might become a 'problem' whenever results need to be interpreted in the light of the literature, that is, of the experience and report of outsider scientists whose work has been reified in the form of a scientific article. Picture 35 illustrates how the negotiation of these boundary objects – protocols – takes place in the local environment of the RG's lab. This picture shows a protocol usually used in Group A, which was printed by Lurdes (BA researcher) from an external source and modified by means of some hand annotations. This shows how boundary objects were usually imported and adapted to the practice and culture of the RG/lab.

Brokering and the use and exchange of boundary objects create *constellations of (interconnected) practices* (Wenger, 1998). CoPs are linked with one another through these processes which their members engage in, and this generates networks of bonds among CoPs. All those variables that facilitate such practice overlaps that have been exposed in chapter 2 (from Wenger, 1998: 127) have been inferred also from the data. The sharing of historical roots linked Diana (former member of Group A) and her new supervisor during her postdoc abroad with Group A. Having related enterprises linked Group A with other RGs through the brokering figure of Tània (PhD-Group A), who had multiple supervisors from different RGs. Belonging to the same institution connected Vince (senior member of Group A) with other colleagues to exchange information or materials; and belonging to the same department allowed interactions

with other RGs through department meetings in both cases (Group A and Group B). the fact of facing similar conditions united doctoral students, for example, within the RG and also with other extra-RG PhD students, with which colleague relations, friendship bonds and even romantic relationships were established. The fact of having members in common fostered Group A's relationship with Tània's other supervisor's group. Sharing artifacts generated bonds between any of the two RGs and other RGs within their institution, since there were some common rooms and machines used by all the 'labs' that belonged to that institution. It also triggered interactions with other RGs around the globe, with which some participants established collaborations of diverse types: internships in their labs to use their materials, machines and/or techniques; the request of applying their techniques or machines on one's object in order to obtain certain derived (experiment) results; and the request for information; among others. Geographical proximity facilitated interactions among RGs in the same building, of neighbouring labs, with individuals using the same experimental rooms (external to the main lab), with other faculty members, like administrative staff, etc. Having overlapping styles or discourses joined participants with other scientists of the same field in conferences, and with other scientists of different fields in strategical meetings to plan joint projects. Competing for the same resources, like grants, triggered the awareness of other competing RGs through documents, grant resolutions, competing RGs' pubished work, etc. The 'geography of practice' that was established between Group A or Group B and other RGs was hence multilayered – overlaping continiously –, multifaceted – with multiple conditions – and multilateral – involving many individuals and thus RGs.

5.5. Discussion and conclusions

The aim of this first chapter of data analysis was to understand in what ways – if so – the RGs studied constitute CoPs, that is, groups of people who mutually engage in a common practice in the pursuit of a joint endeavour, and who, as a result of this sustained practice, learn from each other. In order to compare the RGs with CoPs, we have gone through some main characteristics or dimensions of these communities in successive sections, as defined in the literature: mutual engagement (section 5.1), a sense of joint enterprise and/or a domain of knowledge (section 5.2), a shared repertoire of common resources (section 5.3) and a common core practice around which boundary practices take place, such as brokering and the use of boundary objects (section 5.4).

It has been argued that "[r]esearch groups have the characteristics of a C[o]P" and "can be sites for learning the knowledge and skills required to participate legitimately in the enterprise of science using the repertoires of the science domain" (Feldman, Divoll, & Rogan-Klyve, 2013:

226). Indeed, as has been presented in this chapter, the data analysis has shown that the two main RGs studied have multiple commonalities with the CoP model, though with nuances. The RG-CoP can be described in general terms as a formally defined group of individuals who periodically devote some time and effort to their *mutual engagement*, through events like group meetings, lab mentorships, or interpersonal interactions, in the *joint enterprise* of 'doing science' and specifically of producing new knowledge in order to advance their field of research; as a consequence of this *collective practice*, they generate a *shared repertoire* of common resources like artifacts and ways of expression.

However, when looking closer at the specificities of the RG-CoP, it appears as a community of individuals who share a *domain* of activity (their research field and their laboratory) and who may carry out *coinciding practices*, which they have learned from one another through their *sporadic mutual engagement*, and through which they attempt to achieve their *individual goals*, which again may or may not coincide. This entails their cooperation with other co-members most often in dyads or small subgroups. Accordingly, transactional interest prevails over group cohesion, asymmetrical relations predominate over homogeneous collaboration, and instability dominates over entrenchment. These traits are in line with Grabher's (2004) and Grabher and Ibert's (2006) description of professional groups based on the 'connectivity' principle – whereby relations are established merely for professional purposes, are task-oriented and pursue the exchange of know-how – as well as on the 'sociality' principle – according to which teams are governed by weak ties, loyalty to a shared problem (or project), peer recognition, mobility and flexibility –, as opposed to teams based on 'communality', which cultivate strong social ties, common (work) histories, and personalised experience-based trust.

Regarding the first dimension of the CoP, as defined by Wenger (1998), *mutual engagement* of group members was observed in the two RGs but did not involve all the participants with the same degree. *Mutual engagement* was common in the context of the RG's headquarter laboratory, where group members with a lab-worker status (mainly BA, MA and PhD researchers) spent most of their time at work. More specifically, it used to involve dyads of scientists in a mentor-trainee relationship (see Feldman, Divoll, & Rogan-Klyve, 2009), and thus especially at initial stages of scientists' induction into the *shared practice* of 'doing science'. As scientists progressed in their learning trajectory and status hierarchy, they became more independent from other lab colleagues and engaged in a rather individual activity (this progressive detachment from all colleagues has been described by Diana in excerpt 13). At these stages, *mutual engagement* was more sporadic, taking place in group meetings, private supervisor-supervisee meetings, and specific collaborations or problem-solving situations. Similar to the professionals studied by Wenger (1998), the participants in this study "act[ed] as

resources to each other, exchanging information, making sense of situations, sharing new tricks and new ideas" (Wenger, 1998: 47), although such exchanges and relations did not involve all group members in the same way and intensity, and these were also established with out-group individuals in sometimes very relevant ways for the participants. Different to Wenger's (1998) *claims processors*, scientists did not "see each other every day", "talk with each other all the time", nor "exchange information and opinions" equally (Wenger, 1998: 75). This was only true for some of the participants, at some moments or periods. Some of them did "become important to each other" (Wenger, 1998: 46) but this assertion might apply more to individuals with hierarchical relations (e.g. supervisors were important to supervisees and vice versa) than to same-status individuals (PhD researchers who had entered the RG at the same time and were involved in their individual PhD projects did not need to rely much on each other).

As has been shown in the data analysis, some factors that facilitated the *mutual engagement* of group members in their working environment were: (1) the sharing of a working space, the headquarter laboratory, as well as of a lounge area (as seen in excerpt 14); (2) having a common object of study and/or a similar project, which might imply applying similar techniques and facing common difficulties (as seen in excerpt 3); (3) having the same schedule at work (as seen in excerpt 19); (4) character affinity (as seen in excerpt 18); (5) having the same nationality and/or L1 (as seen in excerpt 20); and (6) mutually engaging in extra-work activities, like going to the gym together, to foreign language lessons, to dinners or to parties (as seen in excerpt 17). On the contrary, there were some aspects and dynamics in the RGs studied that hindered the participants' *mutual engagement* at work. These were: (1) the different nature of their daily practice depending on their status (group leaders and senior researchers used to engage in office work and almost never in lab work, as corroborated by Pere in excerpt 75); (2) the perception of unrelatedness of their individual projects (as seen in excerpt 30); (3) the fragmentation of their working space, which expanded beyond the headquarter lab to other rooms, offices and spaces (e.g. excerpt 21); and (4) the relevance of extra-group collaborations and interactions for many participants (e.g. excerpt 23).

Most of these conditioning factors have been identified in the literature, although they have never been compiled as a list of influencing variables. With reference to the sharing of a working (and/or recreational) space, it has been argued that the layout of the working space may affect the interaction of workers: while open spaces may facilitate it (Beunza & Stark, 2004)*,* "inflexible laboratory modules" and inaccessible offices may hinder it (Collins, 1999). As regards having a common object of study, very similar to engaging in identical or different daily practices (like lab work or office work), it suits Wenger *et al.*'s (2002: 4) characterisation of CoPs as individuals sharing "a concern, a set of problems, or a passion about a topic"; in this

case, the object of study and the kind of the daily practices they engaged in may provide common concerns, interests and problems. Also, Grabher and Ibert (2006: 256) point out that "[p]articularly in knowledge intense fields (…) professional identification with the challenging project task and the expertise-based and motivated project team is stronger than with the more bureaucratic organisational procedures and the hierarchical structures of the firm". This would support the idea that there may be a stronger identification of members of the RG-CoP with external collaborators rather than with co-members. Regarding the work schedule, it has been contended that engaging in a common practice and developing relations of association and dissociation are parallel processes (Wenger, 1998). Spending working time together may foster identification with others for it may provide opportunities for *mutual engagement*, which depends to a great extent on the sharing of space-time with other community members (Wenger, 1998). Concerning character affinity and the sharing of the same nationality and/or L1, just as nationality "is a common source of identification" (Wenger, 1998: 191), character affinity and sharing the same L1 may also strengthen identification. In fact, "personal fit of team members" has been identified by Lettl, Zboralski and Gemünden (2005: 553) as one among several sources for 'swift trust' (in this case within 'virtual teams'). Accordingly, not only is the CoP an important identity marker for its members (Corlett, Bryans & Mavin, 2005), but its members' individual identity may also mark their identification with other members so as to encourage their interaction. In relation to the *mutual engagement* in extra-work activities, it may reinforce group members' bounds through their common participation in the same 'affinity group/s' around a shared interest and common related experiences (Gee, 2001).

Considering some of these variables, Feldman, Divoll and Rogan-Klyve (2013: 225) distinguish between *tightly* and *loosely* organised research groups. On the one hand, the first refer to groups whose members share the same working space, which prompts informal conversations; their members "meet on a regular basis to report on the progress of their research, share knowledge and skills, and critique one another's research", and usually "engage in social activities together, such as cookouts and holiday and birthday parties". On the other hand, in the loosely organised RG, the "lead researcher serves as the center of action", "students work individually", and individual guidance is preferred to group meetings. These scholars claim that "how tightly or loosely organized the group is may depend on the personal characteristics of the lead researcher" (Feldman *et al.*, 2013: 226), as well as on "the way research is done in the scientific domain" (Feldman *et al.*, 2013: 225). Müeller-Prothmann (2005: 266) also attributes community cohesion to the "intensity, frequency, and type of the members' contacts and the continuity of the network/community". The RGs studied seemed to be a mixture of these two types. While individual work was recalled as significant for group members, especially for junior researchers,

and individual guidance was paramount in their practice, group meetings and other joint activities among group members (though not among all of them always) also used to take place. In both cases, the character and ideology of the group leader as regards how science should be done marked profoundly the dynamics of the group. But the extent to which the RG was tightly or loosely organised was not clear-cut, homegenous nor stable. In this vein, Córdoba and Robson (2005) claim that a new mode of research is blooming, different from traditional, monodisciplinary research, that requires a high level of collaboration. This *collaborative research* has been related to excellence and success by different stakeholders and institutions, like the Commission of the European Communities (CEC, 2012), for it arguably encourages and facilitates the transference of knowledge and innovation. Inspired in the CoP theory, these authors describe collaborative research as consisting of two dimensions: a *community-oriented* level and a *practice-oriented* level. The former, which fosters warmth, friendliness, and trust to work together among scientists through practices such as regular meetings, the sharing of research agendas and problems, and the exchange of ideas and information, makes research more effective and sustainable. The latter, which primes attainment, efficiency and practicality and provides direction and legitimation to the community of researchers, implies developing joint activities to seek specific outputs, like joint research projects, joint publications and joint participation in conferences or seminars, (Córdoba & Robson, 2005). In the case of the RGs studied, although the balance between the two was pursued, the practice-oriented level seemed to stand out. Attainment, efficiency and practicality were more explicitly promoted than warmth, friendliness, and trust among group members. Participants' daily activity was very clearly oriented towards results, which most often than not were individual or involved few members of the RG-CoP.

Regarding the existence of a sense of a *joint enterprise* common to all the members of the RG, the data analysis suggests that such a homogeneous endeavour could only be defined in very general terms as '(generating knowledge for) advancing their research field' and 'becoming competent scientists' (which might look as an individual aim but it required group members' cooperation). Beyond these, which at times seemed not to be the participants' priority, their enterprises did not appear to be neither unanimous nor stable. Feldman *et al.* (2009) note that scientists' professional goal is twofold: on the one hand they aim to become "skilled practitioners" in the laboratory while on the other hand they aim to generate *and* warrant new knowledge. While the former enterprise is typical of CoPs, the latter, the authors claim, is more characteristic of 'epistemic communities' (Creplet *et al.*, 2001), which are concerned with convincing outer members of the authority of their claims, through standardised procedures, a certain discourse style, review processes, etc. Therefore, apart from the enterprise of acquiring

skills in their practice, groups of scientists have also the enterprise of learning (and teaching) the procedures that will vest authority to their activity. Moreover, "the multiplication of demands on academic scientists" like "advanc[ing] knowledge, contribut[ing] to technological innovation, support[ing] regional development agendas, and inform[ing] policy debates" (Sá & Oleksiyenko, 2010: 369) may diversify the RG's enterprise. A list of alternative enterprises has been provided in this chapter that might have gathered participants in smaller groups and even with out-group individuals in a more or less extended *mutual engagement*, like 'becoming a full member of the CoP-RG', 'becoming a legitimate scientist', 'becoming a successful researcher', 'earning money', 'completing the postdoc/PhD/practicum', and 'making relevant discoveries'. The success in these endeavours depended on the RG as a supplier of the resources needed, but the RG acted at the same time as a constraint that shaped how they had to be pursued.

In this sense, the group leader seemed to act as a local warrantor of the general enterprises set within their domain or scientific field at a global level and as the moulder of the specific form that local practices should take (as seen in excerpts 32 and 39). The group leaders interpreted the needs and demands of the field and set the objectives of the projects carried out by group members accordingly. They imposed guidelines and norms that should be followed in order to adjust their practice (e.g. excerpts 37 and 38) and outcomes to the quality standards and demands in that domain. They adapted those global norms to the local framework of the nation-state, of the institution and of their RG, conforming this way the *culture* of their RG (see Kaiser, 2005, for conceptions of 'culture' in relation to the practice of science). In this vein, Kimmerle *et al.* (2013) assert that in CoPs "it is mainly the experienced members who are supposed to act as mediators controlling the processes of knowledge construction and refinement of practices". Also, Sá and Oleksiyenko (2010: 379) contend that "globally minded scientists", as the group leader might be, "work across organisational, disciplinary, and national boundaries to advance research and service missions" and develop "local and global connections that supported global research agendas and international collaborations".

In the RGs studied, such adaptation and imposition was usually subtle and presented as a taken-for-granted norm, without overt negotiation, like the need for publishing one's work (e.g. excerpt 47) or for becoming a mobile professional (e.g. excerpt 46). This demanded an effort from other group members to accommodate to the imposed status quo. From the moment they entered the RG-CoP, newcomers had to go through an 'enculturation process' (see Delamont & Atkinson, 2001) replete of implicit norms that would shape their 'identity of participation' (Wenger, 1998). The absence of negotiation of their enterprise generated frustration and a certain alienation in some participants (as seen in excerpt 45). Although referring to a different circumstance, Wenger (1998) already acknowledged the phenomenon of 'alienation' in the CoP

due to a lack of negotiability. Moreover, the dynamic nature of the enterprises set by group leaders increased the difficulties for group members' accommodation to and identification with them. Group members made an effort to pursue the set enterprise through a 'hidden curriculum' (Elliot *et al.*, 2020), which they had to make on their own by means of a trial-and-error learning procedure (Delamont & Atkinson, 2001).

Also, while some successful aspects for the prodution of knowledge in CoPs are "participant commitment towards the endeavour, the clarity of purpose and rules of engagement, and the qualities of leadership and intermediation" (Amin & Roberts, 2008: 364), these were not clear-cut traits of the RGs studied. In these RGs, *transactional leadership* – based on rewarding group members according to the quality of their work – coexisted with *transformational leadership* – that inspires group members' motivation based on their consideration and admiration of the group leader, on their intellectual stimulation and on the group leader's individual mentoring (Wartburg & Teichert, 2005). While the latter, which involves the members' strong identification with the RG's enterprise, has been claimed to be more suitable for the generation of knowledge in CoPs, the ambiguity in this respect generated tensions, problems and identity crises in some cases. Considering that "[t]he voluntary and reciprocal nature of participation in these communities is not based on formal incentives and reward schemes, but on a tacit understanding of common interest and mutual gains" (Ellis, Oldridge, & Vasconcelos, 2004: 160), the data analysis suggests that more efforts should be put in the unequivocal definition of a *joint enterprise* that facilitates group members' identification with the RG-CoP's practice.

The *domain*, understood as the field of inquiry with which CoP members identify themselves and in which they feel legitimised to define competence (Wenger, McDermott & Snyder, 2002; Wenger, 2002), was the 'scientific domain' for the RGs studied, and more specifically the RGs' 'field of specialisation'. This corresponded to a great extent with the group leader's recognised specialisation, defined in turn by her public career: in publications, participation in conferences, policy-making groups, etc. The other members of the RG were diversely recognised (and hence legitimised) in that *domain*, and they also identified diversely with it. Indeed, their daily practices and interactions at work were mainly framed within that *domain* and revolved around the definition of competence within it, always conditioned by the most legitimised member of the RG, the group leader. But the more incipient their career was, the less attached and committed to it they might be. For these group members, the reference *domain* was probably the RG and the institution where their practice was framed. Through their practice within the RG-CoP they defined and acquired competence and were recognised as legimate and competent scientists by other RGs and members of their institution. In these considerations, the psychological concept of the 'frame of reference' (Allport, 1940) appears as especially

pertinent. Understood as a reference context that influences individuals' perceptions, actions and beliefs, it would explain the different behaviours, attitudes and judgements of group members depending on the frame of reference they adhered to. While there were members that did show a motivation for the general *domain* (their scientific field of specialisation) and for the development of knowledge within it, others showed it occasionally or partially, and others did not show it at all. Perhaps the hybrid nature of these RGs as CoPs and also as socio-economic units, which acted in a knowledge market, made the RG-CoPs never be "pure", that is, homogeneous and stable regarding Wenger's definition of a CoP's key elements. The participants' motivation to join the RG-CoP was already hybrid in itself. They liked the topic and the field their studies were framed in, they wanted to deepen their knowledge about it, and, at the same time, they also had the motivation to have a salary (except for students doing their practicum) as well as to be able to access future jobs. Some of them were students who paid tuition fees, and some were employees at the same time. They were group members but for many of them participation in the RG-CoP was a means to gain the necessary skills and capital (Bourdieu, 1986) to transcend it. Everything for them was situated in this limbo, in this hybrid position or dilemma. The participants' interest in their field of research that joined them and motivated their participation in the RG-CoP's practice corresponds with the CoP model. However, the economic tone of their practice as members of the RG, in terms of money, prestige and work aspirations, may distort this idea of participating in the CoP moved by a 'pure' interest in the scientific domain.

As regards the *shared repertoire* of common resources that CoPs develop as a result of their mutual practice, in the case of the RGs studied, it encompassed the following range of elements present in their working space: computers, machines, furniture, tools, materials, books and other artefacts; a certain way of using them, their names – mainly in English in Group A and in Catalan or Spanish in Group B –; a specialised linguistic repertoire typical of their domain; a group jargon; a series of 'techniques' that they apply regularly; a range of specialised images, graphs and symbols and a way of interpreting them; certain jokes and anecdotes; and a discourse reflecting a certain ideological perspective. Some of these repertoire elements have been referred to in the literature as 'linguistic patterns' (Eckert & McConnell-Ginet, 1992), 'machines and instruments' (Pickering, 1995), 'techniques and instrumentation' (Hunter, Laursen & Seymour, 2007), 'computer listings, data sheets, protocol books, diagrams' (Latour & Woolgar, 1986 [1979]), 'unique artifacts, substances, people and theoretical concepts' (Stucky, 2005). Also common to all group members were the norms of practice and interaction, which were passed on from old-timers to newcomers as part of the learning that took place in the RG-CoP (as seen in excerpts 57 and 70). The 'learning trajectory' within the RG-CoP (see

James, 2007) entailed the newcomer's accommodation to all these elements that composed the RG's *shared repertoire* and that constituted a kind of *learning curriculum* – consisting of "work activities, supported participation and inherent workplace pedagogy" (Strand *et al.*, 2015: 532) – or common 'baseline knowledge' (Wenger *et al.*, 2002) onto which innovation should be built. This mix of 'codified', 'tacit' and 'embodied knowledge' (Amin & Roberts, 2008) was instructed or made available in such a subtle way that it was unclear to what extent its shape corresponded to the demands of the *domain*, of the institution or of the group leader. It was also the individuals' endeavour to distinguish between elements of diverse nature and origin and to use them accordingly.

The defining *practice* of the RGs studied could be framed as 'doing science'. As part of it, a central activity, around which most interactions revolved, was 'doing experiments'. The RG-CoP's boundaries, that is, the more or less explicit limits of CoPs that mark the discontinuities between membership and nonmembership (Wenger, 1998), were delimited by different means, which were more or less explicit: official documents certifying group members' membership, their official categories or status (like group leader, predoc, postdoc, etc.), group members' inclusion in mailing lists, access to and assigned roles in group meetings, official research project documents, assigned tasks, others' attentions and forms of interaction, etc. Although the RGs studied constituted communities officially, this is not a requirement for CoPs (Wenger, McDermott, & Snyder, 2002), and thus, the pre-established activity and goals of the RGs did not ensure their constitution as a CoP. As was acknowledged by Wenger himself: "One can attempt to institutionalize a community of practice, but the community of practice itself will slip through the cracks and remain distinct from its institutionalization" (Wenger, 1998: 229).

Also, considering that a CoP "is defined by engagement rather than a reification of membership" (Wenger, 1998: 118), in order to delimit and describe it, the forms of participation of its members should be explored. Within the RG-CoP, group members participated in the practice of the RG-CoP with varying degrees of centrality and peripherality, drawing different trajectories. Similar to the participants in Feldman et al's (2009) study, researchers had different roles in the RG-CoP, like 'novice researcher', 'proficient technician' and 'knowledge producer', depending on their experience and status. Their expected 'learning trajectory' implied "develop[ing] expertise along a continuum from novice researcher to knowledge producer" (Feldman *et al.*, 2009: 442) as a result of their practice in different and subsequent RG-CoPs. Apart from this trajectory from periphery to center, some participants in the RG-CoP were expected to follow 'boundary trajectories' – staying at the boundaries of diverse CoPs (Wenger, 1998). It has been noted that "boundary trajectories are followed by participants who span boundaries and link C[o]Ps" (Feldman *et al.*, 2013: 227), as was the case of researchers with in-

357

group and out-group supervisors, temporary members of the RG (like those doing an internship), scientific writers, and members with special tasks different from 'doing experiments', like the group leader.

Spanning boundaries was one of the main tasks of the group leader, who used to take part in international meetings, policy-making groups, international evaluation panels, etc., but it is uncertain whether her trajectory in the RG could be framed as 'boundary' for she was the identity marker of the RG (the RG would not be "that" RG in particular if it had a different group leader), its cornerstone, at least oficially. While *core members* are defined as those "very actively involved in CoP practices", among whom "the most dedicated" ones "are considered *community leaders*" (Schmitt, Borzillo, & Aznar, 2011: 27), only lab-workers (BA, MA, PhD students and post-docs) used to engage in 'doing experiments' on a daily basis, as a result of which they mastered some aspects of this practice more than the RG's old-timers who used to work in the office (e.g. some senior researchers and the group leader). Group leaders seemed not to be part of the 'task/craft community' of lab-workers, but to act within the frame of reference (Allport, 1940) of the broader 'epistemic community' (Creplet *et al.*, 2001), whereby they enjoyed autonomy and worth based on their "individual skills, experience and reputation" (Amin & Roberts, 2008: 361). The differential task of 'the leaders of the laboratory' has been documented also by Latour and Woolgar (1986 [1979]: 223), who describe the lab's 'chairman' as:

> a capitalist par excellence (…) His work is that of full-time investor. Instead of producing data and making points, he tries to ensure that research is pursued in potentially rewarding areas, that credible data are produced, that the laboratory receives the largest possible share of credit, money and collaboration…

In this sense, the group leader's goals and practice aligned more with those of 'knowledge communities', like research for the development of new ideas and knowledge (Müeller-Prothmann, 2005) than of CoPs, which typically engage in the "practical implementation of knowledge derived from experience" (Müeller-Prothmann, 2005: 267). This poses some questions as regards the centrality of the members of the RG-CoP. Although it could be argued that the core participants of the RG-CoP were the lab-workers, since they were the ones who had more sustained contact with one another, the relevance of their contact with the group leader/supervisor, especially in some periods (as during the writing of the thesis or scientific papers), should not be dismissed. All the participants' productions had to be submitted to the approval of their supervisor and ultimately of the group leader, who was considered a 'master practitioner' (Lave & Wenger, 1991) in the practice of 'doing science', as opposed to the

practice of 'doing experiments', whose 'master practitioners' were the most experienced lab-workers.

Still regarding the centrality of group members, not only peripheral members but all of them had to engage in *boundary practices* as part of their professional activity, such as meetings and seminars with external audiences, conferences, individual collaborations, internships in other labs, etc. And hence they were trained and required to master intra-group as well as inter-group brokering, which was also a key part of their activity. Mastering such brokering practices entailed developing the ability to adapt one's communication to the audience, taking into account the vocabulary, jargon, information and knowledge one shares with it. This was also central part of group members' *learning trajectory* and a key topic of their daily professional interactions. Brokering has been argued to provide enriching resources for CoPs, for it implies the exchange of knowledge and perspectives: "Brokers are able to make new connections across communities of practice, enable coordination, and – if they are good brokers – open new possibilities for meaning" (Wenger, 1998: 109). This asset was also acknowledged by Frank, Group A's leader, when he argued in favour of multiple-supervisor projects (excerpt 79), and by Pere, Group B's leader, when he underscored the importance of participating in international conferences (excerpt 81).

Apart form these ways of *participation* in the RG-CoP, also the *reification* of certain actions into objects was a key aspect of the participants' practice (Wenger, 1998). This was the case of scientific concepts, materials, objects, protocols, machine outputs and documents, among others. The RGs' core practice was based on materiality for it entailed the manipulation of machines, materials and objects to a great degree. In fact, the production of *boundary objects* was a main goal of scientists' practice. Specifically, they 'did experiments' in order to obtain certain 'results' which would materialise in the form of machine outputs and which in turn would be joined conforming a 'story' (this term was frequenty used by Group A's leader) that, in turn, would give place to a scientific article (or another type of scientific report), whose objective was transcending the RG-CoP and 'impacting' other scientists of their *domain*. In the opposite direction, also the use and consumption of *boundary objects* was key for the participants, who needed to rely on imported protocols, materials and external machines to 'do their experiments', as well as on publications from members of other RGs to interpret their own results. Consequently, they often needed to engage in the negotiation of the meaning of these *boundary objects* in order to ascertain their adequate use and/or interpretation. As a result of the use and dissemination of *boundary objects*, the RGs were bound to external individuals and other RGs forming *constellations of practices* (Wenger, 1998) around the world, according to

certain factors, like common origin, geographical proximity, related enterprises, institutional membership, the sharing of past and present members, transactional interests, etc.

These *constellations of practices* that involved group members and out-group individuals might have generated a hybrid identity of group members – apart from members of the RG-CoP, they would also be members of other 'social networks of mutual assistance' (Fong, 2005) – and therefore their *peripheral participation* in the RG-CoP. This is a form of internationalisation and intercultural dialogue. On the one hand, their immediate cosmos was their RG and their group colleagues, with which they negotiated the rules of their daily practice, in the lab, in the faculty, in group events, etc.; the culture they followed was that of the lab/RG, imposed by the group leader to a great extent, who might be local or foreign, but always framed within an institutional culture, marked in turn by a national culture. On the other hand, out-group contact, established with RGs based outside the normative-institutional framework of their country or state, was fostered through individual international collaborations, internships in foreign laboratories, and participation in international forums and conferences, among other practices and events. In these, the local and the global spheres interplayed. Such multimembership adds complexity to the conception of the RG as a CoP, for it implies the participants' learning and mastery of more practices, vocabularies, styles, and canons of performance, among others (Wenger *et al.*, 2002) than those of their RG-CoP. However, despite the trend of policy makers to promote international collaboration in research, the significance of local ties for knowledge creation must not be underestimated. In this vein, Amin and Roberts (2008: 366) assert that "the intersections between network space, corporate space and regional space define the geography of knowledge" in which all levels of engagement interplay and contribute something.

In addition to the characteristics described above, Wenger (1998: 125-126) proposes a list of indicators to establish whether a certain cohort of individuals constitutes a CoP. This list has been cited in chapter 2 (section 2.4). The analysis of the data has shown that some of such indicators suit the observed RGs. These are: (1) the existence of a rapid flow of information and propagation of findings and updates (e.g. through emailing lists, notice boards, reports, meetings of different types, etc.); (2) the existence of spaces and time slots devoted to the discussion of problems (e.g. group meetings, one-to-one meetings); (3) the participants' knowledge of what other members know, what each of them can do and how they can contribute to the joint enterprise; (4) the existence of mutually defining identities of the group's members (e.g. supervisor-supervisee, leader-senior-junior researcher, mentor-trainee); (5) their ability to assess the appropriateness of their actions, their plans, and their outcomes; (6) their use of specific tools, representations, and other artefacts (for instance in the lab); and (7) the existence of a shared discourse among group members reflecting a certain perspective on the world, but more

specifically on science and especially on their scientific field. Ultimately, like in CoPs, the members' participation in the RGs studied did imply a learning journey, an induction into science and into their scientific *domain*, part of their professional career and also an identity trajectory (from novices or apprentices to senior members or experts). They had accountability for one another and also for the development of science. Like CoPs, these RGs were also relatively formal since their members were aware of their membership to the RG and were recognised as such by others (Müeller-Prothmann, 2005). Still, the question of whether the RGs studied constituted CoPs as have been defined in the literature does not demand a yes-or-no answer. I hope that this chapter has helped the understanding of the RG in all its complexty while at the same time showing the advantages of using the CoP model to explore this type of social aggregates.

The objective of this chapter was not only to establish the validity of the CoP model to study RGs, but also to contribute to the adaptation of this framework to the study of scientists' communication. Having showcased the first aspect, another paramount aspect of the present study needs to be addressed: the role of communication in the practice of the RG-CoP explored. In this respect, the sites where the participants' communication was required or fostered, as have been referred to in this chapter, were group meetings, lab mentorships (through mentor-trainee sustained interactions), private supervisor-supervisee meetings (individual guidance), informal conversations (both professional and non-professinal) like those for problem-solving, writing/reading reports on the progress of research, writing scientific articles and PhD theses for the transference of knowledge, correcting these reports and documents (in the case of supervisors), and the organisation of and participation in social activities. Also, out-group collaborations and interactions, used to take place, like online discussions and information exchange, requests of diverse types, policy-making meetings, conferences or seminars, the writing of official research project documents and grant applications, and the dissemination of findings through written works and/or talks. All these communicative practices required the *mutual engagement* with some in-group and/or out-group scientists. Finally, the creation and use of a *shared repertoire* of common resources entailed also the communication of group members, like communicating with others through computers, interacting with machines and generating machine outputs, following written protocols, ordering materials, reading books; learning and using the adequate names for these resources, as well as a specialised linguistic repertoire typical of the domain and a group jargon; learning how to interpret a range of specialised images, graphs and symbols; sharing certain jokes and anecdotes; and contributing to the construction of a discourse reflecting a certain worldview.

Very important in scientists' daily communication was the virtual environment. As long as it was possible, practical issues were discussed in person, but whenever the supervisor was not present in the lab or in her office, or in exchanges that involved written reports, such interactions used to take place mostly online, through emailing. This type of exchanges were also common in contacts with external collaborators, who were often based abroad. And the virtual environment dominated also the participants' practice in other aspects, like ordering materials, getting and/or reading scientific articles and searching information. In the participants' daily communication, ICT, like emailing, web sites, online forums, material ordering systems, text editors, and presentation support software, had a principal role for it facilitated and/or enabled communicative events such as professional discussions, information search, report sharing, evidence storage, activity coordination, and even leisure (see Córdoba & Robson, 2005). To some extent, group members acted as members of online networks, who communicated mainly within this virtual environment. Yet, depending on the online practices they engaged in, their membership, attachment and role in these was variable. While sites like online databases and repositories (of scientific articles or protocols) afforded reading and little manipulation, online discussion forums afforded posting messages and some delayed interaction and intellectual implication, and online project coordination spaces allowed chatting and complex knowledge exchange, among other affordances. The use of the virtual environment was beneficial for the participants' professional activity for it helped the rapid flow of information, the collaboration with absent colleagues, it provided access to an extensive network of people, and most importantly to specialists and even world-leading specialists in each topic, but in contrast, it hindered their mutual engagement with individuals present in their physical milieu. Some of them spent much time engaging virtually with remote interlocutors, in a virtual workplace, through discontinuous interactions, which might have generated *networks* of isolated workers, joined only by sporadic bonds of collaboration for individual interests, who would not conform *communities* (see an overview on the characteristics of virtual communities in Ellis *et al.*, 2004). This seemed to be the case, for instance, of Mara, who showed detachment from her group peers and attachment to remote collaborators (excerpt 22).

To conclude, we ought to recall Amin and Roberts' (2008: 365) claim that "the use of the term community of practice as a proxy for all forms of situated knowing is unhelpful", for "[t]he dynamics of the task or craft-based communities studied by the originators of the term seem to be barely replicated in settings of high creativity, epistemic, professional, or virtual learning and knowledge formation". This assertion applies also to the RGs studied, as has been widely discussed here, which resemble and at the same time differ from the notion of the CoP as was conceived by its founders. Understanding that the practice of science is not only a situated

practice that entails knowing in action but also an intellectual activity that resists space-time constraints, a discourse and a market, the CoP model may be a worthwhile departing framework to study the situated practice of scientists, but it needs further development, perhaps through its combination with other notions like those of knowledge networks and epistemic communities, so that it can fit with the characteristics of RGs.

Despite their divergences with the CoP model, the multiple commonalities between this model and the RGs studied suggest that it may provide useful tools for the analysis of scientific teams. In this chapter, several references to communicative events have been made, whose role in and importance for the daily practice of the participant scientists could be determined thanks to the use of the CoP theory. This indicates that the CoP model may benefit from communicational approaches to communities like the two RGs studied here, and vice versa, as will be further defended in the next chapter. In chapter 6, the communicational dimension of the RG-CoPs studied, still at the meso level, will be explored, aided mainly by the theory of the ehtnography of communication.

Chapter 6: The RG's internationalised multimodal communication policy: Learning by doing (and communicating?)

After having discussed and validated the adequacy of the CoP theory for approaching the scientific group as the social unit to be analysed, another major objective of this thesis is to elucidate the ways in which this learning (and identity) theory can be deemed a good framework for the analysis of multimodal communication, or in other words, the place and role of (multimodal) communication within the CoP and, in this case, within the RG. For this purpose, the communication practices of the RGs studied will be explored so as to answer the following research sub-questions:

Rsub-Q$_1$: What kind of multimodal communication policy does the group abide by?

Rsub-Q$_2$: How is this multimodal communication policy influenced by the internationalisation of higher education?

As has been described in chapter 2, the notion of 'multimodal communication policy' is an adaptation to a multimodal communicative context of Spolsky's (2004, 2007) concept of *language policy,* which encompasses practices, beliefs and management as regards language use. This broadening of the research scope was deemed necessary due to the relevance observed in the field of communicative modes other than speech and writing. This was evident both in the fact that, in the RG's headquarter laboratory, speech was very limited [see excerpts 100 and 101] and in the importance of image as a communicative mode in the participants' professional activity [see excerpt 102].

Excerpt 100: 20131115_Field notes (Page 2) [Group B] – 'in the lab they're focused on work'

«→ in the lab they're focused on work; little space/time to talk about out-work [issues]; some comments about TV (Onofre-Lola), little about life (Montse-Lola)»	(Onof. – Lola) (Montse – Lola) [original in Catalan]
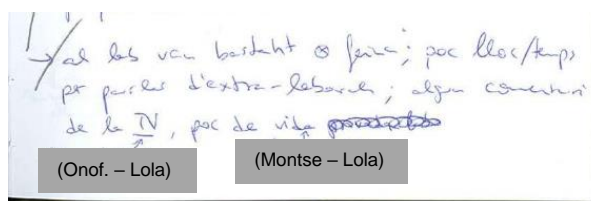
Excerpt 101: 20131115_Field notes (Page 3) [Group B] – 'in general silence reigns'

«→ in general silence reigns [in the lab]»	
	[original in Catalan]

Excerpt 102: Focus group with Group A – 'Would you be able to live without pictures/'(20140527)

Researcher: Would you be able to live without pictures/ Would you be able to explain what you are doing without this projector/ Without a visual support/

Agus [PhD res.]: It depends\

Carol [PhD res.]: Yeah_ it depends_ on the results you show_ or the *

Frank [Gr. leader]: Well_ the answer should& * I mean_ you should answer with a yes or no\

Agus [PhD res.]: No\ It's not possible\

Frank [Gr. leader]: You think it's not possible/

Agus [PhD res.]: No\ It * it * it depends on the person\ For example_ me_ I say =it depends\=

(…)

Carol [PhD res.]: And the pictures help a lot_ to show_

Frank [Gr. leader]: That is not the answer\

Navil [PhD res.]: Yes\ but the *

Frank [Gr. leader]: There is no but\

Navil [PhD res.]: No_ yes\ I * I mean_ yes\ it's possible to * to explain the same information without having a projector\

Ale [PhD res.]: How do you explain a graph/ For example_

Tània [PhD res.]: Yeah\

Ale [PhD res.]: with the lines_ and *

Navil [PhD res.]: How did we learn before/ when we had a blackboard {(?) teaching

without} *

Ale [PhD res.]: But you draw *

Agus [PhD res.]: But you have =a visual support\ With a blackboard\=

Ale [PhD res.]: =You draw a * a graph\=

Agus [PhD res.]: You have a visual support\ We are speaking about not having any visual support\

(...)

Frank [Gr. leader]: I think most of you are missing the fundamentals\ (...) A scientist needs to be able to communicate on a desert island\ With no visual aids at all\ **Of course visual aids help a heck of a lot\ They make our life a lot easier\ And there is no question that a presentation with audiovisual aids is much better_ more comprehensive_ and more complete\ But that does not mean that we cannot convey the same message without any audiovisual aids\ For sure we can**

Agus [PhD res.]: Yes\ But @ +mh+ Depending on the case_ +eh··+ the result in communicating_ *

Frank [Gr. leader]: We're not talking about * We're not talking about results\ =We are talking=

Agus [PhD res.]: =No\ no\ no\=

Frank [Gr. leader]: about whether we are able to communicate without any audiovisual aids\ I'm not arguing that having audiovisual aids * I mean_ I agree with you that **having audiovisual aids is much better_ and more effective** But that was not the question\ The question was whether we could do so without audiovisual aids\ And obviously_ if I put you in a * in the field_ when we went for a picnic\ for a * for a seminar_ in the field_ you did not have a board_ and you did not have a projector\ And you didn't do any worse in your formal seminar\ Did you/

(...)

Agus [PhD res.]: Yeah\ but I mean_ **it's different\ If you have to explain +mh··+ a simple trend in your results_ and if you have to explain a complicated [type] technique with multiple [elements]_ bla bla bla_ without visual support**

Frank [Gr. leader]: Do you know what the ancient generals used to do/ before a battle/

Agus [PhD res.]: No\ @

All: @@@

Frank [Gr. leader]: They would get a stick_ and they would draw battle plans_ very complex battle plans on the sand

Agus [PhD res.]: Yeah_ but_ we are talking about not having any visual support\ No/ Even without a stick

Frank [Gr. leader]: You can improvise\

The first two excerpts reflect the little room for speech that there was in the participants' daily working practice in the laboratory, since they used to engage in lab work, which implied communication through other communicational modes (like image, gesture, writing and object manipulation). The latter excerpt illustrates a debate generated during a focus group with Group A, in which the relevance of image for their practice was discussed. As can be observed, while Frank, the group leader, defended that 'visual aids' were not indispensable for them, other group members, like Agus and Ale, argued that certain things, like 'explain[ing] a graph' or some 'complicated [type] technique', required visual aids unavoidably. In the end, even the description made by Frank to provide an alternative resource to visual aids seems to involve 'drawing' and thus image. For this reason, in order to describe communication in the RG, the focus here will not be on language only, but on the whole range of communicative modes present in the participants' daily practice.

In order to answer the research sub-questions posed in this chapter, which concern the meso level of analysis (that is, the production, distribution and consumption of texts), the data analysis will draw mainly on concepts from the *ethnography of communication* (Hymes, 1964), complemented by notions from the *CoP theory* (Wenger, 1998) and from the *multimodal social semiotic* approach (Kress, 2010).

The first two sections of this chapter follow Saville-Troike's (2003: 108) proposal for a three-step ethnographic analysis of a community's communication. First, the kinds of *events* recognised in the community will be listed, described and related to the idea of 'expertise acquisition' in the CoP, a parallel notion to 'competence' in the EoC (section 6.1). Second, the nature of the *events*' boundary markers signalling their beginning and end will be examined and the features that distinguish one type from another will be identified (section 6.2). The following section will be devoted specifically to the language policy of the RGs studied (section 6.3). And finally, the hints of the IoHE will be tracked across the RGs' multimodal communication policy (section 6.4). Section 6.5 will present a discussion of the findings in the light of the relevant literature and some concluding remarks.

6.1. Communicative events that compose the multimodal communication policy of the RG-CoP and expertise acquisition

Around the participant scientists' core practice of 'doing experiments', as framed in chapter 5, there developed a wide range of usual communicative practices arranged, which were devoted to explaining experiment results, negotiating their relevance and description, learning the procedures involved, and other related aspects. The activity of all the participants included the objective of presenting the outcomes of experiments, namely 'experiment results', in a convincing, attractive and impactful way. In this section, we will focus on unveiling the pattern

of communicative behaviour, that is, the communicative repertoire in the case of the RG-CoP that constitutes its multimodal communication policy. This patterning of communicative behaviour comprises not only the means of communication, the modes of organisation and the codes used, but also what is deemed "appropriate" communication in the specific context of the RG-CoP, that is, the acquisition of 'communicative competence' (an insight on communication rules and cultural knowledge) that group members go through (Hymes, 1980).

For the analysis of RGs' multimodal communication policy, the *communicative event* – routine communicative practice with specific patterns that is recognised as such by group members – has been taken as the central unit of analysis, and the components of Hymes' SPEAKING model (situation, participants, ends, act sequence, key, instrumentalities, norms and genres) as the sub-units that will guide the exploration of such *events*. Beyond the communicative events that the participants used to take part in, there was the communicative situation*,* in this case 'doing science', – understood as the social occasion that frames communication – whithin which the range of communicative events that the participants engaged in were framed. The participants' engagement in each event was neither equal nor stable, but they used to take part in the *events* with more or less frequency, in larger or smaller groups, with more or less implication. Also, some of these *events* took the form of routines and were named in a certain way by the participants, which evidenced their salience. While one of the ethnographer's aim is to discover the 'local taxonomies' for each communicative event, not all types of communicative events may have a specific label (Keating, 2001). When this was the case, the researcher recognised and coded the communicative events after identifying crucial differences among them as regards their components, including mainly three: participants, setting, and norms of participation in them. Identifying and labelling key communicative events of the communities studied may contribute to uncovering the relations between communicative and social behaviour within the RG-CoP as well as the comparison of communication habits across communities.

The coding of communicative events followed an emic approach, according to which no pre-established codes were used to label them, but on the contrary the *events* were identified and coded after the scrutiny of the data. A list of the communicative events identified is presented below as they were coded by the researcher. There were three recurring events (42, 67 and 75) labelled as they were named by the participants themselves.

1. [Institute] Seminar
2. [Institute] seminar: Oral presentation rehearsal
3. Annotations / taking notes
4. Arranging a trip
5. Asking for a favor
6. Attending a scientific writing course
7. Bureaucracy / (personal/professional) Bureaucratic transaction
8. Cleaning/setting up material
9. Coaching explanations / Mentoring
10. Coffee break
11. Conference presentation
12. Conference poster
13. Correcting/editing a paper
14. Cost allocation & accounting
15. CV complementation & ORCID etc.
16. Department seminar
17. Department Seminar rehearsal
18. Designing and planning experiments
19. Doing experiments / Following protocol
20. Doing graphs, Excel tables, etc.
21. Editing journal
22. Evaluating projects
23. Event preparation
24. extra-cop meeting
25. Using Facebook/social media
26. Formal emailing
27. Formal meeting
28. Formal professional conversation
29. Formal Seminar (Gr. A)
30. Fundraising
31. PR and press dissemination (interviews, etc.)
32. Grant application
33. Hanging posters/notices/signs
34. Informal emailing
35. Informal meeting/Celebrations
36. Informal Ppt presentation
37. Informal professional conversation
38. Institutional event
39. Interviewing candidates
40. Job/position application
41. Knowledge transference
42. 'Lab meeting' (Gr. A)
43. Labelling objects
44. Lecturing (courses)
45. Listening to music
46. Looking up on YouTube
47. Lunch together
48. Managing data
49. Meeting supervisor-supervisee
50. Networking/Social activity
51. Ordering materials, exp. kits, etc.
52. Personal announcement
53. Personal conversation
54. PhD Defence
55. PhD defence rehearsal
56. Policy making
57. Post-doc meeting (Gr. G)
58. Preparing classes
59. Preparing materials for practicum session
60. Preparing written handout
61. Presentation preparation
62. Professional announcement
63. Project meeting
64. Reading articles
65. Reading news
66. Searching info online
67. 'Seminari de grup' (Group seminar) (Gr. B)
68. Sending cover letter and CV
69. Strategic meeting
70. Strategic speech
71. Supervising
72. Telephonic personal conversation
73. Telephonic professional conversation
74. Thesis submission
75. 'Seminari de formació' (Training seminar)
76. University class
77. Workshop
78. (Writing an) acknowledgement
79. Writing in the lab notebook
80. Writing a letter
81. Writing a newsletter
82. Writing the PhD dissertation
83. Writing a project proposal
84. Writing a report
85. Writing a review (of the literature)
86. Writing a scientific paper/article
87. Writing a strategic roadmap

This list does not constitute a discrete list of all the communicative events that composed the communicative repertoire of the RGs studied, but a convenient list showing its variety according to the criterion of the researcher. We assume that, in this respect, communicative events are a parallel of *genres*[90] in the genre analysis literature (i.e. Bhatia, 1993; Swales, 1990) that deems them "'points', or better regions, in an entire space of genre possibilities" (Bateman, 2008: 10), and hence we acknowledge that classifying them is a subjective endeavour, as noted by Paltridge (2012: 67): "What to one person, then, may be an instance of a particular genre may, to another person, be more like an instance of another". The parallelism between genres – considering their social dimension – and communicative events has been noted in the literature (i.e. Bateman, 2008).

It is worth remarking that, in this list, communicative events are phrased either in the form of a noun [like 'Formal meeting'] or in the form of a verb with complements [like 'Writing a report']. In the latter case, where the verb expresses the practice and the complements are the reification of that practice, the role of the individual as agent of the action is clear. However, in the former kind of events, whenever these involve more than one participant, the roles may be diverse, depending on the individual. For example, in the event 'Formal meeting', participants could either be the presenter of the meeting or the attendees; and in the event 'Mentoring', participants could either be the mentor or the trainees. In communicative events that express individual endeavours, like 'Presentation preparation', there could either be only one participant involved (the individual that will give the presentation) or more than one (plus other collegues that aid her in this process). Finally, in events like 'Job application' participants could either have the role of agent or receiver. Both, more active involving productive skills (like writing, talking and doing) and more apparently passive roles involving receptive skills (like reading, listening and watching) may be equally significant for scientists' participation in the RG-CoP's practice. It is also worth considering that such roles might be switching throughout the course of a communicative event.

The codes provided above label *prototypical* communicative events in the sense that each time that one takes place, it is different from any other event (i.e. the conversations might not be the same; the roles of each participant might be different, etc.) but at the same time it may share some traits (like typical participants, setting, topic, aim, etc.) with certain events that make it

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[90] In fact, the two concepts have been equated by Swales (1990: 58): "a genre is a class of communicative events that share a recognisable communicative purpose, that exhibit a schematic structure supporting the achievement of that purpose, and which show similarities in form, style, content, structure and intended audience".

recognisable as belonging to the same type. This idea resonates with that of 'prototypical exemplars' of a genre in genre analysis (see Swales, 1990). Also from this approach, some notions may be useful for the analysis of the RGs' multimodal communication policy, like that of 'genre networks' meaning "the totality of genres available in the particular sector" (Swales, 2004: 22), as well as the importance of exploring interactions among genres, typical genre sequences or 'genre chains', and genre hierarchy (Paltridge, 2012). As part of scientists' daily practice, prototypical communicative events repeated with different frequencies and overlapped with others on a timeline; there were disruptant and disrupted communicative events; and there were also compulsory and optional events (e.g. in the course of doing a PhD, making a scientific poster might be optional, whereas the PhD defence may be compulsory). See below a figure showing the hierarchy among communicative events that used to take place in the RG [figure 5].

Figure 5: Hierarchy of communicative events
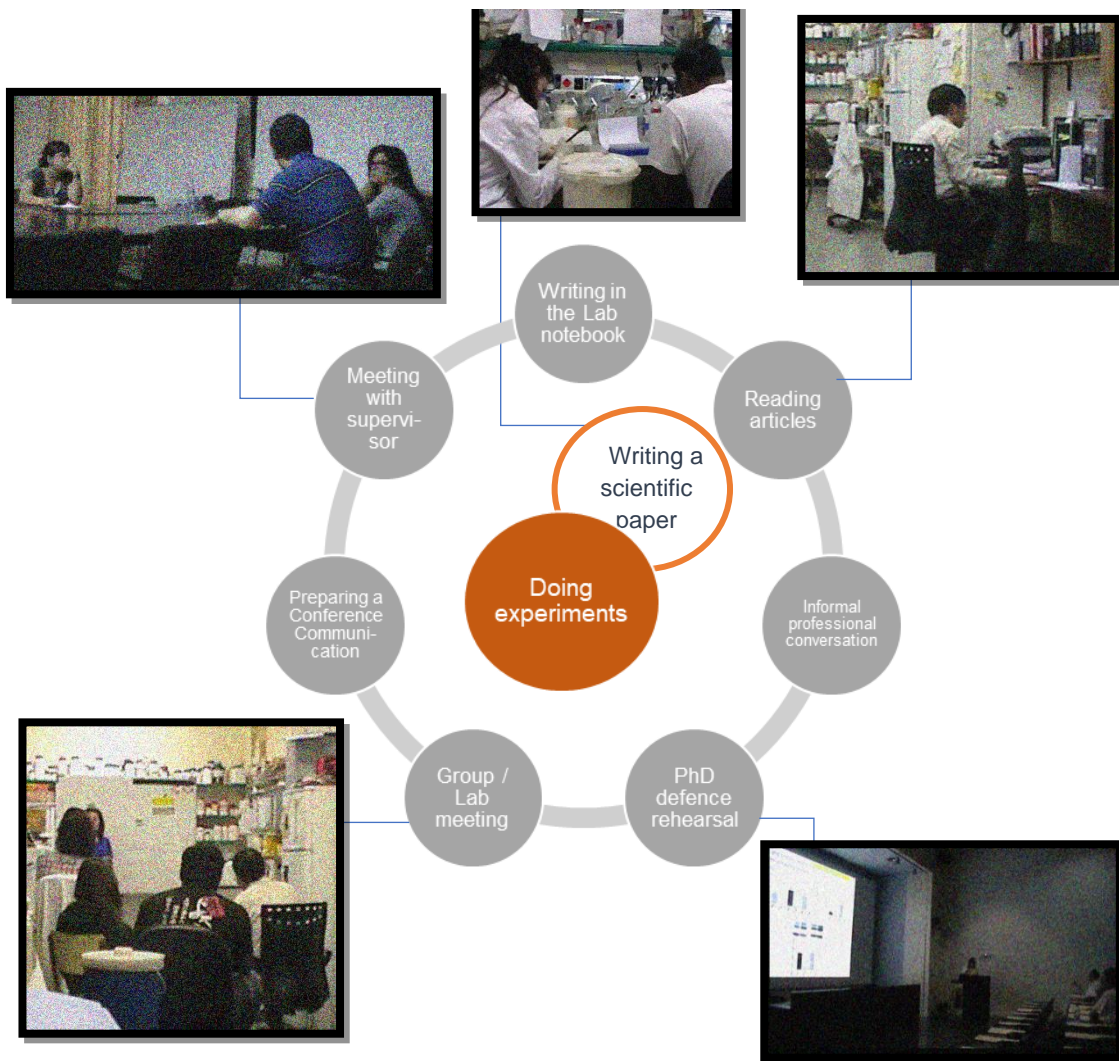
Just as it was the core practice of the RG-CoP, 'doing experiments' was the most important *communicative event* in the hierarchy, since most of the other communicative practices revolved around it. The main topic in most interactions were (past or future) experiments and related issues. However, although it was an indispensable practice and the one which the participants used to spend most time on, their final aim was not the experiments in themselves, but 'obtaining/writing relevant publications' out of them. For PhD researchers, a mid-term goal was probably 'writing the PhD dissertation' and 'doing the PhD defence', but also in these cases 'obtaining relevant publications' was indispensable for those who aimed to become (legitimate) scientists [see excerpt 103].

Excerpt 103: Meeting with Frank [Group A's leader], Hao [Senior res.], Carol [PhD res.], Xènia and Lurdes [BA res.] – 'each one of you are going to get a paper'

> **Frank: …like this each one of you are going to get a paper** well_ I should discuss it yesterday_ but **it's very important if you want to remain in science\ cause it's going to give you a* a* a* a competitive advantage** +ehm··+ when you * if you want to do a PhD and beyond\

In this excerpt, Frank, Group A's leader, explains Xènia and Lurdes, two newcomers to the RG and to the practice of science, the importance of publishing for a scientist's career. This is one of the very few instances in which the importance of publishing was made explicit, since it was in general an implicit ultimate aim of the participants' practice.

Another relevant consideration that could be made regarding the hierarchisation of communicative events is the extent to which they were public and easy to access or not. This is also a consideration made by Swales and Feak (2000), who distinguish between 'open genres' and 'occluded or supporting genres'. The data analysis, though, has revealed a somewhat more complex distinction than the binary one made by Swales and Feak (2000). Besides those communicative events that involved members of the RG exclusively (like the 'group meeting'), and those that were 'open' to the public (like the 'PhD defence'), there were some communicative events (like the department meeting) with a restricted access but that involved both, in-group and out-group individuals. See below a figure of a network of communicative events based on this distinction [figure 6].

Figure 6: Communicative event network (based on Swales and Feak 2000)
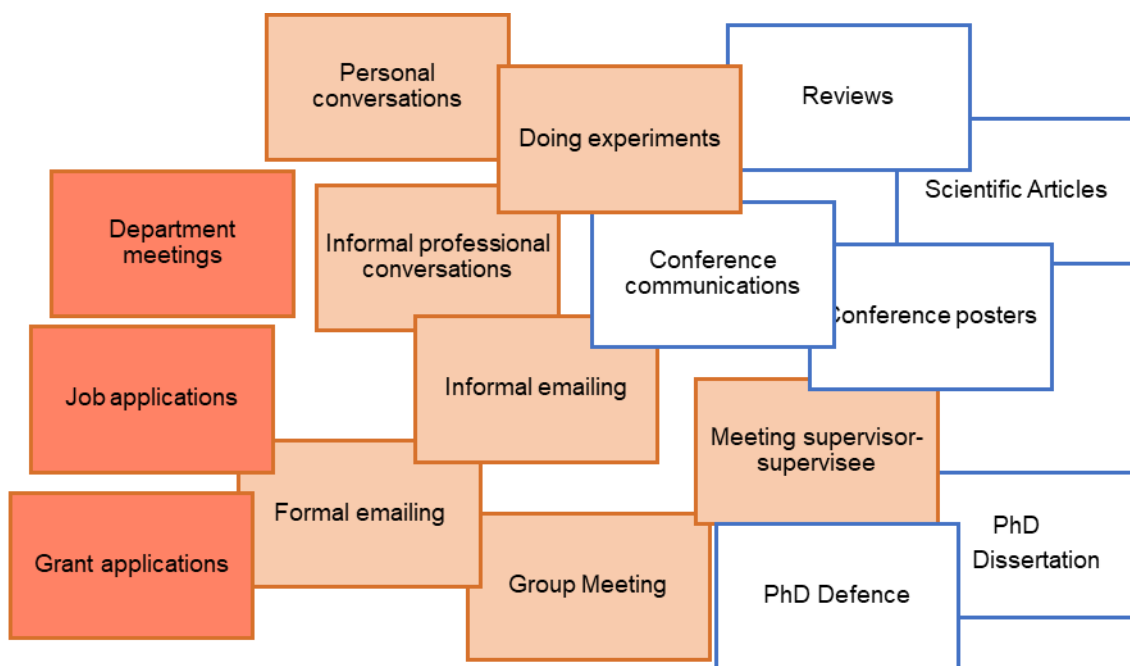
This figure represents a sample of typical communicative events (or their reified outputs in the form of an 'inscription') which group members used to engage in. These have been classified in three types depending on their "openness" or "privacy". In light red, in the centre, there are seven events/inscriptions that were exclusive of group members, which used to take place in private circles, within the domain of the RG and the spaces it occupied legitimately. These entailed communicative practices that were needed in order to achieve the publication of 'open' events/inscriptions. Examples of these were 'group meetings', where experiment results were discussed and doubts solved, 'informal professional conversations', again for problem solving or requests for help, 'emailing with colleagues', as well as other communicative events on non-professional issues that helped the participants' socialisation with one another, their integration in the RG-CoP and their welfare at work. On the right side, outlined in blue, there are six 'open' events/inscriptions that were more or less 'public' outside the domain of the RG. These were: 'published literature reviews' and 'scientific articles/papers' (accessible to the readership of the journals), 'conference presentations' and 'posters' (accessible to conference attendees), the 'PhD defence' (which was a public event) and the 'PhD dissertation' (often available to be consulted at the university and/or through open-access repositories). Finally, on the left side, in dark red, there are three events/inscriptions that had a restricted access but that involved members of the RG as well as external individuals. These were: 'department meetings' (restricted to members of the department), 'job applications' (restricted to the internal hirer of the RG and to the candidate) and 'grant applications' (restricted to the group leader and some senior researchers and to the external evaluation panel). Without implying that certain events

373

were dispensable, I deem the label 'supporting' more apt in this case for those events that "supported" the consecution of either 'doing experiments' or of those communicative events intended to transcend the RG with the purpose of obtaining recognition for its members, and thus more as a notion of hierarchy rather than of openness.

As has been noted before, there was a preferred sequence of prototypical communicative events for each group member, depending on their status, although the events used to overlap, disrupt each other, repeat and follow alternative sequences. The figure below shows a *communicative event chain*, a parallel to 'genre chains' in genre theory (see Räisänen, 2002; Swales, 2004), for PhD researchers.

Figure 7: Ideal *communicative event* chain for PhD researchers
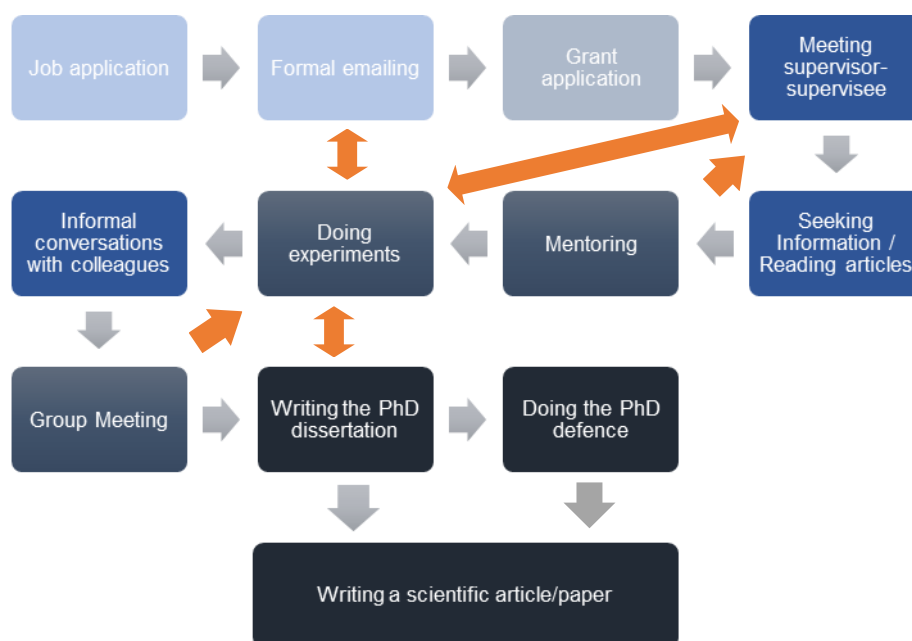
This figure illustrates the preferred sequence of communicative events that a PhD researcher should follow throughout her practice in the RG. The arrows in orange show that despite the existence of a 'preferred' sequence, there are some *events* that need to be consecutive (i.e. 'writing the PhD dissertation' necessarily precedes 'doing the PhD defence') but there can also appear alternative sequences in some cases (i.e. 'doing experiments' can alternate with 'informal conversations with colleagues' and also with 'meeting supervisor-supeervisee). Note also that the final goal of all sequences possible is 'writing the PhD dissertation', 'doing the PhD defence' and 'writing a scientific article/paper', and all the other communicative events/inscriptions are 'supporting events' that lead to the successful execution of these three. The fact that the goal of the last three events was either the production of a public text (in the

case of the PhD dissertation and of the scientific paper) or were public in themselves (in the case of the PhD defence) suggests that practitioners' practice ultimately aimed at the transcendance of the RG through communication. Consequently, these three last communicative events/inscriptions of the chain, as well as those initial *events*, like the 'job application', initial 'formal emailing' and the 'grant application', can be considered *boundary (communicative) practices* (Wenger, 1998) since they involve individuals from different CoPs in which they occupy a peripheral position as mediators between CoPs. As noted by genre theorists, unveiling sequences of genres, or in this case of communicative events, may help practitioners anticipate and plan their actions (Swales, 2004). In the case of the participants in this study, most such sequences used to be implicit and formed part of the members' learning trajectory (Wenger, 1998) and enculturation process (Collins, 1975). These were part of the RG's rules and practitioners had to accommodate to them.

Taking the communicative event of 'doing experiments' as the central one, other *communicative events* common in the two main RGs studied could also be classified in terms of their contribution to a certain stage of the experiment being carried out. Accordingly, three stages could be distinguished: (a) planning the experiment, (b) actually "doing" the experiment (enactment), and (c) reporting the results of the experiment (and procedures). At the 'planning' stage, *events* that used to take place were: 'supervisor-supervisee meetings', 'writing project proposals', 'reading scientific articles', 'formal emailing', and 'writing grant applications'. At the enactment stage, typical *events* were: 'doing experiments', '(looking for and following) protocols', 'writing in the lab notebook', 'ordering materials', 'labelling materials' and 'mentoring (or being mentored)'. Finally, at the 'reporting' on experiments stage, the *events* that the participants used to engage in were: '(presenting in a) group meeting', 'meeting supervisor-supervisee', 'written reports', 'writing scientific articles', 'conference presentation/poster', 'writing the PhD dissertation' and 'doing the PhD defence'. As noted before, most events did not probably follow a fixed sequence, but alternate with one another throughout the execution of the experiment.

As has been discussed in the previous chapter, mastering these communicative events was part of the participants' *learning trajectory* (Wenger, 1998) as members of the RG-CoP in the process of becoming 'competent scientists'. The skills required and the norms that had to be observed in order to accomplish these communicative events successfully were "imposed" onto participants through diverse means. On the one hand, by means of particular indications, recommendations or demands from the group leader or the mentor (mainly as a result of her interpretation of 'competence' and how it materialises) [see excerpts 104 and 105], and on the other hand, by the imitation of other members' practices – the group's 'habitus' (Bourdieu,

1977) – through the processes of observation and imitation [excerpt 106], or a combination of both, as can be seen in excerpt 107.

Excerpt 104: Frank's [Group leader] feedback on Lurdes' [BA researcher] written report [Group A] – 'Please correct all decimals'

Frank:

[Comment 1]. **Better** to refer to it as [tDA blog]

[Comment 2]. **Please correct** all decimals. **In English**, decimals **are** designated by periods NOT commas**!**

[Comment 3]. **Correct** designation is lower case l NOT L

Excerpt 105: Lurdes' lab meeting [BA researcher – Group A] – 'It is a fact'

Frank: So you think/ Or is it a fact/

Lurdes: It is a fact\

Frank: Don't be afraid to express us your opinion if you are sure\

These two excerpts show the explicit corrective feedback of Group A's leader, Frank, to a BA researcher, Lurdes, both written [excerpt 104] and oral [excerpt 105] about writing conventions and speech style.

Excerpt 106: Lurdes' lab meeting [BA res. – Group A] – 'As you usually do in your lab meetings'

Lurdes: So_ good morning everyone\ **As you usually do in your lab meetings**_ I will explain what I have been doing +eh+ during the last two months_ and_ well_ this is the main project\

This excerpt illustrates how the patterns of communication and the norms of interaction (Hymes, 2005) were acquired by newcomer practitioners through the observation of the communicative practices carried out by other group members. This is evidenced in Lurdes' words 'As you usually do in your lab meetings', which denote that she is going to imitate a 'usual' practice, and thus a norm, in 'lab meetings'. Note also in Lurdes' use of the second person pronoun 'you' her detachment from the RG, which she did not feel a member of, probably due to her peripheral position (Wenger, 1998) in it as a temporary practicum researcher.

Excerpt 107: 20140710_Navil [PhD res.] and Joana [BA res.] doing experiments [Group A] – 'It's not advisable to do with your finger'

Sign-maker	Speech	Action	Video shot
Joana	**Why can't I** do it with my finger/	Staring at Navil next to him	
Navil	Why you cannot do it with your finger/ **It's not advisable** to do with your finger\	Manipulating objects	
Joana	+Ah+ then why you * what * why you said me to do before/	Staring at Navil next to him	
Navil	What/	Manipulating objects	
Joana	You said me that I can do it with my finger before\	Staring at Navil and at his hands alternatively	
Navil	Did I tell you/ I didn't tell you that\ When you learn_ **you need to learn** methodology\ **properly**\ Okay/ Not {(@) to touch} the membrane with the finger\	Manipulating objects	
Joana	**You did it**\	Staring at Navil	

Navil	Yes\ I know how to touch_ where to touch\ Do you know where to touch_ and where not to touch/	Manipulating objects and staring in general at the objects and twice at Joana's face	
Joana	Yes\ Where there's no RNA\	Taking the forceps from Navil	
Navil	**Okay**	Giving the forceps to Joana	

This excerpt shows a mixture of the two methods through which practitioners' practice in the RG was shaped. Joana [BA researcher] is being mentored in the lab by Navil [PhD researcher], whom she was observing and whose indications she was following while doing experiments. In this excerpt, Joana negotiates with Navil how a certain membrane that she had seen Navil manipulating should be manipulated by her. Joana has encountered a contradiction that she needs to solve. On the one hand, she has seen Navil manipulating the membrane with his hands ('You did it\'), but on the other hand, Navil had just told her that she cannot 'do [it] with [her] finger'. When Joana asks Navil the reason why she cannot, Navil answers that 'It's not advisable' and that 'When you learn_ you need to learn methodology\ properly\'. This way Navil constructs himself as an expert who knows 'how to touch' and 'where to touch' as opposed to Joana, who is a learner. This is an example of how not only language-based texts were shaped through corrective feedback, but also embodied action, like doing experiments in the lab, which constituted a communicative event that could be observed, talked about and negotiated. Also interesting in this excerpt is the adoption of the supervisor/mentor role by Navil, who was in turn supervised by the group leader.

These are all instances of how 'standards' of scientific communicative formats were assimilated by practitioners through their daily practice in the RG. As can be observed, the ideal orchestration of the diverse components of the prototypical communicative events was learned by the participants following the RG's norms, which arguably consisted in a local adaptation of the norms of the *domain* (the scientific community of their field of specialisation) mediated by the group leader, by the supervisor or by the mentor, on the basis of her "assumed 'correct' view" (Lea & Street, 1998: 169) and legitimacy. The sense of a univocal norm was achieved through the adoption of an authoritative style by the supervisors of practitioners' practices,

instantiated in categorical statements, imperatives, prescriptive statements (Saville-Troike, 2003: 123) and evaluative words, like 'easier', 'better' and 'essential'. This way, the participants accommodated to the disciplinary community's "standards and ideals" (Koutsantoni, 2004: 169) to signal membership and show communicative competence (Duranti, 1985).

As regards competence, the participants were required to accommodate to, and master, a range of rather conventionalised communicative practices that they could observe from old-timers and negotiate with their colleagues and supervisor/s, but there was a general lack of explicit norms on best practices. This is suggested also by Cecília's use of the word 'absorb' in the following excerpt in which she forecasts how Liana, a newly arrived mobility BA researcher, is going to adapt to the RG's practices [excerpt 108].

Excerpt 108: Interview with Frank [Group leader – Group A] and Cecília [Senior res. – Group A] – 'she will just be absorbing the lab'

> **Cecília:** But_ for example_ today the new girl arrived\ She is with Mara\ (…) Mara has been helping her_ and Mara is going to introduce her to the lab =habits=\
>
> **Frank:** =Yes\=
>
> **Cecília:** She's going to **tell** her_ next week we are going to do a seminar\ Because we do seminars\ And_ it's just talking\ And **she will just be absorbing the lab\ She will not realise it_** and **she will be doing the same than everybody else**\

In this excerpt, Cecília uses the metaphor 'absorbing' ('she will just be absorbing the lab\') to make reference to newcomers' learning process. This word denotes that she deems this process subtle, implicit and almost subconscious (denoted also in the sentence 'She will not realise it'), based on the accommodation to external stimuli present in the milieu of the RG's lab ('she will be doing the same than everybody else'). For Cecília, this subtle process implies not only 'doing' (and thus *learning by doing*) but also 'talking' (shown in the fact that Mara [PhD res.] will 'tell' Liana that they are 'going to do a seminar').

Although the RG's norms were chiefly implicit, they were made explicit through the corrective feedback of supervisors, when norms were violated, as pointed out by Saville-Troike (2003), or upon request from the practitioner. Competence was thus not only *learned by doing* but also *by communicating* through diverse means in the course of their practice. Also, there was a high reliance on supervisors' interpretation of best practices and on their ideology as regards 'competence' in science and in scientists' communication. Group members' learning trajectory in the RG-CoP implied not only discovering and adopting the norms of communication, but also

learning about the extent to which and the ways in which these could be negotiated and/or resisted, in negotiation between supervisors and supervisees / old-timers and newcomers.

In this section, we have presented the range of prototypical communicative events that conformed the RG's multimodal communication policy, some characteristics of it, and the way in which communicative 'competence' was acquired in the RG-CoP. In the next section, the mechanisms whereby communicative events were identified by the researcher will be unveiled through the main example of the group meeting apart from other secondary examples, and additionally some more clues on how communication was mastered by practitioners of the RG-CoP will be provided.

6.2. Distinctive features and boundary markers: the example of the group meeting

The **distinction** among communicative events was established by paying attention to "local taxonomies" (Keating, 2001) or "folk labels" (Bateman, 2008) and to the distinctions made by the participants themselves, as well as by assimilating/understanding the value system applied by practitioners as regards the relevance of certain communicative practices. The following figure exemplifies how the different communicative events identified contrasted with one another (resembled and differed) in terms of their components specified in Hymes' SPEAKING model [figure 8].

Figure 8: Communicative event network
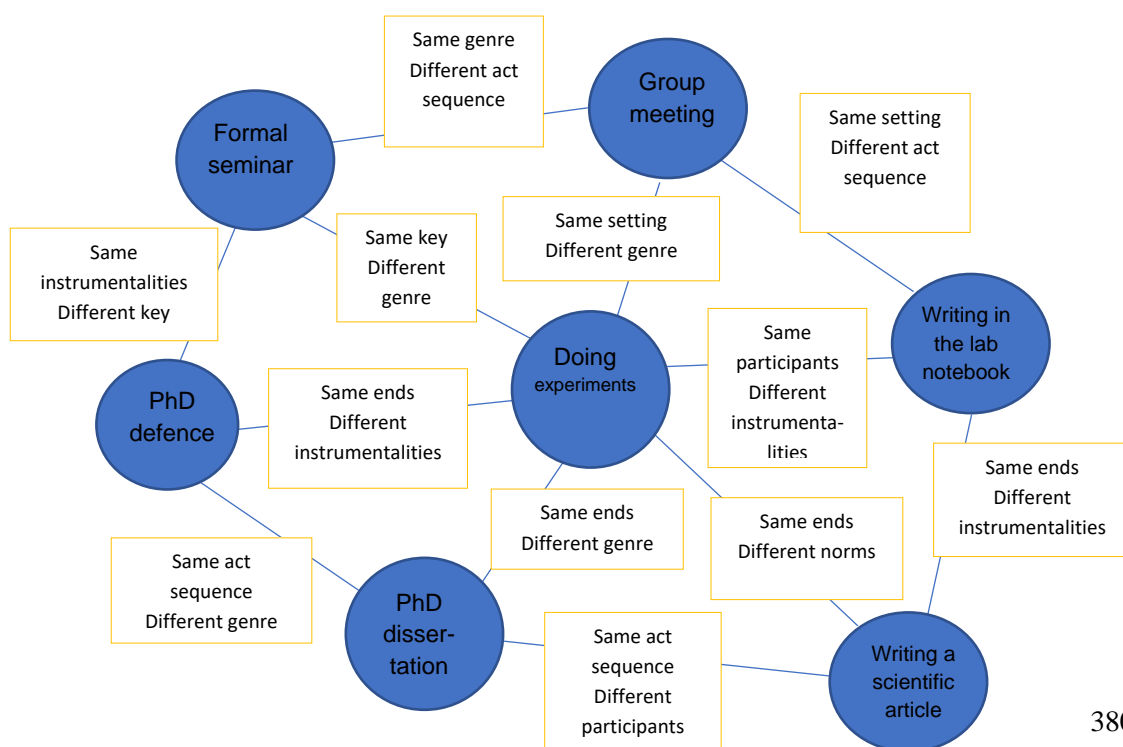
This figure illustrates how the *prototypical communicative events* that conformed the RG's multimodal communication policy have similar and different components with others, which makes them distinguishable as different communicative events. As has been argued in the previous section, the repetition of prototypical communicative events gave place to a tradition within the RG. There were some 'standardised' ways of communicating depending on the aim (e.g. for professional or personal purposes), the interlocutors (e.g. with the supervisor or with same-status colleagues), the setting (e.g. in the laboratory or in the cafeteria), etc.

The way in which a typical communicative event of the RG's multimodal communication policy, the 'group meeting', was distinguished and characterised will be exemplified here, following the outline of Hymes' SPEAKING grid. Group meetings were very common communicative practices in both RGs and they were the only communicative events that elicited the mutual engagement of all group members exclusively (no external participants were invited to them). They were supposed to contribute to group cohesion for they were a means to have awareness about what other group members were working on and to cooperate. Although this event was labelled differently in each RG, as 'lab meeting' [in Group A] and as 'group seminar' (*seminari de grup)* [in Group B], the similar orchestration of their components made them comparable.

Each RG used to have group meetings in a different *setting* – in their laboratory [Group A] and in a classroom [Group B] –, but the arrangement was similar: a vertical surface opposed to several chairs; and the *scene* was sharing one's experiments and results with the RG. The *participants* included a presenter (a member of the RG), who would stand in front of the vertical surface, and an audience (the rest of the group members), who would sit on the chairs opposite to the presenter [see pictures 36 and 37 below].

Picture 36: Lab Meeting [Group A]

Picture 37: Group seminar (seminari de grup) [Group B]
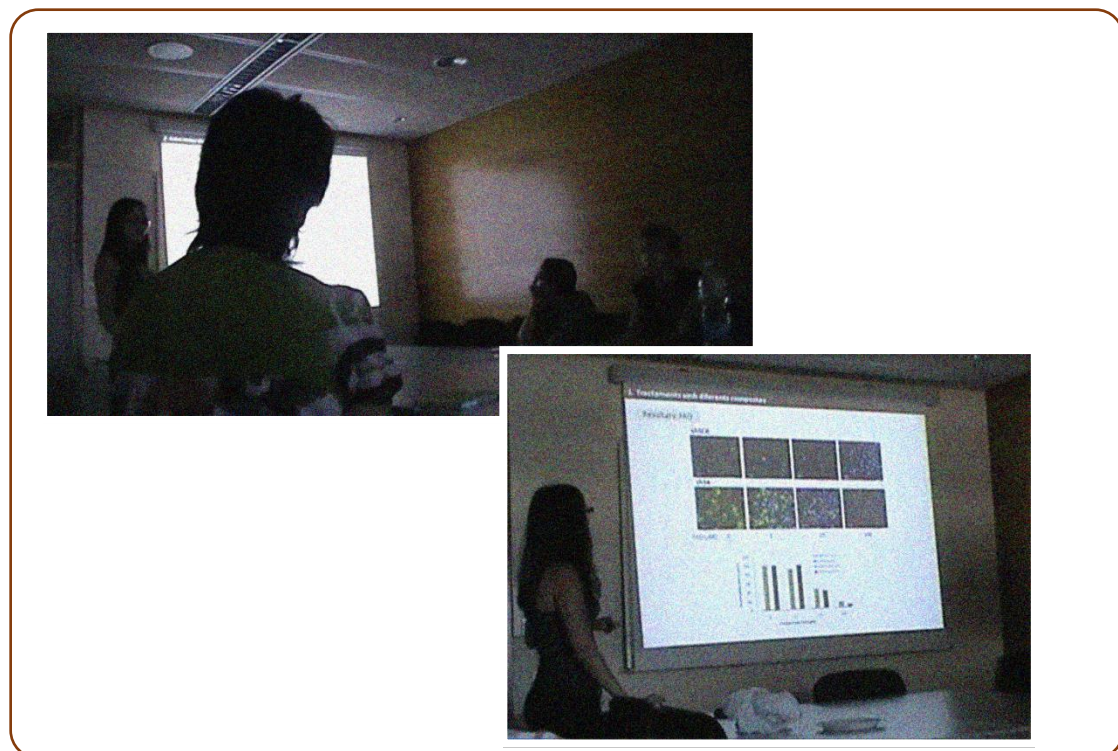
The main *ends* of this event were (a) advising the presenter in her endeavour, (b) contributing to her acquisition of expertise as presenter and scientist, and (c) learning what others are doing within the RG. The typical *act sequence* of group meetings was as follows:

(Announcement)

- Setting materials
- Arrival and seat taking

1. Presenting experiments
2. Question round and discussion

- Applause

3. New topic introduced and follow-up conversation *(optional)*

- Standing up and leaving the scene

Although the final aim of these communicative acts was the successgul performance of the communicative event, each of them had a specific function that marked its different parts.

In terms of the *key*, in both groups these meetings were carried out in a serious tone, especially marked by the presence of the group leader, although it was more relaxed in Group B – where jokes and laughter were sometimes present – than in Group A – where these signals of a relaxed athmosphere were not common. The *instrumentalities* used consisted in both cases of those supporting the oral and the written channels for communication. In both RGs, the presenter would convey the message mainly orally and would be aided by either a whiteboard and occasionally written handouts or real materials [in Group A] or by a projected image [in Group B]; the audience would take part orally. Group meetings in Group A were always be held in English, whereas in Group B they were held in Catalan or Spanish except for those meetings including visiting a scientist who could not understand these languages. The register used was semi-formal in both RGs. Except for the scarce instances of correcting feedback in this respect, the *norms* of interaction and interpretation were mostly implicit and conveyed through the observation of the communicative event repeating over time (as has been shown in excerpt 106 in the previous section.

These norms comprised the instrumentalities to be used, the act sequence typical of the communicative event, the topics, the key, the setting and the form of other components. Also, part of the practitioners' learning trajectory within the RG-CoP implied learning the norms of interpretation of this type of communicative events (the baseline knowledge necessary in order to make the message relevant and understandable for others). The experience in these events allowed old-timers to participate more actively in them than newcomers. The genres typical of these events were the oral narrative (of experiments carried out and their outcomes) and the dialogue (whenever questions were asked or problems posed).

Apart from group meetings, there were other communicative events that involved all group members having a common discussion, although these were open to a few external individuals occasionally. In Group A, an event that was comparable to 'lab meetings' was the 'formal seminar', as it was called by group members themselves [see excerpt 109].

Excerpt 109: Ale's email to the researcher [PhD res. – Group A] – 'that could be after one of the formal seminars'

```
Date: Wed, 23 Oct 2013 14:16:26
Subject: Meeting
From: Ale
To:  [Researcher]
Importance: Normal

Hi Helena,
I'm Ale, from Frank's lab. I'm writing to you because Cecília told
me to organize one day where you can meet with all the lab and
explain your project. We were thinking that could be after one of
the formal seminars we usually have (so we'll be all together). I
write you the dates of the next seminars so you can tell me if you
can come in one
of these days around 9:30:

-tomorrow
-11th November
-12th November
-18th November
-26th November

Otherwise you can propose a date and I'll organize for you! Let me
know!

Ale
```

This excerpt shows an email sent by Ale [PhD res.] to myself in order to arrange a date to present my project to all members of Group A after one of their 'formal seminars' that they 'usually' had. As noted by Ale, that was a perfect occasion for they would 'be all together'.

In what follows, Group A's 'lab meeting' will be compared to its 'formal seminar' in order to make explicit the mechanisms through which the distinction between communicative events has been determined in this study.

As has been mentioned, 'lab meetings' and 'formal seminars' were two communicative events distinguished and named differently by group members themselves. Although both *events* congregated all group members in a room, where a topic would be presented and discussed, each of them had certain distinct formal characteristics. 'Lab meetings' used to take place in Group A's headquarter laboratory, where a whiteboard was placed opposite to an arrangement

of lab chairs and stools. In contrast, 'formal seminars' used to be held in a conference room in the same building where the lab was located, called 'sala de juntes', which had to be formally booked in advance for this purpose. In this case, a laptop, a projector and a screen were set for the occasion [see pictures 38 and 39].

Picture 38: Group A's Headquarter laboratory

Picture 39: Sala de juntes
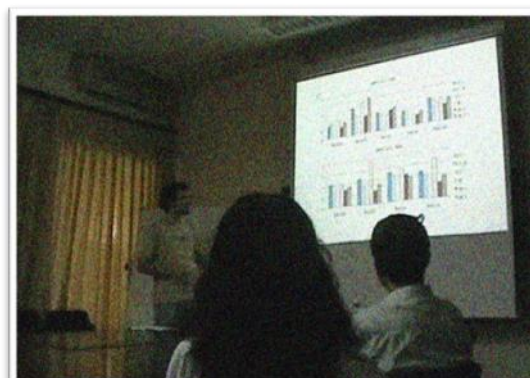
While in 'lab meetings' the presenter (a group member) would narrate her last experiments and the results obtained, after which a question round and a dialogue would take place, 'formal seminars' used to be devoted to a review of the literature about a certain topic, that is, to the exposition of others' findings and the evaluation of their relevance for the group's endeavour. In the course of this exposition, discussions among attendees might also arise. The *ends*, the *act sequence*, the *key* and the *norms* of interaction were generally the same in both *events*. See below a table contrasting the two communicative events [table 4].

Table 4: Components' characteristics for 'lab meetings' and 'formal seminars' [Group A]

	Lab Meeting	**Formal Seminar**
Setting	Headquarter laboratory	'Sala de juntes' (conference room)
Scene	Sharing and discussing the procedures and results of one's experiment's	Sharing the revision of the literature on one topic
Participants	Group members (a presenter	Group members + occasionally out-group

	and an audience)	individuals (a presenter and an audience)
Instrumentalities	Whiteboard (+ marker)	Laptop + projector + screen
Genre	Narrative (of one's experiments) and dialogue (on problems)	Exposition (of others' findings) and dialogue (on related issues)

Different rounds of 'lab meetings' used to be scheduled yearly whereby group members would present their last experiments and results successively. The group leader would designate a group member to assume the programming of 'lab meetings' or of 'formal seminars' and to announce them to the other members. The dates for each member's presentation was announced through e-mail to all group members, and in the case of 'lab meetings' it was also posted on the laboratory's wall in advance. On these occasions, some norms might be made explicit, as was the location of the event (e.g. 'in the lab') [see excerpt 110 and picture 40].

Excerpt 110: Agus' e-mail [PhD res. - Group A] – 'here you have the dates for the next round of lab meetings'
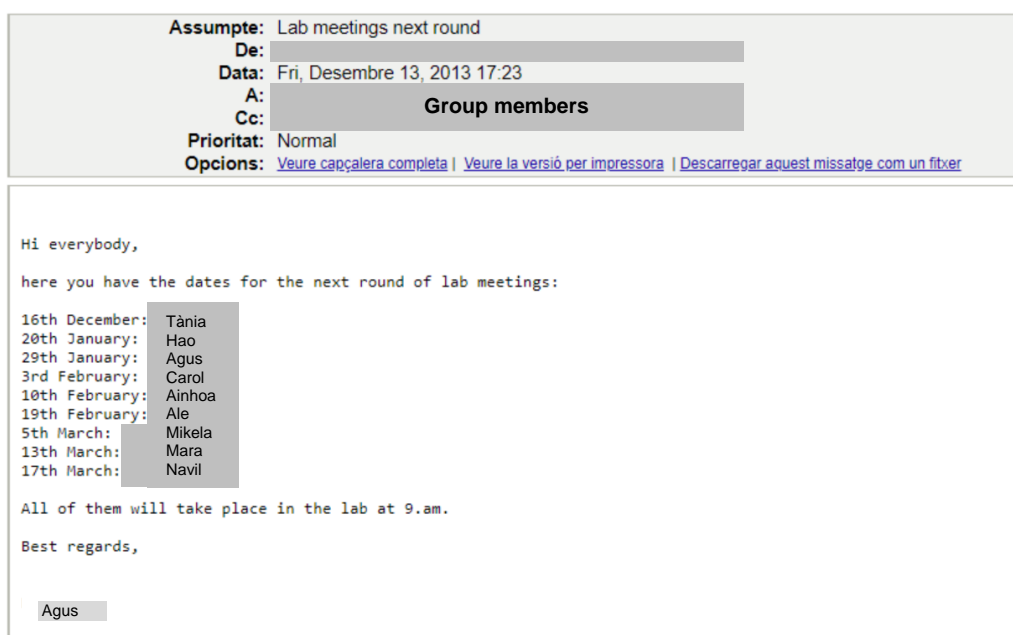
This excerpt illustrates how the group member in charge, in this case Agus, announced the dates of the following round of 'lab meetings' by email to all group members.

Picture 40: Wall sign - 'Lab meetings' programme
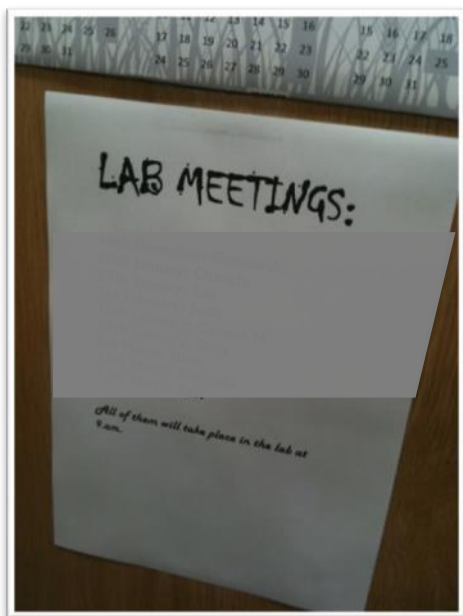
Whenever norms were transgressed, this might trigger the justification of such transgression [see excerpt 111].

Excerpt 111: Carol's email [PhD res. – Group A] – 'my labmeeting will take place

```
Date: Tue, 8 Jul 2014 09:58:15
Subject: Re: New cycle of lab meetings
From: Carol
To:
Importance: Normal

Dear all,

my labmeeting will take place tomorrow (9th July) at 9am in sala de
juntes of our building as I want to show you some microscopy
pictures.

Best regards,

Carol
```

In this case, Carol felt the need to justify the fact that she would hold her lab meeting in the 'sala de juntes' instead of in the lab. She deemed the former, which was equipped with a projector, more suitable for the materials she needed to show ('some microscopy pictures') than the lab, where she could use a whiteboard, as this was the norm. The fact that the norm of the

"normal" setting for 'lab meetings' could be transgressed was also in itself a norm that was learned by practitioners of the RG-CoP. Like Carol, also Agus did hold a 'lab meeting' in 'sala de juntes', for which he set the whiteboard also there [see pictures 41 and 42].

Picture 41: Agus' 'lab meeting' in 'sala de juntes'
[PhD res. - Group A] 1
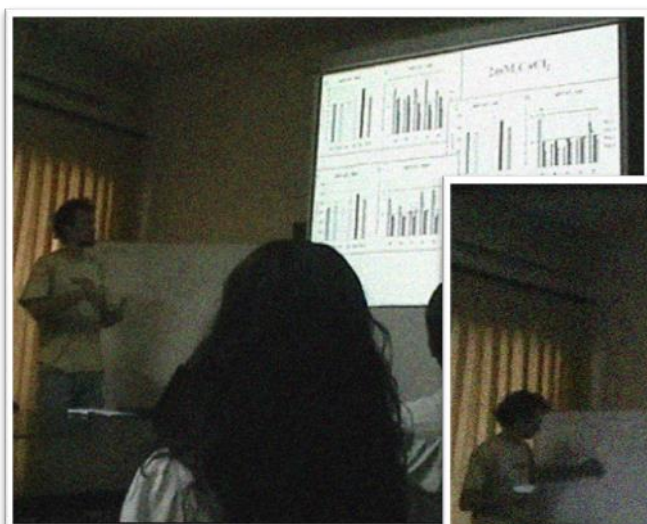
Picture 42: Agus' 'lab meeting' in 'sala de juntes' [PhD res. - Group A] 2

On this occasion, Agus judged it necessary for his 'lab meeting' to use the projector *and* the whiteboard for different purposes in his presentation. What made this event recognisable as a 'lab meeting' was not then its location in itself, but the other features of its components, as described before, and its *scene* (being it a presentation of Agus' last experiments and results) as opposed to that of 'formal seminars'.

Having shown the parallelisms and differences between the 'lab meeting' and the 'formal seminar' in Group A, the former will be now contrasted with a similar prototypical communicative event of Group B. Their distinctive characteristics made 'lab meetings' of Group A the most similar communicative event to the 'group seminars' ('seminaris de grup') of Group B. Their *scene* in both cases was the sharing of a group member's last experiments and results with the rest of the group; their ends, helping group peers in their projects; and their participants, all group members. Yet, 'group seminars' took place in a classroom, similar to the conference room of Group A's 'formal seminars' and using a projector instead of a whiteboard [see picture 43].

Picture 43: 'Group seminar' (seminari de grup) [Group B]

Here we have shown the existence and some characteristics of the multimodal communication policy of the RG-CoP. This policy can be seen as constituting a framework of rules and 'patterns of communication' (Saville-Troike, 2003), a 'habitus' (Bourdieu, 1977) that was "learned by doing" what others did, in similar ways as they did, as well as "by communicating" with other group members as regards what communicative events should be like. These norms were passed on from old-timers to newcomers, most often implicitly, and therefore practitioners were often not aware of them or their purpose, but they were sometimes made explicit through corrective feedback from the most experienced practitioners.

Apart from the range of prototypical communicative events taking place in the RG, the objects and instruments used in such events have been deemed significant in the analysis of 'patterns of communication' (Saville-Troike, 2003). In the case of the two main RGs observed, instruments have been found to retain an important normative load because they were due for specific purposes in certain communicative events and may have been deemed inappropriate in others. The instruments present in the participants' professional milieu were some general tools for reading and writing, like markers, pens, computers and mobile phones, vehicles and surfaces for the inscription of messages, like notebooks, whiteboards, computer software and smartphone apps, projector + screen, papers (for signs), labels and post-it, as well as specialised machines with which the participants interacted (giving them instructions and interpreting their outputs). Each communicative event involved the use of some of these instruments and not others. This resonates with Paltridge's (2012: 69) assertion that "[a]t times people draw on a repertoire of genres to carry out a particular task", though in this case we could say on a repertoire of instruments. For example, while 'doing experiments', the participants would use markers and

labels to label bottles and containers; machines to analyse or transform certain materials; and pens and the lab notebook to note down the progress of the experiments. Whereas for 'writing a scientific article', they would use the lab notebook to look up information, and a computer to write the article, read others' articles and send the drafts and the final version of their paper.

The fact that the norms of interaction regarding the use of instruments were mostly implicit was made evident in the data, specifically in a focus group carried out with Group A, after the explicit mention by the researcher [see excerpt 112].

Excerpt 112: Focus group [Group A] – 'I never articulated that'

Frank [Group leader]: There is one important motive for using this tool\

Researcher: Okay\

Frank [Group leader]: Can [the researcher] or anybody else **guess why we use the board/ and not a laptop and Power Point_ for the lab meetings**/

<10">

Frank [Group leader]: What's a very important aptitude of a successful scientist/

<6">

Carol [PhD res.]: Being able to explain·· things without support_ and_

Frank [Group leader]: And what is the f& * what is the turn for that/

Researcher: Improvising/

Frank [Group leader]: Improvisation\

Carol & Ale [PhD res.]: +mh+

Frank [Group leader]: we need to be able to improvise\ and deal with· pressure Which comes out of an informal form\ and a lot of our interactions with colleagues are informal\ But informal interactions are very tough\ A lot more so than formal presentations\ Because they have no structure\ So ={(?) they're unpredictable}\=

Ale [**PhD res.**]: =+coughs+=

Frank [Group leader]: So my motive for exposing everybody to this tool is to have something in improvisation\ I never articulated that\ but to me it should be obvious <3"> Does it make sense/

Agus [PhD res.]: Yeah_ it makes sense\ **But it was not obvious** So_

As has been shown in this excerpt, Group A's members used a whiteboard (instead of 'a laptop and Power Point') in their 'lab meetings' as part of the norms of interaction of the RG-CoP, without further discussion on its origins or on the logics behind this norm. As evidenced in the excerpt, there was presumably a reason why this norm had been enforced by the group leader ('we need to be able to improvise' - Frank), but even in the case that it did contribute to the group members' expertise acquisition ('improvisation skills'), they seemed not to be aware of those benefits ('it was not obvious' - Agus). This is an instance of how the so-called "learning by doing" process worked within the RG-CoP, underscoring the fact that many norms for interaction were not articulated but internalised by practitioners through practice so as to become their 'habitus' (Bourdieu, 1977). As can be inferred from this example, these norms were set by the group leader, following his criterion for best practices, which not only affected scientific issues, but also the multimodal communication policy of the RG.

After having exemplified the paradigmatic distinction of communicative events, a parallel to the notion of "paradigmatic intertextual relations" suggested by Fairclough (1992), they can also be distinguished as regards their sequentiality. Although transitions between events were not always abrupt but progressive on many occasions, there used to be some 'boundary markers' that indicated them. In what follows, the boundaries of a communicative event, the 'lab meeting' [Group A], will be analysed in order to exemplify how the linear distinction was determined. Below there is a picture representing the central part of a 'lab meeting' as was the (multimodal) narration (using not only speech but also pictures, graphs, gesture and writing) by one group member – in this case, Mara – of the last experiments and results in front of the other group peers [picture 44].

Picture 44: Mara's 'lab meeting' [PhD res. - Group A]
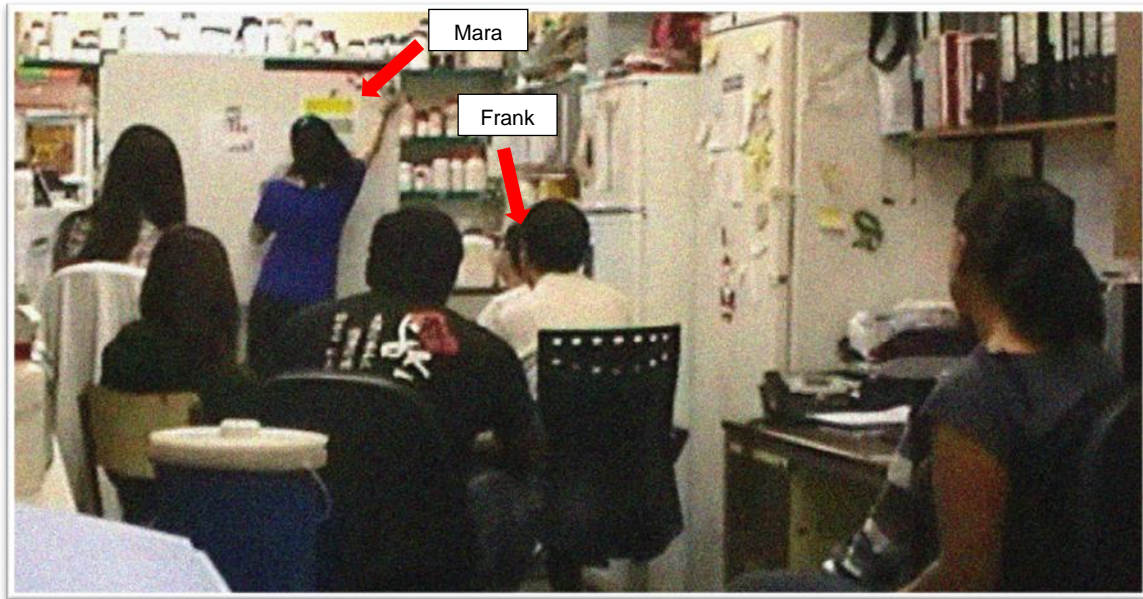
Before reaching this core communicative act, a range of actions and acts took place. The preparation of Mara's lab meeting could be deemed as starting by the announcement, both by email and through the programme hanging on the laboratory's wall some days before. On the day of the meeting, before 9 a.m., the set starting time, Mara and Navil [PhD res.] prepared the setting by placing the whiteboard in the lab, at the usual place; Mara prepared the materials (handouts and images) that she would need for her presentation; Frank [group leader] entered the lab and took a seat, after which the rest of the group members took a seat in front of the whiteboard. The 'preparation' stage finished when Frank gave the command 'you can start\'. See below a multimodal transcript of the 'preparation stage' [excerpt 113].

Excerpt 113: Mara's 'lab meeting' - preparation stage [PhD res. - Group A] – 'You can start'

Speech	Action	Video shot
	Mara and Navil placing the whiteborad in the laboratory	

	Mara setting materials; Frank taking a seat; Hao using the computer	
Frank: You can start	Frank staring at Mara; the audience waiting for Mara to start; Hao using the computer	

Following Frank's command, another boundary marker that signals the beginning of the *body* of the 'lab meeting' is Mara's starting utterance: 'Good morning_ +eh+·· thank you for coming_ today I'm going to speak about…'. After this introduction, she presents her last experiments and results; and she finished this 'part' by stating it overtly: 'A··nd this is all for this part\' [see excerpt 114].

Excerpt 114: Mara's 'lab meeting' - body [PhD res. - Group A] – 'today I'm going to speak about…'

Speech	Action	Video shot
Mara: Good morning_ +eh+·· **thank you for coming_ today I'm going to speak about** +eh+ what results I have until now_ and what I'm planning to do in order to finalize +eh+ my . experiments_ I hope you can see\ this is the table that I have [confidential] analysis_ and . as I already told you_ this is the [confidential] proteins_ (...) **A··nd this is all for this part**	hangs a paper on the whiteboard	

After the *body* of the 'lab meeting', a next stage is introduced through Frank's utterance addressed to the audience: 'Questions/'. This opens the *question round* [see excerpt 115].

Excerpt 115: Mara's 'lab meeting' - Opening the question round [PhD res. - Group A] – 'Questions/'

Speech	Action	Video shot
Frank: Questions/	Frank turning his head towards the audience	

When all questions have been put and have been answered by Mara, the audience applauds, signalling the end of Mara's intervention, after which Frank turns his head towards the audience in order to introduce a new round of questions or comments, through the utterance 'Anything else/', this time not related with Mara's experiments. Since no comments arise, the whole *communicative event* is closed by Frank's acknowledgement to Mara: 'Alright\ Thank you\' and by the audience and himself standing up and leaving the setting [see excerpt 116].

Excerpt 116: Mara's 'lab meeting' - Closure [PhD res. - Group A] – 'Anything else/'

Speech	Action	Video shot
	Applause	

Frank: Anything else/	Frank turning his head towards the audience	
Frank: Alright\ Thank you\	Frank turning his head towards Mara	
	Everybody standing up and leaving the scene	

The outline of the event's communicative acts below shows that several of them are introduced or closed by Frank's intervention (marked in red). He acted as a moderator of the event [table 5].

Table 5: Parts of Mara's 'lab meeting' and its boundary markers

0. Announcement
1. Setting materials
2. Arrival and taking seat
3. Starting command (by Frank)
4. Presenting experiments
5. Opening question round (by Frank)
6. Question round
7. Applause
8. Opening second question and comments round (by Frank)
9. Appreciation (by Frank)
10. Standing up and leaving the scene

As can be observed in the analysis of Mara's 'lab meeting', it was a standardised communicative event, which had common features with other 'lab meetings', like the *setting*, the *participants* and their roles, the *intrumentalties* and the *genres*. These features were observed by newcomers and copied, as a rite, every time the same prototypical event took place. The group leader, Frank, acted as the director, signalling the beginning and the end of the event, as well as organising the sequence of communicative acts within it. Not only the range of prototypical events but also their standard shape (the standard configuration of components) formed the RG's multimodal communication policy.

An important facet of the RG's multimodal communication policy was its language policy, that is, group members' beliefs, the management enforced and the actual practices performed regarding language use. As was evidenced in chapter 4, this part of researchers' communication is made especially relevant by institutions and stakeholders. For this reason, the next section will be devoted to this aspect in particular.

6.3. The language policy of the RGs studied

In chapter 4, the focus placed on language and language policies by different stakeholders related to the IoHE was widely described. In brief, the diversity of languages has been positioned as an asset and a desired goal for governments and institutions within Europe, but at the same time the predominant international language, English, is being increasingly introduced in policy plans and promoted by HE institutions as a hallmark of their international tenor. In Catalonia specifically, university language policy documents and internationalisation plans advocate for the combination of the national and the international dimensions, also as regards language: the protection of the use of Catalan, also in science, and the right to use Spanish at university must coexist with the introduction of a 'third' language, namely English. This way, policy makers convey the idea that the internationally competitive scientist working at Catalan universities must ideally have a 'multilingual profile' combining these three languages. Since the presence and combination of languages are often the most explicit allusion to communication in HE policy documents, in this section, the practices, beliefs and management with reference to *language* use specifically will be analysed.

In both RGs, the 'beliefs' of the group leaders regarding languages, determined in turn by their own linguistic profile and experiences, appeared to be a strong influencing factor for the shaping of the 'management' of their RG's language policy. Yet, as will be set forth in this section, the language 'practices' of group members both complied with and resisted such authority.

Group A's leader, Frank, was not Catalan nor Spanish and could speak very little of either Catalan or Spanish languages. He had a wide international experience, having worked in countries like the US, the UK and Germany before Spain. He used to speak English with other group members and advocated for an English-only (or mainly) rule within the RG [see excerpt 117].

Excerpt 117: Interview with Frank [Group A's leader] – 'everybody does it in English'

> **Researcher 2:** You were * you were saying that actually +uh+ it's the language that brings a special kind of thinking with it\ Right/
>
> **Frank:** No\ It's the reverse\ (…) It's the * it's * it's ***it's the thinking that is modified if people use their own language to interpret things**\ We're maybe saying the same thing in different ways\ (…) But if I * I give a scientific problem to an Indian_ (…) I'm just using I would say_ somebody from any country\ (…) and I ask him to make an interpretation in English_ or in their own language_ I'm going to get two different stories\ (…) **And I don't want to mess around with this**\ (…) **Because it causes chaos**_ (…) **And_ I said_ okay_ everybody does it in English**\ **And that way I solved my problem**\ It's maybe an interesting issue for you\ But for me that is * that is * that is * that is a disaster\ And I don't want to get closed to this\
>
> **Researcher 1:** Because you have experienced this\
>
> **Frank:** Yes\ **I've experienced this numerous times**\ **With many different nationalities**\ And I can tell you I haven't seen an exception yet\

As can be deduced from this excerpt, for Frank, using languages other than English for communication in the RG would be 'mess[ing] around' and 'caus[ing] chaos' because he believes that the language of expression determines the way in which science is explained. In this excerpt, Frank narrates the moment in the past when he decided that English had to be the only language used in the RG ('everybody does it in English'), which he deems a solution to a 'problem'.

In fact, all members of Group A used to write on their lab notebook in English (mainly) and used this language in their PhD dissertation, in scientific articles, in group meetings and all oral presentations within the RG. Frank's language ideologies, that is, "sets of beliefs about language articulated by users as a rationalization or justification of perceived language structure and use" (Silverstein, 1979:193), were based on the belief that having one single common language in science, as English was, was the only way it could be done [see excerpt 118].

Excerpt 118: Interview with Frank [Group A's leader] – 'For me language is irrelevant'

> **Researcher: Are you happy with this situation of English being such a dominant language in the world of science/**
>
> **Frank:** Yes\ **Yes\ Absolutely\ There is no other way\ There is no other way**\
>
> (…)

Researcher: Are you some& somehow worried about the fact that Greek_ or Spanish_ or Catalan may no longer be a language to * to do science/

Frank: No\ **For me language is irrelevant\ Entirely irrelevant** Irrelevant\ Scien& scienc& *

Researcher: But to disseminate science/

Frank: +Uh+ no\ Because no matter what level of spoken or written English skills people have_ they can still follow the literature\ **It's not a problem**

In this excerpt, Frank shows his attitude towards language, which he deems 'irrelevant', 'not a problem', in science. For him, the necessary English language skills, those that enable researchers to 'follow the literature', can be acquired easily, 'no matter what level of spoken or written English skills people have' initially. For Frank, language is not 'a barrier to success' in science 'up to a point' [see excerpt 119].

Excerpt 119: Interview with Frank 2 [Group A's leader] – 'I don't see language being a barrier to success'

Researcher: so language level is not really an issue for you at * when * when they start\

Frank: No\ As I * and I think I mentioned it earlier\

Researcher: Yeah\

Frank: Because **I don't see language being a barrier to success**\

Researcher: But it is a condition that in the long run their skill should be developed\

Frank: Of course\ =Of course\=

Researcher: =And they= should do something for themselves\

Frank: And again * this is for * and again * did you meet Simona/ While she was here/ No\ Okay\ Another student\ a Spanish student\ +Uh+ **her linguistic skills were appalling**\ So_ she was the only one I actually tried to force to take English classes\ And she didn't\ And as a result_ her language skills did not improve\ So it's her loss\ Not mine\ I told her from the beginning_ Simona_ **you are going to do well in science up to a point_ but then you are always going to be paying the price of not being fluent in English**\ Go and take classes\ She said_ no\ no\ no\ I don't have the time\

Although for Frank the lack of English skills at early stages of a scientist's career was not 'a barrier', this was subject to a certain progressive improvement or to a commitment to attain a certain fluency.

Cecília coincided also with the view that the necessary written (in this case) language skills for publishing in science are acquired 'by doing', that is, through the practice of 'reading' and 'writing publications' [see excerpt 120].

Excerpt 120: Interview with Cecília [Senior res. – Group A] – 'It's… by doing\ that you see it\'

Researcher: And * And how does one ac& acquire t& * the knowledge of this form of language that must be used_ for the {(Eng) papers}_ to publish/	**Investigadora:** I * I com s'a& s'adquireix a& * el coneixement d'aquesta forma de llengua que s'ha d'utilitzar_ pels {(Ang) papers}_ per publicar/
Cecília: Writing publications	**Cecília: Escrivint publicacions**
Researcher: By writing_ that they correct you_	**Investigadora:** A base d'escriure_ que t'ho corregeixin_
Cecília: =And then you see it=	**Cecília:** =I llavors ja ho veus=
Researcher: =and see= the changes_	**Investigadora:** =i veure= els canvis_
Cecília: Yes\ =Yes\=	**Cecília:** Sí\ =Sí\=
Researcher: =Or= by reading_ maybe too\	**Investigadora:** =O= de llegir_ potser també\
Cecília: Yes_ **by reading_ and writing** But reading_ means [reading] what you write_ at the end\ Then_ yes_ reading_ and writing\ **It's b& * by doing\ that you see it\ That you see that you have to be very brief_ very * very {(Eng) to the point}\ Don't mess with flowery words_ because there is no space**	**Cecília:** Sí_ **llegint_ i escrivint** És que llegir_ és lo que tu escrius_ al final\ A llavorens_ sí_ llegint_ i escrivint\ A ba& * **és a base de fer\ que ho veus\ Que veus que has de ser molt breu_ molt * molt {(Ang) to the point}\ No t'enredis amb floritures_ perquè no hi cap**
	[original in Catalan]

As shown in this excerpt, for Cecília, the clue to scientific writing is going 'to the point' and not 'messing with flowery words'. This was presented as dominant ideologies, norms for interaction accepted by Cecília as 'neutral' and thus non-negotiable. A similar notion of what scientific writing should look like was also evidenced in Navil's corrective feedback on Joana's written report [see excerpt 121].
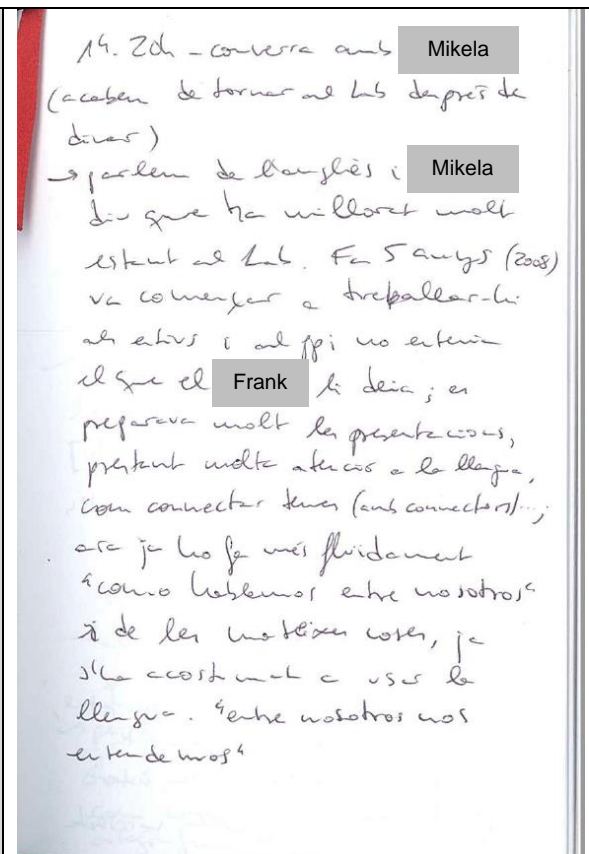
Excerpt 121: Navil's [PhD res.] feedback on Joana's [BA res.] written report [Group A] – 'think of an improved title'

C1: Can you please think of an improved title;
C4: (…) We should be able to cut down the description and improve the writing to more crisp and to the point.

In this excerpt, Navil, in his mentor role, conveys Joana his ideology on what adequate scientific reports should be like. He suggests that her writing should be 'more crisp and to the point', apart from finding a better title and reducing the description. Navil uses his authority to shape Joana's agency by implying the existence of best practices and certain norms of interaction affecting the 'forms of writing'.

The fact that English was acquired through practice in the RG was corroborated by Mikela, a PhD researcher that had been working in Group A for five years [see excerpt 122].

Excerpt 122: 20140120_Field notes (page 16) – conversation with Mikela [PhD res. – Group A] – 'she has got used to using the language'

«14.20h – conversation with Mikela (they have just come bak to the lab after lunch) → we talk about English and Mikela says that she has improved being in the lab. She started working here 5 years ago (2008) during the summers and **at the beginning she could not understand what Frank said**; she used to prepare presentations a lot, paying much attention to language, how to link topics (with linking words)…; now she does it more fluently "{(Spa) since we talk amongst ourselves}" and about the same things, **she has got used to using the language**. "among ourselves we understand each other"»	 [original in Catalan]

This excerpt reflects Mikela's conviction about the fact that her English skills had improved as a result of her professional practice in the RG for the last five years, especially concerning fluency. She also introduces the idea that what she 'has got used to' is communication with group members and concerning a *shared repertoire*: "'{(Spa) since we talk amongst ourselves}" and about the same things'. In the following page of the field notes, there is a description of how the sociolinguistic context of the RG, which positions English as a daily 'need' and as a working tool that practitioners have the 'pressure' to use, had motivated Mikela to learn English [excerpt 123].
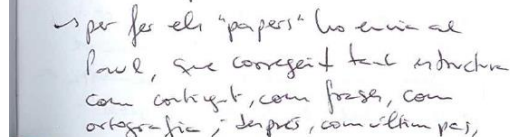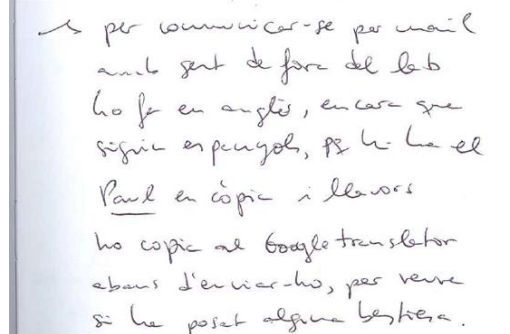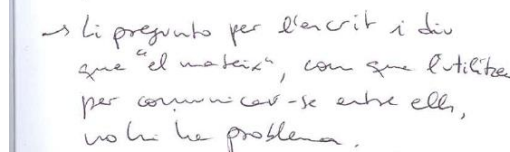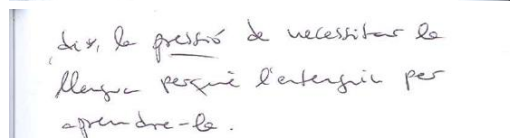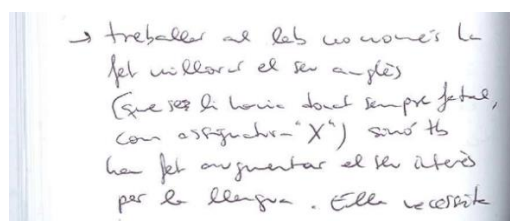
Excerpt 123: 20140120_Field notes (page 17) – conversation with Mikela [PhD res. – Group A] – 'She needs…the pressure of needing the language'

«→ Working in the lab not only has helped her improve her English (which she had always been very bad at, as a subject "X") but it has also increased her interest in this language. **She needs, she says, the <u>pressure</u> of needing the language to be understood**, in order to learn it.

→ I ask her **about writing and she says "the same", since they use it to communicate with one another, there is no problem.**

→ **to communicate by email** with people form outside the lab she does it in English, even if they're Spanish, **because there is Frank copied** and then **she copies it on Google translator before sending it**, in order to see whether she has written any blunder.
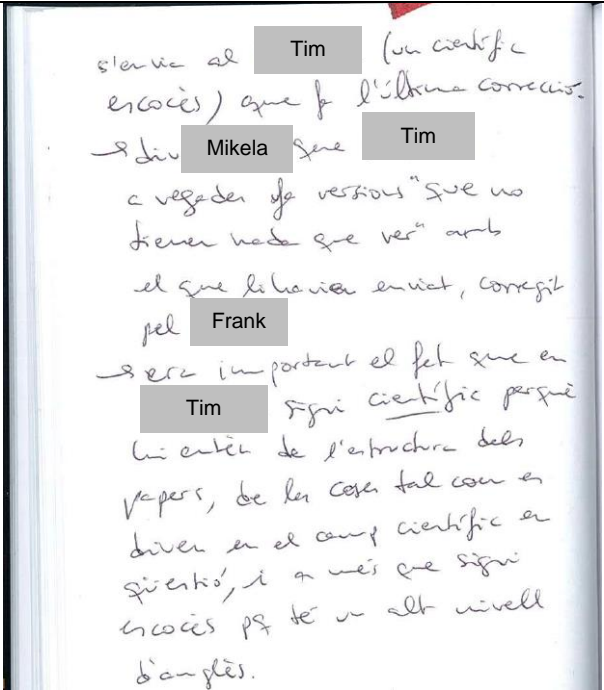
→ **to do the "papers" she sends it to Frank, who corrects both, structure and content, as well as sentences, and orthography**; and then, as the last step,»

[original in Catalan]

This excerpt shows Mikela's normalisation of the use of English in her daily professional practice also as regards writing ('there is no problem'). Mikela also describes the process that she follows in the writing of emails, for which Frank's role as a copied recipient forces the use of English also with Spanish interlocutors, and of scientific articles. This illustrates how the English-only norm enforced by the group leader became a habit in the RG. In this latter case, Frank acts as a first language filter, reviewing 'sentences' and 'orthography', before the 'last step', which is the scientific writer [see excerpt 124].

Excerpt 124: 20140120_Field notes (page 18) – conversation with Mikela [PhD res. – Group A] – 'it was important the fact that Tim is a scientist'

«…it is sent to Tim (a Scottish scientist) who makes the last revision. → Mikela says that **Tim sometimes does versions "{(Spa) that have nothing to do}" with what they had sent him**, after being corrected by Frank. → **it was important the fact that Tim is a scientist because he understands about the structure of papers, about things as they are said in the specific scientific field, and also the fact that he is Scottish because he has a high level of English**.»	 [original in Catalan]

This excerpt synthesises Mikela's beliefs as regards the qualities of the language reviewer of the RG's papers, Tim. The fact that he is a scientist by training and Scottish makes Tim an ideal reviewer, for he 'understands about the structure of papers', about the way things are expressed 'in the specific scientific field' and guarantees his 'high level of English'. These features give him legitimacy and authority to the point that he might even make versions of the papers that 'have nothing to do' with the original ones. Tim's cutlural capital as regards scientific English, materialised in his training background and nationality, positioned him higher in a hierarchy of scientific article writer and neutralised other group members' agency in this regard.

Similar to what happens with the written language skills, also rhetorical skills were considered to be acquired through practice in the RG [see excerpt 125].

Excerpt 125: Interview with Cecília [Senior res. – Group A] – 'and they acquire it\ 100% of them\'

Researcher: to what extent in a researcher in your group_ **are these important_ the * the communication skills_ you know/** **Cecília: Very important\ =Very important**	**Investigador:** fins a quin punt en un investigador del vostre grup_ **són importants això_ les * les habilitats comunicatives_ no/** **Cecília: Molt importants\ =Molt**

Essential	**importants\ Essencials**
Researcher: Essential\	**Investigador:** Essencials\
Cecília: What happens_ you may be a little shy_ but it's the * as long as you make yourself clear_ there's no problem\ **You don't have to be a great speaker\ You have to be able to stand in front of people and explain the results more or less\ And that's it** You don't have to be a * an orator_ a politician\ You have to talk\ And not be shy\	**Cecília:** Lo que passa_ que pot ser que siguis una mica tímid_ però és lo * mentre t'expliquis_ no passa res\ **No cal que siguis un gran orador\ Que siguis capaç de posa't devant de la gent i explica't los resultats més o menos\ I ja està** No cal ser un * un orador_ un polític\ Cal parlar\ I no tindre vergonya\
Researcher: But it's not a predisposition that worries you when someone joins [the group]\	**Investigador:** Però no és una predisposició que us preocupa a l'hora d'entrar\
Cecília: No\ =No\=	**Cecília:** No\ =No\=
Researcher: =I= mean_ **you are confident =that=** in the time lapse that **=you have of** three years_ or whatever_=	**Investigador:** =És= a dir_ **confieu =que=** en el període que =disposeu de tres anys_ o el que sigui_=
Cecília: =Yes\ That if * yes\ yes\ Or four\=	**Cecília:** =Sí\ Que si * sí\ sí\ O quatre\=
Researcher: that this_ +mm+ they =will acquire it_=	**Investigador:** que això_ +mm+ ho =adquirirà_=
Cecília: =that they= will acquire it\ = Yes\ yes\ yes\=	**Cecília:** =que ells= ho adquiriran\ =Sí\ sí\ sí\=
Researcher: =somehow_= through their group mates_ =and * and from their tutors\=	**Investigador:** =d'alguna manera_= a través dels companys_ =i de * i dels tutors\=
Cecília: = Yes\ and they ad& * Yes\= **and they acquire it\ 100% of them** There is no one who has not gone somewhere to present something_ +hu+\	**Cecília:** =Sí\ i ho ad& * Sí\= i **ho adquirixen\ el 100%** No hi ha ningú que no hagi anat a algun puesto a presentar algo_ +eh+\
	[original in Catalan]

According to Cecília, 100% of group members acquire the necessary skills in English to 'be able to stand in front of people and explain their results more or less'. She supports this assertion by indicating that all group members have held such a presentation somewhere. In this sense, the practice in the RG can be deemed a training not only in the practice of doing experiments, but also in that of explaining them effectively, both orally and in writing (in English). There were hence multiple instances – especially observed in Frank – where such training became explicit, like the following excerpt, an email from Frank to Mara, where the group leader summarises how a 'meaningful discussion' should be done [excerpt 126].

Excerpt 126: Frank's [Group A's leader] e-mail to Mara [PhD res.] - August 2014 – 'doing the experiments in science is the easy part'

```
Hi Mara,

here are comments and corrections on Chapter 3. If Chapter 3 is stronger than
Chapter 2, I suggest you make [research topic 1] Chapter 2 and [research topic
2] Chapter 3. Please try harder on the discussion. I will be doing you a
disservice if I wrote the discussion for you. I am giving you here some
suggestions so please do your very best. If I were to give you a mark for the
discussion you would get no more than 1 out of 10!!! Not good enough at all as
I know you can do much better and you are letting yourself down by not trying
hard enough!

So here we go. Read [author]'s paper on [[research topic 1] and also ALL the
references in that paper. Make notes on the key points of all those papers and
make an outline of 5-6 key points which you can use as headings for the
discussion. Then see how your data compare (or not) with what others have done
and follow that path. This is the way to write a meaningful discussion. You
need to read all the relevant papers and make your own notes on those papers,
then use that information to synthesize the discussion.

Mara, doing the experiments in science is the easy part. Whether you will make
a successful career or not as a researcher depends on how good you are at
writing. This is what I want you to really try harder and put in the time. I
know it is not easy but you are making things more difficult for both of us by
not doing a good job when I know you can!!!

Let me see the next version please.

Best regards

Frank
```

The steps that Frank wants Mara to follow are: reading a paper and its references, note key points, choose some of these and make them sections for her discussion, and finally discuss the similarities and differences with what 'others have done' across the sections. This excerpt is also interesting because it has another important purpose apart from teaching Mara how to write a discussion: encouraging her to make a greater effort and do her best. For this, Frank uses different resources, like explicitly asking her to do it ('Please try harder', 'I want you to really try harder and put in the time'), showing his trust on her ('I know you can!!!', 'I know you can do much better and you are letting yourself down') and even asserting that this is a key endeavour in her career as a scientist ('Whether you will make a successful career or not as a researcher depends on how good you are at writing'), which may require more effort than 'doing experiments' ('doing the experiments in science is the easy part').

As can be deduced from Cecília's and Mikela's reflections, the double-revision system established by Frank seems to be effective for the normalised daily use of English in Group A's written texts. However, Frank signals a turning point after which English 'becomes a barrier': 'post PhD'. According to Frank, at a postdoc stage and after, 'people become more

405

independent' and need to use this language without so much support (i.e. 'they need to write their own grants') [see excerpt 127].

Excerpt 127: Interview with Frank 2 [Group A's leader] – 'Where it becomes a barrier is post PhD'

> **Researcher:** Do you think that +eh+ scientists with an Anglosaxon background have a better chance of (…) becoming a scientist =than others=/ (…) Or being * =being better known/=
>
> (…)
>
> **Frank:** No\ **They have an easier time in their career because they don't have a language barrier** But **many non-native English speakers are able to compensate more than enough for that handicap** In different ways\ So **for me_ language_ during the Phd programme_ is not a barrier\ Where it becomes a barrier is post PhD\ When people become more independent_ they need to write their own grants_ And this is where language skills are {(?) into it}** And I point this out to everybody\ and I encourage them to take classes\ English language classes\

For Frank, being an English native speaker may facilitate some aspects for scientists only at the beginning, since he deems it possible for other-language natives to 'compensate' for this 'handicap'. In this same line of thought, Cecília contends that 'native speakers' of English are not especially considered in their domain [see excerpt 128].

Excerpt 128: Interview with Cecília [Senior res. - Group A] – 'what has authority are the results'

Researcher: Therefore they don't have authority_ thus\ Because in our field_ the ={(Eng) native speakers}=	**Investigador:** Per tant no tenen autoritat_ per tant\ Perquè al nostre àmbit_ els ={(Ang) native speakers}=
Cecília: =No\=	**Cecília:** =No\=
Researcher: They have a great authority\	**Investigador:** tenen una autoritat brutal\
Cecília: In ou& in ours_ they don't\ **In our [field]_ what has authority are the results** A boy from * from a small village can come * from wherever he is_ with brilliant results_ with a sloppy English_ and everyone will respect him for his results\ **And about English no one will tell him anything\ On the contrary_ if they see that he has difficulty when they ask him the questions_ people will repeat the question in five different ways_** +hu+\ And no one will make any comment_ +hu+\ **Because if**	**Cecília:** A la no& a la nostra_ no\ **Al nostre_ lo que té autoritat són els resultats** Pot arribar un xiquet de * de un poble petit * d'allà on sigui_ amb uns resultats brillants_ amb un inglès xapussero_ i tothom lo respectarà pels resultats\ **I l'anglès ningú li dirà re\ Al contrari_ si veuen que té dificultat quan li fan les preguntes_ la gent li repetiran la pregunta de cinc formes diferents_** +eh+\ I ningú farà cap comentari_ +eh+\ **Perquè si els seus resultats són bons_ és que és bo** L'anglès ja li& * ja * ja

his results are good_ it means he's good\ English will j& * will * will just be finally learnt\ For us it's the results\	l'acabarà d'agafar\ Nantros són los resultats\ [original in Catalan]

According to Cecília, in her scientific field, one's skills in the English language are not valued at all. These are not hence part of the cultural capital valued in that 'field of power'. What is valued are 'results', since these indicate whether someone is a 'good' scientist, in spite of the difficulties she might have in answering others' questions. Experiments results are thus the reification of that cultural capital most valued in Group A's field.

In this regard, though, it is worth noting that Frank underscored the fact that the RG's scientific writer, Tim, was an 'English native', as if it were a self-evident asset, a necessary cultural capital [see excerpt 129].

Excerpt 129: Interview with Frank 2 [Group A's leader] – 'I correct very few linguistic errors'

Researcher: … I witnessed today the * Daniela's +eh+ presentation_ are there any errors you expect to see every time you go to *
(…)
Frank: Well_ I mean_ you see that **I correct very few linguistic errors\ Because if I were to correct everything_ I wouldn't be doing anything else** So_ I try and point out what I think are the most important linguistic errors\ And then **we have a science writer_ who's Tim_ who is an native English speaker** Which I've been * I mean_ I've been working with him for the last twenty years\ So_ +uh+ whenever I get a manuscript_ or a chapter for a thesis_ or whatever_ I do a * I go through it_ and I * **I correct more the content than the language_** I point out a few language things_ but **I normally I don't worry too much about the language_** and then I say_ okay_ let's fix the content_ and then they interact with Tim one on one to sort out language\

As shown in this excerpt, Tim's support allows Frank to focus on aspects of group members' texts other than language. Here Frank declares that he 'correct[s] very few linguistic errors' and that he does not 'worry too much about language'. In this sense, linguistic accuracy appeared as important, a reification of cultural capital, but the specialisation in this regard of the scientific writer made it less relevant as a skill for scientist. As can be observed in the next excerpt, Frank finds himself in a dilemma: on the one hand he considers that being a language advisor is not his 'job', whereas on the other hand he feels he 'cannot let [group members] be without help' in this respect, because language becomes 'a problem' in some cases [see excerpt 130].

Excerpt 130: Interview with Frank 2 [Group A's leader] – 'I don't feel it's my job to improve their linguistic skills

> **Researcher:** So what do you feel you do for their linguistic skills/ For the linguistic skills they require as a scientist/
>
> **Frank:** Okay\ I mean_ **I don't feel it's my job to improve their linguistic skills** I don't view that as part of my job\ But **I * I recognise also that I cannot let them be without help_** because for some of them their linguistic skills are really a problem\ So_ I hire +uh+ an English language editor_ who works with them to improve their language skills\ And I always **get in to use track changes_** so they see what changes Tim makes_ and then_ **I question them occasionally on the grammatical aspects of the corrections** And I hope that something will stick\

In this excerpt, Frank describes some procedures through which he approaches language issues in the RG, like 'track[ing]' Tim's corrections of written texts and commenting on them with group members 'occasionally'. Nonetheless, these measures applied to written documents that would transcend the RG-CoP (like articles and dissertations) and that could be sent to Tim, who was based abroad, but could not apply to oral communication taking place in the RG's laboratory, offices and meeting rooms. In these cases, Frank acted as the highest authority and the custodian of the "correct" (scientific) English within the RG. As a consequence, the group members' use and style in (scientific) English relied highly on the group leader's proficiency and ideology as regards what constituted linguistic adequacy [see examples of how this referee role was performed by Frank in excerpts 131 and 132].

Excerpt 131: 20140718_Tània's PhD defence rehearsal 1 [Group A] – 'your thesis is not called'
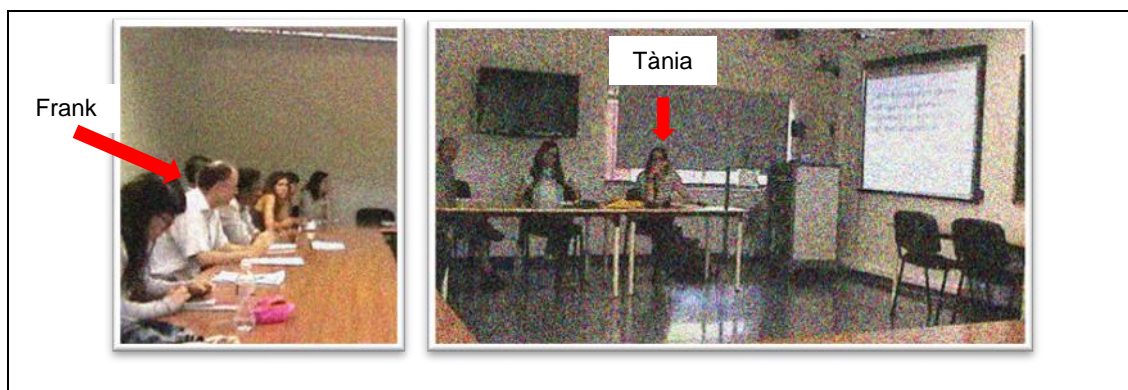
Frank: …Be careful with the English\

Tània: Yeah\

Frank: +uh+ **your thesis is not called\ your thesis is entitled**

Tània: +mhm+

Frank: Okay/

Tània: Okay\

Frank: So_ you are going to defend your doctoral dissertation entitled [confidential]\ When you say_ you're going to introduce_ you don't introduce your panel\ **so you don't say_ I'm going to introduce you_ or I'm going to** * +uh+ I don't know what was the other * +uh+ **or I'm going to explain you_**

Tània: +mh+

Frank: you can do it in one or two ways\ you can say_ I'm going to introduce this\ or I'm going to introduce {(!) to} you\ {(?) you need} a preposition\

Tània: +mhm+

Frank: So_ be careful with +uh+ * with how you do it\

Excerpt 132: 20140723_Tània's PhD defence rehearsal 2 [Group A] – 'you've made 39 errors'
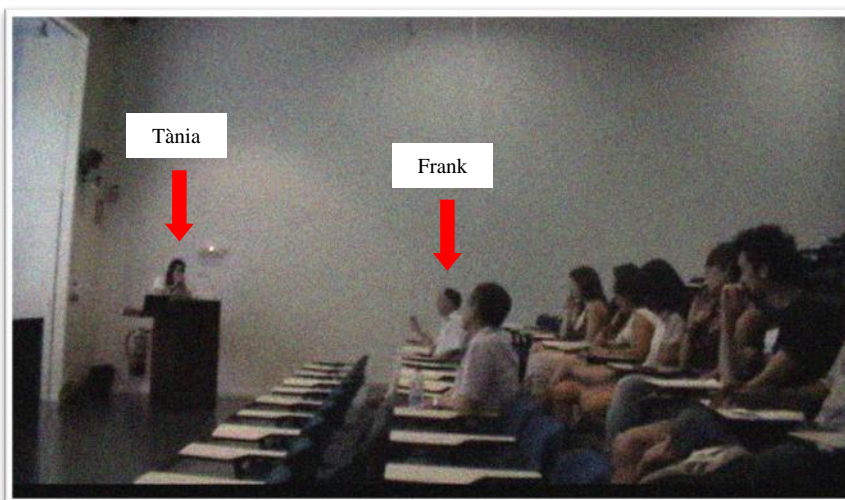
Frank: I made a list\ you've made 39 errors in Past and Past Perfect tenses\

Tània: +mhm+ because I didn't say_ {(?) ai di} at the end/ or *

Frank: Correct\ Or you mispronounce it\

Tània: +ah+\

Frank: So_ [ˈɑːnsərd] not [ˈɑːnsərəd] [ˈkɔːzd] not [ˈkɔːzəd] investi& * +uh+ is [əˈsəʊʃɪeɪtɪd] you say_ is [əˈsəʊʃɪeɪt] [əˈsaɪnd] [ˈmɒnɪtərd] [kənˈfɜːrmd] [?] [ˈjuːzd]]\ okay/

Tània: +mhm+\

In these excerpts from Tània's first and second PhD defence rehearsals, Frank adopts a language counsellor role, and advises Tània (whose L1 was Catalan) in terms of vocabulary, grammar and pronunciation in English. As can be observed, Frank was rather specific in these observations (e.g. he counted the exact number of Tània's 'errors' and specified the words that she had 'mispronounced', in this case emphasising the –ed ending of verbs in the past tense). Again, the authoritarian style of this feedback, consisting of categorical statements devoid of hesitations, besides his past (and present) international experience and recognition, which was known by group members, contributed to his construction as a linguistic authority within the RG.

For those interactions that could not be supervised by Frank, the quality of the language used was questioned [see excerpt 133].

Excerpt 133: Interview with Agus [PhD res. – Group A] – 'the hard part of_ * of English in the lab_'

Researcher: Good\ And tell me about your English\	**Investigadora:** Molt bé\ I parla'm del teu anglès\
Agus: +m+ {(Eng) so so}\ @@@@	**Agus:** +m+ {(Ang) so so}\ @@@@
Researcher: {(Eng) So so}/ You think/	**Investigadora:** {(Ang) So so}/ Tu creus/
Agus: Yes·\ +m+ the hard part of Engli& * I mean_ **the hard part of_ * of English in the lab_ is that_ one_ nobody is a native_ let's say·· Anglo-Saxon_** and in the end_ since the goal is to understand one another_ like_ when you are working_ so_ if you want a reagent_ the goal is that someone gives it to you_ **if you don't ask the question properly_ and if * or if you are talking to someone and you make mistakes_ nobody corrects anyone_ and even worse_ maybe you will still use others' * vices\ Then_ it's a place where you don't completely forget English because you have to use it\ and you read in English_ and you speak in English_ and * and you write in English_ But you don't improve it either\ Maybe when writing_ I think so_ but you improve it in a very academic way\ which in practice_ I mean_ on a more colloquial level_ is of little use** Then_ to get by * that is_ to get by in a · presentation_ then_ yes\ it seems to me that * I do it well_ but·· **when I'm in an informal conversation_ I notice that· +m+ I speak a little_ like_ +nst+ like_ {(Sp) sloppy}** let's say\	**Agus:** Sí·\ +m+ lo fotut de l'anglè& * o sigui_ **lo fotut del_ * de l'anglès al laboratori_ és que_ u_ ningú és nadiu_ diguem-ne·· anglosaxó_** i al final_ com que l'objectiu és entendre's_ així_ com quan estàs treballant_ doncs_ si vols un reactiu_ l'objectiu és que te'l passin_ **si no formules bé la pregunta_ i si * o si estàs parlant amb algú i fas faltes_ ningú corregeix a ningú_ i encara pitjor_ potser encara se t'empeguen els vicis de * dels altres\ Aleshores_ és un lloc on no se t'oxida del tot l'anglès perquè l'has de fer servir\ i llegeixes en anglès_ i parles en anglès_ i * i escrius en anglès_ Però tampoc el millores\ Potser a l'hora d'escriure_ jo crec que sí_ però el millores d'una forma molt acadèmica\ que a la pràctica_ vull dir_ a un nivell més col·loquial_ és poc útil** Aleshores_ per defensar * o sigui_ per defensar-me a una· presentació_ pos_ sí\ em sembla que * que el tinc bé_ però·· **quan estic en una conversa informal_ noto que· +m+ parlo una mica_ en plan_ +nst+ pos_ {(Esp) chapucero}** diguem-ne\
	[original in Catalan]

In this excerpt, Agus complains that, although the RG is a favorable context to use English, the English they speak in the lab is not of good quality, because 'no-one is a native', 'nobody corrects anybody' and 'others' bad habits stick'. He acknowledges that his written skills in English may have improved, but only in an 'academic' register, which is not useful for 'informal' conversations. In this case, what appeared to be a valued cultural capital for Frank, for instance (excerpt 129) is not so valued for Agus.

Despite the time and efforts that it entailed for Frank himself to 'help' group members in their acquisition of English language skills, and the economic costs of having a scientific writer for reviewing the RG's prospective publications, Frank deemed it a 'minor' cost, compared to other research expenses [see excerpt 134].

Excerpt 134: Interview with Frank [Group A's leader] – 'language for us is not a problem'

Researcher: Would you be able to measure the cost of +uh+ the language issue to publish a paper/

Frank: Minor\ Minor\

Researcher: Would it be 10%/ Less than *

Frank: Even less\ **Minor\ Minor\ Minor\ Minor\ So we go full circle back to the beginning_ language for us is not a problem**

In this excerpt, we see how Frank insists on the idea that language 'is not a problem' for scientists, not even in terms of economic costs. For him it is just one more tool that practitioners learn to use while doing science. However, just as has been shown in a previous excerpt of an email to Mara, he used the opposite argument: that writing is important in science, as a resource for encouraging group members to make efforts in this aspect. In the following excerpt, also from an email to Mara, Frank draws on the economic argument to make her react [excerpt 135].

Excerpt 135: Frank's email to Mara (April 2014) – 'I cannot continue to spend large amounts of money'

```
Hi Mara,

I re-edited the abstract and I also sent it to Tim for him to fix language,
etc. As you can see between Tim's and my corrections the abstract is nearly
completely re-written. Furthermore, this is not the end as you need another
round of revisions. OK Mara I want to make it clear that you need to try a
lot harder when you write reports, papers, abstracts, etc. The problem is
not only the language (still a big problem for you) but the fact that you
do not use a logical, linear and comprehensive thought process to put a
holistic story on paper. This is because you do not have clear in your mind
the way to write a story and in my mind this is independent of English
language skills. To make things worse it takes you a lot longer than
necessary to create written outputs and this need to change.

Another more practical problem I have is that I cannot continue to spend
large amounts of money for [copy editor] to keep revising your drafts. So
please invest the time and do as good a job as you can in the first draft
as this will save us a lot of money (and time)! Failing this I may be
forced to make the unpleasant decision of asking you to pay Tim for
revisions I determine to have been "avoidable". I do not do this very often
but I have done it on occasion and even though it is a last resort I may
have to do it if I judge that your effort has not been up to standard.

I do not mean to be overtly critical but please consider this seriously in
planning how you will write the different chapters in your thesis.
```

Although Frank deems the language irrelevant for the RG in terms of economic costs, here we see how he asserts that he is 'spend[ing] large amounts of money' and time with Mara's draft revisions. This might be a rhetorical resource to urge Mara to make greater efforts with her writing, but it also suggests that there is an economic threshold for the RG as regards what is invested in Tim's draft revisions. In this sense, (English) linguistic skills as a cultural capital became an economic capital.

The fact that English was the "official" language of the RG, granted by the group leader, legitimised also other group members to use it and even to claim its use whenever other languages were used in the RG. This can be observed in the following excerpt, taken from Joana's (BA researcher) lab notebook, which used to be reviewed by her lab mentor, Navil (PhD researcher) [excerpt 136].

Excerpt 136: Joana's lab notebook [BA res.] – 'please write in English'
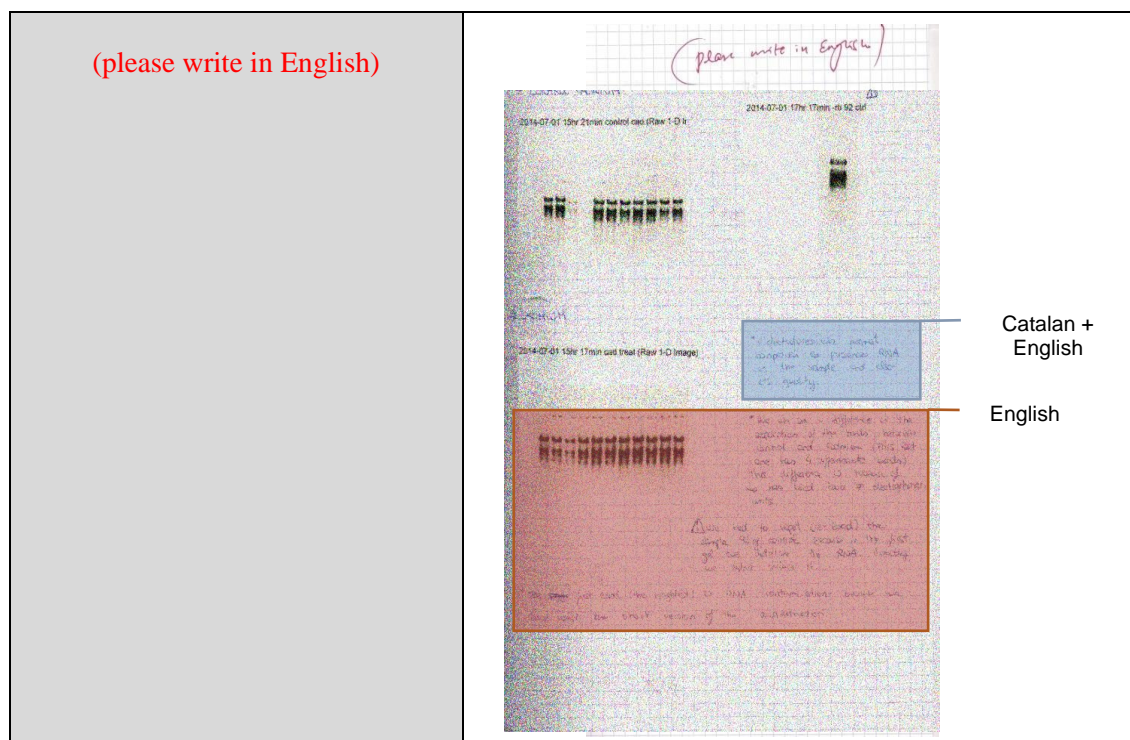
In this excerpt we can see how, Joana (Catalan L1), who was doing a practicum in Group A's laboratory and was being mentored by Navil (Kannada L1), had mixed some Catalan with English in a paragraph of her lab notebook. After reviewing Joana's lab notebook, Navil noted in red letters, at the top of the page, 'please write in English'. Yet, Navil's language-related corrections did not only affect the code used by Joana, but also the style of her writing and other conventions [see excerpt 137].

Excerpt 137: Joana's lab notebook [BA res.] – 'protocols not written clearly'
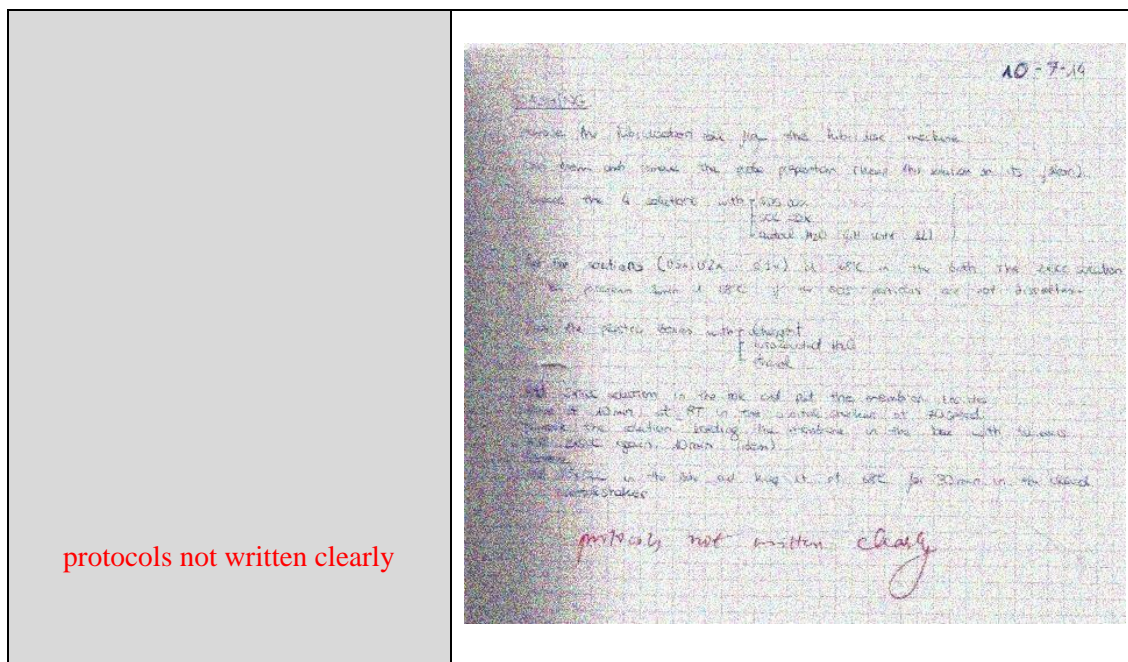
This excerpt shows how the linguistic advisor role is adopted by Navil as part of his mentor role, emulating not only Frank's role but also his authoritarian style. In this case, Joana's rhetorical skills are questioned without further clarification: 'not written clearly'. Although language was deemed a secondary aspect in their job, this kind of language-related feedback was very common in the participants' daily practice.

As regards the language policy of the RG, there was however an ambiguous context. On the one hand, the wider socio-political context of the nation-state and of the institution endorsed the use of Catalan, first, and Spanish, second, at university. On the other hand, though, the highest authority of the RG urged its members to use English. In the following excerpt, Lurdes makes reference to the tensions this situation triggered within the RG [excerpt 138].

Excerpt 138: 20140710_Interview with Lurdes [BA res. – Group A] – 'And it's also curious this thing with conflicts'
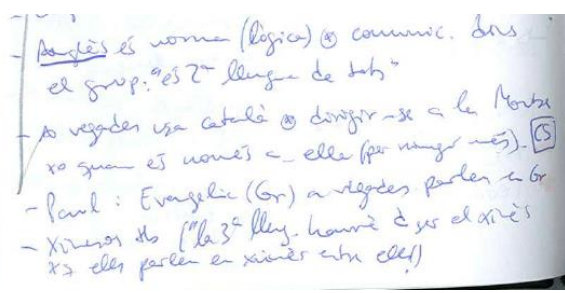
Lurdes: And **it's also curious this thing with conflicts** and so _ that there is a little_ * I mean_ not =conflicts= * (…) **more of coexistence \ I believe \ (…)** And well_ it's this\ it's this\ **Navil is always saying_ speak English\ then that_ because otherwise he doesn't understand** And that\ You know_ That*	**Lurdes:** Y **es curioso también lo de los conflictos** y así _ que hay un poco_ * o sea_ no =conflicto= * (…) **más de convivencia\ Yo creo** (…) Y bueno_ pues eso\ pues eso\ **Navil siempre dice_ habla en inglés** pues eso_ **porque si no él no se entera** Y eso\ Sabes_ Que *
Researcher: And that is a conflict/ Or it creates a	**Investigadora:** Y eso es un conflicto/ O

415

conflict/

Lurdes: No_ well_ but he * **I don't think he likes it_ you know/ Saying_ * Having to say that\ you know/**

Researcher: Ok_ so it may bother him that =it's not done= already * by default\ let's say\

Lurdes: =Sure\= And see_ for example_ at the beginning * compared to the beginning_ **now I understand Catalan more_ because I already * at the beginning it also bothers a little\ you know/**

Researcher: +oh+ of course\ =you felt= like excluded_ maybe_

Lurdes: maybe a bit\ you know/ **Because you don't understand it\ and ·· no ·· * you're not going to be saying all the time_ hey_ I don't understand** you know/ Because **for them it's so normal** Well_ for you\

Researcher: Sure\ Sure_ because being with * with Xènia and Carol_ sometimes they =maybe= speak Catalan\ sure\ of course\ I understand\ Now I understand\

Lurdes: =Yes\= Because at the beginning_ it's so so\

Researcher: You felt a little bad_ at first \

Lurdes: Yes\ But_ But you didn't say anything\ No\ @ Well_ sometimes\ **But see_ you say it once and you're not going to say it again after fifteen minutes**

Researcher: +mh+ And now you understand it\

Lurdes: Yes\

Researcher: Everything/

Lurdes: No\ but_ * but now {(?) half} * almost everything\ so_ it's better\

crea un conflicto/

Lurdes: No_ bueno_ pero a él * **no creo que a él le siente bien_ sabes/ Decir_ * Tener que decir eso\ No/**

Investigadora: Vale_ o sea que a él le puede molestar que =no se= haga ya de * por defecto\ digamos\

Lurdes: =Claro\= Y a ver_ por ejemplo_ al principio * respecto al principio_ **ahora entiendo más el catalán_ pues ya * al principio también molesta un poco\ sabes/**

Investigadora: +ah+ claro\ =te sentías= como excluida_ quizá_

Lurdes: igual un poco\ sabes/ **Porque no lo entiendes\ y·· no·· * no vas a estar todo el rato diciendo_ oye_ no lo entiendo** sabes/ Porque **para ellos es tan normal** Bueno_ para vosotros\

Investigadora: Claro\ Claro_ porque al estar con *con Xènia y Carol_ a veces ellas =quizá= hablan en catalán\ claro\ claro\ Te entiendo\ Ahora lo entiendo\

Lurdes: =Sí\= Porque al principio_ pues es regular\ (…) Pero no decías nada\ No\ @ Bueno_ alguna vez\ **Pero eso_ lo dices una vez y ya no lo vas a volver a decir a los quince minutos**

Investigadora: +mh+ Y ahora ya lo entiendes\

Lurdes: Sí\

Investigadora: Todo/

Lurdes: No\ pero_ * pero ahora {(?) medio} * casi todo\ entonces_ pues mejor\

[original in Spanish]

In this excerpt, Lurdes (Spanish L1), a BA researcher being mentored by Carol (Catalan L1), narrates how Navil often demands the use of English in the lab, whenever other group peers

switch into another language (like Catalan). Lurdes shows sympathy with Navil since she has experienced herself the discomfort at hearing Catalan being used and not understanding it ('at the beginning it is also a bit annoying'), especially between her mentor, Carol, and Carol's other trainee, Xènia. On the one hand, Lurdes comprehends the tendency for Catalan speakers to speak this language with one another ('for them it's so normal'), but, on the other hand, she deems 'annoy[ing]' not understanding what others are saying and having to demand the use of English. From this perspective, English is not only the legitimate *lingua franca* in the RG but also the one that guarantees 'cohabitation' in the laboratory. Language use becomes a matter of ethics and comradeship, for the use of Catalan generates discomfort and the use of English is deemed by some group members the right thing to do. Nonetheless, the use of other languages different from English among group members was a common practice in interpersonal interactions between individuals with the same L1. In the excerpt below, with notes taken during an interview to Cecília (Senior res.), she describes some usual language practices in the RG [see excerpt 139].

Excerpt 139: 20131014_Field notes (page 1) –interview with Cecília [Senior res. - Group A] – 'the 3rd language will have to be Chinese'

«- <u>English</u> is a (logical) norm for communication within the group: "it's the 2nd language for all" - Sometimes uses Catalan to address Isabel but only to her (to no-one else). C[ode]S[witching] - Frank and Mara (Gr[eek]) sometimes speak Gr[eek]» - The Chinese also ("the 3rd language will have to be Chinese because they speak Chinese to each other!") »	 [original in Catalan]

In this excerpt, Cecília (Catalan L1) admits that she uses Catalan 'sometimes' with Isabel (Catalan L1), the secretary of the RG, and that other languages are occasionally used by group members, like Greek (between Frank and Mara) and Chinese (between the two Chinese group members at that time, Hao and Lian). This latter fact is so relevant for Cecília that she jokes saying that Chinese needs to become the '3rd language' of the RG.

Although Cecília's L1 was Catalan, she believed that it was useless for science and even a 'problem' [see excerpt 140].

Excerpt 140: Interview with Cecília [Senior res. - Group A] – 'the way I speak doesn't bring a penny'

Researcher: The whole issue of Catalan_ and the revitalisation_ normalisation of Catalan_ =You say that this cannot * cannot affect you\=	**Investigador:** Tot el tema del català_ i la revitalització_ normalització del català_ =Tu dius que això no * no et pot afectar\=
Cecília: = But it's just that I * This is of no use for me at all\= It's of no use for me_ because I wasn't normalised_ I've spent ten years abroad_ I come here_ I say different words_ but I don't care\ **Because the way I speak doesn't bring a penny_ to me\ It doesn't bring me anything\ What brings me something is what I think and what I write\ And what I think and what I write I have to do it in English\ Then Catalan to me = what it brings me is a problem= ***	**Cecília:** =Ja però és que jo ***A mi això no em servix de re**\= No em servix de re_ perquè a mi no em van normalitzar_ M'he passar deu anys a l'estranger_ arribo aquí_ dic paraules diferents_ però m'és igual\ **Perquè la forma de parlar no em porta cap cèntim_ a mi\ No em porta res\ A mi em porta el que penso i el que escric\ I el que penso i el que escric ho hai de fer en anglès\ Llavons a mi el català =lo que em porta és un problema=** *
Researcher: Because how do you present this situation to the students who come/	**Investigador:** Perquè tu com els hi presentes doncs aquesta situació als estudiants que venen/
Cecília: {(@) I don't present it to them\}	**Cecília:** {(@) no els hi presento\}
Researcher: You don't * talk to them about it\	**Investigador:** no * ni els en parles\
Cecília: No\ No\ =Onc& * Once=	**Cecília:** No\ No\ =Un& * Una vegada=
Researcher: No * =They manage\= They discover Catalan/	**Investigador:** No * =Ells ja s'espavilen\= Descobreixen el català/
Cecília: Yes\ Once we tried to organise a Catalan course here_ for them_ and **they told me it wasn't necessary\ {(@) That this was a waste of time\}**…	**Cecília:** Sí\ Una vegada vam intentar organisar aquí un curs de català_ per a ells_ i **em van dir que no calia\ {(@) Que això era una pèrdua de temps\}**…
	[original in Catalan]

As shown in this excerpt, for Cecília English was the only language necessary in science. Dedicating time to learning Catalan by non-Catalan group members would imply devoting less time to science, and it would be an obstacle in their career, a 'waste of time'. The market-oriented perspective that Cecília adopts positions English as the only cost-effective language [see excerpt 141].

Excerpt 141: Interview with Cecília [Senior res. - Group A] – 'It's a waste of time'

Cecília: .... But sure_ then you realise that thi& * the language they make you learn [German in Germany] doesn't bring you	**Cecília:** .... Però clar_ a llavons te dones compte que aques& * la llengua que et fan aprendre [l'alemany a Alemània] no et

funding\ What brings you funding is to have one more result in the laboratory\ Then_ in end we told them in Germany_ **What do you want_ results/ Or that we learn German/**

Researcher: Of course_ because this can be an impediment_ sometimes_ for research\ because it's a waste of time_ right/

Cecília: It's a waste of time\ And there comes a point_ that when * when * when you see the money we spend in a week_ you don't want a student to go around_ that she has language problems_ and things like that\ Because it's very expensive\ hey In a week we can spend €20,000\ And it's very hard +huh+ to get €20,000\

Researcher: And with English_ do you think that if they had a better level of English_ this could bring benefits/ Somehow_

Cecília: Of course_ **because the better your level of English_ the easier it is for you to write publications** Because it's sometimes hard +huh+_ to write the first one\ Come on_ go_ write\ And everyone is a little scared\ **And once they're_ * the number of publications we write is due to * due to English_ +huh+\ Because they're no longer scared_ and they write_ and throw themselves into it** On the contrary the group of [German city]_ of * the * of Hanns_ they don't publish as much a we do\ Because their people don't want to make the effort with English\ (…) And then_ here_ is a_ * Of course_ **what you have to do is_ what will * what will * what will bring you results/ what will give you funding/ Publications/ Then let's publish\ What do we need for publishing/ English/ Well then_ everyone focus on English**

porta finançament\ Lo que et porta finançament és tindre un resultat més al laboratori\ Llavons_ al final los vam dir a Alemània_ **Què voleu_ resultats/ O que aprenguem alemà/**

Investigadora: Clar_ perquè això pot ser un impediment_ a vegades_ per fer recerca\ perquè és pèrdua de temps_ no/

Cecília: És pèrdua de temps\ I arriba un punt_ que quan * quan * quan veus los diners que gastem a la setmana_ tu no vols que un estudiant vagi por ahí_ tingui problemes de llengua_ i coses així\ Perquè val molts cèntims\ ostras Nosaltres en una setmana podem gastar 20.000€\ I costa molt +eh+ portar 20.000€\

Investigadora: I amb l'anglès_ creus que si tinguessin millor nivell d'anglès_ això podria portar beneficis/ D'alguna manera_

Cecília: Clar_ **perquè com me& * millor nivell d'anglès tens_ més fàcil t'és escriure publicacions** Perquè a vegades costa_ +eh+_ escriure la primera\ Venga_ va_ escriviu\ I tots s'espanten una mica\ **I una vegada estan_ * la quantitat de publicacions que escrivim nantres és per * per l'inglés_ +eh+\ Perquè ja no els hi fa por_ i escriuen_ i s'hi llencen** En canvi el grup de [ciutat alemanya]_ del * del * del Hanns_ no publiquen tant com nantres\ Perquè la seva gent no vol fer l'esforç amb l'anglès\ (…) A llavorens_ aquí_ és un_ * Clar_ **tu el que has de fer és_ què et * què et * què et porta resultats/ què et donarà finançament/ Publicacions/ Doncs a publicar\ Què necessitem per publicar/ l'anglès/ Doncs venga_ tots a per l'anglès**

[original in Catalan]

In this excerpt, Cecília establishes a direct link between English and economic benefits for the RG. This is mediated by the publications written by group members, which, according to her, are numerous because the group members are used to using English and are not 'scared' of

writing in this language (the only language possible for scientific publications). English is thus a necessary resource for publishing, which is in turn a paramount capital in science. For Cecília, the clue to such a positive attitude on the part of group members towards using English is the mixing of linguistic profiles in the RG [see excerpt 142].

Excerpt 142: Interview with Cecília [Senior res. - Group A] – 'Here we all accept to speak English'

Cecília: For example_ at the [foreign research institute] _ sure_ there were one thousand two hundred of us\ Then there every day could arrive seven_ ten_ fifteen_ different people\ arrive_ and leave\ Then_ for them it was a problem to have so many foreigners arriving at the same time in the different groups\ because there originated communities of Spaniards_ of Chinese_ and they stuck together\ Then you were indeed forced you to go to some courses\ of writing_ of presentation_ They forced you because they said_ this way at least you will have the minimums\ because if you stick with your community_ there will be no wa& way to make you speak English\ **Here we all accept to speak English\ But for example_ in the [foreign research institute]_ the Spaniards joined the Spanish community\ Then they did not practice English\ The Chinese_ with the Chinese community\ The Indians_ with the Indian community\ Then they created different communities_ and there certainly was a problem of * of communication**	**Cecília:** Per exemple_ al [institut de recerca estranger]_ clar_ érem mil dos-cents\ Llavons allí cada dia podia arribar set_ deu_ quinze_ persones diferents\ arribar_ i marxar\ Llavorens_ per a ells sí que era un problema tindre tants estrangers arribar alhora als diferents grups\ perquè es feien comunitats d'espanyols_ de xinos_ i aquestos tiraven\ A llavorens sí que t'obligaven a anar a uns cursos\ d'escriptura_ de presentació_ T'hi obligaven perquè feien_ així al menos tindràs los mínims\ perquè si t'ajuntes amb la teua comunitat_ no hi haurà for& forma de fe't parlar en anglès\ Que **aquí ho acceptem tots parlar en anglès\ Però per exemple_ al [institut de recerca estranger]_ los espanyols s'ajuntaven amb la comunitat espanyola\ A llavorens no practicaven l'anglès\ Los xinos_ amb la comunitat xinesa\ los indios_ amb la comunitat índia\ Llavons feien comunitats diferents_ i sí que hi havia un problema de * de comunicació**
Researcher: So_ maybe_ the key somehow of the group is that there's a bit of mixing_ right/ That there's no +nst+	**Investigadora:** Llavors_ potser_ la clau una mica del grup és que hi ha una mica de barreja_ no/ Que no hi ha +nst+
Cecília: It's the mix\	**Cecília:** És la barreja\
Researcher: majority of a = nationality_=	**Investigadora:** majoria de una =nacionalitat_=
Cecília: =No\ It's the mix\=	**Cecília:** =No\ És la barreja\=
Researcher: Well_ maybe there are more Catalans maybe =than anything=	**Investigadora:** Bueno_ potser sí que hi ha més potser catalans =que una=
Cecília: =But it doesn't matter\=	**Cecília:** =Però és igual\=
Researcher: else_	**Investigadora:** altra cosa_
Cecília: It's the mixture\ It's the mixture Because if there were half Chinese_ and half	

Catalans_ there would be only two languages \ Chinese_ and Catalan\ (…) And among them they would get to communicate in Catalan or Chinese\ **Researcher:** So_ also you try_ a little_ =that there is a balance_= **Cecília: =Yes\ that it is mixed\ =Of course_** Helena\ Yes\ That it is mixed\ Yes\ Yes\ Yes\ Yes\	**Cecília: És la barreja\ És la barreja** Perquè si hi hagués la meitat xinos_ i la meitat catalans_ només hi hauria dos llengües\ xino_ i català\ (…) I entre ells arribarien a comunica's en català o en xino\ **Investigadora:** Per tant_ també ho procureu_ una mica_ =que hi hagi un equilibri_= **Cecília: =Sí\ que estigui barrjat\= Clar que sí_** Helena\ Sí\ Que estigui barrejat\ Sí\ Sí\ Sí\ Sí\ [original in Catalan]

In this excerpt, Cecília defends the idea that if there were predominant communities of speakers within the RG, they would stick to their common language, and English would not be used. According to her, this happened in a research institute she had worked in, where there were 1,200 researchers and there was a 'communication problem'. Cecília argues that the clue to the fact that in Group A 'we all accept speaking English' is 'the mixing' of nationalities and linguistic profiles. Note that she does not make reference to the English-only rule imposed by the group leader.
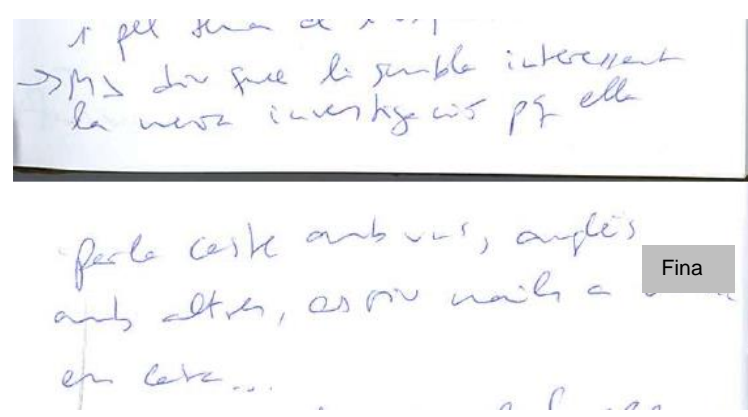
To sum up, although the Catalan language was legitimised by Group A's institution, English was the only language legitimised by its group leader, who believed that English should be the only language used in science. Frank (and Cecília) assumed that the necessary English skills could be achieved through the scientific practice and thus had no specific language requirements for new group members. For them, English was a tool whose use would be mastered by group members after training in the RG. To this aim, a system of language correction was established in Group A: written texts were reviewed twice, by the group leader and by a scientific writer, and speech was supervised by the group leader, whenever he was present. Such corrective feedback included not only linguistic aspects but also rhetorical aspects. Some group members' accounts reveal that there was pressure to use English in daily practices, which might have triggered English language gains, but also some tensions, as regards the free use of other languages and the quality of the English used and learned in the RG. From a market-oriented perspective, as expressed by Cecília, the local language was deemed an obstacle, a problem, an extra cost and should not be compulsory for scientists.

In Group B, the group leader was Catalan and thus had Catalan and Spanish as his L1. He had some international working experience, especially in the US. As regards the RG's group

language policy, he declared not having imposed any *lingua franca* in the RG, and hence languages were used freely, depending on the linguistic profile of interlocutors. This was corroborated by Lola (postdoc researcher), who declared that she used different languages on a daily basis [see excerpt 143].

Excerpt 143: 20131113_Field notes_Observation Group B (Pages 3-4) – 'she speaks Spanish with some, English with others…'

«→ Lola says that she finds my research interesting because she speaks Spanish with some, English with others, writes emails to Fina in Catalan…»	Fina [original in Catalan]

According to this excerpt, Lola (Spanish L1) acknowledged that she used Spanish, English and Catalan for her daily professional practice in the RG, depending on her interlocutor. This was probably eased by the fact that Pere, the group leader, was not especially concerned about language use and was not very strict in this regard. He did not show a strong linguistic ideology regarding the language of science [see excerpt 144].

Excerpt 144: Interview with Pere [Group B's leader] – 'In English\ Well_ I think\'
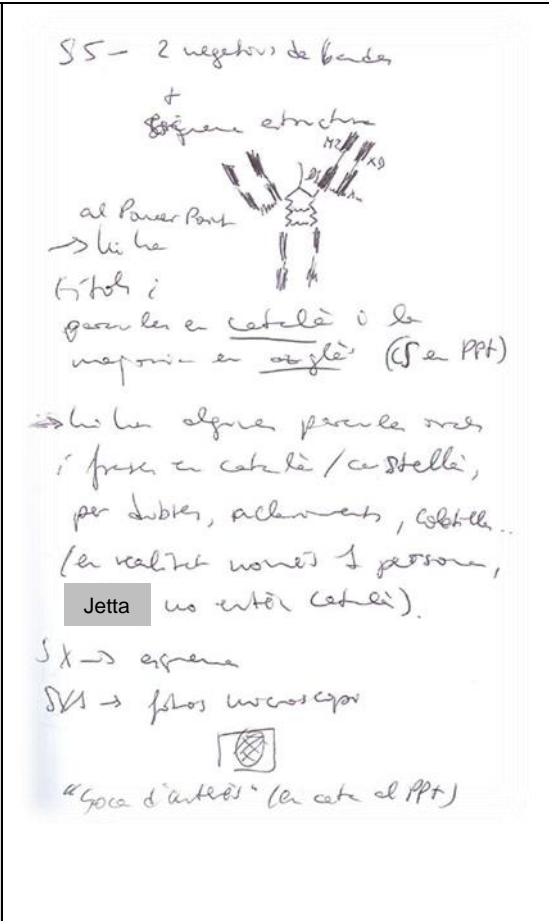
Researcher 1: Because they_ on a daily basis_ well_ **use of English_ basically_ whenever they read papers_** it's then whe& * when they use English\	**Investigadora 1:** Perquè ells_ al dia a dia_ clar_ **pràctica d'anglès_ bàsicament_ quan llegeixen papers_** és qua& * quan l'utilitzen l'anglès\
Pere: Yes\ **Unless there's someone in the laboratory_ =+uh+=**	**Pere:** Sí\ **A no ser que hi hagi algú pel laboratori_ =+eh+=**
Researcher 1: =Exactly\= Then maybe to talk to Yamir_ or to Tira_	**Investigadora 1:** =Exacte\= Després potser per parlar amb el Yamir_ o amb la Tira_
Pere: Right\	**Pere:** Sí\
Researcher 1: or with Jetta_ when she was	**Investigadora 1:** o amb la Jetta_ quan hi

there_	era_
Pere: Right\	**Pere:** Sí\
Researcher 1: But less\	**Investigadora 1:** Però menys\
Pere: Exactly\	**Pere:** Exactament\
Researcher 1: And in the seminars_ when there was Jetta\	**Investigadora 1:** I en els seminaris_ quan hi havia la Jetta\
Pere: Correct\	**Pere:** Correcte\
Researcher 1: Beyond that_ English_ on a daily basis is not_	**Investigadora 1:** A partir d'aquí_ l'anglès_ a diari tampoc no_
Pere: No\	**Pere:** No\
Researcher 1: They don't use it\	**Investigadora 1:** No l'utilitzen\
Pere: No\	**Pere:** No\
Researcher 1: Okay\	**Investigadora 1:** Val\
Researcher 2: Because when they do reports_ and so_ they do it in their language\ I =don't know if = *	**Investigador 2:** Perquè quan fan reports_ i així_ això ho fan en la seva llengua\ No =sé si= *
Researcher 1: =In the= notebook_ you mean/	**Investigadora 1:** =A la= llibreta_ vols dir/
Researcher 2: In the notebook\ =the lab notebook_ or so\=	**Investigador 2:** A la llibreta\ =Del laboratori_ o així\=
Pere: =In their language\=	**Pere:** =En la seva llengua\=
Researcher 2: In their own language\ No/	**Investigador 2:** En la seva llengua\ No/
Pere: Yes\ Yes\	**Pere:** Sí\ Sí\
Researcher 2: But Indians do it in Eng& in English	**Investigador 2: Però els indis ho fan en an& en anglès**
Pere: In English\ Well_ I think	**Pere: En anglès\ Bueno_ em sembla**
	[original in Catalan]

Pere's last words ('Well_ I think\') denote his scarce interest in the language that group members used for writing in their lab notebooks, which was also Pere's general attitude as regards language use within the RG. As he summarises in this excerpt, Catalan was the default language used by most group members 'Unless there's someone in the laboratory' not understanding this language nor Spanish (the two Spanish L1 members of the group had been living in Catalonia for more than five years and could understand Catalan). In this case, in specific interactions with these non-Catalan speakers, and in group meetings, called 'group seminars', English was the language used. English was also used by all group members for reading scientific articles.

423

Despite the general (implicit) norm of using English with non-Catalan/Spanish speakers, there were many instances observed in 'group seminars' in which both, English and Catalan were used even though a non-Catalan speaker (like Jetta, a BA researcher from the Netherlands) was present. Although the main presentation in group meetings was in English, in derived discussions Catalan predominated, except for the interventions of Lola (L1 Spanish), Dana (L1 Bulgarian – fluent Spanish speaker), Jetta, Yamil (L1 Tamil – fluent English speakers) and Tira (L1 Tamil – fluent English speaker). Even projected documents could be written in more than one language, like in Gina's 'group seminar', where she used a projected presentation combining titles in English and in Catalan, her speech was mainly in English but partly in Catalan and partly in Spanish for doubts, clarifications, and some expressions. In this case, only one attendee, Jetta, did not understand Catalan [see excerpt 145].

Excerpt 145: 20140129_Field notes (Page 2)_Gina's 'group seminar' [PhD res. – Group B] – 'there are titles and words in Catalan'

«On the Power Point there are titles and words in Catalan and most of them in English (C[ode]S[witching] on P[ower]P[oin]t)

→ There are some oral words and sentences in Catalan/Spanish, for doubts, clarifications, chunks… (in fact, only one person, Jetta, doesn't understand Catalan).»

«"interest strain" (in Catalan on the PPt)»

[original in Catalan]

This excerpt documents the mix of English and Catalan languages present in Gina's projected document, her presentation's visual support, on the one hand, and also in her speech throughout
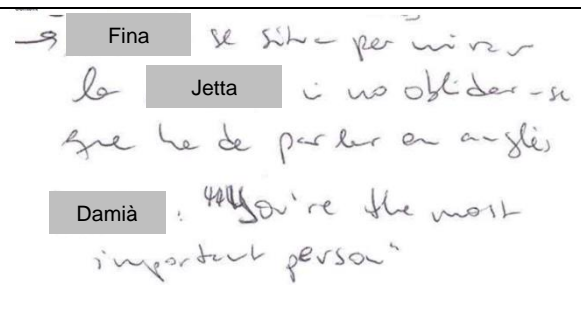
the 'group seminar', despite Jetta's presence. Pere himself acknowledged that code switching used to happen in group seminars [see excerpt 146].

Excerpt 146: Interview with Pere [Group B's leader] –

Pere: In the * Well_ this is perhaps something different\ because **in our group we sometimes start_ * and then we switch * we switch into Catalan_ we switch into Spanish_ and we say_ hey_ let's go back**	**Pere:** En el * en el * Bueno_ això potser és una altra cosa\ perquè **al nostre grup de vegades comencem_ i depués ens n'anem * ens n'anem al català_ ens n'anem al castellà_ i diem_ txé_ tornem-hi** [original in Catalan]

In this excerpt, Pere confesses that in the RG it is a usual practice to begin speaking English and then switching into Catalan and then Spanish without noticing it. This common phenomenon was even designated by some group members as a 'linguistic mess'. The fact that code switching was unintended is illustrated in the following excerpt, which reflects Fina's decision to stand opposite to Jetta so that she will not forget that she has to speak English [see excerpt 147].

Excerpt 147: 20140205_Field notes_Fina's group seminar (Page 3) [PhD res. – Group B] – 'You're the most important person'

«→Fina positions herself in such a way so as to see Jetta and not forget that she has to speak English Damià: [in English to Jetta] "You're the most important person"»	 [original in Catalan]

This excerpt, shows Fina's strategy of looking at Jetta in order to avoid code switching, and it also reproduces Damià's (Senior res.) words for Jetta in this regard: 'You're the most important person'. This proves that the use of English was subject to Jetta's presence in the *communicative event*.

Nonetheless, and despite the efforts made by group members to use English whenever this was the only common language for all interlocutors, Catalan was so present in the RG's daily

communication that the two Indian members of the group, Tira and Yamir, regretted not having taken a Catalan language course from their arrival in the RG [see excerpt 148].

Excerpt 148: Interview with Tira and Yamir [PhD res. – Group B] – 'Catalan is more important'

Researcher: So_ what piece of advice would you give someone who has just arrived in [the city] and in the lab_ like for instance_ like you/ @@@ I don't know_ to make things easier_ or_

Yamir: Better to go for some courses\ Language course

Researcher: Language course/ Do you think it's important/

Yamir: It's important\ (…) And **I think they can enjoy a lot more** (…) Yeah\ I enjoyed a lot here\ But if I would have known the language_ I would have enjoyed more than this\

Researcher: +mh+ But you think it *it would * I mean_ if you went back two years ago_ would you take a course/

Yamir: Yeah\

Researcher: You too/

Tira: Yeah\ Because **by the beginning_ I didn't know that this is that much important to have a·· language for the communication_ but the time I was like I came to lab_ and going home_ I didn't interact much with the people\ But if I learnt the language before_ no/ It would be more im& +uh+ like_ useful for me**

Researcher: You * but * but not for work that much maybe/ Or **also for work/**

Tira: No\ Sometimes also when they * when we have a meeting_ they use to discuss in the Catalan\ Or if it is very serious_ it comes automatically\ and it's common for everyone So_ the time we couldn't understand very clearly\ We know some words_ what * what they are talking about_ because it's common in English and Catalan also\ So_ we could unders& * we could +uh+ identify that they are talking about this problem\ But we don't get it clearly\ So they have to repeat it again in English\ But might be they miss something\ No/

Yamir: No\ But everything you cannot translate\ No/ Everything you cannot translate\ (…) Because +uh+ they will miss some expression * expression they will say\ And you cannot translate to my la& * in the English\ Even if I used to talk\ But when I translate_ the meaning will change\ There are some local thing you * you * you still have\ No/

Tira: Yeah\ It won't be the typical\ Sometimes you have an expression in Catalan that you cannot translate it very clearly\ No/ **And also when we are +uhm+ +uhm+ in a common place like coffee_ or something_ sometimes_ if they have said something funny_ we couldn't get it clearly**

(…)

Researcher: ...and so_ first piece of advice_ take a language course\ In Catalan/ Or Spanish/

Yamir: Catalan is more important

Researcher: Catalan more important here

In this excerpt, Yamir and Tira choose 'go[ing] to some (Catalan) language courses' as the first recommendation for a newcomer in the RG, so that they would 'enjoy a lot more' and understand all conversations. They report that 'Catalan comes automatically' for group members in serious discussions as well as when they are joking, and that they miss some things even when someone translates the discussions because 'everything you cannot translate'. To the question of whether it would be better to take a course in Catalan or in Spanish, they both answer that 'Catalan is more important' in their context.

Despite the flexibility concerning language choice in the RG, Pere deemed English 'fundamental' in science [see excerpt 149].

Excerpt 149: Interview with Pere [Group B's leader] – 'devote a few hours a week to English learning'

Researcher 2: And hence_ if I want to be your doctoral student_ and I come_ for example_ but I have no idea of English\ you will accept me anyway if you see that I_ * if I have a good record\	**Investigador 2:** I per tant_ si vull ser doctorand teu_ i vinc_ per exemple_ però no tinc ni idea d'anglès\ m'acceptaràs igual si tu veus que jo_ * si tinc un bon expedient\
Pere: Wow\ =Is this possible/=	**Pere:** Hosti\ =Es dona això/=
Researcher 2: = Well_ and I'll tell you_ = * I'll tell you * Well_ and I tell you_ I did English in·· high school\ How good is your English/ that good\	**Investigador 2:** =Bueno_ i et diré_= * et dic * Bueno_ i et dic_ jo he fet anglès a·· secundària\ Com ho domines/ tal\
Pere: Well * then we'll be in that situation_ I'll tell her_ listen_ devote a few hours a week to English learning\ That's what I told you before\ And I've lived this\ +huh+/ Saying_ listen_ +mm+ it's fundamental\ +huh+/ It's fundamental\	**Pere:** Pues * pues estarem en aquella situació_ li diré_ escolta_ **dedica unes hores a la setmana a aprendre anglès** Que és lo que t'he dit abans\ I això ho he viscut\ +eh+/ De dir_ escolta'm_ +mm+ és fonamental\ +eh+/ **És fonamental**
Researcher 1: But they don't use it that much at first\ Only when they go to conferences_	**Investigadora 1:** Però d'entrada tampoc l'utilitzen tantíssim\ només quan van a congressos_
Pere: Yes\ No\ No\ Sure\ But * but * the * the first & the * the * the * first reading they will do will be of a {(Eng) paper} in English\ And th& the * and the articles that you will give her_ even though you can explain them to her_ you will give them what you have published and it is English\ Therefore_	**Pere:** Sí\ No\ No\ Clar\ Però * però és que la * la pri& * la * la * **la primera lectura que faran serà d'un {(Ang) paper} en anglès** I e& els * i els articles que tu li donaràs_ tot i que li puguis explicar_ **els hi donaràs de lo que has publicat i és anglès** Per lo tant_
	[original in Catalan]

In this excerpt, Pere declares that, although English is not very used in the RG, this language is 'fundamental' to read the scientific publications necessary in their profession, which are 'in English'.

In those *communicative events* where English was mandatory, like conference presentations and the writing of scientific articles, Pere acted as a language advisor of his group's members. In the following excerpt, he describes his competence in English as 'enough' for this endeavour [excerpt 150].

Excerpt 150: Interview with Pere [Group B's leader] – 'here comes the little English one knows'

Researcher 1: And English_ what/ English/

Pere: +Oh+ Well\ Then_ Of course_ Here * **here comes the little English one knows_ Yeah/ That is limited_ somehow\ It's not like yours** Then_ of course_ +mm+ **we have written enough_ and presented enough_ to know if what someone is saying_ +uh+ will be understood\ Okay/ will be understood** And then_ you * you * you polish it_ like saying_ don't say this this way_ it's wrong\ Okay/ Or * or_ you have put that expression the other way around\ Or_ what you wrote here_ you're saying something different from what you actually * from what you actually mean\ Polish it\ We kno& * we kno& * we know enough at this scientific level_ so as to * so as to see that this is wrong\ We're **probably not aware of many things\ But well_ there is enough knowledge so as to avoid making such mistakes** Indeed\ Which when they are young_ they do them_ and as they learn_

Researcher 1: So_ you notice an evolution\ Don't you/ Also/

Pere: Of course\ Very clearly\ Indeed\

Investigador 2: I l'anglès_ què/ L'anglès/

Pere: +Ah+ Bueno\ Llavors_ Clar_ Aquí * **aquí intervé el poc anglès que un sap_ no/ Que és limitat_ d'alguna manera\ No és el vostre** Llavors_ clar_ +mm+ **hem escrit prou_ i hem presentat prou_ com per saber si allò que està dient_ +eh+ s'entendrà** D'acord/ S'entendrà\ I llavors_ el * el * el retoques_ de dir_ no diguis això d'aquesta manera_ que està mal dit\ Vale/ O * o_ aquesta expressió me l'has fotut al revés\ O_ lo que has escrit aquí_ estàs dient una altra cosa del que en realitat * del que realment vols dir\ Retoca-ho\ en sa& * en sa& * en sabem prou a aquest nivell científic_ com per * com per veure que allò està malament\ **Segurament que moltes coses s'escapen\ Però bueno_ hi ha prou coneixement com perquè no fem errors d'aquest tipus** Això sí\ Que quan són joves_ els fan_ i quan van aprenent_

Investigadora 1: O sigui_ noteu una evolució\ No/ També/

Pere: I tant\ Claríssim\ Això sí\ …

[original in Catalan]

In this excerpt, Pere describes how he draws on 'the little English [he] knows' to 'polish' other group members' written texts in English. He considers that his competence in English, which he acquired through practice ('we have written enough_ and we have presented enough_), is

'enough' to avoid certain linguistic errors. However, Pere's corrective feedback did not only concern language, but also rhetoric and formal aspects, like the time that should be devoted to each part of a conference presentation [see excerpt 151].

Excerpt 151: Interview with Pere [Group B's leader] – 'these things you usually have to polish'

Researcher: and about communicative skills/ Is there any kind of problem_ that you say_ these always appear again and again_ **Pere:** +uh··+ y··es\ yes·\ yes\ but_ well_ this is something * you just said that\ I mean_ you're not * not conscious of it_ but sure\ I mean_ **there are many times that people are not communicating** * or they're investing a lot of time on something_ that given the finite time you have for a presentation_ **you must tell them_ listen_ you're spending too much time on this** Therefore_ listen_ you have fifteen minutes_ three minutes for the introduction_ +uh+ ten minutes for results_ and if you want_ two minutes to present some conclusions\ And then_ **these things you usually have to polish**	**Investigador:** i a nivell d'habilitats comunicatives/ Que hi ha algun tipus de problemes_ que dius_ és que apareixen i apareixen_ **Pere:** +eh··+ s··í\ sí·\ sí\ però_ a veure_ això és una cosa * ara ho acabes de dir\ vull dir_ no * no n'ets conscient_ però sí\ És dir_ **hi ha moltes vegades que no s'està comunicant** * **o s'està invertint molt de temps en algo**_ que donat el temps finit que té una presentació_ **de dir-li_ escolta_ estàs invertint massa temps en això** Per lo tant_ escolta_ tu tens quinze minuts_ tres minuts d'introducció_ +eh+ deu minuts de resultats_ i si vols_ dos minuts per presentar unes conclusions\ I llavors_ **aquestes coses normalment les has de polir** [original in Catalan]

In this excerpt, Pere describes the feedback he 'sometimes' has to give to junior group members in their preparation of a conference presentation. In this case, it is not language related, but it affects the structure of the presentation and the time devoted to each of the standard parts a presentation should have. As can be observed, both the presentation's structure and the time each part should last is presented by Pere as a general norm that applies to all presentations.

Pere believed that the necessary communicative skills for the practice of science were acquired through practice itself ('they will learn it') [see experpt 152].

Excerpt 152: Interview with Pere [Group B's leader] – 'They'll just learn it'

Researcher 2: Because I've seen that within the characteristics of a good initial scientist_ let's say_**You didn't include communication** **Pere:** No\ **Researcher 2:** Because this c& * you just assume that they will just learn it\ **Pere: They'll just learn it** They'll just lear& *	**Investigador 2:** Perquè he vist que dins de les característiques d'un bon científic inicial_ diguem_**no hi has posat la comunicació** **Pere: No** **Investigador 2:** Perquè això c& * ja ho dones que ja ho aprendran\

they'll just learn it_ but al& also *

Researcher 2: Because there are people who can be good in there [in the lab]_ and when they go out to explain it_

Pere: Horrible\

Researcher 2: Really/

Pere: Horrible\ =And vice versa\=

Researcher 2: =Have you= come across_ any such case/

Pere: And the other way around\

Researcher 2: Really\

Pere: And the other way around\ Normally * usually_ anyway_ people who communicate well_

Researcher 2: They're good in there too\

Pere: They are also good\ +huh+/ They are also good\ Not always\ Not always\ But_ see_ I * +mm+ how can I say it/ **it's very good to know how to communicate well_ +huh+/ but_ +mm+ on a scientific level_ let's say_ you cannot take people for a ride** I don't know if I made myself clear\ That is_ you have to say_ with the utmost_ let's say_ willingness and enthusiasm that you want_ but_ this is so_ this is the outcome I got_ therefore_ I conclude this_ and we will do that\ You can't start making pie in the sky\ Because whoever is there will say_ listen *

Researcher 2: You have a lot of imagination\

Pere: {(@) you have a lot of imagination\ +huh+/} That we'll do this_ and get I don't know what\ +Hey+ Maybe yes\ But_ calm down\

Pere: Ja ho aprendran\ Ja ho ap& * ja ho aprendran_ però ta& també *

Investigador 2: Perquè hi ha gent que poden ser bons allà dins [al laboratori]_ i quan surten a explicar-ho_

Pere: Un horror\

Investigador 2: Sí/

Pere: un horror\ =I al revés\=

Investigador 2: =T'hi has= trobat_ amb algun cas/

Pere: I al revés\

Investigador 2: Sí\

Pere: I al revés\ Normalment * normalment_ de totes maneres_ la gent que comunica bé_

Investigador 2: també són bons allà dins\

Pere: També són bons\ +eh+/ També són bons\ No sempre\ No sempre\ Però_ a veure_ Jo * +mm+ com t'ho diria/ **és molt bo saber comunicar bé_ +eh+/ però_ +mm+ a nivell científic_ diguem_ tu tampoc pots vendre motos**\ No sé si m'explico\ És dir_ tu has de dir_ amb la màxima_ diguem_ ganes i· entusiasme que tu vulguis_ però_ això és així_ m'ha sortit això_ per lo tant_ conclueixo això_ i farem allò\ Tampoc pots començar a fer volar coloms\ Perquè el que estigui allà dirà_ escolta *

Investigador 2: tens molta imaginació\

Pere: {(@) tens molta imaginació\ +eh+/} Que farem això_ i cobrarem no sé què\ +Txe+ Potser sí\ però_ calma\

[original in Catalan]

In this excerpt, Pere claims that it is in fact 'very good to know to communicate well' but he considers that communication in science is limited by the content that is communicated, since although scientists can express things with 'enthusiasm', this will not change the value of results

and conclusions. Once more, communicative skills are positioned lower than experiment results in the hierarchy of value in the field of power of natural sciences.

In line with the idea that the necessary communicative skills would be acquired by junior members through their practice in the RG, Pere suggested that junior scientists were still not ready to write scientific articles themselves. In Group B, it was senior researchers who used to engage in the writing of prospective publications. Yet, this was not due so much to the fact that they were written in English as to the difficulty that 'having a holistic view' and 'putting the results in the context of the introduction' entail [see excerpt 153].
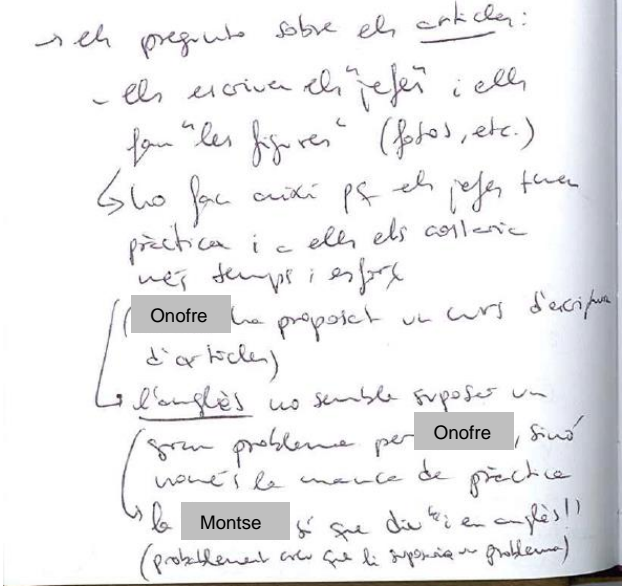
Excerpt 153: Interview with Pere [Group B's leader] – 'it's very hard for them to have a global overview'

Researcher 1: But instead_ when it comes to * to writing a paper_ +m+ don't you think that during the doctorate they are ready to do it/

Pere: It * **it's very hard for them_ * +uhm+ it's very hard for them to have a global overview of what is being * of what they want to explain**\ I mean * I mean_ for example_ indeed I can tell_ second-year people_ for example_ listen to me_ this method _ write it for me\ Because this way I will know exactly how you did it\ And therefore_ from here_ well_ we'll say_ this not\ this yes\ But write it for me\ Now_ **I will never tell them_ write an introduction to the topic for me_ an introduction means_ explaining the context in which you will explain those results_** okay/ Don't do this for me_ for now_ nor * **nor will I tell them_ do the discussion in this work\ This is much more complicated\ A method is a method_ and they have done it_ and therefore they can write it**\ And if it's already written in a notebook of our protocols_ and they have modified it a little_ then they will modify it a bit\ **But well\ Now_ the introduction_ which is knowing the context_ and the discussion_ which is putting the results in the context of the introduction_ this is very complicated**\ Then_ what I do many times * we do many times_ is_ when it is written * I think I told you_

Researcher 2: Yes\

Pere: you pass it to them\ (…) Listen_ read it\

Investigadora 1: Però en canvi_ a l'hora de * d'escriure ells un paper_ +m+ no trobes que durant el doctorat estiguin preparats com per fer-ho/

Pere: Els * **els costa molt_ * +ehm+ els costa molt tenir una visió molt de conjunt del que s'està * del que es vol explicar**\ És dir * és dir_ per exemple_ sí que els hi puc dir_ a la gent de segon any_ per exemple_ escolta'm_ el mètode aquest_ escriu-me'l\ Perquè així jo sabré exactament com l'has fet\ I per tant_ a partir d'aquí_ pos bueno_ direm_ això no\ això sí\ però escriu-me'l\ Ara_ **jo no li diré mai_ escriu-me una introducció del tema_ una introducció vol dir_ explicant el context en què tu explicaràs aquells resultats_** d'acord/ Això no m'ho facis_ de moment_ ni * **ni li diré_ fes-me la discussió en aquest treball\ Això és bastant més complicat\ Un mètode és un mètode_ i l'ha fet_ i per lo tant el pot escriure**\ I si està ja escrit en una llibreta de protocols nostres_ i l'ha variat una mica_ pos el variarà una mica\ **Però bé\ Ara_ la introducció_ que és conèixer el context_ i la discussió_ que és posar els resultats en el context de la introducció_ això és molt complicat**\ Llavors_ el que sí faig moltes vegades * fem moltes vegades_ és_ quan està escrit

431

Let's see what you think\	* em sembla que us ho he dit_
Researcher 2: So that they learn_ =you basically do this=	**Investigador 2:** sí\
Pere: =so that they learn_= so that they learn_ and sometimes you have a positive surprise\ For example_ Onofre_ in the last {(Eng) paper} we wrote_ it happened_ right/ {(imitating) Here I_ here I_ this_ I * I would say it differently\} Why/ For this reason_ this reason_ this reason\ You're right_ dude\ Let's change it\ See_ he won't write everything for you_ but if he sees a sentence {(@) or something that doesn't_} that doesn't fit for him_ because_ I read tha& * I read that that person had described that\ these are the ones who have this {(Eng) insight}_ this * +uh+ / well_ okay\ **Now_ [if] one says_ write a discussion of this text for me_ well_ complicated\ When s& * when they have finished their doctorate_ or when they are about to do so_ of course they are able to do it_ +huh+/ For sure\ They are much more able to do it\ That's what is sought**	**Pere:** els hi passes\ (…) Escolta_ llegeix-te-la\ A veure què et sembla\
	Investigador 2: perquè n'aprenguin_ =ho fas bàsicament això=
	Pere: =perquè n'aprenguin_= perquè n'aprenguin_ i a vegades tens una sorpresa positiva\ Per exemple_ l'Onofre_ en l'últim {(Ang) paper} que vam escriure_ va passar_ no/ {(imitant) Jo aquí_ jo aquí_ això_ jo * jo ho diria diferent\} Per què/ Per això_ per això_ per això\ Tens raó_ tio\ Canviem\ a vere_ ell no t'ho escriurà tot_ però si veu alguna frase {(@) o alguna cosa que no li_} que no li acaba de quadrar_ perquè_ és que fulano& * vaig llegir que fulano de tal havia descrit que\ això són aquells que tenen aquest {(Ang) insight}_ aquest * +eh+/ pues_ vale\ **Ara_ diu_ escriu-me una discussió d'aquest text_ cony_ complicat\ Quan s& * quan han acabat el doctorat_ o quan estan a punt_ segur que són capaços de fer-lo_ +eh+/ Segur\ Són molt més capaços de fer-ho\ Es busca això**
	[original in Catalan]

Following Pere's words, through practice in the RG at a PhD stage, practitioners are supposed to acquire the competence necessary to write a 'discussion' of results in the light of the literature. In fact, he asserts that 'this is what is intended', hence a purpose of the hands-on training during the PhD. The difficulty this entails for some researchers is reflected also in the following excerpt, where Onofre's (PhD res.) and Montse's (administrative technician) stance is revealed [excerpt 154].

Excerpt 154: 20140123_Field notes_Observation Group B (Page 7) – 'for them it would entail more time and effort'

«→ I ask them about the articles: - they are written by the "bosses" and they do "the figures" (photos, etc.) ↳ they do it like this because the bosses have practice and for them it would entail more time and effort (Onofre has proposed a course of article writing) ↳ English doesn't seem a big deal for Onofre, but only the lack of practice ↳ Montse does say "and in English!" (she probably deems it a problem) »	 [original in Catalan]

In this excerpt we can see Onofre's alignment with Pere's belief that it is difficult for junior researchers to write articles. However, while Onofre does not relate this difficulty with the English language but with the writing of scientific articles in general, the linguistic issue appears in Montse's words 'and in English!' that denote her concern.

In contrast with scientific articles, in Group B PhD dissertations were 'usually' written 'in Catalan' [see excerpt 155].

Excerpt 155: Interview with Pere [Group B's leader] – 'usually_ Catalan_ and some in English'

Researcher 1: and the thesis_ in contrast_ it's they who write it_ right/	**Investigadora 1:** i la tesi_ en canvi_ sí que l'escriuen ells_ no/
Pere: +uh+ yes\ yes\ yes\ It has * I mean_ they have to do so\	**Pere:** +eh+ sí\ sí\ sí\ Ho ha * és dir_ ho han de fer\
Researcher 1: and they do it in English/ or they do it in Catalan\	**Investigadora 1:** i ho fan en anglès/ o la fan en català\
Pere: +uh···+ well_ usually_ Catalan_ and some in English\	**Pere:** +eh···+ **pues_ normalment_ català_ i alguns en anglès**
Researcher 1: +oh+ but they are not forced to do it in English\	**Investigadora 1:** +ah+ però no estan obligats a fer-ho en anglès\

Pere: No\ **Unless they want the * this European doctorate_** and * that at least the thesis must be written in English_ and part of the presentation must be done in English_ because you are supposed to bring someone from outside who do not speak Catalan\ nor Spanish\ **Researcher 1:** But this option does not predominate\ **Pere:** It doesn't\ It doesn't\	**Pere:** no\ **A menys que no vulguin el * aquest doctorat europeu_** i * que al menys la tesi ha d'estar escrita en anglès_ i una part de la presentació s'ha de fer en anglès_ perquè se suposa que portaràs alguna persona de fora que no coneix el català\ ni el castellà\ **Investigadora 1:** però no predomina aquesta opció\ **Pere:** no\ no\ [original in Catalan]

In this excerpt, Pere contends that only a few PhD researchers write their dissertation in English, in particular those who want to opt for the 'European doctorate' degree[91]. However, Pere accepts the assertion that 'this option is not predominant' in Group B, where most dissertations are written in Catalan.

Such use of multiple languages for different purposes (i.e. English for articles and Catalan for PhD dissertations) constituted a difficulty for group members. In the following excerpt, Fina acknowledges that she has encountered some difficulties in writing her dissertation in Catalan 'because … all the scientific part and the technical part are in English in your head' [excerpt 156].

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[91] The 'European doctorate' is a distinction granted by the European Union (EU) to doctoral researchers that have fulfilled certain requirements, of which some involve language: A part of the doctoral dissertation must be written in an official language of the EU other than the official languages of Spain; two experts from a higher education institution from a member state of the EU other than Spain must evaluate the dissertation (and they must hence be able to read it in its original language); the examination panel of the PhD defence must contain at least one expert belonging to a higher education institution from a member state of the EU other than Spain (who must understand the language used in the defence).

Excerpt 156: Interview with Fina [PhD res. – Group B] – 'Because everything you read is in English'

Researcher: …In Catalan_ you did it/	**Investigadora:** …En català_ ho has fet/
Fina: Yes\	**Fina:** Sí\
Researcher: And what about the difference Catalan-English/ Because did you have to write the article in English/	**Investigadora:** I què tal la diferència català-anglès/ Perquè l'article l'has hagut de fer en anglès/
Fina: Yes\ **The article was written mainly by Damià_** +eh+_ though\ **I only wrote the results and materials and methods** +Uh+ and I did the same_ he sent it to me_ I redid it_ and returned it to him_ and **then_ when we both had it_ we sent it to Pere**	**Fina:** Sí\ **L'article l'ha escrit sobretot el Damià_** +eh+_ per això\ **Jo només he fet els resultats i materials i mètodes** +Eh+ i feia lo mateix_ ell m'ho enviava_ jo ho refeia_ i li tornava_ i **llavors_ quan ho teníem els dos_ li enviàvem al Pere**
Researcher: To Pere\ +mhm+\	**Investigadora:** Al Pere\ +mhm+\
Fina: +Uhm··+ Well_ **it's difficult\ Because see_ all the scientific_ and technical part_ is in English\ in your head** and in * and in the information\ And in the end it's rather a translation exercise_ and one of * for example_ of writing in Catalan again_ doubts you have about * about the language\	**Fina:** +Ehm··+ Home_ **és difícil\ Perquè clar_ tota la part científica_ i tècnica_ està en anglès\ al teu cap** i al * i a la informació\ I al final és molt un exercici de traducció_ i de * per exemple_ de tornar a escriure en català_ pos dubtes que tens de * sobre la llengua\
Researcher: Because you first wrote the article_ you mean/ Or why/	**Investigadora:** Perquè primer vas fer l'article_ dius/ O per què\
Fina: =Yes\=	**Fina:** =Sí\=
Researcher: Why =XXXXX/=	**Investigadora:** Per què =XXXXX/=
Fina: **Because everything you read is in English\ And because the article is also in English\ And then_ well_ translation_ linking words_ Many linking words {(@) because you don't remember how\}** But that's all\ Yes\	**Fina:** **Perquè tot lo que llegeixes està en anglès\ I perquè l'article també està en anglès\ I llavors_ pos ves_ traducció_ connectors_ Molts connectors {(@) perquè no te n'enrecordes de com\}** Però ja està\ Sí\
Researcher: +mhm+ Do you have the feeling that the Catalan text is a literal translation of the one in English/ Or_	**Investigadora:** +mhm+ Tens la sensació que el text català és traducció literal de l'anglès/ O_
Fina: No\	**Fina:** No\
Researcher: No\	**Investigadora:** No\
	[original in Catalan]

In this excerpt, Fina describes the difficulties that writing her PhD dissertation in Catalan entailed, especially considering that the articles that all group members read are in English and

that she had just written part of a scientific article related to her thesis in English. She specifically mentions the scientific and technical information, the linking words and translating as challenging aspects of the writing of her thesis.

While the use of two languages for her professional practice could potentially entail lingistic gains in both, to the question of whether she thinks that she has learned English as a result of her practice in the RG, Fina declares that she believes that her written skills have improved whereas she has 'lost' her oral skills [see excerpt 157].

Excerpt 157: Interview with Fina [PhD res. – Group B] – 'I think that the oral part…I lost it'

Researcher: ... but English_ at the end_ what did you use it for/	**Investigadora:** ...però l'anglès_ al final_ per a què l'has utilitzat/
Fina: To read_ and to go to conferences	**Fina: Per llegir_ i per anar a congressos**
(…)	(…)
Researcher: Did you learn/ English/ You think/	**Investigadora: N'has après/ D'anglès/ Creus/**
Fina: Maybe yes_ +huh+\ I can't tell you\ Because see_ I think that the oral part is a lo··t * I lost it\ Well_ I didn't lose it Because then I was in the * then_ when I was three or four days with * talking to an English guy_ he told me_ wow_ but you speak much better than it seems\ You know/ I guess that until you use it again_ But the written part_ I guess [it's] okay\ But_ of course_ scientific writing is very much passive_ it's very repetitive\ It's not very_	**Fina: És que potser sí_ +eh+\ No t'ho sabria dir\ Perquè clar_ jo crec que la part oral la tinc molt·· * se m'ha perdut\ Bueno_ no se m'ha perdut** Perquè després vaig estar al * llavors_ quan vaig estar tres o quatre dies amb * parlant amb un anglès_ me va dir_ hosti_ però parles molt millor del que sembla\ Saps/ **Suposo que fins que no ho tornes a enganxar_ Però de la part escrita_ suposo que bé\ Però_ clar_ l'escrit científic és molt passiva_ és molt repetitiu\ Tampoc no és gaire_**
Researcher: So_ you're okay with the scientific one\ You mean\ With the scientific register\ Or not/	**Investigadora:** O sigui_ que estàs bé amb el científic\ Vols dir\ Amb el registre científic\ O no/
Fina: Sure\ Yes\ I mean_ **I understand everything\ (…) At most there's one word you don't understand in the whole article_ and you probably don't need to know it** But I do find that when writing articles_ it's important\ Because_ of course_ **there are articles from the United States and all this_ very well written\ And it's pleasant to read them\ And I think that when it comes to accepting them_ they take this into account\ Because of course_ in the end**	**Fina:** Sí\ Sí\ Vull dir_ **jo ho entenc tot** (...) **És que com a molt hi ha una paraula que no entenguis en tot l'article_ i segurament no la necessitis saber** Però sí que trobo que a l'hora d'escriure articles_ és important\ Perquè_ clar_ **hi ha articles d'Estats Units i tot això_ molt ben escrits\ I dona gust llegir-los\ I jo crec que a l'hora d'acceptar-t'ho_ això ho tenen en compte\ Perquè clar_ tu al final estàs venent la història**

436

you are selling the story\ Of course_ if you explain it very much like that_ I think they know how to give it more emphasis_ to give it_ like_look here_ because it's +uh··+ this_ which changes that_ I don't know\	**Clar_ si l'expliques molt així_ jo crec que ells pos saben donar-li pos més el toc d'èmfasi_** de donar-hi_ pos_ fixa't aquí_ perquè és +eh··+ això_ canvia lo que_ No ho sé\ [original in Catalan]

The RG's diglossia, whereby Catalan is preferred for daily oral communication and English for written communication, is perceived by Fina as having affected her language skills. On the one hand, she declares suffering from attrition in oral English, while on the other hand, she contends having achieved a good level, which she attributes to the repetitive nature of 'scientific written (language)'. Fina specifies that she can 'understand everything' in the articles she reads (in English), but she feels that she lacks the linguistic skills necessary to emphasise certain aspects in a publication and to 'sell the story' to the aimed journal as well as authors from the US do.

In the case of Group B, texts were also reviewed by other group members, sometimes in a triple revision system. For example, Fina had Damià (senior res.) as her immediate supervisor, and she used to send her writings to him. They both had the first draft exchange, after which the text was sent to Pere, the group leader. As soon as Pere deemed it correct, the text would be sent to a scientific writer, Audrey, who was based in the US, for the last linguistic revision. Different to what was perceived by members of Group A, Fina considered that Audrey's editing was very little since her article had 'not changed much' [see excerpt 158].

Excerpt 158: Interview with Fina [PhD res. – Group B] – 'I don't think the article changes much\'

Researcher: Okay\ And_ * but you have a tra& * a proofreader\ Right/ = Who's from there [the US]\=	**Investigadora:** Vale\ I_ * però teniu una tra& * una correctora\ No/ =Que és d'allà [d'Estats Units]\=
Fina: =Right\= But of course_ she_ apart from correcting_ * See_ I don't know\ Maybe when they sent it to me it had already been reviewed by Audrey\ I don't know\ (…) **I don't think the article changes much** It's just that I don't know it\ +huh+/ I can't tell you\ (…) =I don't know how much she modifies it\=	**Fina:** =Sí\= Però clar_ ella_ a més de correcció_ * És que clar_ no ho sé\ Potser a mi quan me l'han enviat ja estava passat per l'Audrey\ no ho sé\ (...) **no crec que canviï molt l'article** És que no ho sé això\ +eh+/ No t'ho puc dir jo\ (...) =No sé fins a quin punt el canvia\=
Researcher: =You don't know how the article has changed/= You don't see it before and after/	**Investigadora:** =No ho saps com ha canviat l'article/= No veus l'abans i el després/
(…)	(...)
Fina: Yes\ **But I didn't see it so different**	

(…) it's already published\ And I've already seen it\ +huh+/ But **I don't find it so different from what we did\ But I don't know if that one had already gone through Audrey's filter_ or not**	**Fina:** Sí\ Però **no el vaig veure tan canviat** (...) ja està publicat\ i ja l'he vist\ +eh+/ Però **no el trobo tan diferent del que vam fer naltros\ Però no sé si aquell ja havia passat pel filtre de la Audrey_ o no** [original in Catalan]

In this excerpt, Fina declares that she had not 'seen [her article] so different' from the original draft in its published version, after Audrey's editing. The positive implication of this is that the original draft may have been linguistically well written, but, in contrast, the fact that Audrey was faithful to the original version might entail that Group B's publications would lack the emphatic resources and the effectiveness that Fina found in publications 'from the US'.

The coexistence of the members of Group B with multiple languages was also evident in the multilingual landscape of their headquarter laboratory, reflected in the signs hanging on its walls. In the following pictures, four text types can be distiguished, each of which was linked to certain languages. The first two pictures show different texts located in the experimental bench of a given group member. Picture 45 captures a text in Spanish about some parameters (tools, container type, sizes, etc.) that should be considered when manipulating certain materials. Picture 46 shows a variety of texts in different languages like Catalan, English and Bulgarian.

Picture 45: Printed document for individual use_ IMG_0455
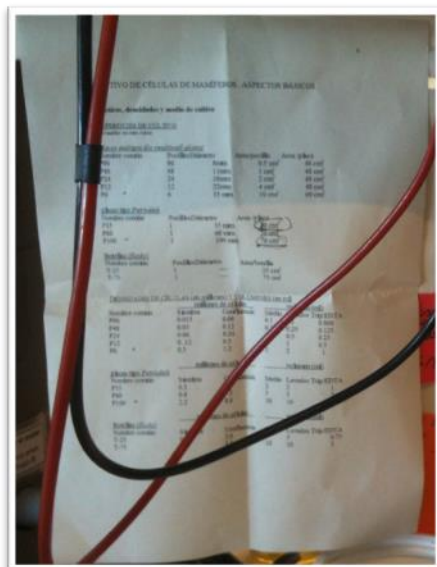
Picture 46: Documents in various languages for individual use_ IMG_0460

The documents shown in pictures 45 and 46 were part of the 'linguistic landscape' (Landry and Bourhis, 1997) of the individual experimental bench of one of the group members, and each of

them had a particular purpose, like supporting the execution of certain experiments, reminding some information and inspiring the practitioner.

The next three pictures show in-group texts, that is, texts written by group members addressing all the other group members. The first two texts are handwritten signs posted next to certain machines to avoid possible conflicts like cleaning the machines and which are intended to improve the cohabitation in the laboratory [pictures 47 and 48]. The third one is the programme of upcoming group meetings [picture 49].

Picture 47: Machine sign 2_ IMG_0451

Picture 48: Machine sign 1_ IMG_0452

Picture 49: 'Group seminar' programme [Group B]_ IMG_0441

While the former two texts, which capture a cohabitation norm, the request from some group member/s that machines are 'kept clean' by all group members, were written in English, the latter text, also relevant for all group members, was written in a combination of Catalan (in the titles and handwritten annotations), English (in the term 'speaker') and Spanish (in the dates).

The following picture illustrates two institutional texts: an emergency protocol (up) and a list of contacts in case of emergency (down) [picture 50].

Picture 50: Institutional texts for emergencies_ IMG_0442
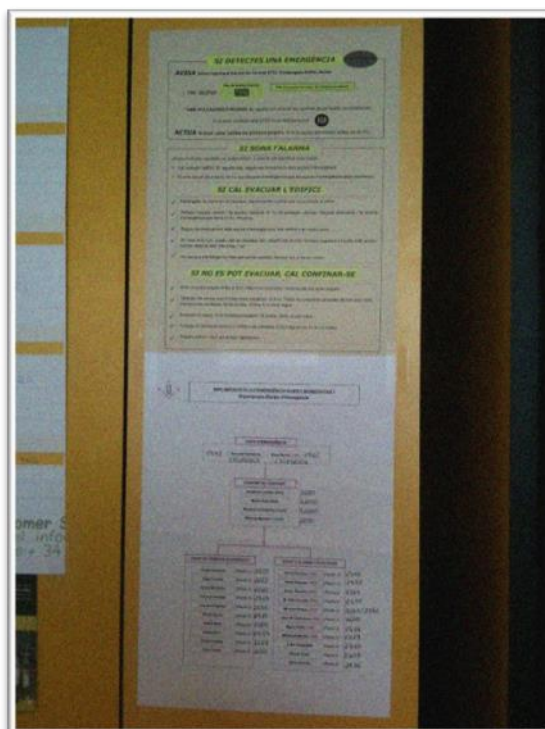
As can be observed in this picture, the language used by the institution to address all the staff working in the building where Group B's headquarter laboratory was based was Catalan.

The issuers of the texts illustrated in the following three pictures were suppliers of materials and experimental 'technologies' that were used by laboratory practitioners. The texts in picture 51 were a standardised protocol of processes that needed to be followed to do a certain experiment (left) and a prospectus containing a list of 'product constituents', the description of the product and its usage norms (right). Picture 52 shows also an experimental protocol.

Picture 51: Protocol and prospectus_ IMG_0454
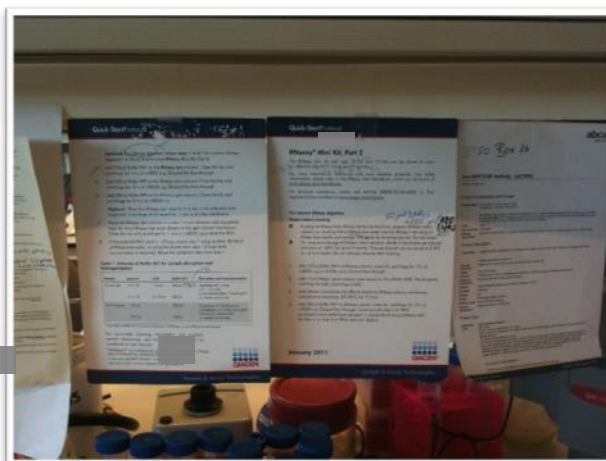
Picture 52: Protocol with images_ IMG_0459
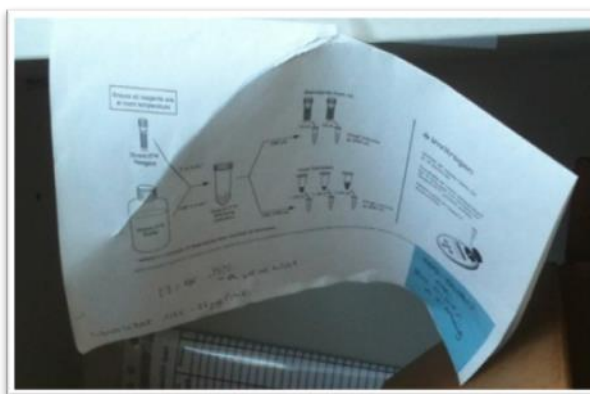
These texts, which were issued by external entities (private companies), and were addressed to an international audience of potential clients, were written in English. Note that in the last one [in picture 52] image predominates over writing.

The linguistic landscape of Group B's laboratory shows that although the 'management' of language use preferred by the institution was Catalan, which was used in institutional texts, and the language of international science introduced by external supplier companies was English, the 'practices' in the laboratory included multiple languages. The texts for the practitioners' individual use were written in any of their L1 and/or in English. Those texts addressed to all group members were written either in English, Catalan or Spanish, or in a mixture of these languages.

To summarise the language policy of Group B, there was in the RG a certain language specialisation. While oral spontaneous interactions could take place in any common language among the interlocutors (most often Catalan, Spanish or English), English was the official language for the reading and writing of scientific articles, for conference presentations and for

the use of imported standard protocols. It was also the official language used in group meetings when non-Catalan-nor-Spanish speakers were present, although this norm was often transgressed and Catalan (most often) or Spanish (sometimes) arose more or less subconsciously. In any other cases, either Catalan or Spanish could be used, depending on the speaker. For written texts aimed to be published, there was a hierarchical production system. These were mainly written by senior members of the group and their ultimate reviewer was the group leader. After Pere's filter, they were sent to a language editor based in the US, who edited only the language. Although Catalan predominated in Group B, English was deemed 'fundamental' for certain communicative practices.

In sum, the two group leaders had quite different language ideologies. Frank (Group A) had a very strong position in favour of using only English for the scientific practice, believing that this prevented the RG from chaos and facilitated understanding and communicative effectiveness. In contrast, Pere (Group B) had a quite different language ideology, prioritising and using himself Catalan (his L1) as a default language, but prioritising also English as the lingua franca of the group when non-Catalan-nor-Spanish speakers were present. The unquestionable preponderance of English in written texts was common in both RGs, which Frank deemed the only way ('There is no other way\') and Pere deemed 'fundamental'. Both group leaders seemed to coincide in their reliance on a/n (English native) scientific writer for the editing of group publications, the cost of which was 'minor' (Frank) compared to other research expenses. Although communication was necessary in the RG-CoP's practice, it was not considered a relevant trait for scientits; it constituted a tool that would be unavoidably mastered by practitioners through the practice of science itself. Despite the similarities in the communicative practices of both RGs, linguistically they had determining differences. The fact that in Group B the group leader had Catalan as his L1, like most group members, facilitated the use of this language in most oral interactions. In contrast, the fact that Group A's leader could not speak Catalan nor Spanish fluently forced the use of English in all communicative events in which he was present, which was also fostered by the fact that several group members could not speak any of these languages either.

Having offered an overview on the multimodal communication policy of the two core RGs studied, in the next section the connection between the IoHE and this communication policy will be described.

6.4. The IoHE in the RG-CoP's multimodal communication policy

This section will explore at the meso level, that of the production, distribution and consumption of texts, the sites of connection between the communication in the RG-CoP and the IoHE, understood as "the process of integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education" (Knight, 2003: 2). To this aim, aspects that have been commented throughout chapters 5 and 6 which suggest this international dimension of communication in the RG will be further discussed here and enriched with additional evidence of data in order to provide a more complete picture of the IoHE in the RG's multimodal communication policy.

A site of internationalisation of the participants' communication that has been described in the previous chapter was the establishment of collaborative bonds between members of the RGs studied and practitioners from other laboratories located abroad. In chapter 5, following the CoP theory, such bonds have been described as forming 'constellations of practices' with outside-CoP practitioners. This implied the mutual agreement on different aspects aiming at an effective communication (and cooperation), as a result of which common repertoires (communicative and scientific) were developed. This in turn generated the establishment of a transnational framework for mutual understanding in form and content (agreement on a shared code, common objectives, compatible value system, etc.). In the following excerpt, Mara describes some concerns, problems and aspects that need to be considered in the process of collaborating with out-group scientists [excerpt 159].

Excerpt 159: 20140317_Informal interview with Mara [PhD res. – Group A] – 'I don't know what one must say'

Researcher: And don't you know anyone else anywhere who does_	**Ερευνήτρια:** Και δεν ξέρεις κανέναν κάπου αλλού που να κάνει_
Mara: No\ And in general my subject is quite difficult\ That is_ I know a professor who is in America_ who works mostly with [object of study]_ blah blah blah\ But neither he knows me nor do I know him\ For example_ that I begin to send him an {(Eng) email}_ Hello_ what are you doing_ there is also the {(Eng) confidentiality}_ that plays a role_ **And I don't know what one must say_ what one mustn't say_** I talk mainly * **I talk with the {(Eng) collaborators}\ Let's say_ with Vienna_** there a guy is an expert	**Μάρα:** Όχι\ Και γενικώς το αντικείμενό μου είναι αρκετά δύσκολο\ Δηλαδή_ ξέρω έναν καθηγητή που είναι στην Αμερική_ που δουλεύει πιο πολύ [αντικείμενο μελέτης]_ μπλα μπλα μπλα\ Αλλά ούτε με ξέρει αυτός_ ούτε τον ξέρω\ Παράδειγμα_ να αρχίζω να στέλνω {(Αγγ) email}_ Γεια σας_ τι κάνετε_ είναι και το {(Αγγ) confidentiality}_ που παίζει ρόλο_ Και δεν ξέρω τι πρέπει να πεις_ τι πρέπει να' μην πεις_ Ποιο πολύ εγώ μιλώ * συνομιλώ με τους {(Αγγ) collaborators}\ Ας πούμε_ με Βιένη_ εκεί ένα παιδί είναι ειδικός σε +εμ+ * στο [αντικείμενο μελέτης]_ να το

in +uhm+ * in [object of study]_ and to have the [object of study] clean_ I talk with him about what experiments I should do_ and if he can give me some information and that\ (…) He starts with * with the concentrations_ with the volumes_ with this_ **until you understand what he is saying_ {(@) My God\} @@@ (…) Then in Brazil_ they're more i··n * with proteins_ and wi··th what is in the [plant]\ So·· I have to first learn the whole technique_ even though I don't * I haven't seen it [before]\ I haven't even seen the machine_ and then to talk with them to see what they can * the results_ how to interpret them_ and what to do next_ and all that** So it's a little·· * it's a little hard\ {(Eng) **Youtube} {(@) has helped me}** = and @@@=	καθαρίσει από αυτό το [αντικείμενο μελέτης]_ και να το έχει τελείως καθαρό_ συνομιλώ μαζί του για το τι πειράματα πρέπει να κάνω_ κι αν μπορεί να μου δώσει κάποια πληροφορία και τα λοιπά\ (...) Αρχίζει με τα * με τις συγκεντρώσεις_ με τα {(Αγγ) volume}_ με τ'από'δώ_ **μέχρι να καταλάβεις τι λέει_ {(@)Παναγίτσα μου\}** @@@ (...) Μετά στη Βραζιλία_ είναι πιο πολύ σε·· * με πρωτεΐνες _ και με·· ο,τι υπάρχει μέσα στο [φυτό]\ **Άρα·· πρέπει να μάθω πριν όλη την τεχνική_ ενώ δε τη * δεν την έχω δει\ Δεν έχω δει καν το μηχάνημα_ και μετά να συνομιλώ μαζί τους για να δω τι μπορούν * τα αποτελέσματα πώς να τα ερμηνεύσω_ και τι να κάνω πάρα πάνω_ κι' όλα αυτά** Άρα είναι λίγο·· * είναι λίγο ζόρι\ Το {(Αγγ) **Youtube} {(@) μ'έχει βοηθήσει}** =και @@@=
Researcher: =Really/= Are there *	**Ερευνήτρια:** =Αλήθεια/= Έχει εκεί *
Mara: There are techniques\ Basic ones\ =Yes_=	**Μάρα:** Έχει τεχνικές\ Βασικές\ =Ναι_=
Researcher: =Really/=	**Ερευνήτρια:** =Αλήθεια/=
Mara: And you press_ I don't know_ and it shows you_ at least how it is done_ so you get an idea of what * how you do it_ what you take_ what you get out of it_ Yes\ It's_ It is\ It is\ It is enlightening\	**Μάρα:** Και πατάς_ ξέρω εγώ_ και σου δείχνει_ τουλάχιστον πώς γίνεται_ για να έχεις μια ιδέα τι * πώς κάνεις_ τι παίρνεις_ τι βγάζεις_ Ναι\ Είναι_ Είναι\ Είναι\ Είναι διαφωτιστικό\
Researcher: Well done\	**Ερευνήτρια:** Μπράβο\
Mara: Otherwise I'd I be * I'd be lost\	**Μάρα:** Γιατί αλλιώς θα ήμουνα * θα ήμουν χαμένη\
	[original in Greek]

In this excerpt, Mara makes reference to some considerations that derive from extra-group collaboration, like acquiring a sense of 'what one must say' and 'what one mustn't say', accommodating to the other's communicative style and repertoire in order to 'understand what he is saying', learning about the other's procedures, tools (like machines) and interpretation framework in order to be able to understand the feedback, the outputs and the reports sent by the collaborators. This excerpt is also interesting because another element of internationalisation arose spontaneously, as was the use of Youtube, an international platform, to learn to do 'basic techniques' in science.

Besides the collaboration with scientists based in a different country, if one considers the RG-CoP as constituting a specific work culture in itself (as argued in the previous chapter), establishing out-group collaborations with practitioners based in the same country or even in the same institution may impliy a similar effort for the development of a shared communication framework. The next two excerpts illustrate this 'cultural' (and communicational) difference and the accommodation efforts needed to overcome it. The first excerpt shows some reflections considering the differences in the communicative repertoire between Group A and an out-group practitioner, Antonio Ortiz, from the same department, who was presenting his work in a joint seminar. The second excerpt displays two instances of what the accommodation process between different-group scientists entails, in this case represented in a meeting between Group A and two collaborators from the same university but different research institute [excerpts 160 and 161].

Excerpt 160: 20140321_Field notes (Page 2) – Group A's seminar with Antonio Ortiz [out-group res.] – 'the graphs, images, diagrams represented…'

«*I realise (or it seems to me) that the graphs, images, diagrams represented in his slides are very different to those usually used by the members of the CoP. → I observe that the <u>vocab</u> that Antonio Ortiz is using is also rather different from the one I am used to hearing in the CoP (*this could be analysed)»	 [original in Catalan]
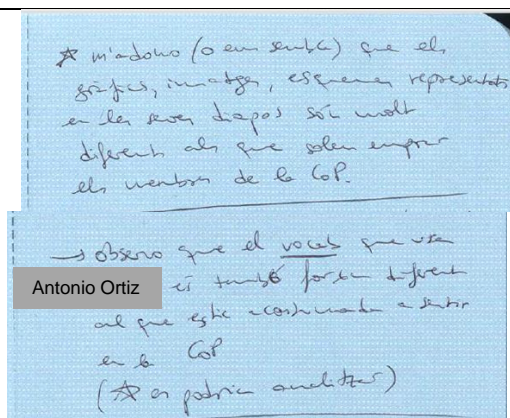
Excerpt 161: 20140305_Field notes (Page 2) – Group A's meeting with out-group collaborators (Alba and Brás) – 'how results must be presented'

«→ Frank (after Alba's intervention) **indicates how results must be presented** so that Alba and Brás can work with the data *it is a matter of different uses of the same object (data) by two different CoPs → Brás asks a question with reference to <u>colour</u> (**it seems significant/relevant for him but it is not for Mikela**, who says that it can be due to other factors, different from what they're investigating»	 [original in Catalan]
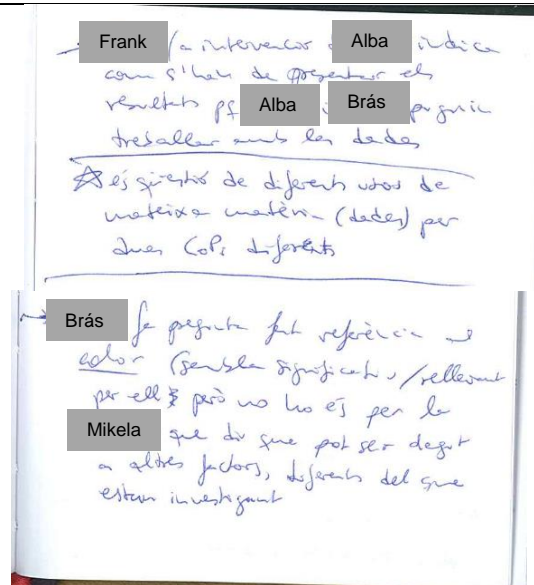
In the last two excerpts, the communicational effort that must be made by practitioners to establish an effective collaboration with out-group individuals is evidenced in instances like the accommodation to different 'graphs, images, [and] diagrams represented', to a different linguistic repertoire ('vocab'), to a different way to present results, and to a different value system that helps discriminate what is relevant from what is not (like a specific 'colour'). Despite the extraordinary effort such collaborations may entail, transcending the routine of one's RG and of the RG's (communicative) repertoire may generate opportunities for innovation and creativity, for it entails the negotiation of multiple perspectives and identities (Wenger, 1998).

The development of constellations of practice may imply the development of networks of trust among scientists who have worked together although in different RGs and maybe also in different countries. These networks at the international level may overlap with networks at the national and institutional level, and might constitute an alternative to these, providing alternative views, alternative resources and in sum an alternative support to that of the institution and of the national system. The following excerpt offers an example of this. In it, Frank explains the usual process he follows to recruit PhD candidates for his RG relying on his own international network of experts [excerpt 162].

Excerpt 162: Interview with Frank [Group A's leader] – 'I call people I know all over the world'
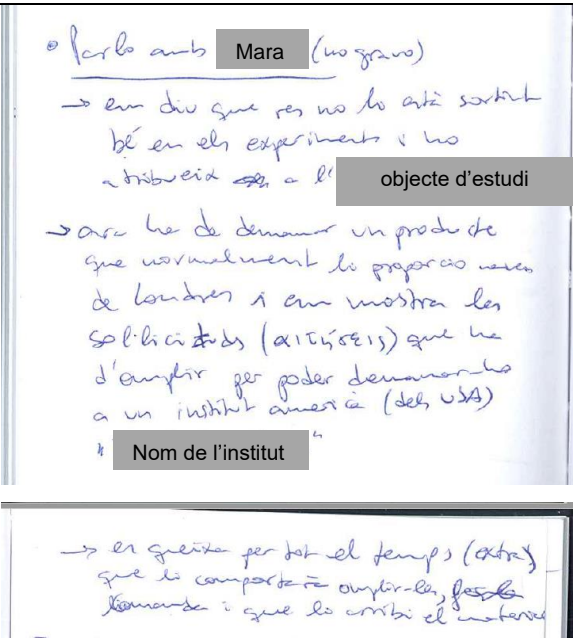
Researcher: So_ are there any requirements previous to their * them coming to the lab/ I mean *

Frank: Yes\ Yes\ +uh+ **There are formal requirements by the university_ and informal requirements_ which I take a lot more seriously than the requirements of the university** The requirements of the university is a certain mark\ Yes/ In my case_ whenever I see somebody over 8.5_ I don't hire them XX XXX\ So_ the university and I are applying different criteria\ (…) So my criterion is to get somebody who·· is not useless in terms of marks_ so I would look at somebody between 6.5 to·· 8\ That would be my criterion\ **I would look for recommendations** but not in writing\ **I would call people and ask them to give me a reference over the telephone** Never in writing\ Because I learnt that in writing people are very kind and they don't say things they would otherwise say over a telephone conversation\ So_ +uh+ and also I do not advertise PhD positions\ **Whenever I have a position_ I call people I know all over the world\ And I say_ Hey_ do you have a promising student who might be interested in coming to my lab and do a PhD/ So_ invariably_ most if not all the PhD students in the lab came through personal contacts**

As can be observed in this excerpt, Frank found in his own international network of 'personal contacts' an alternative support which he did not find in his institution. He declares having different criteria from those of 'the university' for evaluating PhD candidates and consequently he has had to develop his own recruitment system consisting in 'call[ing] people [he] know[s] all over the world' and asking for their recommendation of a 'a promising student' regardless of their marks.

Apart from providing an alternative way for accomplishing one's objectives from that marked by the institution, such personal contact networks have also the advantage of being devoid of the bureaucracy that institutional processes, also in terms of communication, entail. The bureaucratic burden of communication with practitioners in a transnational context was made evident in the following excerpt, taken from an informal interview with Mara (PhD res. – Group A) [excerpt 163].

Excerpt 163: 20140305_Field notes (Page 4) – Conversation with Mara on ordering a product – 'she complains about all the (extra) time'

«• I talk to Mara (not recording) → she tells me that nothing is going well in her experiments and she attributes this to the [object of study] → Now she has to order a product that she normally used to get from London and she shows me the application forms that she has to fill in order to order it from an American institute (form the USA) "[institute name]"» → she complains about all the (extra) time that filling the forms, doing the order and getting the material will take»	[original in Catalan]

This excerpt refers to Mara's complaints about having to fill some application forms to order a product from a new supplier, an institute in the US. The fact of not being able to use her usual supplier from the UK implied spending additional time to meet the new supplier's requirements. This is an instance of the practitioners' adaptation to some standard (bureaucratic) procedures imposed by an institution in a foreign context, and the implications it has for the local context. In this case, communication and products ('boundary objects') (Wenger, 1998) transcended nations, but it could be the case that international communication takes place as a result of the mobility of people across national borders. In the two main RGs studied there were members who had worked in a different country (like China, France, India, Japan, Greece, the UK, Germany and the USA) before Spain. One of these participants was Rober, a researcher from Mexico, who was affiliated with a RG based in a different Catalan city but was working in Group A's lab for some months. In the following two excerpts, Rober compares research done in Mexico and in Europe; explains the reasons why he moved to Europe to do research; and he reacts towards the way research is done in Group A [excerpts 164 and 165].

Excerpt 164: Informal interview with Rober [visiting researcher in Group A] – 'The way of doing science here is very different from [the one] in Mexico'

Rober: The way of doing science here is very different from [the one] in Mexico** Here_ I like that_ as in all of Europe it is * well_ it is big\ But not as big as other bigger countries_ like there is collaboration between countries\ So_ one supports the other_ and two groups_ one in France_ and the other in Portugal_ are in the same topic_ well_ that one does production_ and that one does metabolism\ So_ they collaborate_ but they don't compete directly\ Or it's like one advances as much as the other\ **There [in Mexico] no\ There·· the group is very closed_ and I do this_ and [try that] nobody finds out_ because if not_ they will steal it from me\ Then_ there is little collaboration\ **And I love that here\ Because you can collaborate with one group_ with the other one_ and * and you move forward\ I think you grow more\ As a group_ and as a person** Because also_ collaborating with others_ and learning from others_ helps you\ (…) **Researcher:** And why did you come_ then_ to Europe_ for that reason/ Or for * **Rober:** Yes\ **I really wanted to try a little more what·· science was like around here\ What research was like**	**Rober: Es muy diferente la forma hacer ciencia aquí que en México** Aquí_ me gusta que_ como también en toda Europa es * bueno_ es grande\ Pero no tan grande como otros países más grandes_ como que **hay colaboración entre países** Entonces_ uno apoya al otro_ y dos grupos_ uno en Francia_ y otro en Portugal_ están en el mismo tema_ bueno_ él hace de producción_ y él hace de análisis de metabolismo\ Entonces_ se colaboran_ pero no compiten directamente\ O como que uno avanza a la par del otro\ **Allá [en México] no\ Allá·· el grupo es muy cerrado_** y yo hago lo que esto_ y que nadie se entere_ porque si no_ me lo van a robar\ Entonces_ hay poca colaboración\ **Y eso aquí me encanta\ Porque puedes colaborar con un grupo_ con el otro_ y * y avanzas\ Creo que creces más\ Como grupo_ y como persona** Porque también_ colaborar con otros_ y aprender de otros_ te ayuda\ (…) **Investigadora:** Y por qué viniste_ entonces_ a Europa_ para eso/ O por * **Rober:** Sí\ **Realmente quería probar un poquito más cómo era·· la ciencia por acá\ cómo era la investigación** [original in Spanish]

Excerpt 165: Informal interview with Rober [visiting researcher in Group A] – 'I came to learn'

Rober: Also people organise differently\ (…) **In fact they work differently here *** or well_ **they do it a little different from how I do it\ There [in the other city]** But well\ **I came to learn\ So_ I am doing as they [in Group A] do\ If I notice any difference_ or any improvement_ I would do it directly there**	**Rober:** La gente también se organiza de diferentes maneras\ (…) **De hecho aquí trabajan diferente *** o bueno_ **lo hacen un poco diferente a como lo hago yo\ Allá [en la otra ciudad]** Pero bueno\ **Vine a aprender\ Entonces_ estoy haciendo como ellos [en el Grupo A] lo hacen\ Ya si noto alguna diferencia_ o alguna mejoría_ la haría directamente allá** [original in Spanish]

In the former excerpt, Rober states that the way research is done in Europe is 'very different' to that of Mexico specifically as regards 'collaboration' of RGs across different countries. For Rober, in Mexico RGs are very secretive and reluctant to share information with other RGs, which hinders the progress of RGs and of scientists: 'I think you grow more\ As a group_ and as a person' [in Europe]. His willingness to experience this way of doing research in first person prompted him to work in Catalonia for some years: 'I really wanted to try a little more what·· science was like around here\'. In the latter excerpt, Rober asserts that research is done 'a little differently' from how it is done in his regular RG in another Catalan city; towards which he describes his attitude of accommodating to this difference in order to identify any potential 'improvement' from it and apply the new system to his work in his regular RG. This is explicitly described by Rober as the aim of his research stay in Group A: 'I came to learn\'. Once more, brokering between RGs-CoPs in which one has been given peripheral access is deemed an opportunity for learning. For Rober, comparing different 'structures' (cultural schemata, habits and conventions) would potentially allow him to develop new ways of negotiating meaning and it would thus become a valuable cultural capital for him in the future.

From this, it can be inferred that, as a result of mobility across nations, scientists acquire an symbolic capital that could be named 'international experience'. This 'experience' warrants an abstract body of knowledge and expertise that legitimises certain (communicative) practices, giving authority to its holder. In the two main RGs studied the holders of the greatest authority were the group leaders. This was displayed in the *communicative events* in which they took part through communicative behaviours like adopting the moderator role, expressing statements as general truths, interrupting other group members and/or complementing their explanations [see excerpts 166 and 167].

Excerpt 166: 20140129_Field notes (Page 5) – Ale's [PhD res. – Group A] presentation at the Institute seminar – 'Frank is like a director'

«Frank is like a director (giving the floor to presentations and questions) and at the same time like a <u>defender-warrantor</u> of the experiments and like an authority ↳A question posed to Ale, is answered by Frank "what we did is…" ↳Next he explains why they're doing what they do: "this is a problem…" (a brief history of the experiment) → in the discussion with the audience Frank talks more than Ale (it looks as if Ale had done an intro only and the important part is that Frank can be asked (as an expert and an <u>authority</u>) It is impressive the security with which he talks about everything (he doesn't hesitate nor is he questionned)»	 [original in Catalan]
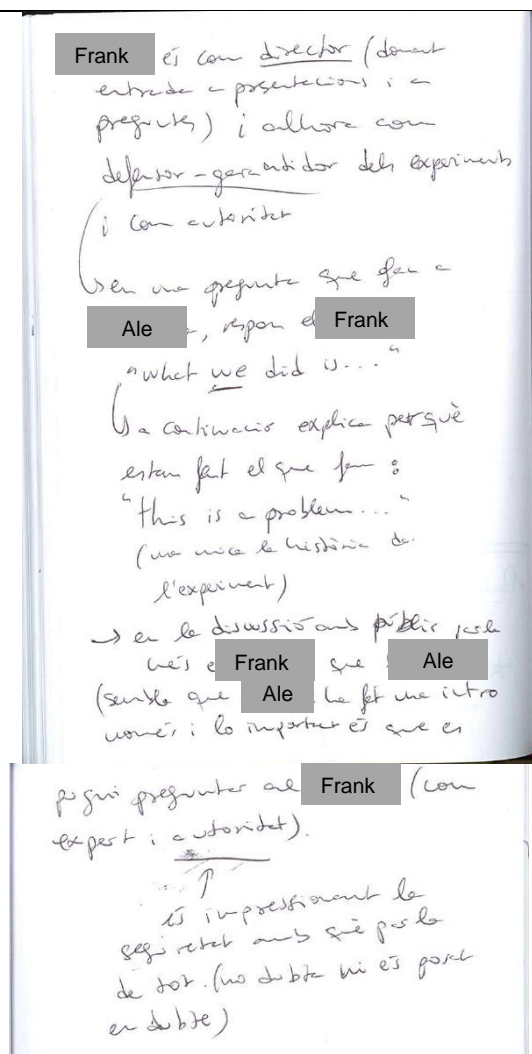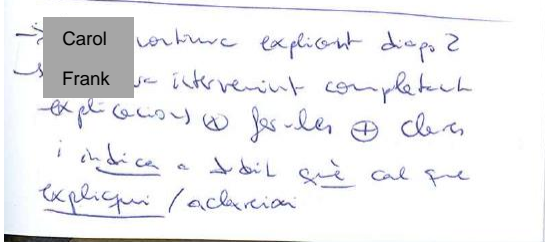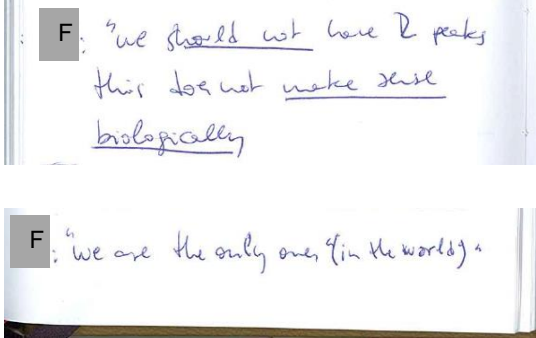
Excerpt 167: 20140219_Field notes (Page 5) – Carol's [PhD res. – Group A] presentation at the new strategy meeting with extra-CoP collaborators – 'Frank has been contributing by complementing…'

«→ Carol keeps on explaining slide 2 → Frank has been contributing by complementing her explanations to make them clearer and <u>indicates</u> to Carol <u>what</u> she must <u>explain</u>/clarify»	 [original in Catalan]

These two excerpts illustrate Frank's performance of authority, through behaviours like 'giving the floor' to group members to talk or intoducing the different communication acts of an event (like presentations, questions, discussions, etc.), intervening by answering or complementing questions posed to other group members, showing self-confidence through his speech style, and guiding discussions by indicating what is worth mentioning, how topics have to be discussed, etc. In this line, in the next excerpt, Frank positions himself, through discourse, as an authority in the field of biology and as a worldwide pioneer scientist [excerpt 168].

Excerpt 168: 20140219_Field notes (Page 9) – Ale's [PhD res. – Group A] presentation at the new strategy meeting with extra-CoP collaborators – 'This does not make sense biologically'

«F: "we <u>should not</u> have 2 peaks This does not <u>make sense</u> <u>biologically</u> F: "we are the only ones (in the world)"»	 [original in English]

This excerpt reflects Frank's guiding style, indicating what 'should' not appear in a given text, in this case made by Ale, what 'does not make sense' (in general terms) in their field of expertise, and the RG's position 'in the world'. These specifications denote Frank's expertise

and status as a knowledgeable agent of other RG's activity in his field of specialisation worldwide, of the logics guiding knowledge in his discipline, of what "makes sense" in their domain, of what constituted 'competence' and of the general criteria to evaluate texts within his domain of expertise.

Besides these demonstrations of authority, granted by the group leader's experience and (international) recognition, within the RG-CoP, the group leader had also an 'agenda-setting function' – a parallel to McCombs and Shaw's (1972) concept concerning the power of the media in shaping the information received by the readership/audience. This means that the group leader determined what objects should be studied, what experiments should be carried out, what results should be given importance, and what should be explained in publications or in other reports [see excerpts 169 an 170].

Excerpt 169: Interview with Pere [Group B's leader] – 'What experiments to do'

Researcher: You are the group leader_ so to speak_	**Investigadora:** Tu ets el cap de grup_ diguéssim_
Pere: Yes\	**Pere:** Sí\
Researcher: So_ what would be your tasks/ The ones you think that are *	**Investigadora:** Llavors_ quines serien les teves tasques/ Que tu creus que són *
(…)	(…)
Pere: Wow\ Let's see_ +uh+ One_ getting funding\ (…) Two_ +uh·+ **coordinating work**\ And three_ very important_ **discussing with everyone +uh+ the projects**\ The daily matters\	**Pere:** Ostres\ A veure_ +eh+ Una_ obtenir fons\ (…) Dos_ +eh·+ **coordinar feina**\ I tres_ molt important_ **discutir amb tothom +eh·+ els projectes**\ El dia a dia\
Researcher: =Okay\ that is_ the doctoral students_=	**Investigadora:** =Vale\ o sigui_ els doctorands_=
Pere: =**What experi& * What experiments= to do_ what not to do_** +uh+ if there is a problem_ Pere_ let's see what happens_ +uh+ if I can't solve it_ then I ask another member of the group_ and so on\ +uh+/ That is_	**Pere:** =**Quins experi& * Quins experiments= fer_ què no fer_** +eh+ si hi ha algun problema_ Pere_ a vere què passa_ +Eh+ si jo no el puc resoldre_ pues li pregunto a un altre del grup_ etcètera\ +Eh+/ O sigui_
	[original in Catalan]

Excerpt 170: Mikela's presentation at Group A's formal seminar [PhD res.] – 'It's something that would enrich your papers'

> **Mikela:** Then: this__ we can do for all the lines that we are obtaining/ or_ =in general/=
>
> **Frank:** =Well_ I= mean_ **I would do it in lines that show an interesting [component] profile** I wouldn't do it on everything\ **So_ the first thing to do is** to look at the [component] +uh··+ composition_ **and then_ we'll** pick lines which have an interesting composition\ **And then_ look** at the general +uhm+ [type] profiles\ And then_ looking at +uhm+ +uhm+ [output] is useful because you can relate the [discipline] side and the [discipline] side with a [discipline] side\ So_ * and Lorenzo Benito is very happy to do this\ So_ +uhm····+**It's something that would enrich your papers**

In the former excerpt, Pere describes his main tasks as the leader of Group B. Apart from fundraising, the coordination of work, and discussing problems in the experiments, he explicitly mentions that he determines 'What experiments' group members should do and 'what not to do'. The latter excerpt reflects a discussion between Mikela [PhD res.] and Frank [Group A's leader] in which Frank suggests what experiments Mikela should do next. What starts as a suggestion in the form of a first-person-singular conditional 'I would do…', becomes an impersonal command: 'the first thing to do is…', and a first-person-plural action: 'then_ we'll…', finally ending up as either another indirect mandate or a direct mandate through an imperative: 'And then_ look at…'. In the end, Frank describes the benefit that Mikela 'would' potentially get from following his advice: her future publications will be 'enrich[ed]' by these procedures.

While this agenda-setting and communication-guiding functions were legitimised by the leader's international background and international recognition, it was also supposedly guided by the leader's perception of what the RG's scientific field demanded and valued in absolute terms, thus at the global level [see excerpts 171 and 172].

Excerpt 171: Interview with Frank [Group A's leader] – 'the market no longer wishes to have specialists'

Frank: …So_ **we are** training generalists\ not specialists\ Because **the market no longer wishes to have specialists** Because of the dynamics of employment\ So_ **industry_ for example_ wants to have people who know many different things\ They don't want** to hire somebody who is a world expert in a narrow field\ If they want that_ they hire a consultant\ So **they don't need** to invest in hiring a scientist to build up a programme\ And when you build up programmes_ **in science_ these days_ these programmes are** what we call_ big science\ they are multidisciplinary_ they require skills well beyond one scientific discipline_ and so on and so forth\ So_ **doing science today_** is very different from the way I was trained to do science\ At my time_ at university_ +uh+ we were trained specialists\ And now **I see** a very steep transition_ and I think we reached the peak_ whereby **we don't want** specialists\ **we want** people who can multitask_ and be able to do many different things\ Not only in their area of expertise_ but also in peripheral areas as well\

Excerpt 172: Interview with Frank [Group A's leader] – 'the projects that we undertake in science now are a lot more prescribed'

Researcher: ... But I was going to say then_ +ehm+ what is the role of creativity and imagination in * in the task of a scientist/ of the scientists that you train/

Frank: Okay\ +uhm+ that * Okay\ +uhm+ that is important_ and a scientist needs to have that\ But I think we * we overvalue creativity\ For the simple reason that **the projects that we undertake in science now are a lot more prescribed\ If you look at calls by the European Union_ for example\ They tell you in the call exactly_ there is the opportunity to apply for this project_ which addresses this challenge_ and we want the consortium that's going to be successful to use this and this and this techniques_ to accomplish this objective_ and this objective_ and this objective** Where is the creativity in that/ So_ **the system destroys the value of creativity in my opinion\ Which is very sad**

Researcher: So you're not very happy about =this situation=\

Frank: =No\ Not very= happy of it\ But *

Researcher: You adapt to it\ =@@@=

Frank: =**You adapt=** to it because **we need to attract funding** So_ creativity goes out of the window\ It's not that we don't value creativity\ We value it a lot\ But at least in the * in * in·· * in terms of designing and implementing scientific research_ creativity takes a back seat to reality\

In the former excerpt, Frank makes reference to 'the market' and 'industry' as the agent/s that mark the kind of training offered in Group A. The personification of these two elements by making them experiencers of mental processes like 'want' and 'wish' situates the power on external entities bigger than the RG and more powerful than his authority. He supports his statements by displaying updated knowledge of 'science' through words like 'these days' and 'today'. And he finally includes himself, together with some other anonymous group member,

through the pronoun 'we' in decisions like 'not want[ing] specialists', 'want[ing] people who can multitask' and 'be able to do many different things' in different areas. In the latter excerpt, Frank declares that external agents like the European Union determine the objectives pursued and the techniques used in their projects through calls for funding allocation, which they have no choice but to 'adapt' to. This leaves no room for group members' agency nor for creativity in science, which Frank qualifies as 'very sad'. The agenda-setting function of the leader at the meso level (of the RG-CoP) thus conveys a global/international agenda, evidenced in grant proposals (and attribution), conference topics, and other global gatekeepers.

In addition to setting the RG's agenda, as part of her expertise, the group leader is responsible for the import of global quality criteria in the field, and of the processes necessary to achieve objectivity and validity, in accordance with her interpretation and their local application. A way to achieve these is by following standardised processes in the laboratory called 'protocols'. Carol in fact asserted that in their laboratory they had the system of applying a specific range of protocols, always in the same way, and they never followed new ones. This corresponded to the preference of the group leader. There were though some exceptions to this norm, in which case new protocols were followed by reading the instructions in an imported experimental 'kit' or by asking other practitioners, either from the same RG or from other RGs [see excerpt 173].

Excerpt 173: Interview with Carol [PhD res. - Group A] – 'the kit will have a protocol'

Researcher: and the rest_ have you learned anything else after that/ After the =practices/=	**Investigadora:** i la resta_ has après després més coses/ Després de les =pràctiques/=
Carol: =Yes\= Because there are new techniques_ that she maybe wasn't' doing_ and * or that she did later_ * Because all the techniques we use * **we all use more or less the same** but there are some experiments that someone has done and others haven't_ then_ **if you haven't done them_ then you ask the person who has done it_** Of course_ Agus has also taught me things_ Simona also taught me things_ and little by little_ based on what people have done in the laboratory_ if someone has done it before_ you try·· that this person teaches you \ **And there are sometimes new things that you come and you have to learn it_ too**	**Carol:** =Sî\= Perquè hi ha tècniques noves_ que potser ella no feia_ i * o ha fet més tard_ *Perquè totes les tècniques que fem servir * **tots fem servir més o menys el mateix** però hi ha alguns experiments que algú ha fet i altres no_ llavors_ **si no ho has fet_ pos preguntes a la persona que ho ha fet_** Clar_ l'Agus també m'ha ensenyat coses_ la Simona també me va ensenyar coses_ i poc a poc_ pos en funció del que ha fet la gent al laboratori_ pos si algú ho ha fet abans_ pos intente··s que t'ho expliqui aquesta persona\ **I a vegades hi ha coses noves que vens i ho has d'aprendre tu_ també**
Researcher: How do you learn them/	**Investigadora:** Com ho aprens tu/
Carol: Well_ if you have to do * now I have to	**Carol:** Pos bueno_ si tu has de fer * ara he de fer uns assajos per determinar un

do some tests to determine a component of the [object of study]\ okay/ Well [component]\ Then_ well_ nobody has ever done it here\ So_ **I know that there is a kit_ a··nd the kit will have a protocol_** then_ * well_ but_ the same kit_ depending on the tissue you analyze_ it has one protocol or another\ **And there in the kit everything is written\ Then_ Well_ it's all about reading it_ and putting it into practice**	component de les [objecte d'estudi]\ vale/ Bueno [component]\ Llavors_ pos Bueno_ ningú ho ha fet mai aquí\ Pos_ **sé que hi ha un kit_ i·· el kit tindrà un protocol_** llavors pos_ * clar_ però_ el mateix kit_ en funció del teixit que tu analitzes_ pos té un protocol o un altre\ **I allí al kit t'ho posa tot\ Llavors_ Bueno_ es tracta de llegir-ho_ i de posar-ho en pràctica**
	[original in Catalan]

In this excerpt, Carol describes the process she usually follows in order to apply new 'techniques' she has never done before. The first resource is 'asking the person who has done it' before. In the case of 'new things', not done before in the RG, 'you must learn' them through an experimental 'kit' that 'has a protocol', by 'reading' it and 'putting it into practice'. These protocols are written sequences of steps to be followed, sometimes aided by images, generally written in English, that involve the use of 'products' bought to private companies or other research institues/labs. Protocols hence implied an imposition at the local level of standardised procedures exported internationally.

Another site of internationalisation of scientists' communication were the scientific articles that practitioners had to write in order to become valued professionals in their domain. These were ultimately aimed at an international audience of potential readers from their field of expertise. However, in the first instance, they were addressed to journal editors and reviewers, usually located in a different national context, in the case of the participants in this study. In order to persuade this first-level audience, practitioners had to acquire a sense of some standard contents and arguments that would be accepted as valid by these stranger readers. In the following excerpt, Fina makes reference to these considerations [excerpt 174].

Excerpt 174: Interview with Xènia [PhD res. - Group B] – 'I can't put it as a reliable result'

Researcher: Because is the article equivalent to the whole thesis/ Or is it what you got_ to the conclusion =let's say_ of the thesis/=	**Investigadora:** Perquè l'article equival a tota la tesi/ O sigui a lo que has tret_ a la conclusió =diguéssim_ de la tesi/=
Fina: =About the published one_= no\ **Some thigs are missing** What happens is that they are to be proved\ They are_ that's what I told you_ like open fronts_ that indicate that such a thing is happening_ but of course_ **I can't put it as a reliable result_ because I haven't checked it with the following**	**Fina:** =Del publicat_= no\ **Falten coses** Lo que passa que estan per demostrar\ Són_ és això que et deia_ com fronts oberts_ que indiquen que està passant tal cosa_ però clar_ **jo no ho puc ficar com un resultat segur_ perquè no ho hai comprovat amb les**

checks I should do	**següents comprovacions que hauria de fer**
Researcher: So **there are like some standards of things you need in order to say that something is proven/**	**Investigadora:** O sigui **hi ha com uns estàndards de coses que necessites per dir que algo està provat/**
Fina: Yes\ Sure_ if I sent an article· with·· * with these things_ they would ask me a lot of experiments They can be done_ +uh+/ but * but it needs time\	**Fina: Sí\ Clar_ si jo enviés un article· amb·· * amb aquestes coses_ me demanarien molts experiments** Que es poden fer_ +eh+/ però * però és temps\
	[original in Catalan]
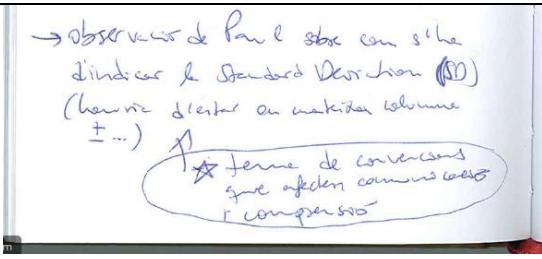
In this excerpt, Fina refers to some 'checks I would have to do' in order to validate some results she got before they could be accepted in a publication. She shows certainty in asserting that she would be asked to do 'many more experiments' for the potential article to be accepted. These reflections suggest Fina's accommodation to a predominant ideology as regards what constitutes good practices, valid and reliable results, and objectivity in science. Again, gatekeepers of these "quality" standards are journal editors, who are backed by a certain global consensus.

Such consensus on certain quality standards affects also text form. An example of this are certain standard international conventions tacitly assumed to be "the good way" of presenting specific data or information [see excerpts 175, 176, 177 and 178].
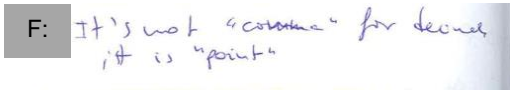
Excerpt 175: Lurdes' written report [BA res. – Group A] – 'I have created a table'

Lurdes: I have created a **table** describing (…) I will add it to this document when ready.
Frank: Yes make sure you do this as it is an essential part of your report and it will make **writing a paper for publication a lot easier.**
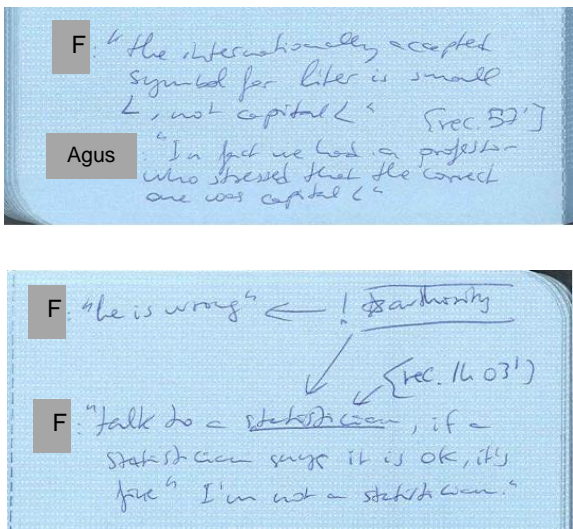
Excerpt 176: 20140305_Field notes (Page 2) – Group A's meeting with out-group collaborators (Alba and Brás) - 'how to indicate the Standard Deviation'

«→ observation of Frank on how to indicate the Standard Deviation (SD) (it should be in the same column ±…) *issue of conventions that affect communication and comprehension»	 [original in Catalan]

Excerpt 177: 20140128_Field notes (Page 6) – Ale's presentation rehearsal for Institute seminar [PhD res. – Group A] – 'It's not "comma" for decimals'

«F: It's not "comma" for decimals it is "point"»	 [original in English]
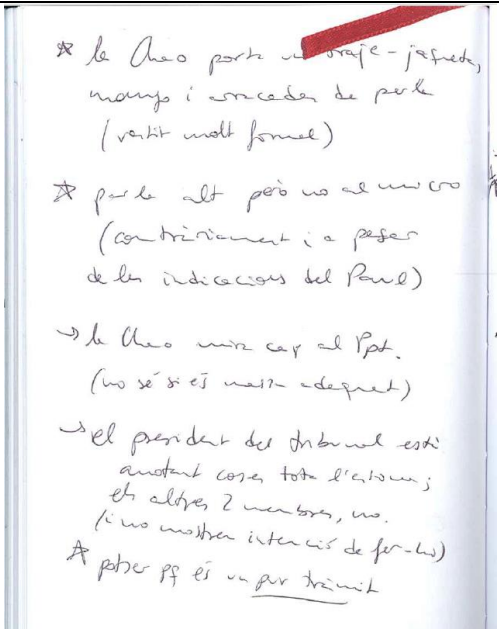
Excerpt 178: 20140718_Field notes (Page 3) – Tània's PhD defence rehearsal 1 [Group A] – 'the internationally accepted symbol for liter'

«**F:** "the internationally accepted symbol for liter is small L, not capital L" **Agus:** "in fact we had a professor who stressed that the correct one was capital L" **F:** "he is wrong" ← ! *authority ↙ **F:** "talk to a statistician, if a statistician says it is OK, it's fine" I'm not a statistician.»	 [original in English]

These excerpts show once more how Frank acted as the local importer and granter of the formal conventions that practitioners need to adopt in order to attain international standards. In these cases, it concerned some specific aspects or conventions that a written text aiming at publication should have: a table [excerpt 175], the Standard Deviation 'in the same column' [excerpt 176], 'point for decimals' [excerpt 177] and the 'symbol for liter is small L' [excerpt 178].

Apart from the standardised procedures while 'doing experiments' imposed by the imported protocols, several *communicative events* that members of the RG-CoP used to engage in had also a standardised, somehow even ritualised tenor [see excerpt 179].

Excerpt 179: 20140217_Field notes (Page 2) – Lian's PhD defence [Group A] – 'maybe because it is a mere formality'

«* Lian is wearing a suit, a bun and pearl earrings

(very formal outfit)

*she speaks loud but not to the microphone (opposite to and in spite of Frank's indications)

→ Lian looks at the Ppt.

(I don't know whether it is very adequate)

→ **the president of the panel is taking notes all the time; the other 2 members, aren't.**

(and they don't show the intention to do so)

maybe because it is a mere formality»

[original in Catalan]

This excerpt describes a detail of Lian's PhD defence, in which only one member of the panel looked interested to the point of taking notes. The fact that the other two members did not take any notes led the researcher-observer to infer that for them that act was 'a mere formality'. This, together with other characteristics of this communicative event, imbued with formality (in its act sequences, in the norms of interaction, in the formal outfit of participants, especially the presenter, etc.), lends it the appearance of a rite. These formal conventions, some of which were imposed by the institution (like the requirement to have three sitting members in the panel plus

two substitute members, and the specification that there has to be a public presentation of the study and a question round), following international policies (such as the *European doctorate*), resonate with those of the same prototypical communicative event in other parts of the world (see Swales, 2004). This denotes the accommodation of the multimodal communication policy to a dominant ideology following a certain 'centre' of influence (Bennett, 2014c), in a fairly standardised way worldwide.

Another site of internationalization of scientists' communication is the practitioners' acceptance of and the accommodation of their practice to a worldwide value system of assessment of their work based on their publications and journals' impact factor. Hints of this can be observed in the following excerpt, in which Agus evaluates his CV [excerpt 180].

Excerpt 180: Interview with Agus [PhD res. – Group A] – 'I need articles'

Researcher: Do you think that if you decide to continue in science_ your curriculum_ as it is now_ will open doors for you/	**Investigadora:** Creus que si decideixes continuar en ciència_ el teu currículum_ tal com està ara_ t'obre portes/
Agus: No\ (…) As it is now_ it won't\ In case I manage to publish one or two articles_ * I have some {(Eng) reviews}\ as author and co-author\ But **I need articles_** +mm+ let's say_ +mm+ scientific_ in the sense of · results_ dis& * discussion_ no/ experiments_ **And if I manage to publish these two_ I will find s& something_ but if don't_ I don't think my CV is nothing to rave about**	**Agus:** No\ (...) Tal com està ara_ no\ En cas que aconsegueixi publicar un o dos articles_ * tinc {(Ang) reviews}\ com a autor i coautor\ Però **necessito articles_** +mm+ diguem-ne_ +mm+ científics_ en el sentit de·· resultats_ dis& * discussió_ no/ experiments_ **I si aconsegueixo publicar aquests dos_ pos a& algo trobaré_ però si no_ no crec que el meu currículum sigui per tirar coets**
Researcher: So_ you depend on two articles_ let's say\	**Investigadora:** O sigui_ depens de dos articles_ diguéssim\
Agus: Yes\ Yes\ (…) I mean_ **if there's any chance of continuing in science_ it's doing this\ I think**	**Agus:** Sí\ Sí\ (...) Vull dir_ **si hi ha alguna possibilitat de seguir en ciència_ passa per aquí\ Crec**
	[original in Catalan]

In the previous excerpt, Agus contends that he needs to publish at least two empirical articles in order to deem his CV a competitive one so as to have a 'chance of continuing in science' and 'find something' (meaning a future position). Although he does not mention it explicitly, 'publishing' entails doing so in international journals.

As regards language, several participants used the adjective 'scientific' to make reference to the language they used in their work. In this case, internationalisation was present in the linguistic conventions of their domain, which affected mainly the vocabulary used and the rhetorical style (like the use of the passive and concision in written texts). The significance of this specialised language was evidenced in instances when the participants interacted with out-group individuals, with scientists with different specialisation fields, and especially with non scientists. This is evidenced in the following excerpt, in which Agus narrates how a member of the panel in his PhD defence questionned his use of a certain 'expression' [excerpt 181].

Excerpt 181: Interview with Agus [Phd res. – Group A] – 'I was surprised that she was surprised'

Researcher: …And_ on the_ this\ the questions of the panel_ * Well_ sure_ now you might not remember\ The third question_ I have written down_ that_ I think you were surprised by the expression they used\ Or the other way around\ (…) **Agus:** The woman/ Or_ (…) +Eh+ she told me * **she commented that I had used the expression_ se& * s& +m+ * negative selection compression\ And she said that * that she had never heard that expression_ and that it was not common_ and I think that it is * Well_ I think that indeed it is_** and in the end the * the * let's say **the president of the panel_ told her that it was_ that * that indeed it was used_ and that there was no problem** **Researcher:** +mh+ okay\ And how come she was surprised/ Maybe because she was from another field/ Or_ **Agus:** Maybe\ But **I was surprised that she was surprised** Because I didn't deem it so * so weird\	**Investigadora:** … I_ a la_ això\ les preguntes del tribunal_ * Bueno_ clar_ ara igual no te'n recordes\ La tercera pregunta_ tinc anotat_ que_ crec que et va sorprendre l'expressió que van usar\ O al revés\ (…) **Agus:** La dona/ O_ **(...)** +Eh+ ella em va dir * **em va fer un comentari que jo havia utilitzat l'expressió_ se& * s& +m+ * compressió de selecció negativa\ I ella deia que * que aquesta expressió no l'havia sentit mai_ i que no era comuna_ i jo crec que sí que * Bueno_ crec que sí que ho és_** i al final el * el * diguem-ne **el president del tribunal_ li va dir que sí_ que * que sí que s'utilitzava_ i que no hi havia problema** **Investigadora:** +mh+ vale\ I com és que li va sobtar/ Potser perquè era d'un altre àmbit_ ella/ O_ **Agus:** Potser\ Però **a mi em va sorprendre que li sorprengués** Perquè tampoc ho considerava tan * tan estranya\ [original in Catalan]

This excerpt shows the negotiation of a common code among scientists. In this case, Agus explains how the expression 'negative selection compression' he used in his PhD defence triggered a reaction from a member of the panel who 'had never heard that expression' and who considered that 'it was not common' in their domain. On the contrary, another member of the panel defended that 'indeed it was used' and 'that there was no problem'. The authority of the

members of the panel was higher than that of Agus, but the fact that the second member felt legitimised to contradict the first suggests that the second might be more legitimised as regards the code used than the first, maybe due to his greater knowledge of Agus' field of expertise.

Moreover, another relevant hint of internationalisation in the code used by the participants was the use of the English language imposed in both RGs at least for the reading and writing of scientific articles and for (international) conference presentations, which penetrated more in Group A where it was used in all group meetings and other oral and written interactions. The usual use of English for reading and writing generated certain incapability or difficulty of practitioners to use other languages for these purposes. This fact was described by Carol, who narrates the difficulties she encountered when she had to write 'a book chapter in Spanish' [excerpt 182].

Excerpt 182: Informal interview with Carol [PhD res. – Group B] – 'We usually write in English'

Carol: ... now it's the other way around_ sometimes I want to write * yesterday_ for example_ I was translating something from··· * from English to Spanish_ {(@) because} **now we have to write a book chapter in Spanish** (...) **We usually write in English_** but this is for an association that is * it's from Spain and Latin America_ and then it is in a& * you can do it either in Spanish_ or in Portuguese\ **And I don't know how to write in Spanish** @ {(@) I collapse_} @@ the computer changes it_ and then_ you say_ +m+ {(Eng) in}/ no\ I don't know\ what can you do/ @	**Carol:** ...ara em passa al revés_ de vegades vull escriure * ahir_ per exemple_ estava traduint una cosa del··· * de l'anglès al castellà_ {(@) perquè} **ara hem d'escriure un capítol d'un llibre en castellà** (...) **Normalment escrivim en anglès_** però això és per una associació que és * és d'Espanya i Iberoamèrica_ i llavors és amb a& * ho pots fer en castellà_ o en portugués\ **I no sé escriure en castellà** @ {(@) se me'n va_} @@ Entre que l'ordinador t'ho canvia_ i tal_ pos dius_ +m+ {(Ang) in}/ no\ jo què sé\ què fas/ @
Researcher: What are you explaining_ then/ your results_ and all that_ but in Spanish/	**Investigadora:** Què estàs explicant_ llavors/ els teus resultats_ i tot això_ però en castellà/
Carol: Well_ yes\ a bit of what we do_ the project and so_ in Spanish\ And_ hey_ when * **when you are always using a language_ then it is diff& * well_ it is hard for me** Well_ the las& * **the last three years_ everything I wrote was in English** then_ now I have to write again in Spanish_ +m+ @@	**Carol:** Bueno_ sí\ una mica el que fem_ el projecte i tal_ en castellà\ I_ tio_ se * **quan fas servir sempre una llengua_ després te cost& * bueno_ a mi em costa** A vere_ que al ul& * **els ultims tres anys_ tot lo que he escrit és en anglès** llavors_ ara he de tornar a escriure en castellà_ +m+ @@
Researcher: Of course these are words you normally use in English\ right/	**Investigadora:** Clar_ que són paraules que utilitzes normalment sempre en anglès\ no/
Carol: Sure \ I don't know\ It's hard_ +uh+/ Well_ hard * well_ hard_ not really\ No/ You	**Carol:** Clar\ No ho sé\ És difícil_ +eh+/

say_ concentrate_ and you do well\ no/ But_	Bueno_ difícil * a vere_ difícil_ tampoc\ No/ Dius_ concentra't_ i ho fas bé\ no/ Però_
	[original in Catalan]

In this excerpt, Carol (Catalan and Spanish-L1) declares that she 'do[es]n't know how to write in Spanish' after having to write a book chapter on her research in this language for the first time. She attributes this struggle to the fact that 'the last three years' 'everything [she] wrote was in English', which illustrates the consequences that the generalised use of English as a lingua franca in science might have for other languages and their speakers.

Having pointed at the several *loci* of connection between the participants' communication and the internationalisation of their practice, in this case framed in a higher education institution, in the next section the findings presented in this chapter will be discussed and contrasted with relevant literature.

6.5. Discussion and conclusions

In this chapter, the data analysis has been guided by the two research sub-questions: *What kind of multimodal communication policy does the group abide by? How is this multimodal communication policy influenced by the internationalisation of higher education?* Sections 6.1 and 6.2 have described the *multimodal communication policy* of the RGs studied; section 6.3 has focused on the RGs' language policy; and section 6.4 has presented the sites of connection between the *multimodal communication policy* of the RGs studied and the IoHE.

This chapter has demonstrated that the RG's central practice of 'doing experiments' requires the practitioners' engagement in a range of communicative practices devoted to learning their procedures, negotiating their details, reporting on those experiments and exposrting their results, among others. Although communication could seem irrelevant or little significant in the scientists' endeavour, as was argued by some participants, this chapter has shown that, on the contrary, communication is intrinsic in 'doing science' and that it is in fact a decisive practice in a scientist's successful career, even closely related to success in science. Indeed, Travaille and Hendriks (2010) found that "communication" was one among the "critical success factors" for scientists in their study, as part of key processes in scientific practice like knowledge creation and socialisation.

In order to answer the first research sub-question about the main features of the multimodal communication policy of the RGs, the RG's 'multimodal communication policy' has been

operationalised following Spolsky (2007) as consisting of *practices*, *beliefs* and *management* concerning communication in the RG.

With reference to communication *practices,* the data analysis has revealed more than 80 (prototypical) communicative events that the participants engaged in or made reference to during the data collection period. The list corresponds to 'prototypical' events meaning that specific communicative events have been grouped according to some constant characteristics as regards the shape of their components (i.e. participants, setting, key, norms, genres, etc.). The identification of communicative events, like that of *genres* in *genre analysis,* is intended to help the analysis of the RGs' multimodal communication policy in the sense that it contributes to our understanding of aspects like how the participants' communication was structured, the roles that group members adopted through communication and the relationships among them, the criteria that made events "acceptable" in the specific culture of the RG, the goals pursued through the execution of the events – as those of genres (Bazerman, 1994) –, and their meanings in relation to their socio-historical context (Bateman, 2008), among other considerations.

Group members' participation in each of the events was uneven as regards the frequency of their engagement (if any), their role in them, their expertise in the event, and their motivation to participate. This coincides with Devitt's (1991) finding of the existence of a given 'genre set' that certain practitioners in a community engaged in more than others. Considering the practitioners' roles in the diverse communicative events connects with the idea that scientists have multiple identities in practice, such as being activators of inscriptions, decision makers, promoters of new ideas and supporters of arguments (Latour & Woolgar, 1986 [1979]). This multifaceted identity may trigger the adoption of one or other roles in different communicative events, especially in connection with their individual rank, like junior researcher, senior researcher and group leader. In the previous chapter, we have argued, for example, that seniority usually entailed a progressive dettachment of practitioners from the experimental bench and thus less engagement in 'doing experiments' and more in office communicative events. In connection with the CoP theory, the range of communicative events typical of the RG constituted part of its shared (communicative) repertoire.

As has been argued in this chapter, 'doing experiments' was in itself a communicative event, for it entailed interaction among practitioners (e.g. when mentoring one another, when asking about some procedures, when sharing materials or machines, etc.) and it involved also interaction with inanimate entities (e.g. when giving instructions to machines, interpreting machine outputs and labelling objects). The relevance of 'things' or 'artifacts' in science as well as of scientists' interactions with them has been approached by sociologists of science (e.g. Latour, 2004; Pinch, 1985) and multimodal researchers (e.g. Alač, 2005b; Lemke, 1990), who have underscored their

465

meaning load and meaning-making potential. As a communicative event, 'doing experiments' was also the central *event* of most participants' daily practice (specifically for lab practitioners). This idea of 'centrality' resonates with Swales' (2004) 'genre hierarchy', a loosely defined notion according to which practitioners attach an abstract "value" to the genres of the texts produced in their discipline. Although Swales (2004:13) places the 'empirical scientific article' as the central research genre, he acknowledges the existence of other possibilities in life sicences and in science more generally. And although 'doing experiments' cannot be deemed a 'genre' in its strict sense, as a communicative event its centrality is evident. 'Doing experiments' was the main topic of most other communicative events; lab practitioners used to spend most of their working time engaging in this *event*; and the success of other communicative events (like 'writing scientific papers' or 'writing the PhD dissertation') depended on it.

In the case of the RGs studied, despite its central role, 'doing experiments' it was not an end in itself. It constituted the legitimising resource for other communicative events that were intended to transcend the RG-CoP, like 'writing scientific publications' or 'doing conference presentations', which reported on the experiments done and whose recognition depended on those experiments. Therefore, those events that aimed at transcending the RG-CoP with the purpose of gaining recognition followed 'doing experiments' in the hierarchy of communicative events since they were critical for the legitimation of practitioners as scientists. This is in line with the idea, presented in the previous chapter, that "doing science" and "producing new knowledge to advance their field" were the RGs' joint enterprises. Following this line of thought, other prototypical communicative events seemed to arrange around the pivotal 'doing experiments' event in three different ways: those that contributed to the planning of the experiments, those that were parallel to the 'doing experiments' event, and those that implied informing on the experiments' results and procedures. Additionally, a range of communicative events have been identified that were not directly linked with 'doing experiments' but had other functions, such as socialisation, managing access in the RG, and fundraising. All these events presented in section 6.1 are "options for behaviour that a society provides for its members" (Bateman, 2008: 190), although their hierarchical arrangement suggests that some options were prioritised over others in that society/community, here the RG framed within a *domain* of practice.

Following *genre theory*, the prototypical communicative events of the RG and/or their inscribed outputs ('inscriptions') have been classified into three types, depending on their degree of openness or confidentiality. This adds to the classification of 'research genres' offered by Swales (2004), which fall into two categories: 'open' and 'occluded or supporting' genres. In

the case of the communicative events identified in this study, at one end there are those events/inscriptions that were public out of the domain of the RG (which could be labelled as 'open'); at the other end, there were the events/inscriptions whose participants were members of the RG only (which could be labelled as 'occluded'); and finally, in a middle position, there were those events/inscriptions with restricted access but that involved in-group as well as out-group individuals (which could be labelled as 'restricted'). The label 'supporting' has been deemed here more appropriate as a criterion of hierarchy instead of confidentiality, and thus to qualify those events/inscriptions that contributed to the most central events and inscriptions like 'doing experiments' and to those events/inscriptions that aimed at transcending the RG for out-group recognition.

As regards their chronological arrangement, some preferred sequences of prototypical communicative events have been identified. These were attached either to the nature of the event – some required the previous execution of other events while others did not – or on the status of each group member – i.e. PhD researchers had a specific pathway of events which they needed to follow. In contrast, several events were not part of a fixed sequence and hence overlapped with others and followed unpredictable sequences. Swales (2004) relates certain 'genre chains' and the characteristics of some 'research genres', like the PhD defence and the PhD dissertation, with national, institutional and departmental conventions; whereas other genres, like the group meeting, have "*localized* and *inherited* ways of proceeding within highly specific communities of practice" (Swales, 2004: 188) like the RG. This has been demonstrated in the data analysis through the detailed description of the 'lab meeting' (Group A) by contrasting it with the 'group seminar' (Group B).

Acquiring notions like the range of communicative events available in the RG, their hierarchical arrangement, their significance, their characteristics and their preferred sequence is an ethnographic achievement which newcomer group members had also to attain as part of their learning trajectory (Wenger, 1998) within the RG-CoP. As has been argued in this chapter, this was a "learning by doing" process (Wright, 2008), whereby these and other notions were subtly and almost subconsciously acquired through the practitioners' engagement in the RG-CoP's practice, and hence through their *situated learning* (Lave & Wenger, 1991). This type of learning has been argued to be typical "in professions where traditions are passed on without explicit instruction by older members of the profession" (Van Leeuwen, 2005: 56), as in science, where high reliance on group peers' knowledge and expertise to develop one's own has been noted (Latour & Woolgar, 1986 [1979]). Yet, it was also a "learning by communicating" process, since all practices entailed some kind of communication through any variety of communicative modes (writing, speech, image, gesture, sound, etc.). With reference to types of

workplace learning, Tynjälä (2008) identifies some in the literature that imply communication, like co-operating and interacting with co-workers and clients. Ashton (2004: 31) includes 'communication' among the "soft skills required for the new system of production" that relies especially on workplace learning and counts on taking advantage of employees' skills as an added-value. And Succi and Canovi (2019) position 'communication' among the three most important soft skills enhancing graduate employability and claim for more efforts from all parties to develop them. As has been shown here, the participants' learning trajectory in the RG depended highly on a wide range of communicative practices.

However, practitioners were immersed in a double learning trajectory in the process of becoming 'competent scientists'; one as members of the RG-CoP that pulled them inwards towards more central positions of expertise in the RG's practice (Lave & Wenger, 1991; Wenger, 1998), and another one as members of the scientific community of their *domain* in which they had to demonstrate competence and attain recognition. These were two distinct authority frameworks, each of them having its own norms, beliefs and practices (Holley, 2009), within which practitioners had to mobilise communication resources skilfully in their performance of membership in these two communities (Lemke, 1990). Both trajectories have hence been proven to be linked with mastering communication. While the first required expertise acquisition in 'doing experiments', the latter was more dependent on those communicative events that aimed at transcending the RG-CoP and reaching an external readership/audience, like 'writing a scientific paper' and 'doing a conference presentation'.

These two kinds of communicative events suit the two kinds of knowledge on which Western science is based: publications correspond to "[t]he primordial status of explicit knowledge…in science", and 'doing experiments' "heavily depends on tacit aspects of knowing" (Travaille & Hendriks, 2010: 427). Therefore, both, explicit and tacit knowledge were chief parts of their learning in the RG-CoP. Accordingly, communicative 'competence' was locally shaped through practitioners' legitimate (peripheral) participation (Lave & Wenger, 1991) in the RG-CoP's practice, based on the observation and imitation of old-timers, as well as by explicit indications and corrective feedback from immediate supervisors and/or ultimately from the group leader. The supervisor's guidelines and (corrective) feedback are two of the few ways in which 'tacit knowledge' (Polanyi, 1958), paramount in scientific practice, became explicit. In fact, the scientific discourse has been argued to conceal deliberately bits of knowledge for different reasons such as competitiveness, rhetorical conventions like concision, and commercialisation imperatives, but also unintentionally due to the non-verbal nature of much scientific knowledge and to its possible fragmentation among the multiple channels/communicative events through which it is conveyed (Collins, 1974). Some communicative events that aimed at making tacit

468

knowledge explicit were 'mentoring', 'informal professional conversations', 'informal emailing' and 'group meetings'.

The conjunction of "observation and imitation" together with "intentional guided learning" has been claimed to be indispensable "to assist develop individuals' procedures and concepts required for shared practice" (Billett, 2002: 465). It has also been claimed that the workplace itself can afford opportunities for all types of learning/training (Kyndt, Dochy & Nijs, 2009), like 'formal' (planned and purposeful) and 'informal' (unplanned and implicit). For Billett (2001: 18), far from being 'informal', workplace learning is "structured by the goals, activities and culture of the work practice", which in the case of RGs is dependent on the 'culture' of the scientific *domain* that their practice is ascribed to. This way, the workplace constitutes an intentionally-shaped learning environment where practice, affordance, negotiation, and regulation intersected (Billett, 2004). Also, following Polanyi, scientific knowledge is "a "hands-on" knowledge that no amount of formal, written instructions could ever replace" (Kaiser, 2005: 2). This implied practitioners' enormous reliance on other *knowledgeable agents* (Giddens, 1984) following a hierarchy of claimed or recognised authority. Mentoring, that is, the guidance of a newcomer by an old-timer, has been argued to be beneficial at early stages of work practice (Carter & Francis, 2001; Loue, 2011; Haeger & Fresquez, 2016). Applied to the RG as a workplace framed within the academia, the tutor or mentor can be perceived as responsible "to induct students into a new 'culture', that of the academy" (Lea & Street, 1998: 159) through a socialisation process (Hakala, 2009; Hopwood, 2010a). Due to this unstructured, highly social and individually-guided nature of learning through practice in the RG, the participants' learning opportunities, also as regards communication, were highly dependent on the predisposition and knowledge of their group peers, and especially of the group leader as the ultimate responsible and highest authority.

The *management* of the RG's multimodal communication policy took the form of "explicit" indications by individuals having a higher hierarchical status recognised (Spolsky, 2007) – either by practitioners themselves, by the institution or by the wider scientific community. In academic literacies, 'staff feedback' (on students' written reports) has been found to be a site for the construction and reproduction of "appropriate knowledge" and simultaneously for the preservation of power relations (or authority) "between novice student and experienced academic" (Lea & Street, 1998: 169). The feedback contains "[a]ssumptions about what constitutes valid knowledge" which are most often implicit (Lea & Street, 1998: 169). Thus, despite taking the form of explicit suggestions, the feedback bears an underlying implicit ideology. As has been demonstrated in the data analysis, the group leaders' explicit formulation of norms of communication (among other types) was a reflection of their *beliefs* on how

'competence' in their *domain* was performed, which in turn were based on the group leaders' own past learning experiences as well as on their interpretation of what their *domain* demanded. The existence in science of certain domain-specific norms of inscription production (or of representation) and of criteria of truthfulness has been widely asserted (i.e. Agazzi, 2014; Beaulieu, 2002; Frow, 2014); and 'institutional and disciplinary networks' have been identified as the models conveying the convention traditions of the *domain* (Mody, 2014), following what van Leeuwen (2005: 56) names the 'rule of the role model', whereby "social control is exercised through examples given by high status people". This way, the group leader acted as the representative of the *domain*'s scientific community and the gatekeeper of 'competence' in the local environment.

Consequently, the group leader finds herself in a complex (and key) position. She has the double, and at times also contradictory, responsibility of paving the way for subordinates (as a leader) and at the same time sifting supervisees' performance (as a gatekeeper). She holds responsibility also for affording the necessary (communicative) means for the attainment of (communicative) 'competence' in the *domain*. As a gatekeeper, she needs to observe 'good practices', 'correctness' and 'efficacy' both for the *domain* of the RG's practice as well as for the institution in which its practice is located (the university in this case), whose criteria and priorities might or might not coincide. The group leader is thus a versatile agent, who acts as a mentor, as a *domain* expert, as a (communication) conventions conveyor, as a field gatekeeper, as a resource manager, as a policymaker, as a communicator, and even as a linguist, among other roles. As has been observed in the data, in her absence, these responsibilities were assumed by other group members (old-timers) that adopted the supervisor role with more peripheral members. Similar to science's auto-capitalisation by drawing on previous findings as the basis for new work (Knorr-Cetina, 1981), also regarding communication, previous communicative events/inscriptions acted as models for new ones. This way a given social order is perpetuated through the 'politics of communication conventions' – a parallel to Kress' (1996) 'politics of aesthetics', according to which ruling classes claim certain literary works (usually written in the 'standard' linguistic variety) to be more valid than others (written in other varieties) based on a hypothetical criterion of aesthetics.

The sense of authority was present in supervisors' communication style, through resources like the formulation of absolute statements, giving direct instructions, the absence of hesitation, and the use of evaluative words. This style emulated the 'rhetorical stance' of scientific discourse, which eliminates uncertainty, variability and flexibility in favour of unrealism, formality, certainty and control (Wynne, 1992) in order to confer 'plausibility' to its claims (Harvey, 1981). Accordingly, certain communicative behaviours and text forms were presented in the

context of the RG as the only right ones, conforming this way a unique set of 'standard' and 'ideal' behaviours and texts legitimised in the RG's practice *domain* on a global scale. Practitioners were offered no alternative options and were urged to accommodate to those in order to show group membership and be evaluated as 'competent' practitioners. Success in this context consisted in learning how to erase uncertainty and contingencies in open communicative events/inscriptions (Delamont & Atkinson, 2001), following the model of the group leader and of other legitimised experts. There was thus low negotiability (see Wenger, 1998) for practitioners, who held little control over the meanings they created and over the form of the communicative events they engaged in or the *inscriptions* they produced. Whenever negotiation was possible, it took place within the hierarchical contexts of the RG, of the institution or of the *domain* and was hence unequal between different-status practitioners.

The participants' professional context was not only ruled by norms of interaction concerning the shape of different components of each communicative event, but they had to learn and to conform to certain norms of interpretation also, many of which obeyed the specificities of their *domain* of expertise, and were thus alien to the general public. This is consistent with findings of studies in scientific representation, which claim that 'seeing' in science is a social accomplishment, and thus linked to a specific social group (Amann & Knorr-Cetina, 1988; Law & Lynch, 1988; Lynch, 1988; Goodwin, 1994) and to the web of texts generated within it (Myers, 1988). The RG hence constituted a framework of rules and 'patterns of communication' (Saville-Troike, 2003) that were "learned by doing" what others did, in similar ways as they did, as well as "by communicating" with group peers as regards what communicative events should be like, and therefore by accommodating to the habits of the RG. Some events even took on a ritualised tone, with very strict norms and imbued with formalities (see Swales, 2004, on the ceremonial configuration of some 'research genres'), which constituted a way to maintain power. A special aspect of the RGs' multimodal communication policy were the *instruments* used by practitioners in their communication practices, whereby each had its own functionality and afforded certain ways of being used. 'Mediating artefacts' (including objects and also graphs and images) have been found to be paramount in novice practitioners' learning as they mediate among individuals, they structure work and convey information from past and present relevant aspects (Eraut, 2014).

Another special aspect of the RGs' multimodal communication policy tackled in this chapter is their *language policy*, the main communication-related aspect underscored in laws and internationalisation policy documents of universities in Catalonia, which urge for the preservation of local languages and at the same time for the introduction of English as a hallmark of internationalisation. The data analysis has revealed that language was an important

part of the RGs' communication practice in different ways. Language was a vehicle embodying diverse important messages, like communication norms (e.g. in emails giving guidelines and in feedback) and protocollary practices (e.g. in experimental protocols and in mentoring). It was an essential part of several communicative events (e.g. 'oral presentations', 'writing in the lab notebook', 'writing scientific articles', etc.). And it was one of the means demonstrating the (lack of) assimilation of communication norms by group members (e.g. using the RG's jargon, accommodating to the linguistic conventions of the *domain*, etc.). With reference to the RGs' *language policy*, the data analysis has shown that each RG had its own language policy, mainly marked by the group leaders' linguistic profile and beliefs.

In Group A, an English-only rule was imposed by its group leader (*management*), based on his *belief* that science should be done in English only, as well as on his advanced command of this language and low command of the official local languages (Catalan and Spanish). This profile gave him legitimacy to act as a/n (English) language editor for other group members' written and oral productions. However, he relied on an 'English native' proof-reader to double-check the RG's written productions. Although Frank did not deem a high command of English necessary for practitioners' success in science, he defended that a certain minimum command needed to be attained by scientists, which could be easily achieved by practitioners through practice in the RG. For Frank (and for Cecíla), English was a tool in science and not an end or an object in itself. In this vein, Cecília (Catalan/Spanish - L1) deemed other languages an economic and time-consuming unnecessary burden. Group A's *management* as regards language implied strictly accepting and embracing the supremacy of English as the language of science, which could only be international, and prioritising work efficiency over emotionalism, identity concerns and members' preferences. In *practice*, this generated some uncertainty in the RG as regards the legitimacy of using other languages, especially orally, but it also contributed to generating an ecosystem for practitioners' immersion in scientific English that contributed to their acquisition of certain skills in this language, especially as regards vocabulary and fluency. The *language policy* of the institution seemed not to be observed and the local languages were not favoured but were relegated to the oral interactions of Catalan/Spanish speakers, though with the misgivings of other group members. In order to preserve the international character of the group, a policy of balancing the nationalities of its members was established to avoid dominant linguistic communities within the RG and thus to facilitate the use of English as a lingua franca among group members.

Group B's *language policy* was marked by a Catalan-English 'diglossia' (Ferguson, 1959), consistent with the group leader's linguistic repertoire (Catalan/Spanish- L1 and English-L2) and *beliefs* (Pere defended that English was 'fundamental' in the RG's practice). Catalan was the

default language used in most oral communications except for interactions in which a non-Catalan speaker was present. Yet, also in these cases Catalan used to arise unwittingly. English was the language used in communication practices that intended to transcend the RG-CoP or that came from external sources (like 'reading/writing scientific articles'). Other languages common to them were used by their speakers in spontaneous oral interactions. Especially significant in this case was also the hierarchical text-production system of the RG. Scientific articles for publication were written by senior members of the group, reviewed by the junior members involved in the experiment reported, and ultimately reviewed by the group leader before being sent to an external 'English native' language editor. Some consequences of this *language policy* are the imbalance between group members' oral English skills (lower) and written English skills (higher), as well as the perception by foreigner group members of the importance of learning Catalan for the practice of science in that RG. In this case, English was accepted and adopted as the international language of science, and thus used exclusively for communication practices that aimed at an international audience. Local languages were used widely for the daily practice of science in the local environment, at the expense of non-Catalan/Spanish speakers. No reference was made to the official *language policy* of the insitution but the local group members' right to use their L1 in communicative inscriptions like the 'PhD dissertation' and the 'PhD defence' was respected implicitly.

In sum, the two RGs had a different positioning that reflected the RG's language *management,* highly influenced in turn by the group leaders' linguistic repertoire and beliefs. Group A seemed to take the stance of a full-fledged international player who relied on the local context only as a supplier of resources but who was subject to the norms of the game of international science. It was a market-oriented stance seeking international competitiveness and the attraction of international students, irrespective of university or national policies claiming for the protection of local languages. It probably did not respond only to a hungering for success but also to a survival instinct, which involved using English as a lingua franca facilitating their access to a broader market of funding agents and of audiences (Medgyes & Kaplan, 1992; Duszak & Lewkowicz, 2008; Englander, 2009). In contrast, Group B implemented a rather 'laisser faire' policy in general, except for communication with external audiences, where English was imposed. Without group members' explicit awareness, and without the university's implication or support, this facilitated the practical implementation of the aspects of the Catalan Law (Law 1/2003, of February 19, of universities of Catalonia) that urge for an international university where the "language" "of Catalonia" – meaning Catalan – be present. Group B's stance was based on its contribution, anchored in the local context, to an international scientific field that was alien and remote. This is consistent with the dominant discourses coming from the EU and

European national governments that recurrently underscore a (European) locality distinct from the global field or "market", like those intending to promote the European Research Area (i.e. EC, 2000; 2016; MEC, 2012). This fragmentation of the scientific space into different spaces (international, European and national) suggests the need for RGs to adopt different strategies (and to use of different languages) in each space, which might become an added burden to their daily practice.

Despite their specificities, though, both RGs coincided in two aspects: in the imposition of English in productions targeting out-group audiences, aligning with the view that international communication, success in science and the use of English are interwoven (Alastrué & Pérez-Llantada, 2015), as well as in their reliance on an 'English native' as a proof-reader. Indeed, this is a widespread practice among (semi-)peripheral scientists (Ventola & Mauranen, 1991; Duszak & Lewkowicz, 2008), although it is a debated issue in the literature, having its supporters, who claim for the need to accommodate to the native ideal in order to avoid comprehension problems (Barbour, 2002), and its detractors, who defend the legitimacy to contribute to an international English from all linguistic perspectives (Ammon, 2000). Scientists may not however be able to choose freely either of the two positions because their practice is contingent upon journal editors' and reviewers' criteria. Yet, the group leaders' decision to rely on a 'native' might be due either to a prejudice – in line with Bardi and Muresan (2014) – and their ignorance of research demonstrating that nativeness is not favoured by journal editors (Flowerdew, 2001), or to their own past "experiences of marginalization" in the academia regarding their language proficiency (Minakova & Canagarajah, 2020: 12). In both cases the RG's language policy had both, positive and negative effects on the *practices* of group members, like contributing to the development of their foreign language skills or generating tensions when the local language was used. The participants had to choose individually whether to adhere to a stance focused on an international 'frame of reference' (Allport, 1940), so that they are focused on and ready for their prospective international mobility – very common for scientists (Bernstein *et al.*, 2014) –, or not, but they might be urged to do so by their RG's policy *management*, as was the case of Group A.

Concerning the role and incidence of the languages used in each RG, the findings resonate with, but at the same time differ slightly from, Vila, Bretxa and Comajoan's (2012) conclusions about the diverse uses of Catalan, Spanish and English among scientists in the Scientific Park of Barcelona. The predominance of Spanish and Catalan is consistent with Group B's *language policy* (more as regards Catalan than Spanish) but not with that of Group A. The same applies to the preference for Catalan in internal interactions, which in Group A were often dominated by English. The role of English as the language for international communication, that is, being used

in conferences and written publications, is also consistent with findings in this study, for both RGs. With reference to Spanish, although some foreign-origin researchers preferred to learn Spanish rather than Catalan (like Ale from Group A and Dana from Group B), coinciding with Vila *et al.*'s (2012) findings, the predominance of English in the first RG and of Catalan in the second RG may have discouraged some others to learn neither language (as was the case of Navil and Mara, in Group A, and Tira and Yamir, in Group B) and encouraged them to stick with English (although in the end Tira and Yamir regreted not having learnt Catalan).

Within an institutional context cluttered with ambiguities and contradictions as regards how the Europeanisation and the internationalisation of research should be undertaken, and neglecting field actions and instructions on how these can match with the preservation of local languages like Catalan, the RGs studied found themselves in an undetermined space, between locality and internationality, having to implement themselves improvised strategies to deal with that position. Despite the Catalan Law's (Law 1/2003, of February 19, of universities of Catalonia) claim for "well-defined policies and strategies" concerning the quality of research and student mobility in the context of the internationalisation of university, there was an evident lack of guidelines and training for practitioners in this respect, which urged group leaders to take on a language policymaker role, ignorant of the actions that could potentially entail "excellence" and "success" in this respect. General university actions like promoting the overt statement of the language of instruction of teaching and offering free Catalan language courses for foreign students have proven to be inadequate for the scientists in this study, who did not perceive Catalan as rewarding or necessary in their career and who deemed it an added obstacle in their way towards success in science. Moreover, the participants seemed alien to any potential political or cultural implications of their language *practices*. The claim that the IoHE in Spain emanates from an 'underdeveloped planning' (Rumbley, 2012) becomes here evident as regards *language policy* at postgraduate levels. As in Mortensen (2014), the two RGs followed a 'local de facto language policy'. Yet, in this case, apart from the two levels of *language policy* identified by this author: 'from above' – corresponding with Spolsky's (2007) *management* – and 'from below' – corresponding with *practices* –, two more levels or intervening forces can be distinguished. Between the practitioners' *practices* and the institutional policy (of the university and of regional and national governments), there is a middle-level *de facto* policy that has been proven to be very influential on scientists' daily *practices*: the *management* of the group leader. Also, the imposition of English as the unquestionable language of out-group communication denotes the existence of a fourth level of language policy, parallel to and more powerful than the institutional one, that is the *language policy* of globalisation, which imposes

475

English as the lingua franca of the global market (Lo Bianco, 2014), including science (Tardy, 2004).

With reference to the second research sub-question posed in this chapter, *How is this multimodal communication policy influenced by the internationalisation of higher education?*, multiple sites of connection between the studied RGs' multimodal communication policy and the international dimension have been identified.

First, the two RGs expanded their practice by establishing collaboration bonds with practitioners working abroad. This entailed a boundary communication whereby *shared communicative repertoires* were negotiated and developed. These repertoires encompassed not only a common code but also a shared sense of "adequate" communication, as well as getting used and conforming to others' communicative style and interpretation framework. Although not implying the transcendance of national borders, inter-RG collaboration within the same country or institution had similar implications as regards practitioners' communication. It also implied practitioners' accommodation to the 'culture' of the collaborator RG as regards its communicative repertoire, code, style, value system and interpretation framework (on the latter see Latour, 1985, 1986; Woolgar, 1988). Being these sites where different 'cultures' met (Kress, 2012), they were also propitious *loci* for innovation and creativity as regards intercultural communication.

The practitioners' (past or present) *mutual engagement* with scientists based abroad entailed the development of international networks of trust – similar to Crane's (1972) influential 'invisible colleges' –, which provided alternative views, resources and support from those found in the national and institutional context. The importance of informal communication in science has been defended by authors like Collins (1974) and Garvey and Griffith (1971). Such personal contact networks had also the advantage of being devoid of the bureaucratic burden – typical of science (Ziman, 2000) – of communication with practitioners in a transnational context. Somehow related with this phenomenon is scientists' trust on international communication platforms, like Youtube, to assist their learning. It constituted also an alternative to conventional or formal sources of information and support. The democratisation of communication, that is, the global and universal access to information and to individuals, be it formal or informal, may counteract the prevalence of a certain elite of scientists monopolising plausibilty (Harvey, 1981) and communication in science. The increase of coinciding trajectories between practitioners – in the form of colleagueship, co-authorship or acquaintanceship (Collins, 1974) – through the promotion of the international mobility of sicentists (Scellato, Franzoni & Stephan, 2015) may also contribute largely to this phenomenon.

476

The mobility of scientists across national borders is in fact another site connecting communication and the internationalisation of HE (and of science). The data analysis has revealed that international mobility was promoted among scientists through institutional policies and discourses commending its benefits in the form of a 'cultural capital' (Bourdieu, 1986) – specific states of the mind more or less stable that have been incorporated through investment of different resources like time – institutionalised in this case through its association with the abstract "quality" of constituting an "international experience". Arguably, scientists' "international experience" legitimised them as 'knowledgeable agents' (Giddens, 1984) in their field of expertise at an international dimension (see Crossman & Clarke, 2010, on the perceived benefits of international experience). This included knowledge about evaluation criteria, about what constituted quality and competence in their *domain* and the (global) trends concerning both, scientific practice in the discipline *and* communication.

In the two RGs studied, the greatest exponents of "international experience", those recognised as knowledgeable of quality and competence in their *domain* at the global level, were the group leaders. They were legitimised as such by their international background experience and international recognition, which constituted key elements of their individual career, determined their position in the *field* (Latour & Woolgar, 1986 [1979]) and conferred them 'verticality' in scale and power (Kell, 2015). Consequently, they acted as importers of international/global criteria and trends into the local context of their RG. This way, (communication) practices in the RG followed international standards filtered by the group leader's perception and interpretation of texts and policies designed international institutions and stakeholders (like the European Union, international scientific journals, private companies and foundations). This translated into the leader's agenda-setting and communication-guiding functions in the RG, for she acted as the personified authority at the local level, integrating the ideas and criteria of these various 'thought collectives' (Fleck, 1935). The multiplicity of roles that scientists are required to adopt has been argued to generate conflicts of different nature (Hess, 2006; Croissant & Smith-Doerr, 2008; Johnson, 2017). The pressure to conform to those international standards – 'obligatory points of passage' in Callon's (1984) terms – was felt so strongly that it constrained practitioners' agency and creativity (as declared by Frank). This constitutes a form of domination of scientists' (communication) practices, who are parallelly immersed in a 'cycle of credibility investment' (Latour & Woolgar, 1986 [1979]) that urges them to conform to the imposed standards, using a discourse that exhibits the independence of science from policy and politics (Yearley, 1988). In this context, creatvity and innovation may be reduced to some micro decisions at the local level with scientists' underlying aspirations to impose them to other scientists and policymakers as *obligatory points of passage*. In the terrain of communication, an

extreme instance of such *rule of conformity* (Farnsworth, Kleanthous & Wenger-Trayner, 2016), which applies to both the global and the local levels, is the teaching of strict communication models that choke practitioners' voice.

One more hint of the impact of internationalisation in scientists' communication is the import and adoption in the RG of foreign experiment protocols (coming from private companies or laboratories exporting their products internationally). Protocols are the reified outcome of the stabilisation of scientific statements (Latour & Woolgar, 1986 [1979]) that become exportable and thus importable, and through this mobility contribute to a process of standardisation of practices (Knorr & Knorr, 1978). They constituted also an important part of the RG's experimental repertoire and culture. Through these protocols, external standardised procedures pursuing a univesal validity permeated local (communicative) practices, like 'doing experiments' and 'writing scientific articles'. These protocols usually involved the import and use of foreign materials and artifacts (Kleinman, 2003), denoting not only the internationalisation of scientists' communication, but also its marketisation (Kleinman & Vallas, 2006), which is in turn a global trend.

Comparable to the two communicative events referred to above ('doing experiments' and 'writing scientific articles'), other events were also shaped locally following a standardised format that made them identifiable internationally (due to formal aspects like their ends, key, act sequence and norms), such as the 'PhD defence' (see Swales, 2004), the 'PhD dissertation' and the 'conference presentation'. This process can be assimilated to that of 'normalisation' of scientific images to enable their comparability (Alač, 2014; Rijcke & Beaulieu, 2014). The conventions of these communicative events/inscriptions were imposed through a chain of authority from the global to the local dimension, that is, from international policies (such as the *European doctorate*) to national regulatory frameworks, institutional (university) policies and norms, and finally by the RG's leader as the local authority. This process has been argued to follow also a centre-periphery direction, from centre to periphery regions (see Bennett, 2014c) having generated a silent colonisation of university and of science by Western standards.

Similar but somewhat different was the connection between the scientific publications written by the participants and the international dimension. The scientific paper, following Fleck (1935) can be deemed the reification of a scientific statement that has been attached scientific symbols, representations and expressions and which affords the exchange of ideas among distant agents. The participants' scientific articles targeted two international audiences: international journal editors and the journals' readership. This required the strategic anticipation of the criteria and perspective of the scientific community of their field as well as their knowledge of the

positioning of the prospective journal (Knorr-Cetina, 1981). Accordingly, practitioners' discourse and text form needed to be adapted to the standard quality and acceptance criteria of both audiences following a 'rhetoric of persuasion' (Zenzen & Restivo, 1982). The conjunction of these criteria formed a sense of international/global consensus on certain aspects affecting communication, like what constitutes "good practices", valid and reliable results, and objectivity, or what "acceptable" images must look like (Bolsen & Druckman, 2015; Knorr-Cetina, 1999; Ziman, 2000), that practitioners needed to know and be able to accommodate to in order to be accepted and recognised by the scientific community of their *domain*. This locus of internationalisation is related to another one, that of the reward system for scientists, based on publications and journal impact factors imposing specific priorities onto practitioners worldwide (Young, Ioannidis & Al-Ubaydli, 2008; Biagioli, 2016).

Finally, internationalisation has been found to be present also in the codes used by the participants of this study in different ways. English appeared as the preponderant and unique language used by them for the reading and writing of scientific articles, reading protocols and preparing (international) conference presentations, as well as in interactions between practitioners not sharing their L1. Although the use of multiple languages in scientists' interactions at the micro level has been ascertained (Mondada, 2005), there is concern regarding the increasing imposition of English in the academia worldwide (Lillis & Curry, 2006; Ammon, 2001) and the subsequent progressive substitution of local languages in this domain (Phillipson & Skutnabb-Kangas, 1996; Ljosland, 2007, 2011). Using English for scientific publication involved also the accommodation to the Anglo-American rhetorical tradition (Bennett, 2014c; Dontcheva-Navratilova, 2014). Other languages were relegated to informal internal communication (mainly orally or through email) but in the case of the internationally-oriented RG, Group A, their use was very limited. Apart from using a given linguistic variety, the participants used also a specialised (scientific) jargon that followed the conventions of their *domain* primarily in terms of vocabulary and rhetoric style (like the use of the passive and concision in written texts). This suggests that, following Swales (1990), the practitioners' scientific field of expertise constituted a 'discourse (or 'sociorhetorical') community' of experts joined around common public goals and sharing certain participation mechanisms to provide information and feedback, a set of consolidated genres and community-specific vocabulary, to which the participants had to accommodate. However, the repertoire and conventions of this discourse community had to be learned and managed by practitioners in parallel to that of the RG, a mix between a 'discourse community' and a 'sociolinguistic community', whose linguistic repertoire is developed in the pursuit of socialisation and solidarity among its members. The international dimension was thus integrated in the local language policy.

Also related to the imposition of an international language was the tendency to use image in experimental protocols. This is in line with Kress' (1996) prediction of the increasing importance of image for (scientific) communication due to globalisation and internationalisation. The displacement of writing by image in communication globally (Kress, 2003) together with the tendency towards the rapid and free flow of images abstracted from their context (Usher & Edwards, 2007) open up a two-sided scenario: an opportunity for the free participation of all agents in a situation of equality (democratisation), but this could also lead to the 'deterritorialisation' (Miller & Wilson, 1995) of communication, depriving it from the cultural symbols tied to a regional territory.

In conclusion, departing from "the starting point", that is, "the ethnographic analysis of the communication conduct of a community" (Hymes, 1974: 9), this chapter has contributed to the ethnographer's final objective of uncovering the norms for "contextually appropriate communicative behavior" (Saville-Troike, 2003: 88) in the two main RGs studied in order to unveil the RGs' multimodal communication policy and relate it to the process of internationalisation of HE. To this aim, we have presented the range of (prototypical) communicative events possible for practitioners in the two RGs, more than 80, as well as some of the norms of communication that were relevant for group members' participation in the RG as functional members. In this endeavour, communication has been shown to be a very significant part of group members' daily practices, directly linked with success. 'Doing science' has revealed itself to be a highly social practice at all levels, from the laboratory to the wider scientific field. This has been historically acknowledged by some scientists, like Walter E. Frick, who stated that "[I]f you wish to succeed at science, you may have to overcome, circumvent, outlive, persuade, or otherwise learn to deal with your peers" (Frick, 1993: 1801). And socialisation is in essence communication. Despite our arguments claiming that scientists' communication is inherently multimodal, the RGs' language policy has been particularly tackled here, for it is one of the core hallmarks of the internationalisation of the university in Catalonia, and the most explicitly referring to communication.

The data analysis has departed from the operationalisation of multimodal communication policy following Spolsky's (2004) notion of language policy. The EoC (Hymes, 1964) has provided useful concepts enabling the contrasting and characterisation of communicative practices, also aided by concepts from genre theory (Chandler, 1997). Their combination with the CoP model has facilitated the comprehension of social processes that took place in the RGs studied and that were relevant to the study's research questions, like learning and peripherality-centrality. The exploration of the influence of the process of internationalisation of the university and of science on the RGs' multimodal communication policy has required also the use of macro-

social concepts, explained in the theoretical chapter of this thesis, although this aspect will be further tackled in chapter 8, devoted to the macro-level data analysis. Before that, through the example of particular communicative events and their reified outcomes (*texts*), the next chapter will illustrate the way in which the glimpses of internationalisation presented here affect scientists' communication at the micro dimension, that of text form.

Chapter 7: The micro-analysis of the internationalisation of scientists' communication

The first two chapters of analysis have shown the influence/s of the internationalisation of HE and of science on scientists' communication as members of a RG that parallels in diverse ways a CoP. These have thus tackled the meso level of analysis, which focuses on the circumstances affecting the production, consumption and distribution of texts. In order to offer another perspective on the phenomenon studied, the present chapter will contribute to illustrate different ways in which the IoHE permeates the micro dimension of analysis, that is, how it becomes evident in the formal characteristics of texts. To this end, the research sub-question that will be answered is: *What is the influence of the IoHE on scientists' communication at the level of text form?*

The main theory that will guide the data analysis in this dimension is *multimodal social semiotics*, which will support the exploration of the resources used by agents (sign-makers) to make meaning in particular texts. Additionally, notions taken from the EoC will contribute to the contextualisation of the texts analysed, and others from the CoP theory will link the findings with the social aspects of the phenomenon studied within the context of the RG. As has been argued already, the informants' communication is considered here to be unquestioningly and chiefly multimodal because its understanding required the gathering of visual data besides audio data, in order to capture elemental aspects of it, like graphs and images produced and used, participants' gestures and movements, apart from oral interactions and sounds. Drawing on the equivalent notions of 'text trajectories' (Silverstein & Urban, 1996; Lillis & Curry, 2010), 'text histories' (see Maybin & Lillis, 2015), 'meaning making trajectories' (Kell, 2015) and 'semiotic chain' (Stein, 2008) – a process whereby meaning is materialised not by one unique text, but by multiple linked texts –, multimodal social semiotics emphasises the continuity of the process of meaning-making, which is fixed and at the same time transformed by texts in particular moments. From this viewpoint, 'texts' are deemed relatively stable 'punctuations of semiosis' (Kress, 2000) that capture meaning in a specific space-time.

For this chapter, specific pieces of data have been selected that illustrate given communicative events/inscriptions that were observed or collected during the data gathering in Group A. These are data sections arbitrarily selected by the analyst with the intention of being analysed as 'multimodal texts' – communicative instances that were produced using diverse culturally-shaped meaning-making resources (or 'modes'), like speech, writing, image, gesture, etc. Assuming that "all multimodal texts, artefacts and communicative events are always discursively shaped", that "all modes, in different ways, offer means for the expression of

discourses" and also that "different discourses may be brought into play modally and, therefore, the choice of modes may itself be used analytically to indicate the presence of different discourses in specific texts" (MODE, 2012), in this chapter, discourse will be considered to draw trajectories through its instantiation in (multimodal) texts (*entextualisation*). The notion of 'discourse', as 'relatively stable uses of language and/or communicative semiotic resources serving the organisation and structuring of social life', will be here equated to the 'experiment', which captures a stable form of human activity and communication – having a consistent object of study, objectives, techniques applied –, and which, as will be shown in this chapter, organises and structures the participants' daily professional practice and thus their social life at work. Unveiling the 'uses of language and/or communicative semiotic resources' that serve the execution of the experiment will thus be an objective of this chapter.

Similar to what happens with texts, discourses are assumed here to "travel" also across communicative events. Consequently, like those studies that investigate how semiotic resources are used to articulate discourses across a variety of contexts and social settings, here the materialisation or *entextualisation* of a specific experiment in different texts will be explored, focusing on the ways it is transduced across diverse communicative events/inscriptions (*recontextualisation*). These issues will be broached in relation to the processes of internationalisation of HE and of science. I will hence analyse a section of one discourse trajectory in which scientists engage through the production and uptake of diverse multimodal texts as part of their ordinary scientific practice. Given that 'doing experiments' was the core communicative event which most participants used to engage in, the trajectory chosen is that of the experiment that two participants, Joana and Navil, were carrying out during the three months of Joana's internship in Group A (from June to September 2014). The (multimodal) texts that instantiated this experiment and that will be analysed here are: (1) an experimental protocol that was followed by Navil and Joana as part of their experiment, (2) a video clip that shows Joana and Navil doing experiments in the lab in July 10th, (3) the page of Joana's lab notebook corresponding to her work that same day, (4) Joana's lab meeting in which she presented her research to her group peers some weeks after her internship had finished, and (5) Joana's final written report where she summarised the experiment and its results.

It is worth mentioning that the 'doing experiments' event was recorded as part of 'mentoring' (while a participant was teaching how to 'do experiments' to another participant), which forced the mentor (Navil) to make his tacit knowledge explicit for his trainee (Joana). Especially enlightening for the analysis at this level has also been the stimulated recall interview with Navil, which also contributed to make some tacit knowledge explicit for the researcher. Following Saville-Troike's (2003) insight that outsiders of a community may be able to identify

behaviours that go unnoticed by insiders but at the same time the former may be unable to fully understand all behaviours of the latter without eliciting their explanations, the stimulated recall interview proved to be an important tool to understand the participants' actions and decisions, to identify aspects of the texts that were relevant for them and to name "their world" as they would do.

The first section of this chapter (section 7.1) will contextualise the data analysis; the following five sections (sections 7.2-7.6) will be devoted to the analysis of a multimodal text each; section 7.7 will argue what the hints of the IoHE are across these texts; and section 7.8 will present the discussion and concluding remarks of the chapter.

7.1. Framing the analysis

The 'experiment' is a long process, mainly defined by a specific objective, which may entail several months. It may consist of different parts, which could be considered as chronological stages or phases (entailing preparation, sample collection, analysis, result interpretation, replication of stages, etc.), which are in turn articulated in established sequences of actions called "protocols" or "techniques", which consist of steps. Therefore, the scientist's work is not necessarily divided into days – which nevertheless do have importance as time units – but most frequently into other kinds of units, which go beyond the time dimension and revolve around objectives, materials used, and other contextual factors (like the publications or dissertation chapters that have to be written out of the experiment).

In Group A, experiments were regarded as "stories" (as it was recurrently claimed by the group leader), in the sense that they needed to have an argument and to advance in a logical and structured way in order to reach a well-defined end. The power of the experiment was assessed in terms of how appealing its argument was. And the final, expected realisation of this argument was the written report, in the form of a scientific article or a dissertation. In this case, the discourse trajectory analysed is part of Navil's PhD research for which, in his 3rd year, he was offered the support of a BA student, Joana, during three months [see picture 53 below].

Picture 53: Navil and Joana

Navil

[PhD researcher– mentor]

Joana

[BA researcher– trainee]

Joana was a BA student at the same university where Group A was based, and had to do a number of hours of *internship* in a laboratory for her studies. She thus entered the RG as an apprentice who had to learn how to do 'lab work' under the direct supervision and mentoring of Navil. She thus contributed with her work to Navil's experiment. After her three-month internship in Group A, Joana was supposed to write a report of what she had been doing in the lab, as a record of her practicum. Therefore, she assisted Navil in his daily work for his PhD, so she would be introduced to different techniques, but she had to focus more on one aspect of his research, and do specific types of experiments for her own report in order to have "a story" to tell.

Therefore, in this case, what gave stability to the experiment as a discourse was that it was carried out by specific participants, Navil (aided by Joana), with a specific role each (mentor-trainee); that it was defined by a specific objective: 'see what is the difference between [plant type 1] and [plant type 2] when it is grown with [substance 1]' (stated by Navil in the stimulated recall interview); and that it was framed and articulated within a stable context or setting: Group A (comprising its members, its laboratory, its resources, its history, its institution, etc.).

As has been argued in the previous chapter, some typical communicative events/inscriptions of the RG could be classified into three stages around the 'doing experiment' central event: planning, developing and reporting on the experiment. The texts selected for the micro analysis belonged to one of these three stages of articulation of the discourse, as shown in the figure below.

Figure 9: Experiment trajectory stages and texts
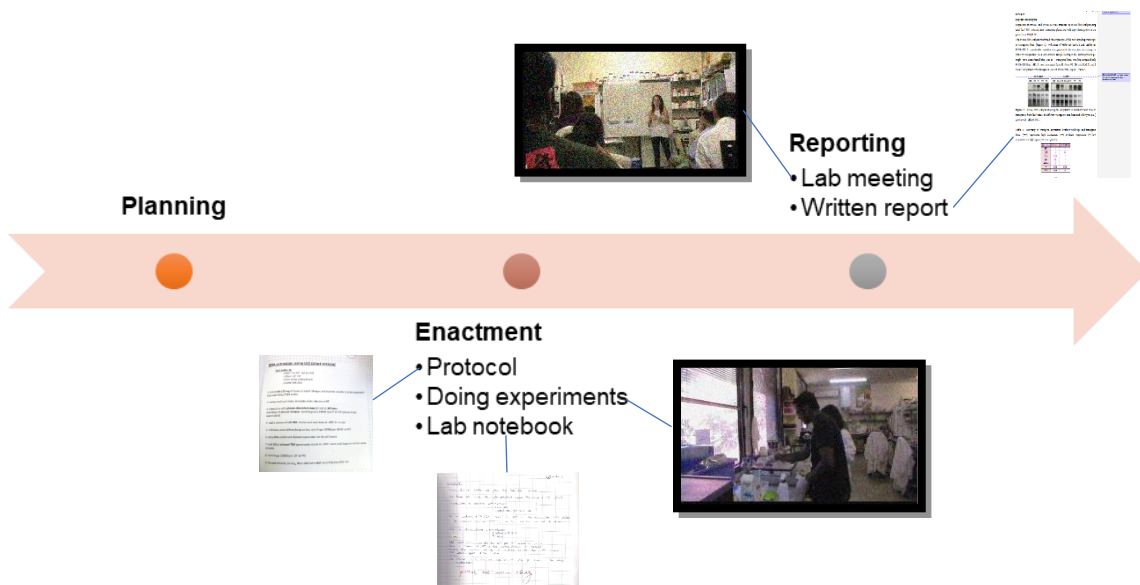
The 'protocol', the 'doing experiments' clip and the 'lab notebook page' are events/inscriptions that contribute to the materialisation of the experimental part of the experiment, that is, to its enactment in the laboratory. The 'lab meeting' and the 'written report' are events/inscriptions, in this case 'texts', that aim at disseminating aspects of the enactment stage to capture its "story" and potentially involve external participants in it (to help, to evaluate it, to learn from it, etc.). No texts belonging to the first stage, the planning stage, will be analysed here because the researcher had no access to any preliminary planning event of this trajectory. However, the video clip analysed contains a planning communicative act that might have commonalities with communicative events typical of this first stage.

In the next section, the first text, the experimental protocol that was followed on the day of the video clip will be analysed.

7.2. The protocol

The experimental protocol that will be analysed here is the particular protocol that Joana and Navil were following the day that they were recorded, in July 10th 2014. It constituted an element of the experiment that they were carrying out. That particular day, the two practitioners were enacting one of the steps of the protocol. In spite of what was indicated in the printed protocol, it was not the third but the fourth day of a one-week process, as narrated by Navil in the stimulated recall interview. Such local adjustments of the protocol were allowed, according to Navil. Although the video clip that will be analysed corresponds to the 'BLOCKING' step of the protocol, we will analyse here the steps corresponding to 'DAY 3' of the printed document; that is, what would correspond to Navil's and Joana's work on July 10th 2014 [see excerpt 183].

Excerpt 183: Protocol DAY 3

As a multimodal text, it is a printed document mainly dominated by the mode of writing – all its signs are letters and numbers and it is devoid of image. It is not however guided only by the linearity of the written language but some meaning is also made by the disposition of elements throughout the page (layout). Two different moments of production can be distinguished considering the two different types of writing: typewriting, first, and handwriting being added later on. This implies also the possibility of two different contexts of production for each type of writing and also the possibility that the text be produced by at least two different sign-makers, with different motivations and intentions. The typewritten part suggests the intervention of a computer in the production and potentially also in the distribution of the text (through the Internet). In contrast, the handwritten part is tied to Navil as its sign-maker (since it corresponds to his handwriting) and to Group A's laboratory as the specific context of its production, distribution and consumption. In the stimulated recall interview, Navil specified that it was a public protocol 'that we normally print'.

The text is structured by diverse headings and horizontal lines. The first one, 'DAY 3', written in bold capital letters and positioned in the middle of the page, left-justified, frames the date in

which the steps indicated below must be enacted in relation to the previous steps (e.g. if the previous steps had been done the day before, practitioners had to wait until the following day). The second heading, positioned under the first one, written in bold letters and underlined, indicates the three main processes or actions that must be carried out that specific day: 'washing', 'blocking' and 'detecti[ng]'. These three actions structure the rest of the text into four main sections with a heading in bold capital letters each: 'WASHING', 'BLOCKING', 'WASHING' and 'DETECTION'. There is however an intermediate section between the first 'washing' and the 'blocking' sections which has no heading but which is delimited by a horizontal line above and another one below. This text thus structured the practitioners' daily activity into five different parts.

Each part was in turn organised into several steps, indicated differently in each section of the text. The first 'washing' section consisted of four steps that were numbered from 1 to 4 in the first column of the text (on the left). The intermediate section consisted of one unique step, as it contained only one line of writing, introduced in the second column by the time indication of '5min'. The 'blocking' section was divided into two steps, each of which was indicated by a time specification in the second column also. And likewise the second 'washing' section and the 'detection' section encompassed one step only, specified by one time indication each in the second column. Therefore, the whole process of DAY 3 consisted of nine steps organised into 5 sections.

Linguistically, the text is characterised by a general lack of verbs, which implies that there are very few complete sentences (5). The verbs are used in the imperative mood (4) or in the passive voice with the obligation modal verb 'must' (1). Numbers, substances, time and capacity indicators predominate. Other actions are implied or phrased as symbols (like '+' = "mix", 'RT' = "incubate with rotation"; '68ºC' = "warm at 68ºC"). Although the code used is English, it is a specialised form of language, abounding in contractions, abbreviations and acronyms. A great deal of information is presupposed, like what 'SSC', 'SDS' and 'Ab' stand for, the existence of a 'blocking solution', the existence of the tools and materials necessary (e.g. tubes and machines for centrifuging, incubating and rotating).

To conclude, the experimental protocol is an instructional text that is used by practitioners for the consultation of how a certain analysis should be done. It guarantees certain outcomes regardless of the context of enactment of its instructions, and thus in a standardised way. It is also a highly structured text that aims equally to structure practitioners' actions, to organise the time devoted to each and also the substances and quantities used. It is a one-way text (the typewritten part was created in a different space-time and afforded its subsequent reproduction

but not its negotiation) that has been adapted to the local context through Navil's superposed handwriting. The unequal negotiation that it affords signals its authority, but there is a certain agency permitted for practitioners at the local level only: they can modify the instructions by executing them differently and by editing the text through handwriting. Such adjustments, however, require a previous experience from the part of the practitioner, which in this case Navil had but Joana did not. Their experience in the enactment of the particular protocol is thus an empowering trait for practitioners. The code used suggests an intended specialised international readership, both for the typewritten as well as for the handwritten parts, although regarding the latter, a predilection for the personal use of its author can be deduced (the handwriting is very personal and not easily accessible).

7.3. Joana and Navil 'doing experiments' (while 'mentoring') [video clip]

This video clip (9.5 min. long) shows an event of lab work in Group A. Joana and Navil were video-recorded while 'doing experiments' as part of their everyday activity in the lab. The sequence shown on this video corresponds to the execution of the protocol analysed in the previous section; specifically, it was the fourth day of a one-week process, and the two participants were executing the 'blocking' step of the same protocol [see excerpt 184].

Excerpt 184: 'Blocking' step of the protocol

As has been noted in the previous section, this protocol step consists of two main processes. In the particular moment recorded, the two practitioners had to prepare the first solution and replace the old solution in the plastic containers with the new one. To prepare the solution, they had to calculate the volumes of each component needed according to the protocol and adapting it to their samples. The day of this particular recording was Joana's ninth day in the lab. She had already seen Navil apply some techniques like preparing a similar solution to the one prepared in the video clip, but was still learning some of them.

The main location of the sign-makers in the video clip is Navil's experimental bench, which is the space that has been assigned to Navil as a member of Group A and as a legitimise user of the lab. The secondary location is by the shaking machine (at the parallel corridor of the lab),

which is a common device, used by all members of the group, and hence the sign-makers' location there and use of the machine must be as brief as possible.

Besides being the core communicative event for most participants, 'doing experiments' can also be analysed as a multimodal accomplishment, as will be shown in this section, since multiple communicative modes are involved in its successful execution. According to the use of modes and considering *frames* (formal discontinuities signalled by communicative resources), three main different stages can be distinguished along the chronological timeline showed on the video. The first one (3 min. long) corresponds to the adaptation of the protocol step that needed to be enacted *(planning stage)*, the second one (1.5 min. long) to the setting up of materials to be used for the experiment *(setting up stage)*, and the third one (5 min. long) is the enactment of the planned step *(enactment stage)*. This stage sequence is comparable to Hymes' *act sequence*, understood as a sequence of sections of the event marked by their function, their form and their content. In what follows, the different uses of communicative modes at each stage/act will be shown.

7.3.1. Planning stage/act

For its adaptation to their samples, at this stage Navil is dictating the protocol (using the mode of speech) and writing it down (using object manipulation[92] and handwriting as a process); Joana is listening (using passively the mode of speech) and reading (passive use of writing). Note that also in this case English was the code used for communication between these two practitioners who did not share their L1 (these were Catalan/Spanish for Joana and Kannada for Navil) [see picture 54].

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[92] 'Object manipulation' is considered here to be a communicative mode since it is very significant within the community of lab practitioners; and since it is subject to the combination of constraints and affordances of the embodied gesture of the sign-maker as well as those of the object/s being manipulated. The conceptualization of 'object manipulation' as a communicative mode reflects also the interconnectedness between *human agency* and *material agency* in the 'machinic field of science' described by Pickering (1995). In this particular text, where two sign-makers give relevance to each other's action, object manipulation becomes a visual mode with great communication potential. For Joana, Navil's object manipulation may represent the model of competence to be imitated. For Navil, Joana's object manipulation may communicate the degree of comprehension and expertise that Joana has acquired. 'Competence' as a lab practitioner relies largely on the mastery of this mode.

Picture 54: Navil and Joana 'doing experiments' – Planning stage/act

The starting position, marking the planning stage, is seated. Navil is foregrounded through his location and position at this stage by sitting closer to the "writing area" of the bench – recontextualised here as a desk –, and facing it with all his body. Joana adopts a secondary role through her oblique position to the bench/desk and a slightly more distant location from the paper. She only interrupts Navil's speech on four occasions, to briefly ask for clarification (three times) or to anticipate a substance that Navil is going to name (once). It is the only stage where writing is used as a process. This mode is devoted to the adaptation of the protocol to the quantities needed for the specific characteristics of Navil's experiment. Its *transactional function* (Halliday, 1978) is that of demonstrating the process of adaptation of the protocol by Navil to Joana as part of the 'mentoring' communicative event. Both sign-makers are staring at the paper while writing is ongoing, and very briefly at each other's face on few occasions. Joana is nodding from time to time. Language-as-speech comprises verbs in future tense, and nouns referring to substances. Its object (the content) is the protocol and its adapted quantities. At this stage, the written protocol is transduced into a combination of location, writing (as a process and as a product), speech, object manipulation, gaze and gesture.

This first act is also articulated by two sub-acts: the two different 'solutions' that Navil adapts following the protocol because they have to be prepared next. This distinction between sub-acts is made evident by Navil through speech and action[93], as shown in excerpt 185.

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[93] This term is used here to name the whole set of embodied visual modes, like gaze, gesture and object manipulation.

Excerpt 185: Navil and Joana doing experiments 10th July 2014 – Planning stage/act – 'after this_ the next solution'[94]

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
	00:00:18.2 Drops pen onto bench 00:00:19.4		00:00:00.1	
		00:00:20.2 done/ 00:00:20.6	stares at paper reading what Navil writes down	
	00:00:20.7 picks pen up 00:00:21.8	00:00:21.4 okay\ 00:00:21.8		
	00:00:21.9	00:00:21.8 after this_ the next solution\ 00:00:23.4		
	writes on paper with pen	00:00:23.7 What will be the next solution/ 00:00:24.7		
		00:00:25.7 00:00:26.8 next solution will be_		
		00:00:30.6 one "x" maleic acid_+mhm+/ 00:00:32.2		
		00:00:32.9 Plus_ 00:00:33.3		
		00:00:34.3 one "x" 00:00:35.2		
		00:00:36.4 blocking liaison_ 00:00:37.5		

	00:01:42.1		00:01:42.8	

This excerpt shows how in the course of writing, Navil drops the pen onto the paper and picks it up again to go on writing. This pause in the process of writing is in consonance with the transition shown also through the overlapping mode of speech, when Navil states: 'done/ okay\ after this_ the next solution\'. This marks the end of this sub-act, and the beginning of the next one: the adaptation of 'the next solution'. Writing as a product is used by Navil (min. 1'42") in the form of a typed paper (the protocol) where Navil checks the 'concentration' of a substance needed for the solution [see picture 55].

Picture 55: Navil's use of writing as a product
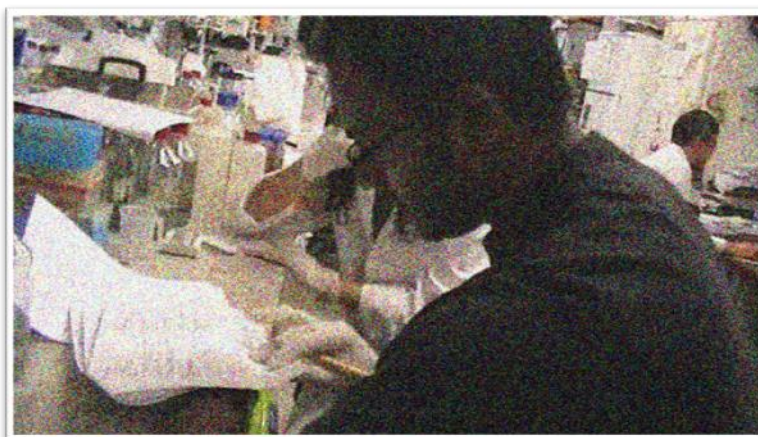
The informed description of the first stage/act, (the *planning stage*) following Navil's stimulated recall interview encompasses four main actions, summarised in the following table [table 6].

Table 6: Insider description of act 1

Num.	Time lapse	Description (by insider)
1	00:00:00.0 00:01:42.3	Navil explains and writes down the protocol to be followed next adapting the quantities to specific volumes needed
2	00:01:42.3 00:01:59.0	Navil checks the concentration of antibody
3	00:01:59.1 00:02:24.2	Navil notes down the usual volume of antibody used

4	00:00:00.1 00:02:24.5	Joana reads the protocol throughout

As can be noted, this description of action from an insider's perspective implies a more general and abstract description of action than the outsider's (the analyst's) detailed description, as well as the use of a more specialised vocabulary. The transcript in excerpt 185 corresponds to actions 1 and 4 in the table above.

The end of the whole planning act is marked by the ceasing of the writing process and Navil's verification of Joana's comprehension through speech ('okay/') [see excerpt 186].

Excerpt 186: Navil and Joana doing experiments 10th July 2014 – Planning stage/act – 'okay/'

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
			00:02:22.1 stares at paper	
	00:02:25.4 takes hands away from paper		00:02:26.0	00:02:25.0 okay\
		00:02:26.0 okay/ 00:02:26.5	00:02:26.0 nods	00:02:26.2
	00:02:26.4		00:02:26.6	
	00:02:26.4 raises open hands with palms outwards at shoulder level and makes a quick		00:02:26.6 with	

	move forward		two fingers of right hand seeks to pick pen from Navil's hand	
	00:02:27.9			
	00:02:27.9 turns hands down, closing fists and pointing at paper with thumbs	00:02:27.0 theoretically\		00:02:28.2 yeah\
	00:02:28.7		00:02:28.7	00:02:28.7

Note the different use of modes of each individual at this stage. During the first stage/act, Navil interacts constantly with the pen and the paper to note down what he is saying. Navil has a short interaction with the other paper, to check some information. Joana only interacts briefly with the pen and the paper to note something down once. Joana's gaze is moving from the paper to Navil, showing that she is paying attention to Navil's writing. Navil's active use of writing, speech, object manipulation and gesture contrasts with Joana's passive use, whereby she listens (speech), reads (writing) and nods (gesture). Accordingly, Navil has taken on the role of an expert practitioner and a mentor, while Joana has assumed the role of a novice trainee, the "learner" in this case.

After Navil has written down the two adapted solutions that need to be prepared for the 'blocking' step of the protocol, he "closes" this act through speech ('that's all\'); he frames the first solution to be prepared next through object manipulation (he metaphorically "cuts" the

paper in the middle with his left hand showing the separation between the two solutions written and points at the written area of the first solution); and he gives the instruction to Joana to 'prepare' the 'next solution' through a combination of speech ('can you prepare this_ please/') and object manipulation (tapping on the paper) [see excerpt 187].

Excerpt 187: Navil and Joana doing experiments 10th July 2014 – End of planning stage/act – 'next solution will be this'

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
	00:02:42.2 opens hands over paper with palms facing it 00:02:43.8	00:02:42.0 That's all\ 00:02:42.6	00:02:42.4 nods while staring at paper	
	00:02:43.8	00:02:43.1 we will··· 00:02:44.9		
	turns left hand perpendi-cularly to paper and hits once 00:02:47.1	00:02:45.5 **next solution will be this_** 00:02:46.8	00:02:45.5 stares at Navil 00:02:45.9 00:02:46.6 00:02:46.6	
	00:02:47.1 points at two spots on paper with pen 00:02:49.3	00:02:46.8 one "x" maleic acid plus two "x" blocking X\ 00:02:49.1 00:02:49.1	nods while staring at paper	
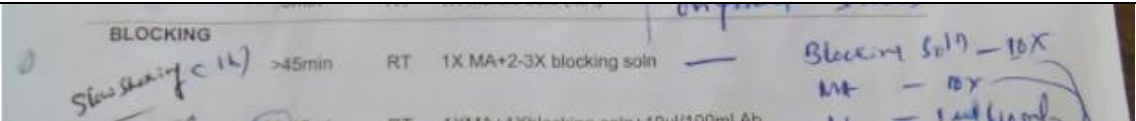
The written protocol is the (top-down) foregrounded text. It is dictated by Navil and adapted to his needs. It will have to be enacted in its adapted form, as illustrated in his words 'can you prepare this _ please/', while tapping the paper with his forefinger on the new document he has written. It is therefore the script to be followed by action, although it does not describe action

497

thoroughly but through few general verbs. As has been shown, the imported protocol structures the practitioners' use of modes across communicative events/inscriptions. However, it takes a local form through its transduction at this 'planning act' from writing as a product and layout to the multimodal combination of location, position, speech, writing, object manipulation, gesture and gaze.

The planning stage finishes definitely when both sign-makers stand up and stop the writing process once and for all. From that moment the enactment of the protocol starts, in this case, the step phrased '1X MA + 2-3 blocking soln', the first of the two solutions of the 'blocking' step [see excerpt 188].

Excerpt 188: Protocol 'blocking' step – first solution

slow shaking (1h) >45min RT 1X MA+2-3X blocking soln *- *Blocking soln – 10X*	
	MA – 10X

Before the 'enactment' of the experiment though, there is a transitional stage/act (the second stage/act), consisting in setting up the materials needed to prepare the solution.

7.3.2. Setting up stage/act

At this second stage/act, both sign-makers are standing in front of the bench and move away once each (position and location) in order to pick up some materials needed for the experiment. Action (object manipulation and gaze) is thus devoted to the inspection and search of these (specialised) materials (falcon tubes and flasks). Speech is used to negotiate the need for materials, their appropriateness, and their location. Navil uses the imperative mood (i.e. 'bring another one\') and indirect commands ('we can use this\'; 'you can transfer this\'; 'can you take fifty_ Joana/') to indicate Joana what materials have to be set up. Joana uses interrogations to check what needs to be done (i.e. 'we will need three/'; 'are we going to use the same flask/'; 'shall I write/'). The nouns used name the materials needed, and deixis (through the pronouns 'this' and 'it') acquires an important role here, in combination with the object-manipulation mode, whereby the objects referred to by these pronouns are pointed at or touched by the sign-maker. Also, numeric information is core for the negotiation of action at this stage.

At the beginning of this stage, both practitioners look up information on the handwritten paper. The writing(-as-a-product) mode is thus used to check the appropriateness of their actions, like the requirement to use certain materials [see excerpts 189 and 190].

Excerpt 189: Joana using writing as a product to look up information during setting up stage

Video shot	Joana's action (by outsider)	
	00:02:51.7 00:02:54.3	looks at paper and points at a particular spot

Excerpt 190: Navil and Joana using writing as a product to look up information during setting up stage – 'we will use only one\'

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
 	00:03:01.6 Approaches left hand to bench 00:03:04.5 00:03:04.5 looks and points	 +m···+ no\ we will use	00:03:02.4 bends to-wards the bench and	00:03:03.3 we will need three/ 00:03:04.1

		at paper and taps it twice	00:03:04.9 only one\	points at paper	
		00:03:06.4		00:03:06.6	
		00:03:06.4 raises forefinger [meaning "one"]		00:03:06.6 walks away from bench	
		00:03:07.0	00:03:07.0		00:03:07.0
				…	00:03:07.4 okay\

At this stage, the gaze mainly swaps from the paper to the objects manipulated, and from one sign-maker to the other in the brief conversations that take place. The written text, in this case the local adaptation of the protocol, is the authority; it directs the embodied action.

After the stimulated recall interview with Navil, the informed description of this act comprehends three main actions [see table 7].

Table 7: Insider description of act 2

Num.	Time lapse	Description (by insider)
1	00:03:11.3 00:03:43.7	Navil merges two falcon tubes of blocking solution
2	00:03:44.8	Joana pours the blocking solution into a flask

	00:03:53.3	
3	00:04:27.4 00:04:31.4	Navil brings a new falcon tube to be used

The differences in time lapses between the excerpts transcribed by the analyst and the insider's descriptions are due to the difference in the significance attributed to the actions by each actor.

At the end of this stage, Navil, through his location and position (he sits down facing Joana), "gives the floor" to Joana. This way, Joana is being foregrounded because she has been asked to 'prepare the solution' at the end of the first act, and Navil is backgrounded. The next excerpt, thus, followed action 3 in the table above [see excerpt 191].

Excerpt 191: Navil sits down to "give the floor" to Joana

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
	00:04:31.5 gives tube to Joana 00:04:31.9	00:04:31.0 can you find the maleic =acid=/	00:04:31.1 picks tube from Navil's hand	
	00:04:31.9 points at bottle 00:04:32.3 00:04:32.3	00:04:32.5	00:04:32.3 00:04:32.3	00:04:31.9 =+mhm+= 00:04:32.5

	sits down on a chair beside Joana		takes blue cap off bottle	
	00:04:35.5		00:04:35.7	

From this moment, Joana becomes the active practitioner and Navil adopts the "supervisor" role, based on the use of gaze (and potentially speech to give instructions or correct Joana's actions). This signals the beginning of the 'enactment' act.

7.3.3. Enactment stage/act

Two different sub-acts can be distinguished within this stage/act, which are marked by (a) two different locations, Navil's bench and the shaking-machine area; and (b) by two main activities or ends (in the EoC): first, the preparation of the solution, and, second, the removal of the old solution from the plastic containers and the pouring of the new one onto the 'membranes'. In the first sub-act, Navil is sitting down while Joana is standing [see picture 56].

Picture 56: Navil supervising Joana's object manipulation

During this sub-act, Joana prepares the first solution as has been planned and written on the paper by Navil (based on the protocol step). Joana has to be standing presumably in order to easily reach the materials that she needs to manipulate for the experiment. The actions, the substances and especially the quantities correspond to the (local) adaptation of the protocol step. In this case, not only the protocol is "imported", but also the substance used (which Navil specified in the stimulated recall interview that was commonly bought from a company) as well as the containers used to contain and measure the solutions. The object-manipulation mode is the main mode used by Joana throughout this sub-act – in actions like pouring, capping, filling, putting, picking and dropping –, whereas Navil uses gaze mainly to supervise Joana's action. A specialised use of gaze (combined with object manipulation) can be observed here by Joana, who raises the falcon tube to the eye level while staring at it in order to check the quantity of liquid it contains in an "appropriate" way (perpendicularly) [see picture 57].

Picture 57: Joana's specialised use of gaze

During the course of this sub-act, speech is sporadic but chief also, since it is used to verify the correctness of Joana's actions (i.e. Joana: 'another one hundred twenty-five_'; 'now twenty-five\'; Navil: 'okay_ it's fine\'; 'okay\ it's okay\').

This first sub-act of the 'enactment' act may comprise two main actions, following Navil's description during the stimulated recall interview [see table 8].

Table 8: Insider description of act 3: sub-act 1

Num.	Time lapse	Description (by insider)
1	00:04:34.0 00:06:16.1	Joana dilutes the blocking solution
2	00:04:33.9 00:06:16.0	Navil supervises Joana and makes sure she does things properly

At the end of this sub-act (the preparation of the solution), Navil stands up, caps one of the bottles used by Joana and gives Joana the instruction of what needs to be done next: 'okay_ let's go and change the solution\'.

The second sub-act of this third act (the *enactment act*) starts when both sign-makers move to another area of the lab (by the shaking machine) [see picture 58].

Picture 58: Navil and Joana by the shaking machine

During this second sub-act, object manipulation and speech are the modes mostly used by both sign-makers. The objects manipulated are lab materials, like falcon tubes, bottles, plastic containers, substances, forceps, gloves and a timer, and some actions through which the sign-makers interact with them are picking up, giving, pouring, uncapping, leaving, pointing and putting. Here Navil takes the lead first and removes the old solution from two of the four plastic boxes that lie on the shaking machine; then he gives the forceps back to Joana so that she can do the same action with the two remaining boxes and pour the solution that she has prepared into the four boxes [see excerpt 192].

504

Excerpt 192: Navil and Joana 'doing experiments' 10th July 2014 – Enactment act – 'go on\'

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
	00:07:22.5	00:07:22.4 okay\ 00:07:23.3	00:07:20.0 picks forceps from Navil's hand 00:07:23.0	… where there's no [component]\ 00:07:21.0 00:07:22.4
	stands by Joana and observes her	00:07:24.8 yes\ 00:07:25.5 00:07:26.1 take it\ 00:07:26.8 take it\	00:07:23.2 picks box from machine and pours liquid into jar while holding solid content with forceps 00:07:38.5	00:07:25.5 yes/ 00:07:26.1
			00:07:38.5 leaves box back onto shaking machine 00:07:40.9	
			00:07:40.9 repeats same process with another box from	

505

	00:07:52.2 picks up flask and gives it to Joana		machine	
			00:07:55.9	
			00:07:55.9 takes flask from Navil's hand	
	00:07:58.9	00:07:57.6 go on\ 00:07:58.1		
			00:07:59.9	
	00:07:59.0 looks at box used by Joana		00:07:59.9 pours some liquid from flask into one box on machine	
	00:08:07.4		00:08:08.0	
	00:08:07.4 points at different box 00:08:09.0	00:08:08.1 next one\ 00:08:09.2	00:08:08.0	
			repeats action with another box	

			00:08:14.8	

This excerpt illustrates how Joana is foregrounded as a practitioner by Navil when he gives her the forceps necessary to carry out the task. From this moment, Navil becomes again the supervisor that directs Joana's actions, through speech (i.e. 'go on\'; 'next one\') and through action (i.e. 'picks up flask and gives it to Joana'; 'points at different box'). The combination of writing with layout (from the protocol) and writing with speech (from Navil's adaptation) is transduced here into embodied action through the mode of object manipulation, but this is being monitored, as part of the 'mentoring' communicative event, through gaze, speech and object manipulation.

The informed description of this second sub-act of the enactment act (after the stimulated recall interview with Navil), corresponding to the removal of the old solution and the adding of the new one by the shaking machine, includes three main actions [see table 9].

Table 9: Insider's description of act 3: sub-act 2

Num.	Time lapse	Description (by insider)
1	00:06:48.8 00:07:20.6	Navil removes the old solution from two membranes
2	00:07:26.8 00:08:40.7	Joana removes the old solution from the remaining membranes and adds the new solution
3	00:08:40.9 00:09:27.1	Both leave the membranes shaking for 40 minutes

The third act (the *enactment act*) finishes when Joana and Navil move to a different room in order to engage in an activity not directly related with the previous protocol step. However, as is shown in the following excerpt, another step of the same protocol will be enacted after 35-40 minutes [see excerpt 193].

Excerpt 193: Navil and Joana doing experiments 10th July 2014 – Enactment stage/act – 'now we've got forty minutes'

Video shot	Navil's action (by outsider)	Navil's speech	Joana's action (by outsider)	Joana's speech
	00:08:37.0 puts cap on the three boxes 00:08:46.6	00:08:38.0 okay\ **now we've got forty minutes_** okay/ 00:08:40.8	00:08:40.7 picks up flask and forceps 00:08:45.8	00:08:41.2 +mhm\+ 00:08:41.5
 	00:08:46.8 takes gloves off while walking away 00:08:51.9		00:08:45.8 walks away 00:08:50.6	
	00:08:51.9 goes by his bench	00:08:53.3 Yes··\ 00:08:53.7 00:08:56.2 the timer··_ 00:08:57.7	00:08:50.6 walks to Navil's bench [out of camera] 00:08:58.3	00:08:50.7 I'm going to put the timer\ 00:08:52.3
		00:08:58.2 Fo··r 00:08:58.9	00:08:58.3 leaves flask and forceps on bench [out of camera] 00:08:59.1	

508

00:08:59.4				
00:08:59.4	00:08:59.3 / 00:09:00.1 thirty-five minutes\	00:08:59.2 takes gloves off		
takes gloves off and leaves them onto bench	00:09:02.0			
	00:09:01.4 **then we come back\ in thirty-five minutes**	drops gloves under bench 00:09:02.1 / 00:09:02.5		
	00:09:03.4	00:09:02.6		
		picks and sets timer		
00:09:11.2				
00:09:11.3 pushes stool closer to bench				
00:09:14.0		00:09:15.4		
00:09:14.1 picks up key from key panel		00:09:15.4 walks to computer area		
00:09:16.9		00:09:19.8		

As can be deduced from this excerpt, the time lapses stipulated in the protocol in which materials undergo machine treatments or other processes that do not require human action allow for the execution of overlapping tasks by practitioners. This causes (the discourse of) the experiment to be instantiated in an interrupted or fragmented trajectory across non-contiguous texts that can last several days or weeks.

When Joana and Navil will come back to the lab after 35 minutes, they will need to continue with the next step of the protocol, by preparing the second solution planned in the first act of this text [see excerpt 194].

Excerpt 194: Second solution of the protocol step
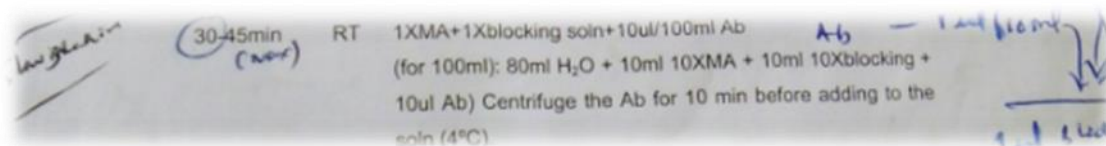
In conclusion, this text evidences that 'doing experiments' is an action-based and process-focused communicative event. This specific text instantiates the local interpretation of an imported protocol, which implies complex processes of deduction and induction that need to be guided by old-timer practitioners so that every protocol step can be split up into diverse communicative acts and sub-acts in the lab, comprising specialised uses of communicative modes and resources. As has been shown, one "sentence" of the written protocol was transduced in the lab into a string of actions which were not specified on the protocol, but had to be deduced by the experienced scientist. In this text, three acts have been distinguished (the 'planning', the 'setting up' and the 'enactment' acts), varying in terms of the purpose of the sign-makers and their use of modes. These were separated by multimodal frames, like the sign-makers' location, their position, and the main mode being used in each. Considering the multimodal frames, the first and the third acts encompassed in turn two sub-acts each.

Object manipulation has been shown to be the central mode in the enactment of the actions stipulated by the protocol, and gaze and speech in the enactment of 'mentoring'. In parallel, all modes were used in a specialised way as part of laboratory practice, which required a certain training and expertise from the sign-makers. All modes contributed to signalling the sign-makers' role in the event, that is, the sign-makers' identity was performed through their use of communicative modes in the communicative event. Navil initiated actions and gave instructions, while Joana imitated actions and raised doubts. Navil observed Joana in order to supervise her action while Joana observed Navil in order to learn from his actions. The mentor's action was a model of 'competence' for the trainee. Each sign-maker stuck to her role, using the necessary communicative modes accordingly.

Position and location were used to foreground and background the sign-maker and her action, to signal expertise and competence, and also to frame the different acts and sub-acts. The sign-makers' location in the lab also had a local significance (culture-dependent), based on group members' status, in relation to the RG, to their institution and to their domain. For instance,

510

Navil, like the other PhD researchers of Group A, had an experimental bench assigned, but Joana, like all BA researchers, did not. Writing as a process had the significance of foregrounding (and making explicit) the process of adapting a protocol locally. Writing as a product was given authority in this context and thus guided embodied action, like a script. However, the enactment of written texts required their specialised interpretation (relying on background knowledge) and their development (based on the practitioners' expertise). As an instrumentality of the 'mentoring' communicative event, the mode of speech was also relevant for the monitoring of the scientific practice in the lab, specifically to negotiate practice, to guide it, to evaluate it and to check its adequacy. This communicative mode was present throughout the event as intermittent and brief interventions, comprising commands, questions and the planning of future actions, also depending on the sign-maker's role. Through this mode, some tacit knowledge was made explicit, like what the most adequate materials for the particular experiment were, how the protocol should be adapted to the practitioners' needs, how action could be optimised, etc. The specialisation of speech affected mainly the vocabulary used, specifically the nouns, referring to laboratory materials and scientific substances. The use of the English language denoted group membership and the acceptance of this language as a lingua franca. Object manipulation was specialised considering the objects being manipulated (like falcon tubes, solutions, membranes, etc.) and also the ways in which they were manipulated, which had to follow certain norms. The specialised use of gaze required practitioners to look at materials and substances in certain ways and to focus on certain aspects.

This has been demonstrated to affect also the way in which experienced practitioners (insiders) describe the *entextualisation* of the experiment in the laboratory. Navil's description was a lot less detailed than the outsider-annotator's description, but still more than the stipulated by the protocol. This evidences the existence of some tacit knowledge necessary to interpret and enact the protocol, a part of which Navil made explicit in his description, but at the same time much of which was not unveiled by him but was observed and described by the annotator.

7.4. Joana's lab notebook page

This text was handwritten by Joana in her lab notebook in July 10th, as a summary of her work that day, and subsequently reviewed by Navil [see excerpt 195].

Excerpt 195: Joana's lab notebook page in July 10th 2014
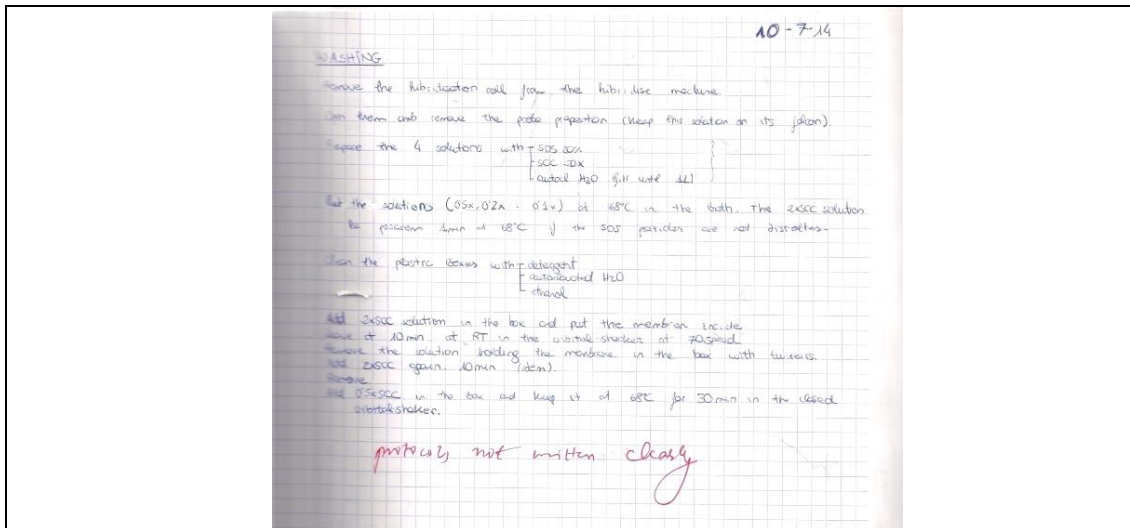
10-7-14

WASHING

Remove the hibridisation roll from the hibridise machine.

Open them and remove the probe preparation (keep this solution on its falcon).

Prepare the 4 solutions with - SDS 20%

-SCC 20X

-autocl H_2O (fill until 1L)

Let the solutions (0,5x, 0,2x : 0'1x) at 68ºC in the bath. The 2x SCC solution la posarem 1min al 68ºC if the SDS particles are not dissoltes.

Clean the plastic boxes with - detergent

-autoclavated H_2O

-ethanol

Add 2xSCC solution in the box and put the membran inside

Leave it 10min at RT in the orbital-shacker at 70speed.

Remove the solution holding the membrane in the box with twizeers.

Add 2xSCC again. 10min (idem).

Remove.

Add 0'5xSCC in the box and keep it at 68ºC for 30min in the closed orbital-shaker.

Protocols not written clearly

This is also a multimodal text dominated by writing. Two colours, blue and red, and two handwriting styles can be distinguished, which denotes the existence of two different sign-makers, with two different ends. The first one, Joana (writing in blue pen), intended to summarise the steps she had followed that day for the 'washing' process. This was the longest part of the text. The second one, Navil (writing in red) aimed at reviewing and evaluating Joana's text. From this follows also the existence of two different target readers: Joana wrote for herself mainly, which explains the fact that Catalan was used in three words (in purple), and at the same time she wrote for whomever could be interested in looking up her lab notebook, including Navil, which explains the general use of English. Conversely, Navil's target audience was exclusively Joana, in spite of being conscious that other group members could potentially read her notebook. The fact that it was written in pen instead of pencil suggests the intention of making it rather definitive; but the fact that codeswitching and certain inaccuracies (as in 'membran', 'shacker' and 'twizeers') were allowed by the sign-maker denotes its unofficial character.

In terms of its content, this text corresponds to one section of the experimental protocol, the first 'washing' section, as is indicated in the overarching heading in capital letters and in bold [see excerpt 196].

Excerpt 196: 'Washing' section of the protocol

Strangely enough, Joana's lab notebook page reflects only the first of the four main sections of DAY 3 of the protocol. It is thus incomplete and does not include the steps followed in the video clip analysed so far (sections 7.2 and 7.3). The particular section reflected is linked to the local context through different means: it is linked to a specific time frame, the concrete date that it was created; it is linked to two identifiable authors through their handwriting; and it is linked

to the context of Group A's lab through the vehicle of the text, the lab notebook, which was exclusively kept in Group A's headquarter laboratory. In this case, the context of production of the text is thus made relevant.

This text resembles the protocol in the lexis used (same substances, quantities, time and temperature indications are used) and in the verbal mood (imperatives predominate). However, in contrast with the protocol, this text contains more detailed indications, in the form of material processes being described through verbs like 'remove', 'add', 'open', 'clean', 'fill', which were ommitted in the protocol and which give clues about intermediate actions or steps followed, as well as in the specification of containers and machines used in 'doing experiments' (like 'from the h[i]bridise machine', 'on its falcon', 'in the box' and 'in the orbital-sha[c]ker') and of more concrete specifications (like the '70 speed' indication corresponding to the 'high speed' indicated in the protocol). Although it is a summary of the 'doing experiments' event, it is not as succinct as the protocol. It thus contains knowledge that was elided in the protocol, but made explicit multimodally in the 'doing experiments' event. This is also evidenced in the inclusion in this text of a potential contingency, introduced by the conjunction 'if': 'if the SDS particles are not *dissoltes* [meaning 'diluted']', which could only be considered after experience. In essence, this text is the result of the *entextualisation* of part of the experiment in the form of the written experimental protocol and its subsequent *recontextualisation* in the laboratory, through the enactment of the protocol step, and again in the lab notebook.

Finally, the sentence written by Navil, in red (the typical colour of teachers' corrections), placed in the end, signals his authority as the observer of the text's quality and as the gatekeeper of the protocol against Joana. As argued in the previous chapter, the authoritative style of the sentence ('Protocols not written clearly'), conveyed by the passive construction devoid of agency and the general, categorical assertion made. Yet, Navil's sign may have required further negotiation for it presupposed a shared notion of 'clearly' between addressor and addressee, which can be assumed to be deduced as inexistent for the fact that Joana had not attained this quality standard.

7.5. Joana's lab meeting

As has been explained in the previous chapter, Group A's lab meetings consisted in an individual oral presentation of one group member followed by a question round and possibly by other comments about non-related issues. These used to take place in the RG's headquarter laboratory and all group members were invited to attend them. This was the case also of Joana's lab meeting, which took place in September 17th 2014, some days after her internship in Group A had finished [see picture 59].

Picture 59: Joana's lab meeting on September 17th 2014

Joana did a 10.5-minute-long presentation (1,300 words aprox.) where she explained, in front of all her (former) group peers, the experiments that she and Navil had done throughout her three-month internship. The presentation was followed by a 3.5-minutes-long question round, in which Frank asked three questions to Joana, one to Navil and one to the rest of group members and in which a brief dialogue between Navil and Frank took place. For the purpose of this chapter, in which the trajectory of Joana's and Navil's experiment as a discourse is investigated, we will focus here on Joana's oral presentation only, as a multimodal text to be analysed.

Joana's presentation relied mainly on the mode of speech, but additionally on visual modes, like writing (on the whiteboard), gesture (for reinforcing speech), and object manipulation (for pointing at visual prompts) and still image (in the form of printed images that Joana stuck on the whiteboard and that she projected on a computer's screen) [see pictures 60 and 61].

Picture 60: Joana's use of object manipulation

Picture 61: Joana's use of still image (on a computer)

Following the RG's culture, Joana's presentation started with a greeting ('Good morning everyone_'), as she had observed and thus "learned" from other group peers' lab meetings. Following, Joana introduced the topic of her presentation for 1.5 minutes (aprox.), as she indicated herself ('I'm going to start my lab meeting talking * +m+ doing a·· short introduction_'). The body of the presentation (8.5 minutes aprox.) was Joana's narration of the analyses that she and Navil had done, the description of the results they obtained and the argumentation of the meaning of such results. The next four excerpts are samples of her narration of an analysis [excerpts 197, 198 and 199] and of her final interpretation of the analyses' results [excerpt 200].

Excerpt 197: Joana's lab meeting – Analysis 1

…with these plants we· grow * we {(sic) grew} them in two different growth * in two different conditions_ one control_ without [substance 1]_ and another one with [substance 1]_ +eh+ one& 155 micromolar [substance 1]\ and then we did the [kind] expression analysis_ in order to·· check if * which [components 6] * I mean_ to check the ge& * the [kind] expression of each [component 6]\ here * well_ you can see the results that we got_ +ehm+ first of all this one is the [component 1]_ the first picture is the {(?) theme} that we got_ and in the second one you can see the XXX register for the [component 3]_ unfortunately I lost five samples_ but we went on with the analysis_ but we have to repeat this Northern_ so that we will be able to have XXX [components 6]\ +ehm+ in this * in this analysis +ehm+ we also collect seeds from these lines_ from control and from [substance 1] treatment_ and we did the·· [substance 2] digestions_ and then we quantified the * some minerals_ like iron_ manganese_ and {(sic) cooper}_ in the XXX XX\ but we still not have the results_ but they will be shown in Navil's lab meeting\

Excerpt 198: Joana's lab meeting – Analysis 2

okay\ then +eh+ we can move on to the [substance 1] tolerance experiment_ we carry out this * this experiment in order to evaluate the tolerance of different [type 2] {(sic) rilines} * [plant] lines to presence of [substance 1] * +oh+ sorry\ +ehm+ first of all we did a preliminary toxicity assay_ we used the [type 1 plant]_ And we grow * and we germinate the seeds in four different conditions\ one was the control_ without [substance 1]_ another one with 100 micromolar of [substance 1]_ another one with 300_ and 600\ because we wanted to··· * to find the·· toxi& toxic +ehm+ level of [substance 1] in the media_ I mean_ the amount of [substance 1] that let us to see visible differences in the growth\ +ehm+ after seven days * seven days of let them grow in the growing chamber_ we· could see * {(Sp) bueno}_ as you can see in this picture_ [mouse clicks] I don't know if you can see properly\ [noise] +ehm+ As you can see +ehm+ we can see clear differences between the 600 micromolar plants_ and the other groups of plants\ so we decided to· take this * this concentration as the toxic * toxic cotese& * concentration of [substance 1] to work in the following step\

Excerpt 199: Joana's lab meeting – Analysis 3

then_ +ehm+ we did the· tolerance toxicity es& assay_ we germinate seeds from [type 1 plant] and also from different * from 13 different [type 2 pla& plant] lines_ +ehm+ these three different [type 2 plant] lines_ +ehm+ four of them expressed [component 2]_ another four [component 1]_ another five both [components]\ +ehm+ all the lines * {(Sp) bueno}_ all the seeds were * were long_ in control_ and the 6 mic& * 600 micromolar of [substance 1]\ +ehm··+ To· * To·· evaluate the·· [substance 1] tolerance_ we measured three different parameters\ we measured the length of the growing leaf_ the length of the stem_ and the length of the main root\ and after·· 12 days_ we could see {(Cat?) desnutrits els}\ [mouse clicks] Well_ +ehm+ maybe it's too small\ but I XX XXX\ +ehm+ in the first line is the * there are all the control li& * all the control lines\ +ehm+ as you can see_ there is no clear difference between * between the growth of all of them\ but if you look at the second line_ you can see that these lines_ which are the ones that express only [component 2]_ +ehm+ has a {(Cat?) bé} quite reduced growth\

Excerpt 200: Joana's lab meeting – Final interpretation

what does it mean/ +ehm+ here we have the·· {(sic) graphics} that we * that we got_ [paper noise - showing graphs] okay\ well_ as you can see_ in the·· [type 2 plant] line that were ex& * that were expressing only [component 2]_ +ehm+ we can see a clear +ehm+ reduced in the length of three organs that we measured\ the· leaf_ the stem_ and the main root\ +ehm+ it is because of· the·· * the expression of [component 2]_ it is to the XXation of [component 4] to be converted in [component 5]\ as is this shown in this pathway\ so there is not enough [component 4] to bind all the [substance 1] in the plant_ so this [substance 1] becam& become toxic for the plant\ and in the * in the other lines which were expressing [component 1] and [component 2] plus [component 1]_ there is·· * I mean_ there is no difference between this growth and the growth of the control\ * I mean_ they express hi& high level of [co& component 4] and [component 5]_ so this leads to an * to an high tolerance of

[substance 1] in the media_ because there is enough amount of [component 4] to bind all the [substance 1]\

These excerpts show the main traits of this (multimodal) text. As can be seen, highlighted in blue, references to visual prompts were very frequent; in these four excerpts only there are six such references total, like 'picture', 'graph[ic]s' and 'pathway', as evidences that support assertions made through speech. This demonstrates the significance of visual aids for these practitioners' effective communication. Also characteristic of this text is the high presence of agency throughout [highlighted in purple], through the use of 'we' (37 times total in the text) and 'I' (10 times total) although with mental processes (Halliday, 2004) (entailing less human influence on material objects). Similarly, the practitioners' agency is underscored through the use of the active voice in material processes (Halliday, 2004) [in red], like 'we· grow * we {(sic) grew} them…', 'we carry out this * this experiment…', 'we did a preliminary toxicity assay_', 'And we grow * and we germinate the seeds…', 'then_ +ehm+ we did the· tolerance toxicity es& assay_ we germinate seeds…' and '…that we measured\'. In this case, the justification of decisions and actions [highlighted in pink] (i.e. '…in order to·· check…', '…in order to evaluate…') is very common throughout the text.

The local context was made present in the text in three ways [highlighted in green], first, by directly addressing the audience (i.e. '(as) you can see'), second, in the form of references to contingencies (i.e. 'unfortunately I lost five samples'; 'we have to repeat this Northern'; 'we still not have the results_ but they will be shown in Navil's lab meeting\), and third, to negotiate meaning and the use of communicative resources ('I don't know if you can see properly\'; 'maybe it's too small\'). Furthermore, by stressing the local scope of the text, informal expressions were commonly used by Joana [in yellow] (i.e. 'okay\ then +eh+ we can move on to the [substance 1] tolerance experiment_'; the rhetorical question 'what does it mean/'; 'so…so…so…because…').

English was the language used throughout, as was the norm in Group A's lab meetings, but a few words in Joana's L1 were used on four occasions: in spontaneous discourse markers for reformulating previous statements (Joana used the Spanish word 'bueno' meaning 'well' three times and its Catalan equivalent, 'bé' once) and to say a word she could not remember or she did not know in English (she used the Catalan 'desnutrits' meaning 'undernourished'). This latter instance, resonates with the code switching found in her lab notebook page. The improvisation that the lab meeting and the lab notebook required may have triggered this phenomenon. The improvisation characteristic of this text (which could not be read as a norm) generated also much hesitation (39 times) and reformulation (54 times) from the part of Joana,

518

and most of her sentences ended with a continuing pitch movement (102 times against 73 falling-pitch-movement assertions and only one rising-pitch-movement question), which denoted her nervousness and/or insecurity.

In terms of the lexis used, scientific terms, like substances, plant components, types of plants and kinds of analysis, as well as common-use terms with scientific specialised meaning, like 'concentration' and 'tolerance' are core aspects of the message. The ten most common words (without articles, conjunctions, prepositions and the verb 'to be') were scientific terms (which cannot be reproduced here for confidentiality reasons) and common-use terms with a specialised meaning (like 'line' and 'express/ion') [see table 10].

Table 10: Most common terms in Joana's report

TYPES	TOKENS
line/s	24
[substance 1]	22
express/ing/ion/ed	20
[component 6]	16
grow/grew/growth/ing	16
[component 4]	16
can	15
see	14
different/ce/s	13
[component 5]	13

These words alone could summarise the research question of Joana's and Navil's experiment: *What differences in growth can be seen in lines that express different [component 6] due to contact with [substance 1]and in relation with the amount of [component 4] and [component 5] they have?* In this text, numbers were much less preponderant than in other texts (15 types and 47 tokens).

Joana's presentation ended with a one-sentence conclusion ('so·· after all we could conclude that [component 4] binds [substance 1]_ leading to an enhanced tolerance to [substance 1] in the

media_ but this cannot be done by [component 5]\'), a closing statement and her expression of gratitude to the audience ('so_ that's all_ and thank you for your attention\').

In conclusion, this is a highly localised text that follows the norms of the RG, probably with the chief intention of showing "competent" membership. It however includes standardised traits that may be valid out of the RG, and which are mainly domain specific, like the topic, the object of study and the processes referred to in the text, as well as the use of specialised English and of concepts typical of the practitioners' domain of practice.

7.6. Joana's report

A report was written by Joana after her internship in Group A in order to summarise her findings, and it was reviewed by Navil before being delivered to Joana's *practicum* professor. It is a typewritten, ten-page long multimodal text dominated by writing (totalling 1,940 words) but with some importance given to image, in the form of specialised pictures, figures and tables (which combine writing with characteristics of image like the significance of layout). It is composed by a main text (written by Joana, as its main author) and additional comments on the margins, originally from Navil (as a reviewer), but some of which contain a dialogue between both sign-makers. The fact that writing was standardised through typewriting suggests an official character of the text (as was the fact that it had to be delivered to Joana's professor), but the presence of margin comments indicates its status as a preliminary draft [see picture 62].

Picture 62: First page of Joana's report [edited for confidentiality reasons]

Its overarching title is a noun-phrase that summarises the object of study and the characteristics that have been checked in relation to a certain substance specified. As indicated in its subtitle (in bold capital letters and below the title), it corresponds to the 'results' section of a typical scientific article. Accordingly, it is organised by the narration of consecutive analyses, with the presentation of their results and the argumentation of their interpretation. The different analyses are distinguished by a section title (in bold letters). In this case, and in contrast with the protocol and the lab notebook page, the analyses are not described as a chain of steps or actions, but are simply named, presupposing their identification by the readership [see excerpts 201 and 202].

Excerpt 201: Joana's report - Reference to analysis 1

Expression analysis

Expression of [component 1] and [component 2] was screened by [kind] blot analysis using total leaf [component 3] isolated from [type 2] plants and [type 1] plants grown in

the presence of 150µM [substance 1].

Excerpt 202: Joana's report - Reference to analysis 2

Correlation between [component 6] expression and levels of [component 4] and [component 5]

Unpolished grains of [type 1] and [type 2] plants were analysed by high-performance liquid chromatography (HPLC) (experiment performed by ([author 1]) in order to investigate whether [presence of component 1 and 2] individually or in combination might affect accumulation of [component 4] and [component 5] in seeds.

Through this text, the actions developed in 'doing experiments' is transduced into writing and image. However, this text is more result-focused than the texts analysed previously, which results in very few references to material processes (Halliday, 2004). Only three such processes can be observed in the report: 'were grown', 'were germinated' and 'carry out (an experiment)', once each. The narration and the argumentation rely on writing only, but the presentation of results is supported by still image, in the form of graphs and tables summarising counts, and of (specialised) pictures illustrating some aspects of the object of study [see excerpts 203 and 204].

Excerpt 203: Joana's report - presentation of results

Out of 7 [plant type 2] lines, One line expressed only [component 2] (line 198), 3 lines expressed [component 1] (lines 92, 234 and Ed-2.1) and 3 lines co-expressed both [components] (lines 8, 89 and 98) (Figure 1;Table 1).
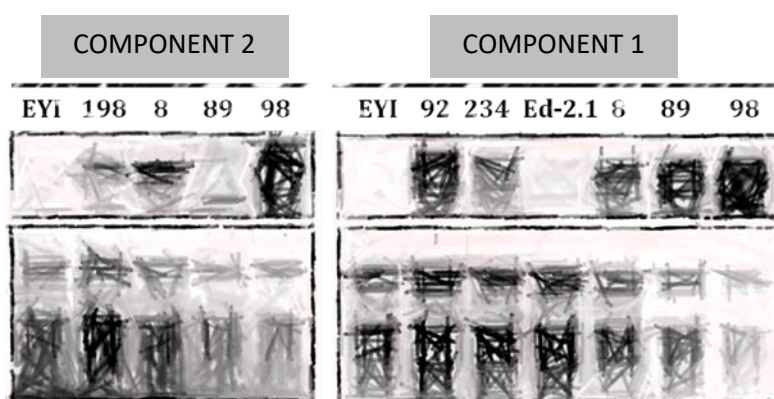
Figure 1. [kind] blot analysis showing the expression of [component 2] and [component 1] from leaf tissue of different [plant type 2] lines and [plant type 2] (EYI) grown with 150µM [substance 1].

Note here that image relies also on writing for the specification of the referent of numbers and abbreviations.

Excerpt 204: Joana's report - argumentation

> Mobilisation of [substance 1] to husk in these lines is attributed to increased level of [component 5]. Therefore, the results indicate that [component 4] directs [substance 1] to the seeds, most preferable towards endosperm and [component 5] directs [substance 1] to the husk.

The text is devoid of any contextual contingency; it makes reference to substances, analyses and components that are presupposed to be known by the readership, regardless of any local (or national) context. The readership is thus treated as knowledgeable practitioners, specialised in the same domain as Joana (and Navil). Likewise, the terminology used must correspond to the shared repertoire of the community of the domain. The rhetorical style adopted consists of the use of the passive voice ('Mobilisation of [substance 1] to husk in these lines is attributed to increased level of [component 5]'), the recontextualisation of inanimate entities as subjects ('[component 4] directs [substance 1] to the seeds'), and the use of inference for argumentation. Agency is not emphasised, but on the contrary removed from the text, although its authorship is known and may potentially be made relevant to claim property over the results presented in it. The style of the images included suggests also domain specialisation, since images have a standardised format that requires specific production machines from the part of the sign-maker, and some background knowledge from the reader to compensate for elisions and presuppositions (like the meaning of blots, of some abbreviations, of the layout and of other characteristics). This suggests that the framework of the domain (of practice and of knowledge) is more relevant than the national framework for the interpretation of this text.

The code used is again English imbued with a specialised terminology. The ten most common words (without articles, conjunctions, prepositions and the verb 'to be') were scientific terms (which cannot be reproduced here for confidentiality reasons) and common-use terms with a specialised meaning (like 'line' and 'concentration') or with specialised use/understanding (like 'figure', 'plant', 'seeds' and 'husk') [see table 11].
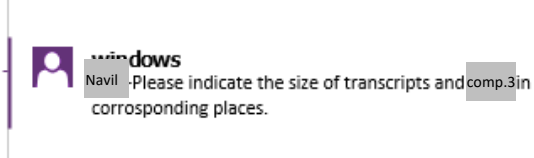
Table 11: Most common terms in Joana's report

TYPES	TOKENS
line/s	54
[plant type 1]	27
figure	23
[plant type 2]	23
plants	21
concentration	19
seeds	19
[trait]	18
husk	14
[substance 1]	14

The frequency of use of the word 'figure' (the third most frequent word) reinforces the significance of (specialised) image in this text as a complement of writing and at the same time as the guarantee of the truthfulness of assertions. The other terms make reference to the object of study and to some of its characteristics that were the focus of the experiment (i.e. type, trait, concentration and presence of substance 1 in it). Numbers were preponderant, accounting for 75 types and 247 tokens (in the written part only).
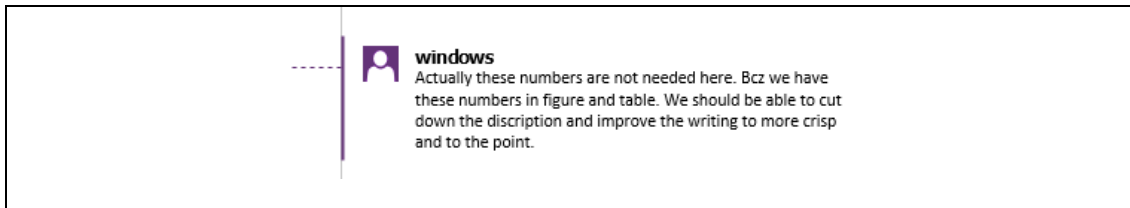
Navil's comments in the margin make reference to the location of information and images [see excerpts 22 and 23], to Joana's writing style and quality [see excerpts 205, 206 and 207] and to the addition and removal of data or figures [see excerpts 208 and 209].

Excerpt 205: The report – Navil's comment – 'Please indicate the size of transcripts'
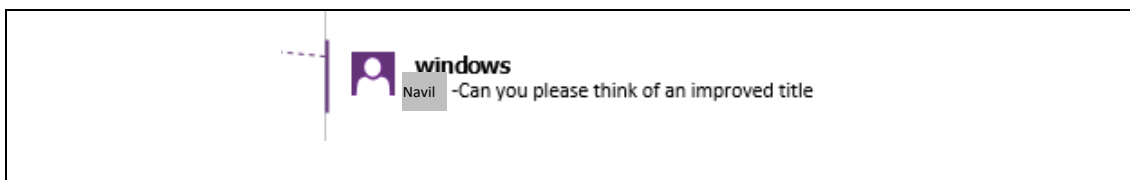
Navil -Please indicate the size of transcripts and [component 3] **in corr[e]sponding places**.

Excerpt 206: The report – Navil's comment – 'these numbers are not needed here'
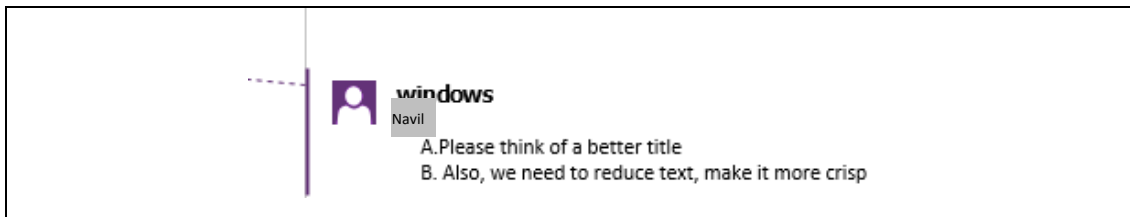
windows
Actually these numbers are not needed here. Bcz we have these numbers in figure and table. We should be able to cut down the discription and improve the writing to more crisp and to the point.

Actually these numbers are **not needed here**. Bcz we have these numbers in figure and table. We should be able to **cut down the d[e]scription and improve the writing to more crisp and to the point**.

Excerpt 207: The report – Navil's comment – 'think of an improved title'

windows
Navil -Can you please think of an improved title
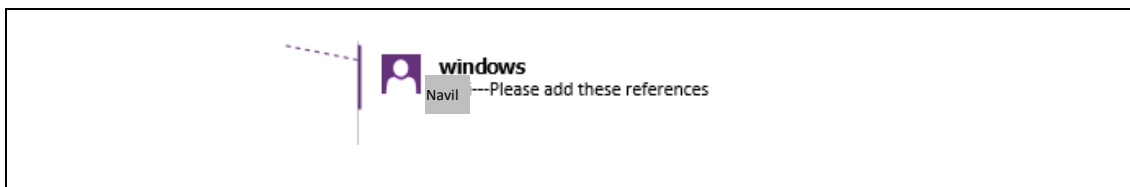
Navil -Can you please think of an **improved title**

Excerpt 208: The report – Navil's comment – 'make it more crisp'

windows
Navil
A.Please think of a better title
B. Also, we need to reduce text, make it more crisp

Navil

A. Please think of a **better title**
B. Also, **we need to reduce text, make it more crisp**

Excerpt 209: The report – Navil's comment – 'add these references'

windows
Navil ---Please add these references
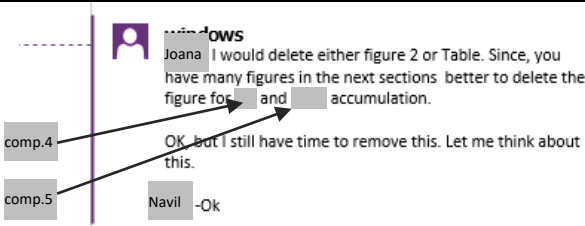
Navil---Please **add** these references

The mentor's authoritative style is softened here through the use of words like 'please' and 'would', the inclusion of the first person (by using the pronouns 'I' and 'we') and the justification of some indications (like in the clause introduced by 'Bcz'). Yet, there are still categorical statements and evaluative adjectives that presuppose the existence of one "good" way of writing the report: 'better to', 'are not needed', 'an improved title', 'a better title', 'more crisp'. The latter aspect contributes to the construction of Navil's identity as Joana's mentor, while the former shows proximity (possibly due to their similar status as students). In this case, some negotiation seems to be allowed, as shown in the few dialogues between both sign-makers present in the margin comments [see excerpt 210].

Excerpt 210: The report – Navil's and Joana's comment – 'Let me think about this'

Joana I would delete either figure 2 or Table. Since, you have many figures in the next sections better to delete the figure for [component 4] and [component 5] accumulation.

OK, but I still have time to remove this. **Let me think about this.**

Navil -Ok

As can be observed in this excerpt, from his authoritative position, Navil makes suggestions to Joana, stating what he 'would' do and explaining why, but Joana feels empowered to ask for some more time to 'think about this'. In contrast with Group A's leader, in this case, Navil does not adopt the role of a language editor, and no comments referring to language are made throughout the report.

To conclude, the report is a text in-between the lab notebook and the scientific article, not only chronologically speaking (since it summarises and takes information from the lab notebook and contains preliminary results that need to be developed further for publication), but also as regards its characteristics. Like the lab notebook, it is semi-formal, not adapted fully to publication standards; it keeps some chronology as regards the order of the analyses carried out; and the information presented is quite faithful to that presented in the lab notebook (i.e. particular analyses done, result details, data tables, machine outputs, etc.). Parallel to the scientific article, it emulates its structure (or part of it, as the 'results' section in this case), its

526

linguistic and rhetorical style, the style of images, and the absence of contextual contingencies and of human agency, among other traits.

7.7. Hints of internationalisation at the local level

The description and analysis of the form of the texts presented in this chapter reveals the presence of an international dimension in more or less evident ways. First, the content of the texts is framed within a field of expertise or otherwise a domain of practice that is relevant for an international community. This way, the topic, the object of study and the processes referred to in the texts have to be validated a priori and posteriori by this community beyond the RG. In this case, the study of plants was framed within a specific scientific field; the specific experiment designed (by Navil under Frank's supervision) followed the line of a literature of previous experiments; the processes carried out by Navil and Joana in the laboratory were backed up by the tradition of the domain and by the protocols that guided them; all of these were external, international inputs. This knowledge was conveyed through (international) scientific publications, (international) imported protocols, and interpersonal communication among group members, in 'mentoring' events or other types of communicative events, which could be based on the practitioners' international experience, like in the case of Navil, who had some previous research experience in India.

In the case of the protocol, as has been shown, it is designed as a standardised, top-down text, independent from contextual contingencies, aimed at an international audience, which affords its reproduction internationally (it can be downloaded and printed form accredited sources), but whose negotiation at this international level is complex and arduous. Its unequal negotiability entails its adaptation to local needs and circumstances (materials, resources, etc.) only at the local level, as was observed in Navil's handwritten notes on the text and on the adapted version that Navil dictated and wrote in the lab.

The laboratory itself framed practice within an international setting to some extent. Although it was located in a university in Catalonia, it could be internationally identified as a scientific laboratory. It was equipped with scientific machines with standard form and affordances (like the orbital-shaker), with internationally supplied objects and materials that followed international standards of quality, and with computers and scientific software from international companies. The laboratory equipment and layout are marked by internationally recognised processes and practices – like the ones described in protocols – typical of the scientific domain in which the RG's practice is framed. As has been argued, these texts presuppose the existence in the laboratory of the machines, the tools and the materials necessary to execute the

instructions they describe; which constitutes also an international directive of the configuration of the laboratory at the local level.

Internationalisation is not only present in the tools, materials and machines used globally in the same scientific field, but also in the internationally legitimised ways in which such elements are used. One example is the specialised way in which, while 'doing experiments', Joana measures the quantity of liquid with the falcon tube raising it to the eye level, or the way in which she and Navil remove the solution from the plastic containers using the tweezers. Despite the local nature of these practices, tied to the particular practitioners, their intentions and their immediate context, they are framed within internationally accepted norms of "good practice", domain-specific criteria and the international discourse of science. This applies also to the standardised traits of the texts that represent scientific objects and ideas, from the texts consumed by practitioners (like protocols and scientific publications), to the texts produced by them (like oral presentations, reports and even the doing of experiments in the laboratory), as well as to the outputs of the machines used worldwide for similar experiments (like the images obtained through the [type] blot analysis shown in Joana's report). According to such standard formats, these texts may be assessed by international criteria within a domain of practice, which explains Navil's implication of the existence of "good practices" in absolute terms in his feedback, like in the evaluative comments made by him on Joana's report that assumed the existence of 'better', 'more crisp' and 'improved' ways of writing reports beyond personal criteria.

The potential international scope of the experiment itself, which must transcend the RG through reporting texts, is underlying the sign-makers' decisions. These are based on the local interpretation (of themselves and of their group peers) of international norms for scientific representation, which are ascribable to the referent academic genre for each text (in the case of linguistic texts). An example of this is the rhetorical style chosen by sign-makers for their linguistic texts (i.e. the use of the active or the passive voice, the concealment of agency or its emphasis, the prevalence of mental or material processes, etc.), which changed across the texts analysed, depending on the sign-makers' evaluation of their audience, of the norms of the genre and of the quality criteria prevailing in each case. Another example is the use of images (including pictures and graphs) as an evidence of the reliability of the claims made (like in Joana's report and in her lab meeting), following (arguably) international scientific norms (as the practitioners could find in the scientific publications they consumed).

The code used in the text implies also an international dimension. In terms of language, all texts relied on English as a lingua franca both for local as well as for international recipients, but in a specialised form, which affects the lexis used, referring to laboratory materials, scientific

substances, analyses and processes, as well as the use of abbreviations, contractions and acronyms which conforms a domain-specific jargon. To some extent it can be adapted to the local context through the development of an in-group jargon and inter-personal repertoire (i.e. between Joana and Navil), but the knowledge and use of the code of the domain of practice is required in texts with an intended specialised international readership, like scientific publications, or in those texts imported into the RG from international sources, as in the case of the protocol. Knowing and developing such code/s is dependent on the consumption of the kind of texts analysed in this chapter, and thus tied to the practice of science within a particular domain, due to their specialised nature. Beyond language, other international codes observed in the texts include numeric information and internationally recognised gestures, like nodding and pointing.

A special mention will be made here regarding an aspect of representation that has appeared to be especially affected by an international dimension. The analysis of the discourse trajectory of Joana's and Navil's experiment across different texts has revealed that the way of thinking about the experiment itself, the content of representation or, phrased otherwise, what is expressed, may also be influenced by the internationalisation of science. Different depths of description have been observed in the data, depending on the more or less localised nature of the text and the higher or lower degree of specialisation of the sign-maker. While the annotation of action (by the analyst) in the laboratory for the 'doing experiments' event included a wide range of actions, this was interpreted by Navil (in the stimulated recall interview) as encompassing very few significant actions, few of which were in turn described by the imported protocol. Put differently, one protocol step (represented in one line of writing) triggered a string of actions in the laboratory that lasted hours, but which were mediated by the sign-makers'/scientist practitioners' interpretation of grand actions that made sense scientifically. The international dimension of science thus implies the abstraction of thinking about scientific practice by experienced practitioners. This 'scientific thinking' is presupposed in texts, which omit much information that needs to be recovered by knowledgeable practitioners. Of course, such 'scientific thinking' is one of the skills that needed to be learned through participation in the RG-CoP.

Finally, internationalisation was present in the configuration of the 'mentoring' event in a way that it was recognisable as such. It involved the performance of the (internationally recognised) mentor role (by Navil) and that of the (internationally recognised) trainee (by Joana). The local execution of international norms for 'mentoring' implied that Navil took the lead and assumed a supervising task, becoming the model, the evaluator and the guide, while Joana adopted a secondary role, always reliant on Navil's instructions and approval. This affected not only

actions in the laboratory but also written texts, like Joana's lab notebook and written report, which were supervised by Navil. As has been claimed, their performance as sign-makers was marked also by their status in the institution (PhD student, Navil, and BA student, Joana) and in the RG (mid-term old-timer, Navil, temporary newcomer, Joana), with implications as regards power relations that are also internationally identifiable. Yet, while their hierarchy responds to internationally recognised categories/statuses, the ways in which this is performed and made relevant or ignored depends much on the specific local circumstance (i.e. Navil used a softened authoritative style with Joana that denoted proximity).

In conclusion, not only language, but multimodal communication was affected by the internationalisation of HE and of science, as can be observed also at the micro level of analysis. International inputs, the setting of the laboratory as a global sign, the rules for scientific representation, the codes used, the way of thinking about and expressing science, and the 'mentoring' event itself were all imbued with the international dimension, which was negotiated and adapted to the local context through (multimodal) communication and materialised in the form of texts like the ones analysed in this chapter. International science, and more specifically the knowledge and norms of the participants' domain of practice, was concretised in its enactment and *entextualisation* in the local context, being strongly mediated by the interpretation of old-timer scientist practitioners.

In the next section, a discussion of findings in the light of the literature will be presented, as well as some concluding comments.

7.8. Discussion and conclusions

This chapter has sought to answer the research sub-question *What is the influence of the IoHE on scientists' communication at the level of text form?* To this end, a multimodal analysis of different texts that conformed the discourse trajectory of a scientific experiment has been carried out, in order to contribute first to the understanding of the process of meaning making through the *entextualisation* and *recontextualisation* of the experiment, and second, to unveil how it is influenced by the internationalisation of HE and of science. This way, the "conjurer's tricks" (Lynch & Woolgar, 1988: 105) for the orchestration of meaning in scientific representation have been revealed and linked to the international dimension of her practices.

The IoHE is a macro construct that has been operationalised at the meso level as consisting of 'strategies' and 'activities' like the internationalisation of the curriculum at home, student and staff mobility, the development of international networks, the international export of academic systems and cultures, and international credit recognition and transfer. Applied to the scientific

practice, the IoHE includes the formation of multinational research groups (at home), the international mobility of scientists (in internships or career positions), international cooperation between scientists, and international projects. However, although communication is underlying all these practices, the ways in which these activities influence scientists' communication has not been thoroughly studied. Micro-level research that can be related to this topic conforms a fragmented map, addressing issues such as the consensual validation of scientific knowledge (Knorr-Cetina, 1999; Latour & Woolgar, 1986 [1979]), the identity construction of scientists (Hakala, 2009; Holley, 2009), the strategic rhetorics of scientific textual discourse (Bazerman, 1981; Lynch, 1988; Mody, 2014), the use of English as a lingua franca in the academia (Lillis & Curry, 2006, 2010; Bennett, 2014c), the multilingual practices of scientists (Mondada, 2005; Uzuner, 2008) and the particularities of scientific representation (Amann & Knorr-Cetina, 1988; Suchman, 1988). Although the connection between these issues and the IoHE can be inferred, these studies rarely make such connection explicit. This chapter is an effort in this direction, by going beyond the description of scientists' micro-level communication and by finding out the ways in which it relates with the IoHE.

The use of *multimodal social semiotics* as a chief theoretical approach for the micro-level analysis of scientists' communication has proven to be fruitful. The data analysis has confirmed the claim that "scientific discourse evolved into a multi-semiotic ensemble to meet the needs of new scientific methods and theories" (Liu & Owyong, 2011: 832). Multiple modes of communication and significant communicative resources have been identified in all the texts analysed, contributing differently to the making of meaning in each text. Moreover, hints of internationalisation have been found across these modes and resources. Therefore, relying on (academic) literacy approaches – and thus focusing only on the modes of writing and speech – would have been too limiting for the purposes of this study. Regarding the scientist practitioner not only as a writer or as a speaker, but also as a sign-maker opens up a wider range of possibilities in the exploration of her agency, her motivations, her intentions and her semiotic work.

In order to understand the influence of the IoHE on scientists' communication at a micro level, the explicit (or evident) traits of the texts analysed have been proven to be as important as their implicit aspects. The absence of explicit contextualisation and framing of texts by the participants does not impede this work by the analyst. The sign-makers' decisions in the orchestration of meaning through the texts analysed were clearly framed within a specific scientific field or domain of practice. This claim is demonstrated by (1) the specialisation of the topic of the experiment and of its object of study – which must be strategically positioned within a 'field of demands' (Knorr & Knorr, 1978) –, (2) the specialised use of communication

531

modes and resources – conforming 'complex multi-literacy practices' (Lemke, 2000) –, (3) the rhetorical aspects of the texts produced – named also "the 'rhetoric' of scientific writing" (Latour & Woolgar 1986 [1979]: 103) –, and (4) the codes chosen by the sign-makers to encode the texts – consisting of "special expressions", "technical terms", "special symbols" and even "a whole sign language" (Fleck, 1935: 144). Moreover, the general lack of explicit rules for communication previous to text production and the absence of identification of the source of such rules whenever they were made explicit suggest the existence of a conventional system that transcended the RG. This idea is consistent with the theorisation of science as a 'culture' that legitimises and constrains scientific practice (and thus scientists' text production) without making norms explicit (Collins, 1975), and of laboratory work as a set of reactions to external demands and interpreted needs, dependent on contextual aspects (Zenzen & Restivo, 1982).

As has been demonstrated in the data analysis, this system of norms is conveyed to the individual scientist through her consumption of texts that have been validated and hence legitimised by external (international) agents (like scientific publications and protocols) – which constitute the "socially shared and socially validated body of knowledge" (Merton, 1973: 450) that science is – and through the guidance of old-timer practitioners (supervisors, mentors, etc.), who act as gatekeepers of certain (arguably absolute) quality standards, as has been shown in Navil's corrective feedback. In line with this, categorical and authoritative corrective comments introducing conventions as self-evident truths have also been found to be common in formal training in academic literacies (Lea & Street, 1998). The scientist-sign-makers' situated learning in the RG consists thus in acquiring a sense of what the validating criteria – the 'criteria of protocollarity' or 'criteria of objectivity' in Agazzi's (2014) terms – of these international agents – the *epistemic community* (Creplet *et al.*, 2001) of their field of expertise – are and of how these affect their production of texts. In this endeavour, the RG – here exemplified in the relations between Joana and Navil – plays an important role as a mediator between the international and the local dimensions, between the international community and the individual scientist, contributing with its (hierarchically) organised machinery to the assessment and modification of the sign-maker's outputs so that they conform to these international standards. The improvement of quality in higher education through the attainment of international quality standards is one of the rationales of the IoHE (Knight, 1997). Also, the mediating nature of social processes and negotiation has been widely acknowledged by works in the sociology of scientific knowledge (Collins, 1975; Lynch, 1985; Martin & Richards, 1995). The entextualisation of the experiment in its different forms analysed here evidences this process of guided local text production dependent on the validation of this international community.

The analysis of the discourse trajectory of the experiment across texts, from the experimental protocol to the written report, has illustrated how an international input (the original protocol) is adopted by the RG and adapted to its local characteristics. The protocol has been shown to be a highly specialised and synthesised text, which requires the active recovery of elided parts by knowledgeable agents (experienced practitioners) for its local enactment in the laboratory. The idea of the partiality of scientific texts is underlying also in constructionist views of scientific knowledge (i.e. Knorr-Cetina, 1981; Lynch, 1985; Woolgar, 1988; Zenzen & Restivo, 1982). Also, the production of the protocol entails the abstraction of local practices into standardised processes, substances and codes that must be decoded through deduction and concretion when this text is consumed and interpreted (on the abstraction of 'scientific objects' see Agazzi, 2014). The transduction of discourse across texts and modes requires the development of deduction and induction skills by sign-makers as well as the ability of abstraction and concretion in the articulation of the experiment. For example, one line of the written protocol was transduced by Joana and Navil in the laboratory as a string of actions throughout 9.5 + 40 minutes, which in turn became an elided part of a noun phrase (the name of the whole analysis) + an image in Joana's written report. Accordingly, the 'tacit knowledge' (Polanyi, 1958) is made explicit variably across the texts, and local contingencies and details are included in or excluded from them, depending on the sign-maker's intention and assessment of the communicative situation, her 'interest' (Kress, 1993; Stein, 2008). This is in line with Amerine and Bilmes' (1988) claim that following instructions in the laboratory requires being able to sort the essential from the unessential, to fill in the gaps of the instructions, to recognise the importance of practices, and to deal with vagueness; and with Latour's (1985, 1986) description of the process of progressive simplification of scientific observations along 'cascades of inscriptions' that make scientific phenomena ever more mobile. The transduction of writing and layout from the protocol into embodied action in the laboratory hence depends on the sign-makers' previous experience and expertise and on their previous development of the necessary skills. The process of making 'tacit knowledge' explicit has been named the 'externalisation' mode (the second of a cycle of four knowledge conversion modes, including socialisation, externalisation, combination and internalisation) in Nonaka *et al.*'s (2005) 'spiral of knowledge creation'. The acquisition of tacit skills and knowledge as well as the mandate of omitting uncertainties and contingencies in public texts have been identified as core part of doctoral training (Delamont & Atkinson, 2001b); and removing details from scientific representations has been considered a move from particularity to generality (Myers, 1988) and thus form the local to the global dimension. The assessment of the communicative situation by sign-makers may be based on their anticipation of the target audience's evaluation of the text produced (Knorr-Cetina, 1981).

Despite being framed within one same field of expertise and sharing some traits, the texts that formed the discourse trajectory contrasted also in some rhetorical aspects. The protocol was devoid of agency (any sign-maker could enact it) and of contingencies (any laboratory with the presupposed equipment was potentially valid for its enactment). Both are common characteristics of scientific discourse, which seeks an appearance of objectivity and universalism, and aims at emphasising phenomena over agency (Myers, 1988; Suchman, 1988; Hyland, 2012). This way, the situated character of scientific practice (Ziman, 2000) becomes an underlying, silenced background – "a remote and subtle background environment" for Zenzen and Restivo (1982: 467). The succinctness and absoluteness of the protocol became a more detailed list of material processes, substances, containers, machines and parameters in the lab notebook page. The lab meeting presentation was a highly agentive text with presence of the local context throughout, informal expressions, hesitation and reformulations, whereas the written report was devoid of any contextual contingency, relied on the passive voice mainly, and human agency was concealed behind the use of inanimate entities as subjects. In fact, scientists' oral, informal discourse ('scientific shop talk') has been found to contain modifications, superstition and reformulations (Lynch, 1985), as opposed to the sense of absoluteness and certainty of public scientific discourse. And the two discursive strategies of emphasising either human action or inanimate entities as subjects in scientific texts have been documented by Ochs, Gonzales and Jacoby (1996).

The authority of the written protocol was implied (see Leeuwen, 2005 on the 'authority of the written word'), and supported by its legitimation by practitioners acting within the same domain of practice. It thus afforded its reproduction and distribution internationally but its negotiation only locally, and it was in this latter process in which the practitioners' power lied (i.e. in editing the text locally and enacting it in the lab with modifications). Law and Lynch (1988) also found that specialised texts held authority, especially for novice practitioners. This inflexibility, absolute certainty and standardisation of procedures that characterise the written protocol have been deemed general features of the scientific discourse also (Wynne, 1992).

The protocol has been demonstrated to structure and guide scientists' experimental practice in the lab. Its enactment in the laboratory, through 'doing experiments', implies a specialised use of modes of communication and resources, uncommon in other contexts (Dimopoulos, Koulaidis & Sklaveniti, 2003; Alač, 2005a, 2008). The mode of object manipulation itself, which is core in 'doing experiments', relies on the existence of the "objects" – specialised materials, machines and tools – necessary to enact the protocol, which might be recontextualised as communication resources whenever the experiments are enacted by multiple practitioners, as in 'mentoring'. This equipment, also imported, standardised, legitimised and

field- or domain-specific, links the local practices of sign-makers with the international dimension of science. Both, the protocol and the lab equipment constitute 'obligatory points of passage' (Callon, 1984) for scientists working in that domain, and thus tools for domination through the typical process of standardisation in science (Knorr-Cetina, 1981; Latour & Woolgar, 1986 [1979]; Star & Griesemer, 1989). The connection between the local and the global through mobilised texts and instruments has been widely acknowledged (Hughes, 1985; Latour, 1987; Fujimura, 1992; Kleinman, 2003; Nersessian *et al.*, 2003; Kell, 2015).

The specialised uses of communicative modes and resources are trained in the RG through 'mentoring' between old-timers and newcomers "by doing" and "by communicating" in the lab, as has been shown in the previous and in the present chapters. This way, the laboratory constitutes an intentional learning site structured and regulated by norms of participation and by the practices afforded by the tools and artefacts available in it (Billett, 2001a). And 'mentoring' guides 'co-participation' between the affordances of this workplace (the laboratory and its equipment) and the situated elections of practitioners (Billett, 2004), like the local adaptation of the protocol and the negotiation of use of the objects manipulated. The need for explicit instruction regarding the 'grammar' of multimodal scientific discourse, as it occurs through 'mentoring', has been claimed by Liu and Owyong (2011). Yet, mentoring has been claimed to enable the teaching and acquisition of some tacit practical skills that can only be acquired through 'trial and error' and the supervision of experienced mentors (Delamont & Atkinson, 2001; Gusterson, 2005). Furthermore, as a text, 'mentoring' entails the skilful use of multiple modes by the sign-makers implicated for two purposes: on the one hand, for the accomplishment of teaching/learning of the necessary skills and knowledge, and on the other hand, for their adequate performance of the role of mentor and that of trainee. The performance of these roles in the texts analysed responds also to internationally recognisable behaviours (Eraut, 2007; Tynjälä, 2008), tied in turn to local-global aspects, like the sign-makers' status in the institution and in the RG (e.g. student vs. professor, pre-PhD vs. PhD, junior vs. senior researcher) – which might correspond to internationally recognisable categories.

Apart from any strategic intention, the capacity of the scientist practitioner to articulate the experiment has been claimed to be marked by a specialised way of understanding it, which has been named here 'scientific thinking' to emphasise the mental processes involved (see Murtonen & Balloo, 2019 on the theorisation of this concept within higher education), a parallel to the concept of 'professional vision' (Goodwin, 1994; Mondada, 2005), whereby scientists' perceptions are determined by paradigms, rules, standards and research traditions (Amann & Knorr-Cetina, 1988), by 'thematic patterns' (typical connections among concepts) of the scientific field (Lemke, 1990), as well as by contextual and local expertise (Law & Lynch,

535

1988; Prentice, 2014). This coincides with Lynch and Woolgar's (1988) claim that scientific representation does not consist in reproducing and emulating an original sign only, but mainly in interpreting it through theory and in modifying its principles. The texts analysed are thus theory-laden representations.

All the texts examined combine internationalising or standardising traits with local traits, signalling this way their local scope framed within an internationally relevant field. Despite their local nature and scope, they encompass standardised traits that make them recognisable as part of the scientific practice in absolute terms. The texts analysed observe some international norms for scientific representation, like characteristics of their rhetorical style (i.e. the use of the active or the passive voice, the concealment of agency or its emphasis, the prevalence of mental or material processes, etc.) and the configuration (formal presentation) and use of images as supporting evidences. Kemp (2014) asserts that scientific texts adopt a 'rhetoric of reality' through selective representation and the inclusion of signs of authenticity. The relevance of image (encompassing graphs, pictures, figures, etc.) in STEM has been documented (Minakova & Canagarajah, 2020) and deemed the source and the 'core' of scientific papers (Knorr & Knorr, 1978). Latour (1985) brings this point further in asserting that scientific literature is distinguished by its unique use of 'inscriptions' (here 'specialised image') whereby they are the referent of writing, which comments on and develops them in turn. This specialised use of these modes confers scientific literature "optical coherence" and "semiotic homogeneity" (Latour, 1985: 52). Moreover, the texts explored share commonalities with internationally recognisable academic genres, such as the research report, the scientific article, and the oral presentation (e.g. in conferences), among others. As a concept, the 'genre' has been theorised as a nexus between the local and the global dimensions (Kramsch & Thorne, 2002), and practitioners' accommodation to certain generic conventions has been claimed to be a key aspect of 'scientificness' (Kress *et al.*, 2001). Lynch (1988) argues that 'generic pedagogy' and 'abstract theorising' guide scientific representation (in multimodal texts) following the conventions of a particular scientific field, which often include selection, simplification and synthesis of form to attain a supposed universality of features of the studied object/phenomenon.

In all texts, linguistic modes (speech and writing) had been encoded in English, showing this way group membership – conforming to the RG's English-only norm (as explained in the previous chapter) – and embracing the supremacy of English as the international language of science (Ammon, 2001). This way, an analogy of a centre-based evaluation (from gatekeepers working at centre zones) (Bennett, 2014c) is imported into the local context of the RG through Navil's gatekeeping practice. This is an evidence of how the centre of academia is approached in semiperipheral zones, in this case through the imposition of English also in texts produced for

536

a local audience. However, on some occasions codeswitching was allowed by the sign-maker (Joana), considering the localised scope and semi-formal character of the text – in line with Mondada's (2005) finding of the local multilingual practices of scientists –, but could potentially be censured (as in fact was on some occasions not shown in the particular texts chosen in this chapter) by the supervisor of the text (Navil) in his gatekeeping function. Such gatekeeping, whereby Navil becomes the spokesperson of many, could be deemed a local form of domination, in Callon's (1984) terms, of the wider international 'epistemic community' (Creplet *et al.*, 2001) or 'professional discourse community' (Freedman & Medway, 1994) of Joana's and Navil's domain of practice.

The English used in the texts is yet not a standardised but a specialised form of English, affecting their lexis and the use of abbreviations, contractions and acronyms (named also 'symbolic formulas' by Liu & Owyog, 2011), marked by a domain-specific jargon or specialised terminology, but more or less adapted to the local audiences that all the texts examined targeted (in-group/inter-personal jargon). The use of domain-specific specialised English has been considered a paradox, whereby the increasing use of English internationally follows a globalising trend but its field specialisation generates its fragmentation (Montgomery, 2004). Consistent with this, Fleck (1935) identifies the special terminology used by a group of people as bounding the members of 'thought communities' together and at the same time as marking the community's boundaries. Apart from the language, other international codes observed in the texts include numeric information and internationally recognisable gestures, like nodding (Maynard, 1987) and pointing (Kita, 2003), which have been found to complement linguistic modes and contribute to comprehension in interactions among scientists with different linguistic skills (Kimura & Canagarajah, 2020).

In conclusion, even in texts produced at the local level and with a local scope, the micro-level effects of the internationalisation of scientists' practices as a consequence of the IoHE are obvious. The international dimension was present in the framing of the texts produced by the participants, through their topic and object of study. This positioned them within a specific (international) epistemic community that was the potential audience of the scientists' public texts and also their evaluators. Despite their local scope, all the texts presented had some standardised features that made them recognisable as 'scientific'. This scientificness was materialised in a specialised use of communication modes and resources. Although variably, all the texts observed international norms for scientific representation in their rhetorical style, in their use of image and in their commonalities with recognisable academic and scientific genres. The 'mentoring' event was a local process of induction into the RG as well as into the (international) 'thought' and 'professional discourse' community that had created and was

governed by this system of norms. Even the local context of the laboratory was itself international in some aspects, as in the presence of international textual and material artefacts in it, of which local texts were a mirror. The choice of English as the code for local texts aligns with the international trend in science; and the specialised type of English used follows a tradition imposed by external agents internationally. Yet, as put by Lemke (2000), 'talking science' involves not only using a specific code and a rhetorical style, conforming to scientific genres and performing certain actions, but also developing given mental processes. As has been argued, in the articulation of the experiment the sign-makers' decisions followed certain cognitive predeterminations that required a specialised experience in the (international) discourse of science and of the participants' scientific field. In all these threads between the local and the international dimensions, the RG and its members acted as a mediator by importing and adapting features from the international dimension into the local context and vice versa.

Having analysed so far scientists' communication at the meso and at the micro levels, the next chapter will be devoted to the analysis of its macro level, in which communication is considered as a socio-cultural practice in the international dimension of science.

Chapter 8: Scientists' communication for international success

After having explored the ways in which the RGs studied can be analysed in accordance with the CoP model (chapter 5) and how the IoHE influences their consumption, production and distribution of texts (chapter 6) as well as the form of these texts (chapter 7), in this chapter the macro level of analysis will be approached. Understanding that a text is a motivated sign that "embodies [a] social state, and in doing so both naturalizes and deproblematizes that state of affairs" (Kress, 1993: 183), in this chapter, the focus will be placed on the social 'state of affairs' indexed in the data, that is on broader socio-cultural phenomena beyond the RG – at institutional, national or international levels –, power relations, ideologies represented in texts and 'enacted' by the participants in their social practices. Despite not being the focus of the current project, centered on the RG, the main research question, *In what ways does the process of the internationalisation of higher education that prevails nowadays influence scientists' daily communication?*, unavoidably implies tackling the international dimension of scientists' communication, and a holistic critical examination of this phenomenon requires necessarily the analysis of discourse at the macro level. Accordingly, the research sub-question that will guide this chapter is: *What is the influence of the IoHE on scientists' communication regarded as a socio-cultural practice?* For this endeavor, concepts from Bourdieu's (1977) *theory of practice* and Giddens' (1984) *structuration theory*, will be drawn upon in this chapter, along with concepts from the theories used in the previous chapters of analysis. Conceiving the set of texts produced by a social group as a "semiotic, social and cultural mesh" (Kress, 1996: 189) that reflects the norms, values and meanings of that group, and which conveys the communication conventions to its members, some 'rules of social life' (Giddens, 1984) and cultural schemata affecting scienists' communication will be unveiled and discussed.

Science as a 'culture' encompasses a set of aspects connected with communication, such as the meaning systems that determine the production of texts, the repertoire of texts historically produced in a certain field of knowledge, the codes used, the practices, the norms and the relations of power (Frickel & Moore, 2006). The exploration of these aspects is in turn linked to the investigation of the political and economic structures of science, and of its organisation, through issues like profit drivers, forces underlying decisions, issues of access to resources, to fields and to knowledge, and the privilege of certain discourses, perspectives and actors over others. My aim is thus to reveal how the RG's culture is embedded in the 'scientific culture' (Pickering, 1995), encompassing a certain set of social relations, skills, instruments, discourses, techniques, perspectives, styles, codes, among other elements, considering especially the processes affected by the IoHE, such as knowledge production and dissemination across national borders, international public policies on higher education and research, cross-national

networks, the mobility of scientists, and the marketisation of higher education. The focus across these issues will be scientists' communication.

The entry point into the macro level of data analysis will be the exploration of the idea of *success* across the data. The aim of practitioner scientists and of RGs is to succeed in their endeavour, whatever form it may take. Consequently, success is deemed here as being implied by different terms, like 'competitiveness', 'employment' and 'professional practice'. It is deemed a global aspect affecting scientists' career in absolute terms and at a global dimension. Also, success has been linked with communication in its different dimensions: individually, at the level of the RG, and at that of the institution (Travaille & Hendriks, 2010); and one of the core globally accepted measures of scientists' success is a form of communication: scientific publications. The first section of this chapter (section 8.1) is devoted to discussing the relevance of publishing for scientists' success, and it also includes other aspects and considerations related to the assessment of success in science. Assuming that publishing relevant papers implies competitiveness, in the sense that RGs/scientists must be the first to publish a specific 'story' before their competitors and as a consequence they will receive funding before their competitors, section 8.2 will offer an overview of the elements that contribute to scientists' and RGs' competitiveness, which rely on communication in different ways. In section 8.3, some connections between science and social, political and economic discourses will be established in order to uncover ways in which these affect scientists' communication. Section 8.4 will explore the significance of the internationalisation activity of mobility for scientists and its effects on their communication. And finally, section 8.5 will present a discussion of the findings in relation to relevant studies as well as some conclusions.

8.1. Publishing as the measure of success

As has been argued in previous chapters, writing scientific articles and publishing them are ultimate aims of scientists' daily practices. These are so because they are a global and absolute measure for scientists' success. This fact was evidenced in the data, for instance, by the direct link established by Cecília and Frank (Group A) between 'a successful scientist' and the number of authored publications she had [see excerpt 211].

Excerpt 211: Interview with Frank [Group leader – Group A] and Cecília [Senior res. – Group A] – 'she would be the best one'

Researcher: So_ you think Lian was a good * a * a successful researcher_ or *

Cecília: =Very successful\=

Frank: =Well_= In all * = I mean_=

Cecília: =Very successful\=

Frank: She's * She's going * She had *

Cecília: She * she would be the best one\

Frank: She had * she had four **first-author scientific papers_** one of them in [journal 1]_ one in the [journal 2]_ which are the two top journals in our field_ **she's a co-author on another three or four papers_ she····· presented six or seven posters_** at international meetings_ **and two oral presentations** What more would I ask/

Cecília: Yeah\

In this excerpt, Lian's list of scientific publications and conference presentations and posters is presented by Frank and Cecília as an objective and self-evident measure of her success. It is pesented as the unquestionable reification of competence in the epistemic community of their field.

The value of publications in the scientific domain was confirmed by Hao, who specified that publications had to belong to 'the same field' to account as valuable components of a scientist's career [see excerpt 212].

Excerpt 212: Interview with Hao [Senior res. – Group A] – 'It's based o··n your publications'

Researcher: Do you consider yourself a good scientist/

Hao: +Uh+_ So so\ =@ @ @ @=

Researcher: So so\ Why/

Hao: {(@) So so\} Yeah\ Yeah_ How to say/ It's ok\ I * In the XX field_ I'm * I'm okay_ I think\ Yeah\ Yeah\ In the same X I think_ is_ yeah\ I *

Researcher: What do you have that makes you a good scientist/

(…)

Hao: It's based o··n your publications_ and on your projects_ yeah\ and on the projects_ and * in the same field You * you can * you cannot compare with other fields\ Yeah\

In this case, Hao adds also the 'projects in the same field' as another measure of success in science. Note that field specificity is a conditioning factor of both, publications and projects, and that the epistemic community of the field may transcend the RG, the HE institution to which it is ascribed, and the national framework.

A factor conditioning the possibility of publishing in highly ranked journals was subject to their editing by an expert in the English language and in the scientific 'writing style', as suggested by Hao [see excerpt 213].

Excerpt 213: Interview with Hao [Senior res. – Group A] – 'More than 20%_ I think\'

Researcher: So_ for you_ you write your paper_ your draft_ and then you send it to Frank as well/

Hao: Send to Frank\ Yeah\ Frank gives us co& comments_ yeah\ Then_ sometimes_ **if we want to make a high im& publis& * +uh+ paper in a high-impact journal_ we * we sometimes +uh+ send to the writing company to correct the English** and the grammar\

(…)

Researcher: Because otherwise you wouldn't be able to publish in a good *

Hao: Because for the *

Researcher: Journal/

Hao: Writing style_ you must_

Researcher: +Oh+\ =the style XX\=

Hao: Yeah\ =Because we are= not * not native +uh+ * native +uh+ English speaking people\ You know\

Researcher: +Mh+ so it's important to * =to be native\=

Hao: =It's important\ Yeah\=

Researcher: =To be able to write=

Hao: =It's very important\= It's very important\ And also to have a very good +uh+ company to * to have you correct the * the language and the grammar\ It's very important\ Yeah\

Researcher: So_ out of * of 100%_ how * how * how important_ or how much impact do you think that Tim or his company has on the success of your papers/

Hao: It's very important

Researcher: Like 20%/ Or like half of it/

Hao: More than 20%_ I think

According to Hao, the linguistic counselling accounted for 'more than 20%' of the success of the publication, and such success was related in particular to the English nativeness of the language editor. Once more, linguistic accuracy (in English) was presented as a relevant feature

in the economy of meaning of science (Wenger, 1998); indispensable for success and thus a source of power. Similarly, the idea that language proficiency and scientific quality correlate was also implied by Giulia (Group G) [see excerpt 214].

Excerpt 214: Interview with Giulia [post-doc from Italy – Group G] – 'The language of science is * +uh+ is English\'

Researcher: Have you ever felt that here_ in Germany_ if you don't speak German maybe people might think you are not a good scientist/

Giulia: No\

Researcher: So if you *

Giulia: It's rather the opposite\ I think\ That someone doesn't speak English good enough_ then @ it's not a good scientists\ I mean_ we * we

Researcher: That could happen with English/

Giulia: Yeah\ **The language of science is * +uh+ is English**\ So_ yeah\ When * when you hear a talk from someone which is an experienced post-doc_ for example_ but that has a terrible English_ then you're a little bit disappointed\ But_

In this excerpt, Giulia asserts that English is 'the language of science' and recalls as a general belief the fact that good scientists have a good command of English. English proficiency may thus be viewed as an important cultural capital; indexing competence as a scientist.

Still confirming that publications as a sign of productivity are a key measure of scientists' success, Rober pointed at another factor besides linguistic adequacy that according to him facilitates the publishing of scientific articles: the accurate planning of experiments [see excerpt 215].

Excerpt 215: Interview with Rober [visiting PhD res. – Group A] – 'to save time you have to plan it well\'

Researcher: What differentiates one scientist from another/	**Investigadora:** Qué diferencia un científico de otro/
Rober: In what [sense]/ XX/	**Rober:** En qué/ XX/
Researcher: Or a good scientist from a mediocre one/	**Investigadora:** O un buen científico de uno mediocre/
Rober: It's so relative_ **Now it is measured * it is measured a lot in [terms of] productivity**\ A mediocre doctor would be someone who hardly produces\ Who does not generate articles_ or new articles\	**Rober:** Es tan relativo_ **Ahora se mide * se mide mucho en productividad**\ Un médico mediocre sería alguien que casi no produce\ Que no genera artículos_ o artículos nuevos\
Researcher: Above all * +oh+ okay\ that is_	**Investigadora:** Sobre todo * +ah+ vale\ o sea_ con resultados_

543

with results_

Rober: Yes\ **Here this is measured a lot based on results\ If you have them or not_ if it works or not_ if you can improve or not_ or if you have improved something** I think that {(?) that will be}\ Also a mediocre boss or a mediocre researcher would be someone who * who does not work * or who is distracted in when * who does not focus on doing what he has to do\ But well_ it is very * mediocrity is little production here\ Or at least in this area\ Who does not produce_ let's say_ that he's left behind_ he's left behind_ he's left behind\

Researcher: Production depends on the hours you devote/ Or on how lucky you are to get the results you want/

Rober: No\ Many times it's not a matter of luck\ You really have to plan it well\ **I think that production obviously depends on the results_ and these depend on the planning they have** So if you plan your experiment well_ you'll get good results_ and they can be publishable or not \ (…) **to save time you have to plan it well**

Rober: Sí\ **Aquí se mide mucho esto en base a resultados\ Si tienes o no_ si funciona o no_ si puedes mejorar o no_ o si has mejorado algo** Yo creo que {(?) eso será}\ También un jefe mediocre o un investigador mediocre sería alguien que * que no trabaja * o que está distraído en la hora * que no se enfocaliza a hacer lo que tiene que hacer\ Pero bueno_ es que es muy * mediocridad es poca producción aquí\ O al menos en este ámbito\ Quien no produce_ digamos_ que se va quedando atrás_ se va quedando atrás_ se va quedando atrás\

Investigadora: La producción depende de las horas que dediques/ O de la suerte que tengas para que salgan los resultados que tú quieres/

Rober: No\ Es que muchas veces no es suerte\ Realmente tienes que planearlo bien\ **Yo creo que la producción depende obviamente de los resultados_ y estos dependen de la planeación que tengan** Entonces si planeas bien tu experimento_ obtendrás buenos resultados_ y pueden ser publicables o no\ (…) **para ahorrarte tiempo tienes que planearlo bien**

[original in Spanish]

In this excerpt, Rober describes a direct correlation between 'the planning' of experiments and the 'productivity' of a scientist, measured in terms of the publication of results. These two factors are mediated by 'time', which can be optimised with a proper planning, potentially increasing this way the productivity. Developing efficient planning skills may thus be a significant locus of investment (Latour & Woolgar, 1986 [1979]).

Yet, besides acknowledging the importance of 'results' to assess a scientist's career, Mara emphasised another measure of success, different from one's publications, as 'the most important' aspect being valued by potential employers: 'the group you come from' [see excerpt 216].

Excerpt 216: Interview with Mara [PhD res. – Group A] – 'I believe that it's the combination\'

Researcher: Do you think you have a plus because you come from this {(Eng) group}/ Or from Frank or something/	**Ερευνήτρια:** Νομίζεις ότι έχεις κάποιο συν επειδή έρχεσαι από αυτό το {(Αγγ) group}/ Ή από τον Φρανκ ή κάτι/
Mara: Of course\ This is why I came here\ It's··· * **the most important [aspect] is the {(Eng) group}you come from_ and then what you have been doing_ and··· what results you got** If I told them that I am in Frank's but I have done nothing_ I have found nothing_ I don't have··· any {(Eng) paper under} * it would be absolutely different\ I believe it wouldn't··· count so much\ Regardless of me being in Frank's\ That is_ **I believe that it's the combination\ That you are in the lab you are in_ but also the work you show**	**Μάρα:** Εννοείται\ Γι'αυτό και ήρθα εδώ πέρα\ Είναι··· * **το πιο σημαντικό είναι το {(Αγγ) group} σου_ και μετά είναι το πιο σημαντικό τι κάνεις_ και··· τι αποτελέσματα έχεις** Αν τους έλεγα ότι ναι μεν είμαι στον Φρανκ αλλά δεν έχω κάνει τίποτα_ δεν έχω βρει τίποτα_ δεν έχω··· {(Αγγ) paper under} * θα ήτανε τελείως διαφορετικά\ Πιστεύω δε θα·· μετρούσε τόσο\ Ασχέτως που θα ήμουνα στον Φρανκ\ Δηλαδή_ **πιστεύω ότι είναι ο συνδυασμός\ Τ'ότι είσαι στο εργαστήριο που είσαι_ αλλά και το τι δουλειά δείχνεις**
	[original in Greek]

In this excerpt, Mara points at one's identity as a community member (Wenger, 1998) as indexing competence in the economy of meaning of science; again as the reification of some kind of cultural and social capital. After having underscored the RG as the most valued factor, in this excerpt, Mara finally puts it at the same level as 'the work you show', in this case making reference to her PhD thesis and to an article she was writing. Therefore, according to the participants, the reification of the accumulated capital recognised in science takes the form of the past projects carried out, the RGs groups in which one had held membership, and the (oral/written) publications; the latter being conditioned by their accommodation to a specific style and language, and maximised through an efficient planning and time management.

Although success being measured in terms of publications appeared as a general norm in science, Hans (Group G's leader) argued that it was avoided by some practitioners [see excerpt 217].

Excerpt 217: Interview with Hans [Group G's leader] – 'some can survive\'

Researcher: Don't people +ehm+ measure * people in the institute_ measure their success in terms of publications/ Or their professional * their professional standing in terms of publications/ Or is it * is it something else/ I mean_ can they * can they go on working without publishing things/
Hans: Some * **some can survive** Yeah\

Researcher: Really/

Hans: Yeah\

Researcher: So_ how do you measure their professional +uh··+ success then/

Hans: Yet * Because they run a project\ Probably\

Researcher: Alright\

Hans: Yes\ They say they are happy with that_ of course **they all know that publishing is important** Yeah/ But sometimes **They * they find a lot of * in my view_ excuses not to publish something** +Oh+ a control experiment is missing_ this is not a perfect result_ and then I'm always saying_ okay_ you have to tell another story\ (…) Because most of them +uh+ don't have an independent research group_ **they can survive with a low amount of publications** They * they only see that if they write their own proposal_ And often you have to list your five most relevant * +oh+ +oh+ +oh+ +oh+\ Yeah/ What should I do here/

In this excerpt, Hans defends that the publishing norm is eluded by 'some' members of his RG, who resort to 'excuses', but that it becomes unavoidable whenever these practitioners 'have to write their own proposal' for which publications become paramount because they are a parameter to assess the project proposal. There seems to be a contradiction in the principles guiding action in the specific field in this regard. While the importance of publishing is presented by Hans as self-evident and acknowledged by all agents ('they all know'), it seems not to be so important for all scientists in the end. Some of them 'can survive with a low amount of publications'. The publishing norm appears to have some "cracks" through which some sceintists can leak. The existence of these two 'categories of people': those whose job depends on publications and those whose job does not, was acknowledged by Sonja (Group G), who explained the reason for this distinction [see excerpt 218].

Excerpt 218: Focus group with postdocs [Group G] – 'there are like different categories of people'

Researcher: So it's like a bit ambiguous\ Because some people think it is important_ some other people do not_ So_ when * when so& *

Sonja: No\ Everyone thinks it's important\ But there are things that make it less important for certain things * for certain people\ Say you have a * you have a particular skill\ Say we have a very complicated machine\ And you are the one who can perfectly treat it\ And no one else cannot here\ It doesn't matter if you have publications\ You will have employment\ Because you're s& * too important to us** And then there are other people that don't have the skill\ And maybe they will have no possibility to stay here in the institute\ **And once they go outside they need the publications\ But it's difficult for them to understand that** Because you_ the person with the machine_ you don't have any publications_ but you still have employment_ and you don't even have to fight for it\ So why should they/ See what I mean/ **So there are like different categories of people_ and it's * in the beginning I think it's difficult for them to see_ because it's also * there's no so often that they meet people from outside the institute_ like in a scientific professional context_ where

> they would discuss things like that_ and say * and someone else would say_ +oh+ yes_ but we have to have papers_ as many as possible\

In this excerpt, Sonja explains how some scientists undervalue publications because some positions do not depend on them but on certain skills, like 'perfectly treat[ing]' 'a very complicated machine'. In Sonja's view, publications are important for most practitioners 'that don't have the skill' but they often realise it too late, when they need to find a new job. Sonja's account of the rules of science as regards publishing denotes the existence of (at least) two markers of demands (Knorr & Knorr, 1978): one in which mastering the use of certain machines is most valued and another one in which publications are most valued. According to her, those scientists who invest in only one of them may encounter problems to hold credibility in front of those actors who take as a reference the other marker of demands.

The publishing norm, which on occasions can be resisted at the local dimension through scientists' prioritisation of activities other than publishing, was explicitly criticised by Agus (Group A), who argued that this was not 'a reliable indicator' of quality. According to Agus, the way in which the published results had been obtained should also be considered [see excerpt 219].

Excerpt 219: Informal interview with Agus [PhD res. - Group A] – 'what have you contributed/'

Researcher: Do you think you are a good scientist /	**Investigadora:** Creus que ets un bon científic/
Agus: Well_ this may be too much\ @@@ +uh···+ I don't know\ I feel I have learned\ But so much as to become a good scientist_ +m+ I don't know\ I think this can be seen with a lot of perspective_ who is a good scientist and who is not\ I don't know_ with a perspective of a decade_ **and by looking at what s/he has done and how s/he has done it_ and ·· well_ I don't know**	**Agus:** Home_ això potser és dir molt\ @@@ +eh··· No ho sé\ Sento que he après\ Ara tant com per arribar a ser un bon científic_ +m+ no sé jo\ crec que això es veu amb molta perspectiva_ qui és un bon científic i qui no\ No sé_ amb una perspectiva d'una dècada_ **i de mirar el que ha fet i com ho ha fet_ i·· bueno_ no sé**
Researcher: And by looking at the results/ You need to have results_ to be good/	**Investigadora:** I mirant els resultats/ T'han d'acompanyar els resultats_ per ser bo/
Agus: Yes\ I mean_ I think * that is to say_ if in ten years you don't get anything_ well_ well_ you can have bad luck_ but I don't know if so much\ But ·· * that is to say_ nei& * neither the extreme of· not getting anything_ nor * nor * nor the need to * to have many [journal 1]_ and [journal 2]_ and···\ If not_ I	**Agus:** Sí\ o sigui_ crec que * és a dir_ si amb deu anys no treus res_ hòstia_ bueno_ pots tenir mala sort_ però no sé si tanta\ Però·· * és a dir_ tam& * ni un extrem de· no treure res_ ni treure * ni * ni * ni la necessitat de * de tenir molts [revista 1]_ i [revista 2]_ i···\ Si no_ no ho sé\ +eh··+ o

don't know\ +eh··+ I mean_ I don't know how I would evaluate_ **who is a good scientist and who isn't_ now it is just evaluated by productivity at the scientific level_ and·· I think it's not a good * I mean_ it's not a very reliable indicator_ sometimes_ because·· * well_ never mind\ I think it's not very reliable_ and··· * and I think it's like a mix between·· getting things_ but * but also looking at how you got them_ and how you solved the problems_ or·· I don't know how to say it\ +M+ yes_ I don't know\ Like how you directed the re& * your research\ and·· * and if you intended to·· * like to do science_ or to··· * or just to keep·· your Ministry project_ +uh+ doing things that in the end are not too productive_ but that will end up having your project extended** I sometimes think that this is what's happening in this field\ But·· * **But well_ I don't know_ I'm very young_ I don't have much experience in this either_ and I don't want to prejudge\ But I sometimes have the feeling that it's a bit * I mean that you see the research that has been done in the last ten years_ and you think * of a certain group_ and you think_ very well_ they will have your project extended_ but what * what have you contributed/** or what *

Researcher: It's {(Sp) more of the same thing}\ You mean/ =It doesn't have anything new\=

Agus: =Yes\ I don't know\ =Exactly\ **Or {(Sp) more of the same thing}_ or ·· * or turning around in circles_ pretending that·· you are contributing a lot_ but···** * Then_ I don't know\ That is_ what is that * I'm not sure about how to assess whether you're a good scientist or not_ I don't know if I am one_ I think I could be such_ but we'll see\

sigui_ no sé com ho avaluaria_ **qui és un bon científic i qui no_ ara només s'avalua per la productivitat a nivell científic_ i·· penso que tampoc és un bon * o sigui_ no és un indicador molt fiable_ de vegades_ perquè·· * bueno_ és igual\ Penso que no és molt fiable_ i··· * i penso que és com una barreja entre·· treure coses_ però * però també mirar com les has tret_ i com has solucionat els problemes_ o·· no sé com dir-ho\ +m+ sí_ no sé\ com has encarat una mica la re& * la teva recerca\ i·· * i si has anat a·· * com a fer ciència_ o a··· * o simplement a mantenir·· el teu projecte del Ministeri_ +eh+ fent coses que al final no són massa productives_ però que t'acabaran renovant el projecte** De vegades jo crec que és lo que passa en aquest camp\ Però·· * **Però bueno_ jo què sé_ Soc molt jove_ tampoc tinc molta experiència en això_ i tampoc vull prejutjar\ Però a vegades em dona la sensació que és una mica lo * vull dir que veus la recerca que s'ha fet els últims deu anys_ i penses * d'algun grup determinat_ i penses_ molt bé_ et renovaran el projecte_ però què * què has aportat/** o què *

Investigadora: És {(Esp) más de lo mismo}\ Vols dir/ =No té algo nou\=

Agus: =Sí\ No ho sé\= Exacte\ **O {(Esp) más de lo mismo}_ o·· * o anar a donant tomets_ fent veure que·· estàs aportant molt_ però···** * Aleshores_ no ho sé\ O sigui_ què és lo que * No ho tinc molt clar com avaluar si ets un bon científic o no_ no sé si ho soc_ jo crec que ho podria ser_ però ja ho veurem\

[original in Catalan]

In this excerpt, Agus questions the reliability of qualifying scientists as good depending on the number of publications they have and on the journals where they have published. Agust adopts a critical stance with the prevailing evaluation system of science and proposes an alternative. Apart from the quantity of results, Agus argues, also 'how you got them' and 'how you solved

the problems' should be considered so that science that 'contribut[es]' something is more valued and thus encouraged. In this sense, note the importance given by Angus to 'contribut[ing]' to the field. Agus distinguishes between those scientists who aim at 'solving problems' and 'doing science' from those who aim at 'maintainig their project', and thus at surviving only.

Illustrating how the way in which publications are obtained could be problematic, as defended by Agus, in the next excerpt Antonio Ortiz, a member of Group A's department, narrates a past conflict with a field colleague (and competitor) during one of Group A's sporadic formal seminars [excerpt 220].

Excerpt 220: Formal seminar with Antonio Ortiz [invited speaker – Group A] – 'because he was saying that'

Antonio Ortiz: The biggest * or the most important meeting in my field is the [conference name]\ Everyone is there\ Everyone\ And there +eh+ four or five years ago I started raising my hand and saying that the model was wrong_ because we have this data not fitting_ And the father of the field_ this [name]_ +uh+ the one that published the [journal 1] and the * he's basically a cheater\ Okay/ But_ nevertheless_ (…) But because he's [journal 1] and [journal 2] papers_ and now he's a major professor in [U.S. state]_ that's what he wanted\ So_ there I had a major major argument_ a really tough argument_ okay/ But then I went to this meeting when we already had the data_ that eventually got published in [journal 3]_ that settled the point\ There was no discussion if you look at the data\ (…) So two years later we meet again\ Now I'm the speaker_ he's in the audience_ I show my data_ and then he rises his hand_ **and he actually said_ everything that you are saying is wrong\ That data is fake** You know what/ He went back to his lab_ and three months later_ he published a paper very similar to my paper_ okay/ With just a fraction of the data\ **But because he was saying that_ they published it** So basically_ he defeated me_ by publishing a {(?) shorter} paper_ months before_ with exactly the same message that he publicly said that I was a cheater\

In this excerpt, Antonio Ortiz recounts a past event in which a conflict with a competitor scientist ended up in that person publishing Antonio's results before him due to that person's good reputation in their field ('because he was saying that_ they published it\'). This evidences that the publishing criterion may have drawbacks, in this case enhancing inequalities among scientists. Antonio Ortiz's experience demonstrates Bourdieu's (1975) claim about the importance of the position of agents in the structure of the scientific field for their recognition.

As regards the shortcomings of the publishing norm, in the next excerpt Agus criticises the generalised 'rejection of failure' prevailing in science whereby negative or unexpected results are not published, despite scientific journals' taste for 'innovative things' [excerpt 221].

Excerpt 221: Interview with Agus [PhD res. – Group A] – 'it does disappoint me a bit'

Researcher: And that disappoints you somehow/ Because I sort of notice this on	**Investigadora:** I això et decep d'alguna manera/ Perquè em sembla notar això en la

your face\ No/ A bit like saying_ it's kind of cheating\ Or what/

Agus: Yes··\ It's like·· +pf+ * I mean_ that I'm not a na& * I'm not naive_ I know that_ well_ things go like this\ and··· * and **the journals want things that are new_ and· I don't know\ But it does disappoint me a bit in the sense that··· * I mean_ like·· this kind of·· * rejection of failure** You know/ As if failure was in& * failure in the sense of not reaching the initial goal\ But_ I mean li& * like this stigma of * of the failure_ of saying_ no_ no_ we_ let's hide it_let's hide it\ Everything that doesn't work_ let's hide it\ Then_ then well_ we've made an effort to do this_ it didn't work_ maybe it's that we did it wrong_ or maybe it's not the case\ And thus_ anyway_ +mm+ **let the rest of·· * of the scientific community know that we did this and that it didn't work_ then I mean_ it would probably be more use& * it would be useful** Sooner or later it would be useful\ **But I guess that if·· * if you say many times_ no_ we tried this and it didn't work _ then you will be given fewer projects_** or whatever\ And so I understand that it's not possible * well_ not possible_ that right now it's not like that\ But it does disappoint you a bit\ I mean_ It does\ I don't know_ this\ That if it's not all shining_ then it's not * it's worthless\ It's hidden under the carpet_ and that's it\ And done\

Agus: Sí··\ És com·· +pf+ * vull dir_ que no soc un in&* no soc ingenu_ ja sé que_ pos mira_ les coses van així\ i··· * **i les revistes volen coses que siguin novedoses_ i· no sé\ Però sí que em decep una mica en el sentit que··· * vull dir_ com·· aquesta mena de·· * de rebuig al fracàs** Saps/ Com si el fracàs fos al& * el fracàs en sentit de no aconseguir l'objectiu inicial\ Però_ vull dir co& * com que aquest estigma de * del fracàs_ de dir_ no_ no_ amaguem-ho_ amaguem-ho\ Tot lo que no funciona_ amaguem-ho\ Pos_ pos coi_ hem invertit uns esforços a fer això_ no ens ha funcionat_ potser és que ho hem fet malament_ o potser no\ I doncs_ sigui com sigui_ +mm+ **que la resta de·· * de la comunitat científica s'assabenti de que hem fet això i de que no ens ha sortit_ vull dir doncs_ seguramen seria més ut& * seria útil** Tard o d'hora seria útil\ **Però suposo que si·· * si dius moltes vegades_ no_ és que ho hem provat i no ens ha sortit_ doncs et donaran menys projectes_** o lo que sigui\ I doncs ja entenc que no pot ser * bueno_ que no pot ser_ que ara mateix no és així\ Però sí que et decep una mica\ Vull dir_ Sí\ No sé_ doncs això\ De que si no és tot brillant_ doncs no * no val res\ S'amaga sota la catifa_ i ja està\ I fora\

[original in Catalan]

In this excerpt, Agus regrets that there is a tendency to conceal failures, which are not accepted as publishable by scientific journals, and are consequently rejected by scientists who fear from loosing competitiveness if their multiple failures are revealed. As claimed by Agus, a science that welcomes failures and deems them as important and enriching as positive results would be 'useful' and desirable. What Agust proposes is thus a redefinition of scientific competence.

This (imposed) strategy of publishing research only partially was argued by Vince (Group A) to affect not only negative and positive results, but also 'the tricks' of experiments [see excerpt 222].

Excerpt 222: Interview with Vince [Senior res. – Group A] – 'They don't give all the information\'

Vince: In our field_ sometimes_ people don't want to tell_	**Vince:** En el nostre camp_ a vegades_ la gent no vol dir_
Researcher: =They don't want to tell/ =	**Investigadora:** =No vol dir/=
Vince: =the tricks\= the tricks	**Vince: =els trucs\= els trucs**
Researcher: =+Oh+ I see\=	**Investigadora:** =+Ah+ ja\=
Vince: In order to prevent others from doing it * from doing it\ It seems a co& * a contradiction\ No/ But it is like this\ They don't give all the information\ Sometimes often within the articles_ it is * it's done on purpose_ They don't * don't * don't * don't * don't * **they don't give you the complete information**	**Vince: Per evitar que algú ho fa** * ho fa\ Sembla un co& * una contradicció\ No/ Però és així\ No donen tota la informació\ A vegades sovint dins dels articles_ es * es fa expressament_ No * no * no * no * no * **no et donen la informació completa**
Researcher: It's like they're keeping the +uh+ *	**Investigadora:** És com que es reserven una mica la +eh+ *
Vince: It's very···	**Vince:** És molt···
Researcher: Intellectual property\ No/	**Investigadora:** La propietat intel·lectual\ No/
Vince: Y&·· * n&··· * I don't know\ Yes\ But hid& * like hidden\ No/ No/	**Vince:** S&·· * n&··· * no sé\ Sí\ Però am& * com amagada\ No/ No/
Researcher: Yes\	**Investigadora:** Sí\
Vince: Not everyone does it\ But some do\ And this I know\ @@@@	**Vince:** No tothom ho fa\ Però n'hi ha que ho fan\ I això jo ho sé\ @@@@
Researcher: Like a patent_ no/ They want the patent of··· *	**Investigadora:** Com una patent_ no/ Que volen la patent de··· *
Vince: They want the exclu& * **a kind of exclusivity_ but·· unofficial\ No/**	**Vince:** Volen exclusi& * **un tipus d'exclusivitat_ però·· no oficial\ No/**
	[original in Catalan]

In this excerpt, Vince asserts that it is a common practice not to publish 'the complete information' of some experiments 'in order to prevent others from doing' the same experiments. Vince deems it an 'unofficial' 'exclusivity' practice. This evidences the practitioners' perception of science as a site of struggle and competitiveness (Bourdieu, 1975).

Besides the shortcomings of the publishing norm mentioned so far like its neglect of important aspects of experiments (e.g. how they were carried out) and failures as well as the favouring of already credited scientists, another drawback appeared in the data. The prevailing assessment system of science has been found to favor men over women, as explained by Frank, who

presented this inequality as a present status quo that was going to evolve in forthcoming years [see excerpt 223].

Excerpt 223: 20140923_Field notes [Group A] – 'in the future the situation would be more balanced'

Women and Science	Dona i Ciència
Frank said that **in the future the situation would be more balanced (for instance the fact of not publishing during the maternal leave period in the publication/time ratios), but the generation still in the PhD phase would have to choose between professional or personal life.**	Frank va dir que **en el futur la situació estaria més equilibrada (p.ex. no es tindria en compte la no-publicació durant la baixa maternal en les ratios de publicació/temps), però la generació encara en fase PhD hauria de triar entre professió i vida personal.**
Mara doesn't give up and wants to "change" things. It doesn't seem fair (to me, and then to her) the evaluation system of the researcher's capacity, which penalizes maternal leaves, reduced schedules…, which takes into account publications, but not HOW one got there (Mara).	Mara no es resigna i vol "canviar" les coses. No sembla just (a mi, i després a ella) el sistema d'avaluació de la capacitat investigadora, que penalitza les baixes maternals, les jornades reduides..., que té en compte publicacions, però no COM s'hi ha arribat (Mara).
	[original in Catalan]

Following Frank's words, the ratio of the number of publications per time period that prevails in science nowadays is insensitive to maternity leave periods and thus is detrimental to mother-scientists. For this reason, women scientists may feel forced to choose between professional and personal life. In the next excerpt, Rita (Group G) narrates in first person the difficulties she encountered to reconciling lab work with taking care of her child. Sonja (Group G), who had studied her PhD in Sweden, showed her conviction that this conflict, which affected mainly women, could be solved by means of government support to daycare and of effective communication in the workplace, as she had with one of her work peers who had small children [see excerpt 224].

Excerpt 224: Focus group with postdocs [Group G] – 'in Sweden nearly all the mothers work'

Researcher: Do you miss the lab/

Rita: +Uhm+ Yes···_ but * yes\ **There are moments_ when I'm fed up_ or it is too * becoming too much_ and then I like just go to the lab to·· * because it is easier sometimes** But I don't have this time that the lab is * you have to {(?) do} everything\ I don't have the time that the XXX is going * it has to grow for me_ at XXX_ it has to be XX ready_ (…) Before_ because my child was born_ I stayed away seven months_ at home_ and then I came working as well in the lab_ in the beginning\ Then I realised that it was not possible\ I had to leave a lot of +uh+ time * a lot of work not completed because I had to go

to pick up [child's name] from the (…) daycare\ Yeah\ It's not_

Sonja: I think it * I mean_ +uh+ because I did my PhD in Sweden_ and **in Sweden nearly all the mothers work_ and they're also in science_ there are lots of people that * I mean_ women that have small children_ and it works_ because they have a good daycare_ and the whole system is sort of like_ it's * it's meant that way\ The Swedish state wants the women to work_ and it sort of like supports them in the * +uh+ in this situation** And because I experienced that for I lived for in total eight years in Sweden_ I experienced it for a long time_ I always feel it must be possible here as well\ Because we are just as developed as * as Sweden\ So why is it not possible/ **But I think it's * +uh+ in many ways_ there are too few women out working_ it comes now_ I think the next generation will be dif& different\ so_ in * in most of the leading positions there are men\ And I think that makes a difference for the atmosphere_ and also for the +uh+ expectations\ Because they expect * they are always working\ Because obviously they didn't stay at home with their children\ So they expect the women to do it in the same way\ Which is not possible with a sma& small child** But what I see is +uh+ the wo& * the girl * the woman that just came in_ she is a technical assistant that works together with Franziska and me_ so we work on the same project\ And +uhm+ the * +uh+ we've been working together on different projects for the la& last five years_ and we * so * it didn't work at the beginning so well_ but after maybe two years or so we * +uhm+ we * we got a very good routine_ and she has a small child as well\ (…) So he was five when we first started to work together\ And she has also only a thirty * a 30-hour contract_ and she starts usually relatively early in the morning_ say eight o'clock or so_ sometimes even earlier_ and then she goes home at one_ or two_ or something like that_ And +uh+ we have a communication that she says_ okay_ I started this and this_ and I prepared everything for you\ Can you just finish it/ Which is not a problem for me\ And it's +uh+ * it's very good working the communication between us\ So it's really like she prepares a note and I just have to write down\ Or she says_ +uhm+ please_ move this plate from there to there_ Or_ please_ could you calculate something/ So it's not a lot of work for me_ but it saves mone& * it saves time for the project_ and we both want the project to go on\ (…) And so_ **I have the feeling that it can work\ But you need someone no& * someone you can rely on_ and someone with whom the communication is right**

In this excerpt, Sonja complains that the fact that 'in most of the leading positions there are men' puts pressure on women workers to 'be always working' and not 'stay[ing] at home with their children'. Sonja's previous working experience in Sweden, where 'nearly all the mothers work' thanks to the government's support, as well as her good experience in her current lab in Germany, where she could work efficiently with a technical assistant who was a mother thank to an effective communication system between the two, made Sonja 'feel' 'that it can work'. Sonja's testimony implies that family-work reconciliation may require adequate policies that consider communication as a key aspect.

In this vein, the reconciliation between personal life and work was found to be increasingly possible in Group G, as declared by Inge [see excerpt 225].

Excerpt 225: Focus group with junior researchers [Group G] – 'for me it's okay to go home'

> **Researcher:** Do you feel that maybe some time you will need to * to choose between your career and your social life or your personal life/
>
> **Inge:** Yeah_ definitely it's like this\ For example_ for me_ when I +uhm+ decided where to do my PhD_ I thought about doing it in another institute_ where I know that I have to work sixty hours a week_ and **I decided for me I don't want to do this\ I don't want to work so much that I don't have social life after\ So_ I think that's always a matter here as well**
>
> **Paola:** Yeah\ Also_ +uh+ yeah\ But they never have to * to acco& * XX_ because I can * **here it's very easy\ You have your social life_ and depending how you organise your work_ you can also work**
>
> **Researcher:** So you think it's because the institute& * it's the institute's policy that allows you to have both/
>
> **Inge:** Yeah\ I think * Yeah\ I think * yeah_ **it has shifted as well a little bit_** because when I was first year_ I think five years ago_ it only counts when you go home\ in ev& * in the evening\ So_ if you went home at four o'clock afternoon_ they say_ why/ Why you go home/ It's only four o'clock\ And * and +uhm+ now it has shifted\ So_ we start early in the morning_ at eight o'clock now_ and * or half past seven_ and then when you go home at four o'clock or five o'clock_ it's okay\ So everybody says_ +oh+ I have to XX my small daughter_ or I have to do something * other stuff_ **now it's okay\ I think\ But yeah_ it depends always on your colleagues\ What they think\ So if you have workaholics in your group_ you should be as well a workaholic\ But for me it's okay to go home** @@@
>
> (…)
>
> **Researcher:** But you said now it's changing/
>
> **Inge:** Yeah_ it's changing a little bit\ I think\
>
> **Researcher:** Because of the card/ Or this system/
>
> **Inge: No_ it's just a feeling in this group\ Yeah\ So * because now +uhm+ some +uhm+ people get father and mothers_ and they * they have children now_ and that's shifted *** yeah_ the * so_ before they worked really a lot_ **and now they want to enjoy that they are parents now_ and they went home earlier_** and I think there are really different reasons why that's shifted_ I don't know\ But now I think everybody works {(?) his} eight hours_ or maybe nine or ten_ but not whole weekend and not so intense anymore\

As can be deduced from Inge's excerpt, the possibility of balance between professional and personal facets of live was a consideration that scientist practitioners had to face even at the beginning of their career. In this case, Inge had the possibility to choose between working in an institute where the norm was to work 60 hours per week and the institute were she was working, where it was 40 hours per week. In the latter, she identified a new *habitus* (Bourdieu, 1977) of 'go[ing] home at four o'clock or five o'clock' that did not exist before. This could be another aspect, apart from the recognition of mother leave periods, signalling the feminisation of

science, understood as the increasing sensitivity to the balancing of professional and personal life; a claim that has been traditionally attributed to women-mothers.

In this section, the prevalence of the publishing criterion as the core, absolute and globally accepted measure of scientists' success has been illustrated, together with other secondary criteria, like the projects done and the RGs where one has worked, as well as some critical stances with this criterion and several aspects that facilitate or hinder the equal access to this practice by all individual scientists, like gender and language skills. In the next section, other elements that facilitate or are required for scientists' attainment of success will be presented.

8.2. The means for success

In this section we will identify the factors that the participants related to success in science, that is, the factors that contribute to scientists' and to RGs' successful performance in their field and to their professional career and the role of communication in the achievement of success.

8.2.1. Attitude, willingness and dedication

Some participants attributed a RG's competitiveness to its human force. In particular, Frank and Cecília (Group A) highlighted individual attitude as the unique requirement to achieve success [see excerpts 226 and 227].

Excerpt 226: Interview with Frank [Group A's leader] – 'they need to be a little bit arrogant'

> **Researcher:** And * well * what elements do you think a group needs to have in order to be competitive/
>
> **Frank: It has to come from within the people in the group** They have to be competitive_ **they need to be a little bit arrogant** as well\ But arrogance in the good sense of the word\ Not arrogant in terms of being obnoxious\ **Arrogant in a way that they want to be the best in the world** Because we can be the best in the world in all the projects we're working in\ And I would say_ two thirds of the people in the group are the best in the world in what we do\

Excerpt 227: Interview with Cecília [Senior res. – Group A] – 'That she wants to be a scientist\'

Researcher: So_ what do you think that * what is needed to be a good scientist/ What elements_ characteristics should someone who wanted *	**Investigadora:** Llavors_ tu què creus que * que cal per ser un bon científic/ Quins elements_ característiques hauria de tenir algú que volgués *
Cecília: Just wanting to be one\ Feeling	**Cecília: Vulguer-ho ser\ Que ho sentís\ Que**

it\ That she wants to be a scientist If a person doesn't want it_ you can't force her\	**vulgui ser científic** Si una persona no ho vol ser_ no l'hi pots obligar\ [original in Catalan]

In the first excerpt, Frank relates the RG's competitiveness with its members' 'arrogance' and willingness to become 'the best in the world'. A similar view is reflected in Cecília's words in the second excerpt, where she states that a 'good scientist' has 'to want it' and 'to feel it'; in this case as an inner feeling and not in terms of competitivenes. Following Frank's and Cecília's opinion, success can hence be attained by having the adequate personal attitude.

Apart from the attitude requirement, Frank pointed also at 'hard work' and spending much time in the lab as two key means to increase productivity, the core criterion of success [see excerpt 228].

Excerpt 228: Interview with Frank [Group A's leader] – 'this correlates with how hard you work\'

Researcher: So it * you think it is a win-win relationship/ I mean_ if they do better_ you win_ because the * the lab *

Frank: I don't win\ (…) **The * the ability to compete for grants_ which is what sustains a lab_** is becoming harder and harder and harder\ There are * there is less money and more people to go after that money\ **And there are criteria for people to be successful in gaining grants\ there is only one criterion_ scientific excellence** How do you measure scientific excellence in science/ **Scientific output_ publications_ how many papers_ in which journals they are published_ what is the impact factor of the paper_ of the journal_ how many citations you get_ and all this correlates with how hard you work** And of course_ **the more hours you spend in the lab_ the more productive you are_ everything else being equal\ Now_ in a lot of cases everything else is not equal\ Cause one student may be more adept at experimental work\ So_ that student would only have to do one experiment once and that experiment works\ (…) So_ obviously_ the person who is more adept at doing experiments will do a lot more successful experiments in a shorter period of time\ And this is where the Chinese win\ They win even if they are on either side of the spectrum**\ If they are really good_ they do a lot more successful experiments_ and they publish a lot more\ If they are not as good_ they do * they repeat their experiments so many times_ but because they have 24 hours to do them_ because this is what they do\ **They can reach the end of the experiment_ either a positive or a negative end_ a lot quicker**\

(…)

Researcher: So the& they * they face frustration differently\

Frank: Yes\ Yes\ A Chinese student would persevere\ Would persevere until the end\ Whatever that end is\ But **I know that the Chinese student would get to the end**

As can be observed in this excerpt, there is an individual conditioning factor of productivity: being 'more adept at doing experiments'. Following Frank, this feature facilitates successful experiments and can be compensated by those practitioners who lack it by repeating the failed experiments 'many times'. Following Frank, in both cases 'the Chinese win' because they work many hours and they always 'get to the end'. Accordingly, in Frank's view the national culture relates with a certain working culture, especially involving a certain attitude.

Both, Cecília and Frank put the focus on the individual agency as conditioning success. Differences in outcomes and success were attributed by them to personal skills and attitudes, instead of to the structure of scientific practice. This coincides with Diana's (former member of Group A) view, who emphasised 'hard work' as a means for success, but who identified the group leader as the originator and trigger for other group members' willingness and motivation [see excerpt 229].

Excerpt 229: Interview with Diana [postdoc – former member of Group A] – 'the job of the {(Eng) group leader}is to motivate'

Researcher: And competitive/ How do you know that a group is competitive/	**Investigadora:** I competitiu/ Com se nota que un grup és competitiu/
Diana: Because you will work a lot\ And you can publish_and don't stop\ You have to always read_	**Diana: Perquè treballaràs molt\ I pots publicar_ i no pares\ Has d'anar llegint sempre_**
Researcher: But does this depend on you/	**Investigadora:** Però això depèn de tu/
Diana: No \ You see it in the group too\ that is_ if it's a group that works a lot of hours_ you see that people also have results_ they keep publishing a lot_ for me it's a group that is * that works\ That works a lot\	**Diana:** No\ Ho notes també en el grup\ És a dir_ si és un grup que treballa moltes hores_ veus que la gent també té resultats_ se va publicant molt_ per mi és un grup que sí que està * que treballa\ Que treballa molt\
Researcher: And whose merit is it/ **Who makes a group competitive/**	**Investigadora:** I això de qui és mèrit/ **Qui fa que un grup sigui competitiu/**
Diana: Well_ I think that the first person who does it is the {(Eng) group leader}\ She's the one in charge of the lab that forces people to * not to work_ but it's also to motivate you_ I guess\ I mean_ they motivate you so that you like it\ And to be * In ge& * I speak in general_ + uh +	**Diana: Home_ jo crec que la primera persona que ho fa és el {(Ang) group leader}\ És el responsable del laboratori que força la gent a * no és a treballar_ però també és a estimular-te_ suposo\ Vull dir_ que t'estimulen perquè t'agradi\ I per ser * En ge& * parlo en general_ +eh+**
Researcher: Yes\ =Yes\=	**Investigadora:** Sí\ =Sí\=
Diana: =Not only here\= if you have * also the job of the {(Eng) group leader} is to motivate those who have * the students or	**Diana: =No només aquí\= si té * també la feina del {(Ang) group leader} és estimular als que té * els estudiants o els**

her workers_ I mean_ not only because you work_ but intellectually you have to like it\	seus treballadors_ és a dir_ no només perquè tu treballis_ sinó intel·lectualment t'ha d'agradar\
	[original in Catalan]

Diana's opinion coincides largely with that of Frank and Cecília, in the sense that she refers to 'working many hours' and 'liking the job' as means for success. However, she places greater responsibility of the RG's success on the group leader, as the person who must 'force people' and 'stimulate them' to work. The ideology of the two leading members of Group A, Frank and Cecília as regards the means to attain success in science, seemed to condition the view of other group members, like Diana, of the value system of science. Considering the framework described and conveyed by Frank and Cecília, other group members evaluated their own position and possibilities. This is reflected in the following excerpt, in which Carol doubts about her possibilities to continue her scientific career after her PhD in Group A [see excerpt 230].

Excerpt 230: Interview with Carol [PhD res. – Group A] – 'I don't know if I fit in\'

Researcher: And do you see yourself continuing after/ In this field_ and with this career/	**Investigadora:** I et veus continuant després/ En aquest camp_ i amb aquesta carrera/
Carol: If I don't change my attitude_ I don't\ @	**Carol: Si no canvio d'actitud_ no\ @**
Researcher: You don't/	**Investigadora:** No/
Carol: I don't\	**Carol:** No\
Researcher: You don't like it enough/ Or_	**Investigadora:** No t'agrada suficient/ O_
Carol: I don't know_ I see that * what I was telling you_ that what makes a good scientist/ Well· * the thing is that I don't know if ·· the way things are_ I don't know if I fit in	**Carol: No sé_ veig que * el que et deia_ que què és un bon científic/ Pos· * és que no sé si·· de la manera que estan muntades les coses_ no sé si encaixo**
Researcher: Because of this/ Because you lack a little selfishness/ Or··	**Investigadora:** Per això/ Perquè et falta una mica d'egoïsme/ O··
Carol: Yes\ And because of what I say * because of what I told you before_ right/ That I think that there are people who are very scrupulous_ very rigorous_ very methodical_ so to speak_ and then * we talked about Agus_ but also Simona_ (…) Well_ Simona.. I think +uh+ that she was quite a methodical person_ quite organized_ and then_ well_ she didn't have many publications_ and·· when she	**Carol:** Sí\ I pel que dic * pel que t'he dit abans_ no/ Pos que hi ha gent que veig que és molt escrupulosa_ molt rigorosa_ molt metòdica_ diguéssim_ i després * hem parlat de l'Agus_ però també la Simona_ (…) Pos bueno_ la Simona·· jo considero +eh+ pos que era una persona pos bastant metòdica_ bastant organitzada_ i després_ pos bueno_ publicacions no en va tenir gaires_ i·· quan va acabar la tesi_ com a que estaven molt descontents amb ella\ I

finished her thesis_ they were kind of very unhappy with her\ And I say_ well_ she is a person who also * who_ I don't know\ Of course_ I'm talking about the group\ Here of& of * of the people that I have met\ But I also know colleagues who are doing PhDs in other groups_ and the situation is pretty much the same\ That there are always people_ right/ that * that **I don't see the correlation of what a good scientist is\ It is valued that a good scientist is the one who has publications\ But how this person has made the publications_ this is not valued\ If she has done it by any means_ or * this is not valued\ That in theory_ when you send an article_ in a magazine_ they have to correct it_ there has to be & * there is a * some scales_ right/ to say if it's good or not good_ but some things go unnoticed**

Researcher: And * and wouldn't you able to keep working in this field_ but be a mediocre scientist/ To the * the point that you can and want/

Carol: Yes \ I don't know what I will do\ +uh+/ To be honest\ Now_ for now_ I'm like this· _ and when_ I don't know_ when it's time to finish_ then_

dic_ ostres_ és una persona que també * que_ no sé\ Clar_ això t'ho dic intern\ Aquí del& dels * de les persones que he conegut\ Però també conec companys que estan fent doctorats en altres grups_ i la situació és una mica la mateixa\ Que sempre hi ha gent_ no/ que * que **no veig la correlació del que és un bon científic\ Que es valora que un bon científic és el que té publicacions\ Però com aquesta persona ha fet les publicacions_ això no es valora\ De si ho ha fet de qualsevol manera_ o * això no es valora\ Que en teoria_ quan tu envies un article_ a una revista_ ho han de corregir_ hi ha d'ha& * hi ha un * uns barems_ no/ per dir si és bo o no és bo_ però colen coses**

Investigadora: I * i no podries continuar treballant en aquest camp_ però ser una científica mediocre/ Fins al * al punt que tu pots i vols/

Carol: Sí\ No sé el que faré\ +eh+/ La veritat\ Ara_ de moment_ estic així·_ i ja quan_ no sé_ quan arribi el moment d'acabar_ llavors_

[original in Catalan]

In this excerpt, Carol deems her 'attitude' potentially incompatible with 'the way things are set' in science. Carol's words highlighting 'attitude', that is her agency over structure, resonate with those of Frank and Cecília. Also, her view on how success should be assessed contrasts with what she perceives to be the dominant paradigm, since she does not 'see the correlation of what a good scientist is' and her publications. Carol implies that although there is a peer review system that warrants the quality of the publications, 'some things go unnoticed' and escape this control, which she shows her disappointment at. Carol's critical stance towards the evaluation system of science coincides also with the one expressed by Agus in excerpt 219.

Still coinciding with the paradigm described by Frank and Cecília whereby hard work and spending much time in the lab are clues for success, Carol expressed her belief that working and personal life are incompatible when aiming at success [see excerpt 231].

Excerpt 231: Interview with Carol [PhD res. – Goup A] – 'I don't want to be 100% like that\'

Researcher: And_ for example_ in the career of science_ that is_ do you think that * (…) Do you think that to move up_ you have to spend many hours and maybe abandon more the profe& * personal life/ Do you think this is incompatible_ one thing with the other/	**Investigadora:** I_ per exemple_ a la carrera de la ciència_ o sigui_ tu creus que * (…) Creus que per escalar amunt_ cal dedicar moltes hores i renunciar potser més a la vida profe& * personal/ Creus que això està renyit_ una cosa amb l'altra/
Carol: I think so\ **Yes_ because there is no person like this as a group leader who stands out a lot_ and·· * and has another life @@ * another life\ I don't know_ yes_ it is quite·· commitment\ I mean_ yes**	**Carol:** Jo penso que sí\ **Sí_ perquè no hi ha cap persona així com cap de grup que destaqui molt_ i·· * i tingui una altra vida @@ * una altra vida\ No sé_ que sí_ que és bastant·· dedicació\ Vull dir_ sí**
Researcher: Do you think that * that you could reach this level/ Or would you like to/	**Investigadora:** Tu creus que * que podries arribar a aquest nivell/ O voldries/
Carol: No\ I don't think so\ I don't want to @	**Carol: No\ Crec que no\ No vull** @
Researcher: Do you think you have this balance now/ between personal life_ professional life/	**Investigadora:** Ara tu creus que tens aquest equilibri/ De vida personal_ vida professional/
Carol: No\ I'm pretty immersed in professional life_ +uh+ / Probably more than =I'd like to=\	**Carol:** No\ Estic bastant decantada per vida professional_ +eh+/ Més del que potser =m'agradaria=\
Researcher: =Are you/= And how do you notice this/	**Investigadora:** =Sí/= I com ho notes/
Carol: Well_ meeting friends_	**Carol:** Pues bueno_ quedar amb els amics_
Researcher: You don't do it\	**Investigadora:** No ho fas\
Carol: No\ family_ either \ Less than * Probably less than I would like to\ And I see family more than my friends_ Because the family_ because it's more of an obligation_ maybe if there's something_ one day_ well_ you go there\ With the friends_ of course_ it's more_ and I really don't * or things that I feel like doing_ you don't have to go with other people either\ I put it aside quite a lot\	**Carol:** No\ Família_ tampoc\ Menos de * de lo que potser m'agradaria\ I veig més a la família que als amics_ Perquè la família_ com que és més obligació_ potser pos hi ha aquest dia una cosa_ pos beno_ hi vas\ Amb els amics_ clar_ és més_ i realment no * o coses que a mi m'apeteix fer_ tampoc no cal anar amb altra gent\ Ho deixo bastant de banda\
Researcher: You don't * you don't do anything extracurricular/ That is_ some activity_	**Investigadora:** No * no fas res extraescolar/ O sigui_ alguna activitat_
Carol: +m····+ no\ I don't want more obligations either\ So_ I do_ well sometimes I go biking_ I go for a walk_ I like the mountains_ And I do it\ But I don't have another calendar\ I mean_ I already have	**Carol: +m····+ no\ Tampoc no vull més obligacions\ O sigui_ faig_ pos a vegades vaig en bicicleta_ vaig a caminar_ m'agrada la muntanya_ I**

enough\ (...)

Researcher: And you think you can't do it because of the hours you spend here/ Or because =you're exhausted_=

Carol: =Because= I don't want more obligations\ I mean_ I already have a schedule here that isn't a schedule_ that is_ that * that when I get out of here_ well_ well_ I do what I feel like doing\ Many times I don't do anything because I'm tired\ =because here= *

Researcher: =That's what= I was going to tell you_ because the friends it's not because * it's not an obligation_ right/ But why don't you do it/

Carol: Because well * I'm tired_ and I don't feel like *

Researcher: So_ it's very exhausting_ in the end/ the everyday life here_

Carol: +mhm+\ Sure_ and little by little * maybe at first you don't realize it_ but now you look back at these two last years_ * it's also true that the older you get_ * well_ that * I don't know_ (...) because everyone_ if you work_ and so on_ well everyone has a different schedule_ and it's more difficult to meet\ (...)

Researcher: And do you miss it_ or not/

Carol: When I'm in my routine_ and I'm like super busy_ the truth is that you don't even miss it\ Because I only get home_ have dinner_ and go to bed\ And·· then the same\ **But of course_ there comes a time when you say_ gosh_ and what am I doing with my life/ That I'm here_ and only here_ and I don't do anything else\ (...) Whenever I think_ let's say_ about my life_ and about what I want * for example_ when I think_ sometimes_ right/ after that_ what/ well_ well_ I don't want to be 100% like that**

faig\ **Però no tinc un altre calendari\ Vull dir_ ja en tinc prou** (...)

Investigadora: I creus que no ho pots fer per les hores que dediques aquí/ O per =l'esgotament_=

Carol: =Perquè= no vull més obligacions ja\ O sigui_ ja aquí ja tinc un horari que no és un horari_ o sigui_ que * que quan surto d'aquí_ pues_ bueno_ faig lo que tinc ganes Moltes vegades no faig res perquè estic cansada\ =perquè aquí= *

Investigadora: =És lo que= t'anava a dir_ perquè els amics tampoc és per * no és una obligació_ no/ Però no ho fas per què/

Carol: Perquè no * estic cansada _i no tinc més ganes de *

Investigadora: O sigui_ és molt esgotador_ al final/ aquí el dia a dia_

Carol: +mhm+\ Clar_ i poc a poc * potser al començament no ho notes_ però ara mires dos anys enrere_ * també és veritat que com més gran te fas_ * bueno_ que * no sé_ (...) perquè cadascú_ si treballes_ i així_ pos cadascú té un horari diferent_ i costa més quedar\ (...)

Investigadora: I ho trobes a faltar_ o no/

Carol: Quan estic en rutina_ i estic així a tope_ és que ni ho trobes a faltar\ Perquè només arribo a casa_ sopo_ i me'n vaig a dormir\ I·· torna-hi\ **Però clar_ arriba un moment que dius_ ostres_ i què estic fent a la meua vida/ Que estic aquí_ i només aquí_ i no faig res més\ (...) Quan penso_ diguéssim_ en la meva vida_ i en lo que vull * per exemple_ quan em plantejo_ a vegades_ no/ després d'això_ què/ pos_ hosti_ jo no vull estar 100% així**

[original in Catalan]

In this excerpt, Carol describes her current life during her PhD as being centered on work, having renounced to social relations and hobbies because she is tired or has a different schedule to everybody else. Although she does not realise this predominance of work in her life on a daily basis, whenever she looks back, she questions it and concludes that she does 'not want to be like this 100%'. Once more, the dilemma of choosing between professional success and personal life emerges, and Carol's hesitation in this regard seems to contravene Frank's and Cecília's conception of the right attitude to pursue success in science.

The view of a member of a different RG, Fina from Group B, aligns with Cecília's perspective in pointing at 'willingness' as a characteristic of a 'good scientist', and she specifies the emotional dimension of this feature, which is that it helps practitioners not to be discouraged when things fail [see excerpt 232].

Excerpt 232: Interview with Fina [PhD res. - Group B] – 'A lot of eagerness_ I guess_'

Researcher: What do you think * a good scientist should have/ What do you think he should be like/	**Investigadora:** Què creus que * que ha de tenir un bon científic/ Com creus que ha de ser/
Fina: Eagerness\ A lot of eagerness_ I guess_ because if not_ you don't_ * if not_ you are very demotivated\ +Mm··+ Curiosity\ A lot of curiosity\ And then_ be * be methodical_ so to speak_ with things \ Repeat them well_ or note them down well_ or···	**Fina: Ganes\ Moltes ganes_ suposo_ perquè si no_ no_ * si no_ et desanimes molt\ +Mm··+ Curiositat\ Molta curiositat\ I llavors_ ser * ser metòdic_ diguéssim_ amb les coses\ Repetir-les bé_ o apuntar-ho bé_ o···**
	[original in Catalan]

As shown in this excerpt, apart from eagerness, also curiosity and being methodical are important characteristics of the 'good scientist' according to Fina. However, Fina showed a different stance from Frank's belief that more time in the lab increases productivity [see excerpt 233].

Excerpt 233: Interview with Fina [PhD res. - Group B] – 'they don't have to be good and publishable\'

Fina: … before I * **I stayed until twelve or one\ At night**	**Fina:** … Jo abans * **jo abans me quedava fins a les dotze o la una\ De la nit**
Researcher: And now you've changed_ let's say	**Investigadora: I ara has canviat_ diguéssim**
Fina: And now I never do it \ Well_ I do it when I need it But not because I'm reading_ or because * I simply stayed * you had work_ practical work_ * because the problem	**Fina: I ara no ho fai mai\ Bueno_ ho fai quan ho necessito** Però no perquè estic llegint_ o perquè * És que em quedava * tenies feina_ pràctica_ * perquè el problema

is that you have a lot of waiting_ also_ you know/ With the protocols\ well now it's one hour_ now half an hour_ now I don't know what\ And then_ while you wait_ sometimes you already_ well you read_ and everything you want\ But the thing is that sometimes you just stayed to * for something you can do the next day_ to do it at that moment_to see how well you did it_ But now I don't do it so much_ maybe\

Researcher: +Mhm+ okay\ And when did this change/ **What changed in you/**

Fina: Well_ also to see that it's useless\ Because you can spend millions of hours_ and work ten billion times_ but nobody values this more

Researcher: And with the results/ You don't get more results after staying = XX =

Fine: =You get more= results_ but they don't have to be good and publishable Of course\ Of course_ I've done millions of things\ But in the end what you can publish is what you can sell as a story_ and that it makes sense\ **Everything that does not make sense_ or that is contradictory_ all this you don't publish**

és que tens moltes esperes_ també_ saps/ Amb els protocols\ pos tenen ara una hora_ ara mitja hora_ ara no sé què\ I llavors_ mentres t'esperes_ a vegades ja_ pos ja llegeixes_ i tot lo que vulguis\ Però és que a vegades te quedaves ja per * o per una cosa que pots fer l'endemà_ per fer-la al mateix momento_ per vere com te sortia_ Però ara ja no ho faig tant_ potser\

Investigadora: +Mhm+ vale\ I en quin moment va canviar això/ **Què va canviar en tu/**

Fina: Bueno_ veure també que no serveix de re\ Perquè pots fer milions d'hores_ i treballar deu mil milions de vegades_ però tampoc ningú t'ho valora més

Investigadora: I tampoc els resultats/ No obtens més resultats per quedar-te =XX=

Fina: =Obtens més= resultats_ però no tenen per què ser bons i publicables Clar\ Clar_ jo he fet milions de coses\ Però al final lo que pots publicar és lo que pots vendre com una historia_ i que tingui sentit\ **Tot lo que queda al marge_ o que t'ho contradiu_ tot això no ho publiques**

[original in Catalan]

In this excerpt, Fina questions the correlation between devoting many hours and success in science, since she defends that 'nobody values it more'. Although more hours may bring 'more results', greater quantity does not imply greater quality, and thus it does not necessarily translate into more publications. In this excerpt, Fina coincides with Agus' assertion in the previous section of this chapter (excerpt 221) that some results that contradict the story of the article to be published are omitted.

8.2.2. Exposure, networking and PR skills

Still focusing on individual agency, Hans, the leader of Group G, mentioned 'good expertise', 'know[ing] the research field', 'transform[ing] the lab work to something recognised in the outside field' and 'hav[ing] also ideas' as key characteristics and abilities of 'good scientists' [see excerpt 234].

Excerpt 234: Interview with Hans [Group G's leader] – 'otherwise we are not recognised'

> **Researcher:** What is for you a good researcher/ A good member of your group/ You know_ are there any specific qualities that you would say_ well_ you know_ if I think of someone who I really think is a * is a good researcher_ you know_ what does he or she need to have/
>
> **Hans: Yeah\ Good expertise_** in a specific field_ so that techniques {(?) is easy} * they know how * +uh+ he has to **know +uh+ the research field_ including the publications_** he has to be able to * to +uhm+ * to * **to transform the * the lab work to something +uh+ which is recognised in the outside field_ because otherwise we are not recognised and don't get contracts_ so_** meaning that he has **to give talks_ presentations_ and publications_** and finally_ **have also ideas** to +uh+ * to generate new projects\ +Uh+ including writing of * of proposals\ Because many even postdocs sometimes lack the +uh+ * yeah_ the * the imagination to * to write new projects\ They do their job_ very good_ they are experts_ they are great_ yeah_ but having also new ideas is very challenging\ And this is absolutely needed because otherwise you * you stop_ and then no new projects are coming\

According to Hans, dissemination of the RG's accomplishments 'in the outside field' is essential to obtain new contracts, which he presents as the RG's central aim. Such dissemination takes place through scientists' participation in communicative events like 'giv[ing] talks, presentations, and publications'. In the same interview, Hans added also 'newsletters' and 'reports' as part of the PR necessary to gain visibility [see excerpt 235].

Excerpt 235: Interview with Hans [Group G's leader] – 'you have to go to the outside'

> **Researcher:** Would you say that it is not very common for good researchers * +oh+ no\ For researchers to be good at communication skills/
>
> **Hans:** Yes_ really successful researchers are\ Yeah/ Sometimes they tell too much\ Yeah/ I do not know\ I * I have met so many good researchers\ Yeah/ And I always say_ +oh+ God_ Yeah/ +uh+ It's always like_ my lab_ my group_ my * my publications_ my * Yeah/
>
> **Researcher:** So_ ego pe& * =ego people\ @@@=
>
> **Hans:** =Yeah\ Yes\ Yeah/= And * and * +uh+ but the people that are shy_ working in the lab_ don't go to the outside_ don't publish_ they are not recognized\ Yeah/ *
>
> **Researcher:** Cause that's the idea we have of a researcher_ right/
>
> **Hans:** Yes\
>
> **Researcher:** A guy who doesn't know very well * who's shy_

Hans: Yeah\ Yeah_ but we had these examples in the lab that people were giving a talk_ and suddenly the audience we said_ wow_ we didn't know that\ Yeah/ She's staying here for five years_ and she's so brilliant\ Yeah/ Because she was not visible\ And visibility is one of the key things\ Yeah/

Researcher: Yeah\ And it's not forced\ Visibility is not forced by you\ I mean_ you could be =now in the lab XXX that importance=

Hans: =Yeah_ because frustration * yeah_ * and * or * and= and **we try to * to * to force people also to publish** So there's always * +uhm+ it is supported also by seminars_ but +uh+ visibility {(?) into} different levels is * is * is a key\ Yeah/ And +uhm+ I always tell to people_ okay_ you have done great things\ And/ Yeah/ Who c& * who will see that/ What is the use of it/ You are IP_ I am IP_ but that's it\ So_ **you have to go to the outside_ and * this includes also PR\ So * so_ newsletters_ or general reports that we have_ and things like that_ also publications_ because many people see us due to publications_ and * and call us as_ hey_ shall we do a project/ And * and this is +uh+ very very important**

As declared by Hans, out-group visibility is the reason why Group G is 'call[ed] to do projects' by its partners. Communication beyond the RG is thus deemed essential for its success and its survival. This was also acknowledged by Frank, who stated that 'establish[ing] and maintain[ing] links with key institutions and key individuals' was a means to obtain funding [see excerpt 236].

Excerpt 236: Interview with Frank [Group A's leader] – 'establish and maintain links with key institutions'

Researcher: Do you think that because of all this travelling and this sort of more political commitment_ +ehm+ your * your * your research group suffers from it/

Frank: +Uhm+ it suffers to some degree_ but it benefits in a different way\ **Because I'm able to main* establish and maintain links with key institutions and key individuals which on occasion I can leverage for funding** So_ it has its prons * pros and its cons\ Like everything\

Although it was not recognised by Frank himself, Hans considered Frank's experience in discussing about science with 'so many people' as giving him a different perspective on the field that made him more capable of 'making the story more interesting' in Group A's publications [see excerpt 237].

Excerpt 237: Interview with Hans [Group G's leader] – 'he had so many different discussions about science'

Hans: I say_ try also to find something\ Yeah/ Frank is very good at that\ So_ here also +uh+ +uh+ some people say_ okay_ I write A_ B_ C_ D_ introduction_ +uh··+ results_ Yeah/ But Frank also finds a story\ =He is a st&= *

Researcher: =Yeah_ he talks= a lot about =stories\=

Hans: =He= * he is a storyteller\ Yeah/ And this is the reason * +uh+ or the reason for that he i& * he i& * he is a very good scientist_ he has a lot of experience_ he has met so many people_ **he had so many different discussions about science_ so_ he sometimes feels from a different angle\ * from a different angle\ Making the story more interesting than just the normal way of describing your research**

Following this excerpt, Hans believed that discussing on science with out-group individuals may bring inspiring insights and ideas that may be benefitial for publishing. Networking and PR are thus related with success in science, especially concerning resource allocation and intellectual enrichment. However, these activities were found to be linked with seniority, that is, the more senior position the practitioner had, the more she was expected and/or required to engage in these types of activities [see excerpt 238].

Excerpt 238: Interview with Hans [Group G's leader] – 'he had so many different discussions about science'

Researcher 1: Do you think they are * +ehm+ when they come here_ they are trained to * to acquire all these skills/

Hans: No\ Not all of them\

Researcher 2: So * so_ some people die on the way\ In a way * I& in a way\ Not everybody has good ideas\ And if that person_ you know_ doesn't have ideas_ then he or she doesn't have a future in the group\ In a way\ Right/

Hans: Yeah_ sometimes you recognise that even too late\ Yeah/ @ Because until the end of the PhD_ it's * its'_ it's very regulated\ Yeah/ You know what to do_ you have your project_ you know your way\ But after that it's * it's a huge step\ Yeah/ Maybe as a young post-doc you still have your project_ but then_ getting independent and * and starting your own research group_ you need also +uh+ the energy to do that\ Yeah/ And * and * and very often they decide_ Okay_ I go until here_ but I have also my private life\ I have my social life\ And I don't want to invest my weekend in writing proposals_ or in reading something\ Yeah/ And this is especially here the case because +uh+ people are interested in applied research_ so they are more closer to industry_ These are not [institute's name] guys that are really * live for * +uh+ for * for science\ Yeah/ So_ +uh+ And sometimes you may know also * I think it's called pittas principle/ Yeah/ That your race +uh+ in your career_ and **at a certain point you enter a level that you cannot cope anymore\ Yeah/ You feel * you * you feel very comfortable at this * at this level_ you * you know everything_ you can make a decision_ your responsibilities_ but in the next step you don't have the ability\ You were moved to the next step because you were excellent here_ but then you reach the position +uh+ which you cannot fill because you are lacking something** Yeah/ **Communication_ +uh+ making decisions_ or * or whatever** (…) **Most of the people like to work at the bench in the lab** Yeah/ They are also very good in doing that_ Yeah/ And then becoming a post-doc they **have to move away from the bench** Yeah/ Because **you have to write proposals_ you have to do this kind of boring things in front of the computer_** Yeah/ You have to **talk to people_ And * so_ it's very different to the work that you did before durig a PhD** Yeah/ And * and * **and many people have problems with that_ and would**

> **like to stay at the bench** But making career means actually you have to move away from the bench because this positions at the bench as a postdoc are very very rare\

In this excerpt, Hans explains that typical practices of postdocs and beyond include 'communication', like 'writing proposals' and 'talking to people'. According to him, this implies a potential problem because the skills required in the PhD, based mainly in laboratory work, are very different from those required after the PhD, when more office work is needed, and some practitioners either reject this type of work or lack the necessary skills. This was the case of Giulia, a postdoc in Group G, who expressed that she preferred experimental work to 'bureaucracy' and 'PR' and thus did not 'have the ambition of becoming a group leader or anything' [see excerpt 239].

Excerpt 239: Interview with Giulia [Postdoc res. – Group G] – 'I don't like the rest\'

> **Researcher:** Do you think that a scientist has to coose at some point in his or her life between personal life or professional career/
>
> **Giulia:** Yeah\ To some extent: I think so\ If you want to have a professional career at * at certain level I think you have to·· * not necessarily to sacrifice your perosinal life_ but you need to realise that your personal life goes in one direction_ yeah/ They might not be the one you go * you * you want\ I mean_ it's not * If you see the head of the institute here_ he is always travelling and * from one continent to the other_ within two days_ and always on the run_ and never taking off @ the * +eh+ the power_ and +uh+ yeah\ It's +uh+ * for me it wouldn't be * it wouldn't be thinkable something like this\ No\ So_ in these * in these terms definitely\ But on the other hand_ especially here_ I think that they're quite +uh+ flexible\ So you can pretty well combine your private life with your * with your working time also\ Yeah/ You don't have to {(?) be} at work from eight till four_ but you can be flexible as long as you do what you have to do_ and this is really really helpful\ I see also my colleagues that already have kids_ for example_ +uh+ they * they appreciate this\ Yeah/ So they try to put you in a situation where you can perform even if you have your private +uh··+ things to * to * to do\ Of course_ whenever it's possible_ I mean\
>
> **Researcher:** So_ I& it's quite easy to combine both in this * working here I mean\
>
> **Giulia:** I * I think so\ Yeah\ I think so\
>
> **Researcher:** +Eh+ well_ you have to decide you don't want to go further in your level of responsibility ma& maybe_ or_
>
> **Giulia:** +Uh+ probably\ I mean_ I already know that I don't want @ to go high_ because +uh+ yeah_ then_ **the higher you go_ +uh···+ bureaucracy you have to deal with_ the more diplomatic skills you need_ rather than * yeah_ it goes more on business_ and on diplomacy_ rather than on science than I * I like the science part\ I don't like the rest\ And I'm probably also not good at the rest\ So_ to have a * a group of small people is fine_ but I wouldn't want to become a head of department or a head of the institute or a head of anything\ I am * it's not * it's nothing for me\ (…) I don't have the ambition of becoming a group leader_ or anything like this\ It's too stress and too little fun for me**

Following this excerpt, apart from considering that she lacked the skills needed, like 'diplomatic skills', Giulia believed that becoming the head of the department or the group leader involved doing activities that required a different engagement in work from the one she had, and hence entailed having to renounce to personal life, which she was not willing to do.

In line with Hans' belief that posdocs needed certain innate communication skills, Franziska and Sonja (postdocs in Group G) discussed about the importance of having 'a nice network' and the requirements for it [see excerpt 240].

Excerpt 240: Focus group with postdocs [Group G] – 'always you need to have a nice network\'

> **Rita:** at least it [the course on getting industry projects] gives you the security that I'm not completely wrong\ (…)
>
> **Franziska:** I mean_ The outcome is **always you need to have a nice network**
>
> (…)
>
> **Researcher:** What does this mean/ I mean_ to have a nice net& network\ To know many people from the industry_ the right person_ is it_
>
> **Franziska:** Yeah\ You don't contact someone only when you need something_ but you have * you have contact with people anyway_ and then it's not like * yeah_ you just =XXX=
>
> **Researcher:** =So doing public relations\=
>
> **Franziska:** Yeah\ And of course **you have more information if you know more people**
>
> **Sonja:** But I think **a lot of the * of the important network are things that are done by Hans or Karl Lehmann_ the institute head_** and I think that also * **it's not that I'm unable to * to make the contacts_ but it's more that * I mean the people from industry of course they don't want to talk to a senior scientist_ they want to talk to the boss_ And I think quite often they will feel more comfortable talking to a man_** and then it's also that **I think I don't have the right personality_** I think Rita is much better at that_ that I feel I * I'm too +uh+ neutral_ or I'm too scientific maybe_ or I'm too sauber\ so **I have difficultires in packaging things in something beautiful_ like sort of like selling the thing_** I mean I think I can * I'm not saying_ +ah+_ it's not good what we do or so\ I'm not doing that\ But maybe I say_ Yeah _ we're doing a really good job\ And I think Rita would say_ +Oh+_ you know_ you've come to the best institute in Germany\ So_ you see the difference/ **So I'm * I'm trying to learn_ but I * I * it's not so much my style**

In this excerpt, both Franziska and Sonja align with the view that networking is necessary after the PhD, but Sonja points at some aspects that might hinder it: that 'people from the industry' may prefer to communicate 'with the boss' (either Hans, the group leader, or Karl Lehmann, the head of the research institute) and with 'a man', and that it is necessary to adopt a selling discourse style, which according to Sonja requires a certain personality that she lacks. This way,

scientists' potentiality of accumulating social capital is dependent upon their agency (personality) and upon structural aspects (one's rank and gender).

As regards agency, apart from some individual skills like curiosity, fairness, interest and passion, Giulia (Group G) mentioned also communication as a key skill of a 'good researcher' [see excerpt 241].

Excerpt 241: Interview with Giulia [Postdoc – Group G] – 'you need +uh+ to present your stuff also if you want funding'

Researcher: Do you think that you are a good researcher/

Giulia: (…) Yeah_ of course\

Researcher: What do you think that makes you a good researcher/

Giulia: I think I have a +uh+ I'm curious_ I'm * I'm fair_ I'm * I'm * I'm able to interact with people_ and I'm interested in what I'm doing\ So I do it with passion_ I would say\ Yeah

(…)

Researcher: These things you've told me_ interaction capability_ curiosity_ passion_ these are * are characteristics you already had from the beginning/ or you have acquired them/

Giulia: I think most of them are innate\ So you have to have them_ kind of\ But of course in the communication_ for example_ you get a lot of experience while you're doing\ Yeah

Researcher: How important do you think that communication skills are for a scientist/

Giulia: I think they're very important\ I think they're very important_ not only on a daily basis_ as I said_ when you need the interaction with the colleagues_ or whatever_ but if you * if you can't communicate your science_ then it's of no use\ Yeah/ **So you have to be able to * to * to present your work well_ and also to interact with other people to * to·· * to get feedback on what you're doing_ you need +uh+ to present your stuff also if you want funding_** yeah/ You have to know how to present it_ and it's another form of communication in somehow * in some way\ And +uh+ * yeah_ **you can be the best researcher and have the best discovery of all_ but if you are not able to share it with the world_ it's worth nothing** So_

In this excerpt, the importance of the exposure of one's work through communication is emphasised by Giulia, who asserts that 'you can be the best researcher and have the best discovery of all_ but if you are not able to share it with the world_ it's worth nothing\'. She deems different types of communication essential for science as means for 'get[ting] feedback' and 'funding'. Therefore, communication is presented by her, as well as by other participants mentioned in this subsection, as an indispensable means for the accumulation of *scientific capital* (Bourdieu, 1975).

8.2.3. Group strategy

Another set of means for success in science revealed in the data concern the strategy of the RG in terms of its research topic, project proposals and planned publications. In the next excerpt, Hao describes this strategy that makes a RG's project proposal 'competitive' as relying on a research experience in the same field, innovative ideas, good publications in the same field, taking risks, maximising the potential benefits and aiming at a social impact (being 'very important for the world') [excerpt 242].

Excerpt 242: Interview with Hao [Senior res. – Group A] – 'You need a·· very good research background'

> **Researcher:** What do you need to be able compete [for a project]/
>
> **Hao: You need a·· very good research background_ in this field\ For example_ if you** want to +uh+ apply some project in the XX possible you must XX background_ **and a very good publication in this field\ Then you also make a very +uh+ competitive new project\ And it's high risk_ and also high benefit\ And it's very important for * for the world**
>
> **Researcher:** +mhm+ So_ to get a grant_ or to * to win a competition_ you need to have high risk and high benefits/
>
> **Hao:** Yeah\ +Uh+ yeah\ Of course\
>
> **Researcher:** Potential benefits\
>
> **Hao: Yeah\ Potential benefits\ Yeah**
>
> **Researcher:** Okay\ So risk is important as well\
>
> **Hao: It's high innovation_ you know/ If not_ it's very easy_ is * +uh+ the project is just so so_ you know/ You must outreach the idea_ you know/** (…)
>
> **Researcher:** So you need to know what has been done_
>
> **Hao:** Yes\
>
> **Researcher:** in the field_
>
> **Hao:** Yeah\ Yeah\ Yeah\ in the pa& * in the past_ * **what has been done in the past_ and now what the people are working on_ and in the future what you plan to do\ Yeah**

According to Hao, in order to do highly innovative project proposals, being knowledgeable of 'what has been done in the past_ and now what the people are working on' is crucial. Once more, the competitiveness of the scientific field is made evident in the participants' discourse.

Also equating success with obtaining research grants through project proposals, Cecília declared that Group A's clues for success were two: the way the RG was managed – through the task specialisation of its four most senior members – and the fact that the RG had stuck to the same

topic and had consequently 'a large curriculum' (meaning experience and publications) in that field [see excerpt 243].

Excerpt 243: Interview with Cecília [Senior res. – Group A] – 'It's the strategy of leading the group\'

Researcher: And do you think that thi success of the * of the group* or of the * + nst + can also be due to the success of the strategy/ I mean tha·t you aim at a path that maybe nobody is aiming at_ **Cecília:** No\ **It's the strategy of leading the group\ Not the path** We already have the topic\ **But one thing we've done is that we've never changed the topic** (…) So_ of course_ **now we have a long curriculum on this\ So if there is a call_ we'll be among the first** So_ our strategy has been not to change the topic\ Sticking_ come what may_ sticking to our topic\ (…) **And by sticking to it_ it gives us the advantage that we have a long curriculum\ That's one thing \ And the other strategy has been the specialisation of the four** Because if we all did everything_ if Hao had to fill out all the papers that have to be filled out_ we wouldn't manage\ And if I had to do all the classes I have to do_ I wouldn't manage\ So_ the fact that the four of us work well together and have assumed this_ * well_ I'd have a whale of a time in the lab\ But if I have a whale of a time in the lab_ Hao will be there with some papers_ and will look at you in such a way_ and_ * + nst + of course_ And I could also go and do classes\ Hours and hours of classes_ and abandon everyone\ And when I would return to the lab_ what would I find_ So we have assumed this specialization and that's all\ **It seems to me that this_ the fact of sticking to the topic_ and the specialization_ is what makes us progress**	**Investigadora:** I creus que l'èxit aquest del * del grup_ o del * +nst+ pot ser també per èxit d'estratègia/ O sigui que· apunteu cap a un camí que potser ningú està apuntant_ **Cecília:** No\ **És l'estratègia de portar el grup\ No el camí** Nantres lo tema ja el tenim\ **Però una cosa que hem fet és que nantres no hem canviat mai de tema** (…) Avons_ clar_ **ara tenim molt currículum amb això\ Doncs si hi ha una convocatòria_ sirem dels primers** Avons_ la nostra estratègia ha set no canviar de tema\ Mantindre-mos_ passi el que passi_ mantindre-mos amb lo nostre tema\ (…) **I al mantindre-mos_ mos dona l'avantatge que tenim molt currículum\ Això una cosa\ I l'altra estratègia ha set l'especialització dels quatre** Perquè si tots ho féssim tot_ si el Hao s'hagués d'emplenar tots los papers que s'ha d'emplenar_ no mos en sortiríem\ I si jo haguessa de fer totes les classes que he de fer_ no me'n sortiria\ Llavons_ lo fet de que tots quatre mos hagem avingut i hagem assumit això_ * Home_ jo m'ho passaria bomba al laboratori\ Però si m'ho passo bomba al laboratori_ el Hao estarà allà amb uns papers_ i et farà una cara_ i_ * +nst+ clar_ I també me'n podria anar a fer classes\ Hores i hores de classes_ i abandonar tothom\ I quan tornaria al laboratori_ el que em trobaria_ Llavons hem assumit aquesta especialització i ja està\ **Em sembla que això_ mantindre-mos amb lo tema_ i l'especialització_ és lo que mos fa tirar endavant** [original in Catalan]

As can be inferred from Cecília's words, the RG's success is intimately connected to its (economic) survival. Apart from the 'curriculum' of publications in the field, whereby 'if there

is a [grant] call_ we'll be among the first', the RG's success in grant calls for new research projects may also depend on the communicative input of the RG, that is on the RG's knowledge of the related literature. Reading relevant publications may be paramount to get an idea of what has been done and what remains to be done in the field, as noted by Hao [see excerpt 244].

Excerpt 244: Interview with Hao [Senior res. – Group A] – 'Because I want to know what's important\'

> **Researcher:** So_ how important is reading for you_ or for your work/
>
> **Hao: For me it's very important** I think that I cannot do work like PhD students_ you know/ just on the bench\ You know/ (…)
>
> **Researcher:** So your work is different from their work\
>
> **Hao:** Yeah\
>
> **Researcher:** Because you need to read more\
>
> **Hao: Read more\ Yeah**
>
> **Researcher:** Why/
>
> **Hao: Because I want to know what's important** When the students work on it * for example XXX_ I will * **I try to know what we should do for their project_ and maybe we can make good pu& *good publications and {(?) can also our question}**

This excerpt shows the strategic importance of reading in Hao's daily professional practice. It is a means to 'know what is important' in the field, beyond the RG or any local and national context. Such knowledge may be an asset in the planning of new projects and prospective publications. This latter idea was also mentioned by Cecília, as illustrated in the following excerpt [excerpt 245].

Excerpt 245: Interview with Cecília [Senior res. – Group A] – 'you have to know whether what you are doing has been published by someone or not\'

Researcher: It is important to read/	**Investigador:** És important llegir/
Cecilia: Yes_ well_	**Cecília:** Sí_ home_
Researcher: No_ I mean_	**Investigador:** No_ dic jo_
Cecília: Yes\ because **you have to know whether what you are doing has been published by someone or not** Sure\ Frank every time * every week he sends them publications\ And I know from my area what situation we are in\ **Because there are people who work on the same or very similar\ And if they publish it before_ + m + you have to change the * your objective_ because they have already published it** Of	**Cecília:** Sí\ perquè **has de sàpiguer si el que tu estàs fent ho ha publicat algú o no** Clar\ Lo Frank cada vegada * cada setmana els hi envia publicacions\ I jo sé de la meua àrea en quina situació estem\ **Perquè hi ha gent que treballen en lo mateix o molt semblant\ I si ho publiquen abans_ +m+ has de canviar la * l'objectiu teu_ perquè ja te l'han publicat** Clar_ has d'estar al dia\ Avui lo que fan és posa's al dia de una tecnologia

course_ you have to be up to date\ Today what they do is catch up on new technology\ So they have had to read loads\	nova\ Pos han tingut que llegir la tira\ [original in Catalan]

In this excerpt, Cecília describes science to some extent as a race (a competition) for publishing original results, for which being aware of what others have published through reading is core. In line with Cecília's argument in excerpt 243, field or topic specialisation was also deemed important for success by Hans (Group G's leader), since it arguably facilitates having 'high output' and 'high ranking' of publishing journals [see excerpt 246].

Excerpt 246: Interview with Hans [Group G's leader] – 'the advantage of a small group is…'

> **Researcher:** When you compare yourself * your group with * with [Group A]_ what would be the main difference/ (…)
>
> **Hans:** (…) What I know_ there's a * more * there's a higher turnover of PhD students_ Yeah/ And also a small group_ **but the advantage of a small group is that sometimes you can work more focused** Yeah/ And so it might be_ I don't know if it's the case_ but for Frank it's easier +uh+ to control certain things_ Yeah/ and to put it into the right direction\ I often have the feeling that some edges of the group are getting out of c& * of the control_ and not so focused anymore\ Yeah/ So_ Frank is very good in * in publications\ +Uh+ so he has a really **high output of * also high ranking_** +uh+ publications_ and he achieves that by forcing the people to work on publications\ Forcing more or less\ Yeah/ But it's also good for the students_ because if * at the end of the {(?) seasons} they have a lot of publications\ Yeah/ And they are highly competitive\

In this excerpt, Hans attributes the fact that Group A is 'more focused' in a field/topic to its small size. In contrast, as can be observed in the next excerpt, working for the industry prevented Group G from being focused and having publications [excerpt 247].

Excerpt 247: Interview with Hans [Group G's leader] – 'just by delivering something\'

> **Hans:** …the area is * here is * is really broad\ Yeah/ And sometimes it's also a disadvantage because you do a little bit here_ you do a little bit here_ Yeah/ **But it's not really +uh···+ very deep science based\ Because you have to fulfil the deliverables of the project** Yeah/ We have also projects where we work for companies_ which are only 20,000€\ So we have to deliver something_ that's it\ **No publications_ no +uh+ very good science_ but just by delivering something**

According to Hans, research done for companies is not 'very good science' because it is done 'just by delivereing something', and it requires a diversifying expertise that has also an impact on communication (through the lack of publications). The lack of field specialisation as an obstacle for success was also referred to by Sonja (Group G) [see excerpt 248].

Excerpt 248: Focus group with Post-docs [Group G] – 'you make a network that is useful for your work\'

> **Sonja:** …quite often here we have projects that run for three years_ (…) So **it takes you say two and a half years to get the skills and the data for the first publication_** and **then you have the first publication_ and then the project ends\ And you have a new project_ and you start again from new * from the scratch** So I have one publication_ +Oh+ no_ I have two publications for the first project_ I have one for the second project_ I have none for the third project_ I have one from the fourth project_ You see_ **it's very difficult to make a name if I have only one publication on one subject_ and then the next on a totally different subject** While Rita has been working continuously on very similar subjects_ and therefore she has more publications in the field_ and she has made more a name for her\ **I have maybe the same number of publications_ but they're so varied_ that {(?) you wouldn't come to me}\ I'm not an expert** I know a little bit of this_ a little bit of that_ I'm not an expert\
>
> (…)
>
> **Researcher:** So_ to make a name it's better to focus on a topic\
>
> **All:** Yes\
>
> **Sonja:** Because then also **you meet the same people all the time_ you go to the same conferences_ you make a network that is useful for your work** …

In this excerpt, Sonja complains that 'it's very difficult to make a name' in a scientific field if one's publications do not belong to the same 'subject'. Following Sonja, the diversity of topics tackled in her publications prevented her from becoming 'an expert' in a field and from 'mak[ing] a network that is useful' by attending 'the same conferences' as other experts. This view underscores the importance in the scientific field of the recognition of one's work and thus of one's authority (Bourdieu, 1975). This description of the research done for the industry coincides with Frank's words illustrated in excerpt 171 (chapter 6), asserting that in Group A they are 'training generalists\ not specialists\'' to meet the requirements of the industry. This way, science and the industry are constructed as two different fields with different systems of value and guiding principles.

As part of the RG's strategy for attaining success, also the establishment of a clear hierarchy and an effective decision-making system in projects were mentioned as important communicative aspects [see excerpt 249].

574

Excerpt 249: Focus group with postdocs [Group G] – 'there should be a clear direction\'

> **Researcher:** So_ communication is important_ but maybe sometimes too much communication can be··
>
> **Rita:** Too much\
>
> **Sonja:** No_ I don't think so\ Because I think what we have * I mean_ in * because I worked in other projects_ where there was very difficult communication\ And I think that **communication is not only meeting and talking_ it's also to have a hierarchy to say who*** And because there will be questions and someone will have to make a decision\ And it has to be * there has to be I think **a clear * I wouldn't say that it's right or wrong_ but there should be a clear direction** If different people +uh+ make different * +uh+ give different directions for the project_ then you're not moving forward\ You're moving sidewise somehow\ And if someone makes a decision_ and other people don't follow it_ because they think_ I don't care of what he says or what she says_ then the project is not moving on\ So I think **you have to have a strategy on how to * who makes the decisions** I mean_ even if you make the decisions together_ this is the decision_ everyone understands it\ Everyone follows it\ Then **I think it's a good idea to meet regularly_**

According to Sonja, projects that involve many people need 'to have a strategy about who makes the decisions', 'a clear direction' as well as regular meetings in order to be successful.

As has been argued, an important part of the RG's success lied in its survival, for which provision of resources was necessary. The next sub-section will present the RG's resources of different types as a means for success in science.

8.2.4. Resources

Although acknowledging the importance of 'having an attractive [research] topic', which he deems 'the philosophical' means for achieving the RG's competitiveness, Pere (Group B's leader) pointed at 'having money' as the 'pragmatic' means [see excerpt 250].

Excerpt 250: Interview with Pere [Group B's leader] – 'The pragmatic one is that you have money\'

Researcher 1: What does a group need to be competitive/	Investigadora 1: Què necessita un grup per ser competitiu/
(…)	(…)
Pere: It needs * **I think it needs two things** I'll * I'll tell you the philosophical and I'll tell you the pragmatic one\ **The philosophical is that you have an attractive topic\ The pragmatic one is that you have money** and * and to be competitive it's this\ Because what does competitive mean/ Competitive	**Pere:** Necessita * **jo crec que necessita dues coses** Te * te diré la filosòfica i te diré la pragmàtica\ **La filosòfica és que tinguis un tema atractiu\ La pragmàtica és que tinguis cuartos** i * i perquè sigui competitiu és això\ Perquè què vol dir competitiu/ Competitiu vol dir que +eh+ pots tenir un

575

means that + uh + you can have a group working_ you can advance that * that branch of science_ or that branch of whatever_ but_ that's great_ **but if you don't have money to do it there's no way\ then_ if you have very good ideas but you don't have money_ you won't be competitive** If you have a lot of money but you're a * Well_ **if you have a lot of money {(@) you usually won't_ you won't have bad ideas\} so_ you have to combine both things** so_ competitive means this\

Researcher 1: And what would the money be used for / for machines_

Pere: Yes \

Researcher 1: For materials_ and also for * more people working_

Pere: Basically * basically * **basically for materials\ Basically for materials\ I'm talking about the Spanish system + uh + /** Basically for materials\ A little less for + uh + machines_ that you say \ Infrastructure \ Afterwards I'll tell you why \

Researcher 2: When you say materials_ it's··

Pere: Materials means reagents_ it means pipettes_ it means liquids_ (…) then there is another section_ **infrastructure_ which means machines_ machinery to do whatever_** right/ of course_ what happens at least in our field of science is one thing\ And this is that_ there is machinery that is very cheap_ but **in general you need to use very expensive machinery\ Then these groups do not · * have no way to buy it\ And you always depend on scientific and technical services_ you depend on calls from the ministry of infrastructure and so on\ Therefore_ from this point of view the amount of money spent on machinery is smaller than the amount of money spent on reagents_ material of * of * research\ and to a lesser extent_ in principle_ * to a lesser extent in principle on staff** Okay/

grup treballant_ pots fer avançar aquell * aquella branca de la ciència_ o aquella branca de lo que sigui_ però_ això està molt bé_ **però si no tens diners per fer-ho no hi ha manera\ llavors_ si tu tens molt bones idees però no tens diners_ no seràs competitiu** Si tens molts diners però ets un * Bueno_ **si tens molts diners {(@) normalment no_ no tindràs males idees\} per tant_ has de combinar dues coses** llavors_ competitiu vol dir això\

Investigadora 1: I els diners per a què servirien/ per màquines_

Pere: sí\

Investigadora 1: Per material_ i també per * per més gent treballant_

Pere: Bàsicament * bàsicament * **bàsicament per material\ Bàsicament per material\ t'estic parlant del sistema espanyol +eh+/** Bàsicament per material\ Una mica menys per +eh+ màquines_ que dius tu\ Infraestructura\ Després t'explico per què\

Investigador 2: Quan dius material_ és··

Pere: Material vol dir reactius_ vol dir pipetes_ vol dir líquids_ (…) llavors hi ha un altre apartat_ **infraestructura_ que vol dir màquines_ maquinari per fer lo que sigui_** no/ clar_ el que passa almenys en el nostre camp de ciència és una qüestió\ I és_ sí que hi ha maquinari que és molt baratet_ però **en general necessites accedir a maquinari molt car\ Llavores això els grups no· * no tenen manera de comprar-s'ho\ I sempre depens de serveis científico-tècnics_ depens de convocatòries del ministeri d'infraestructures i etcètera** Per tant_ **des d'aquest punt de vista la quantitat de diners dedicada a maquinari és més petita que no pas la quantitat de diners dedicada a reactius_ material de * de * de recerca\ i en menys mesura_ en principi_ * en menys mesura en principi per personal** Vale/ Per què/ +eh+ en el

Why/ +uh+ in the Spanish system basically +uh+ there are at the same time scholarships\ Okay/ If * if you were in **the American system of projects_** normally when you ask for a project_ you ask& * European_ you ask for a project that means_ **salaries_ materials_ infrastructure_ etcetera\ But salaries\ And this can be a very important part\ Very important\ So important that even_ in the American system_ part of this salary is what the main researcher is paid\ Okay/ So_ of course_ clear_ your salary and your modus vivendi depend on you having competitive projects\ And if it is more competitive your salary will be {(@) better} or not so much**	sistema espanyol bàsicament +eh+ hi ha en paral·lel beques\ D'acord/ Si * si anessis al **sistema americà de projectes_** normalment quan demanes un projecte_ demane& * europeu_ demanes projecte que vol dir_ **sous_ material_ infraestructura_ etcètera\ Però sous\ I això pot ser una part molt important\ Molt important\ Tan important que fins i tot_ sistema americà_ part d'aquest sou és el que es paga el propi investigador principal\ D'acord/ O sigui_ clar_ el seu sou i el seu modus vivendi depèn de que tinguis projectes competitius\ I en la mesura que sigui més competitiu el seu sou serà {(@) més bo} o no tant**
	[original in Catalan]

In this excerpt, Pere underscores the importance of economic resources for the RG's competitiveness, contending that without money, competitiveness is impossible, while with money, it is inevitable ('if you have a lot of money_ you normally won't have bad ideas'). This way, Pere positions the economic capital higher than the cultural capital in the hierarchy. According to Pere, money is generally devoted to materials, like pipettes, reagents and liquids, to machinery, to paying third parties' scientific and technical services, and to scientists' salaries to a lesser degree. Pere distinguishes the Spanish from the American granting system in this regard, and explains that in the latter salaries are usually encompassed in project grants, while in the former they depend on independent scholarships.

For Pere, this economic conditioning factor affects not only the competitiveness of the RG but also the definition of 'good scientist'. This is such an important aspect in science that a 'good scientist' needs to be aware of the economic constraints of the RG and know how to select what (experiments) she can and cannot do accordingly [see excerpt 251].

Excerpt 251: Interview with Pere [Group B's leader] – 'I have imagined it in a way that I need a Ferrari\'

Researcher: What does it take to be a good scientist/	**Investigadora:** Què es necessita per ser un bon científic/
(…)	(…)
Pere: Okay\ +Uh+ he is able to * to see_ that in this progression we were talking about_ you see that he is able to·· **use the**	**Pere:** Vale\ +Eh+ és capaç de * a veure_ que en aquesta progressió que dèiem_ vegis que és capaç de·· **utilitzar la metodologia bé_**

methodology well_ to know how to read articles_ and draw * and draw consequences_ to apply them in his * in his research\ Only this\ And when you present him problems_ to know how to manage I searched_ I looked_ I tried_

(…)

Pere: As they evolve_ they select much better what they do and what they don't do

Researcher: This is also an important point_ right/ **To know how to select where to go\ to focus**

Pere: Yes\ but * yes_ yes_ yes_ but with a * with a * with a certain confidence_ +uh+/ That is to say * because science is not exact (…) And he must have enough flexibility so as to say_ well_ this no_ but what if I modify it a bit_ let's see if\ **And this * this point of * inflection point of saying_ well_ this seems to be like this_ but I'll try it this way and this other way_ this is what you see in people **

Researcher: And you see this much more easily_ because of your experience_ etcetera_ you see it more easily than someone who is starting_ maybe\

Pere: Obviously\ Obviously\ Yes_ yes The thing is that * that * that sometimes * well_ sometimes there are very basic things * there are very basic things_ that one thing is to think what can be done_ and what should be done_ and the other is to say_ okay_ this is very good_ but what methodology will you adopt to get here/ Okay/ **I mean_well_ the thing is that I ne& * that I need * that I need to go from here to here_ I have imagined it in a way that I need a Ferrari\ You say_ you're wrong\ Because we don't have Ferraris\ You'll have to find another way_ easier_ so you can get there** If you go to Harvard_ or go with the [name of a well-known scientist]_ he * he will give you a Ferrari to get there\ But for now you have

de saber llegir articles_ i treure'n * i treure'n conseqüències_ que les apliqui en la seva * a la seva recerca\ Només això\ I quan li plantegis problemes_ sàpiga com sortir-se'n He buscat_ he mirat_ he provat_

(…)

Pere: A mesura que evolucionen_ seleccionen molt millor allò que fan i allò que no fan

Investigadora: Això també és un punt important_ no/ **El saber seleccionar cap on vas_ focalitzar-te**

Pere: Sí\ però * sí_ sí_ sí_ però amb un * amb un * amb una certa holgura_ +eh+/ És dir_ * perquè la ciència no són faves comptades (…) I ha de tenir la suficient flexibilitat com per dir_ hòstia_ això no_ però qui sap si ho modifico una mica_ a veure si\ **I aquesta * aquest punt de * d'inflexió de dir_ hosti_ això sembla que va per aquí_ però ho provaré d'aquesta manera i d'aquesta altra_ això és lo que veus en la gent**

Investigadora: I tu ho veus molt més fácil_ per la teva experiencia_ etcétera_ ho veus més fàcilment que algú que està començant_ potser\

Pere: Evidentment\ Evidentment\ Sí_ sí És que * és que de * és que de vegades * hosti_ de vegades hi ha coses molt bàsiques * hi ha coses molt bàsiques_ que una cosa és pensar què és el que es pot fer_ i què és el que seria bo fer_ i l'altra és dir_ vale_ això està molt bé_ però quina metodologia faràs servir per arribar aquí/ Vale/ **És dir_ bueno_ és que ne& * és que necessito * és que necessito per anar d'aquí aquí_ jo m'ho he imaginat que necessito un Ferrari\ Dic_ vas malament\ Perquè de Ferraris nosaltres no en tenim\ T'hauràs de buscar un altre camí_ més senzill_ perquè hi puguis arribar** Si te'n vas a Harvard_ o te'n vas amb el [nom d'un científic reconegut]_ ja * ja et donarà un Ferrari per arribar\ Però de

578

to deal with it in a different way\ It's okay_ but **you have to have different methodologies at your disposal that you can apply to solve problems**\ And to be aware of where you are_ + uh +/	moment t'ho has d'empescar d'una altra manera\ Ja està bé_ però **has de tenir a l'abast metodologies diferents que tu puguis aplicar per resoldre problemes**\ I ser conscient d'on ets_ +eh+/
	[original in Catalan]

In this excerpt, Pere describes the 'evol[ution]' of students into good researchers as necessarily involving an increasingly better selection capacity considering the resources available in the RG. He illustrates this idea through an imaginary dialogue with another group member who argues to 'need a Ferrari' for an experiment (a metaphor for expensive machinery or materials) to which Pere replies that 'we don't have a Ferrari here'. In this sense, a good scientist needs to be flexible and 'conscious of where [she is]', which means managing the (limited) economic capital of her RG efficiently.

The availability of resources was argued to affect not only experimental work but also the broader group strategy, as illustrated in the next excerpt [excerpt 252].

Excerpt 252: Interview with Cecília [Senior res. – Group A] – 'we can spend two years just writing\'

Researcher: Now that four people will finish the thesis_ are you already thinking *	**Investigadora:** Ara que acabaran quatre persones la tesi_ ja esteu pensant *
Cecília: No\	**Cecília:** No\
Researcher: That more people enter/ =Or does it depend on= funding_	**Investigadora:** Que n'entrin més/ =O depèn del= finançament_
Cecília: No\ = No\ No\= (…) but_ now we want * this& this year they finish_ and we want to see what will happen next year\ Now there will be the resolutions of the Ministry_ we will see what economy cuts there have been_ to whom they have given projects_ how many scholarships they have given\ Imagine_ if in all of Spain twenty scholarships are given_ we * we * we can't do anything\ Right/ **Now we want to see what will happen\ Because now it's a very difficult moment\ And we have to be careful** Sometimes it's better to stop for a while_ +nst+ consolidate_ endure_ **Since we have many results_ we can spend two years just writing**\ And we'll be out again\	**Cecília:** No\ =No\ No\= (…) però_ ara volem * aques& aquest any a que acabin aquestos_ i **volem veure què passarà l'any que ve**\ Ara hi haurà les resolucions del Ministerio_ **veurem quines retallades hi ha hagut**_ a qui han donat projectes_ quantes beques han donat\ Imagina't_ si a tota Espanya dona vint beques_ ja * ja * ja cal que pleguem\ No/ **Ara nantres volem veure el que passarà\ Perquè ara és un moment molt dur\ I hem de nar al tanto**\ A vegades val més aparar una mica_ +nst+ consolidar_ aguantar_ **Com que tenim molts resultats_ Nantres podem passar dos anys només escrivint**\ I ja tornarem a sortir\
	[original in Catalan]

In this excerpt, Cecília describes the immediate strategy of the RG as depending on the national economic situation, which she considers to find itself in 'a very hard moment' due to the '[budget] cuts that there have been', and consequently the group leader's plan to rely on the results that the RG already has to continue publishing and still be competitive whenever they 'go out again'. Once more, publications appear as commodities that may potentially turn into more resources; that is, into more capital.

Despite considering funding inequalities as conditioning differences in competitiveness among RGs, Pere (Group B's leader) defends that diversitiy in competitiveness among RGs was positive because less competitive groups served as training contexts for scientists who would end up working in more competitive groups [see excerpt 253].

Excerpt 253: Interview with Pere [Group B's leader] – 'Everything is related\'

Researcher: Because doing the science you do right now_ is * it's like being on top of the league_ isn't it/ I mean_ with a * within a frame like Catalonia and so on_	**Investigador:** Perquè fer ciència de la vostra en aquests moments_ és * és com estar a la cresta de la ola_ no/ Vull dir_ amb un * amb un clúster com a Catalunya i així_
(…)	(…)
Pere: No\ We play in the Premier League\ But not in the Champions League\	**Pere:** No\ Juguem a primera divisió\ Però no a la Champions\
Researcher: and instead those from Barcelona play in the Champions League\	**Investigador:** i en canvi els de Barcelona juguen a la Champions\
Pere: Some of them\	**Pere:** Alguns\
Researcher: Some of them\	**Investigador:** Alguns\
Pere: +Uh+\ Some of them\ And some of them from Barcelona play in the second division_ +uh+\ But_ there are some who do\ Oh my God_ of course\ of course\ Yes_ yes \ And it's good +uh+ that it's like that\ And **the fact that there is the Champions league_ the Premier League_ the Football League Championship +uh+/ is good** (…) people who are very good and who make a lot of progress in science and who do very cutting-edge things_ well_ let's allocate a special amount of money to them\ Another amount to the first division_ hey_ and to the second as well +uh+/ **Because a lot of people leave from here +uh+/ And they climb_ and they are trained from here_ from the Football League Championship_ to the Premier and then to the Champions League** Am I making myself clear/	**Pere:** +Eh+\ Alguns\ I alguns de Barcelona juguen a segona_ +eh+\ Ara_ hi ha alguns que sí\ Hosti_ i tant\ I tant\ Sí_ sí\ I és bo +eh+ que sigui així\ I **és bo que hi hagi Champions_ primera_ segona +eh+/** (…) la gent que és molt bona i que fa avançar molt la ciència i que fan coses molt punteres_ hosti_ dediquem-los-hi una partida especial de diners\ Una altra part a primera_ ei_ i a segona també +eh+/ **Perquè molta gent surt d'aquí +eh+/ I va escalant amunt_ i els va formant des d'aquí_ des de segona_ primera i a Champions** M'explico/ Perquè sí que els de Champions volen gent bona i

Because the Champions league does want good and well-trained people\ If you send them people without any training_ they have a lot of work\ and their daily life is a different one +uh+/ of course\ then_ Well_

Researcher: And here we play * we don't play in the Champions league_

Pere: Well_ I mean_ it depends on what aspects_ +uh+/ (…) again we go back to the same_ right/ Of course_ I would definitely like to have the same infrastructures and financial support that these centers have\ +nst+ the thing is that everything is related_ +uh+/ **Everything is related\ That is_ +uh+ of course_ if you * if you are good and get money_ you can sign the best\ And then the level of your center goes up**

formada\ Si tu els hi envies allí gent sense cap formació_ tenen molta feina\ i el seu dia a dia és un altre +eh+/ clar\ llavors_ Bueno_

Investigador: I aquí juguem a * no juguem la Champions_

Pere: Bueno_ a veure_ depèn de quins aspectos_ +eh+/ (…) **altra vegada tornem al mateix_ no/ Clar_ a mi ja m'agradaria tenir les mateixes infraestructures i dotació econòmica que tenen aquests centres** +nst+ és que tot és una bola això_ +eh+/ **Tot és una bola\ És dir_ +eh+ clar_ si tu * si tu ets bo i reps diners_ tu pots fitxar els millors\ I llavores el nivell del teu centre puja**

[original in Catalan]

In this excerpt, through a sports metaphor, Pere describes his RG as not being in the first but in secondary positions of its field ('We play in the Premier League\ But not in the Champions League\'). Towards the end of the excerpt, Pere describes the existence of a general tendency in science as regards resource allocation, which he names 'a ball', whereby 'if you are good and get money_ you can sign the best ones\ And then the level of your center goes up\'. Following Pere's words, science is structured in different hierarchical layers of competitiveness, encompassing different research centres each, and which cannot be transcended because each layer affords a certain amount of capital accumulation (lower or higher depending on the layer occupied).

The funding constraints described by Pere with reference to Group B contrasted with the impression of some members of Group G who argued that research was 'easy' in their institute thanks to the resources available there, like 'machines', 'technology' and 'people' [see excerpts 254 and 255].

Excerpt 254: Interview with Giulia [Postdoc res. from Italy – Group G] – 'Here it's pretty * pretty easy'

Researcher: So_ what did you like from this place/

(…)

Giulia: Well_ it was much much different from the university environment that I was used to in [home town in Italy]_ so in the very beginning I was really attracted by the * **also**

availability of resources_ of space_ of machinery_ and everything that was * it's * it's much easier to do research here** You have all the * **and then in this institute there are a lot of competences also_ that you can access pretty easily_ and +uh+ **there's a lot of really bright people_** and * so_ if you get a chance to * not to be closed into your own research_ but also to talk to other people_ there's a lot of ideas going on_ and I like this very much_ this discussion and interaction with other people_ and it's really really fruitful\ And +uh+ that's the part of my job that I really like a lot\ It really makes it fun_ Yeah/ working_ (…)

Researcher: What do you think that makes research easier here/

Giulia: +Uh···+ I would say there's a little bit less bureaucracy than in Italy_ @@@ It helps_ +uhm+ **but within the group really there's a lot of competences that make you +uh+ yeah_ be able to access_ or to ask_ or whenever you * you need something_ or you don't know how to * to do something_ there's always someone you can ask** While in the university in [home town in Italy] every group was very much +uh+ isolated from the others_ there's a lot of competitions_ yeah/ and so unless the knowledge that you need is within your group_ it's difficult to access for information_ and +uh+ yeah_ if you have to start something new_ for example_ you have to start form scratch\ Here you might find someone who already knows something_ or that +uh+ helps you_ and * and then as I said already also the * **the availability of * of resources here is much * is much better than what we had** (…) We have really great machines available\ Going from huge microscopes to +uh+ XXX centrifuges_ to devices for measuring proteins_ etcetera_ it really spans the process of investigation that a scientist * that a X scientist would need\ So that's really *

Researcher: If you didn't have these machines_ then you would have to order_ I don't know_ to collaborate with other people who do have =these=

Giulia: =Yeah\= Yeah\

Researcher: And wait for the results_ =from them_=

Giulia: =At some point\= Yeah\ And find someone who is willing to collaborate with you @@@ This is also not always the case\ **Here it's pretty * pretty easy_ I find**

Excerpt 255: Focus group with junior researchers [Group G] – 'here you have everything in your hands'

Paola: …when I realised I can go to here_ I was_ okay_ I go\ Of course\ @@@

Researcher: Here it's better_ you think/

Paola: Yes\

Researcher: You prefer that\

Paola: Yes\

Researcher: Why/

Paola: It's a challenge (…) because of the language_ because I like the * also because Germany is very * a developed country_ and also in biotechnology_ so_ +eh+ in comparison with Chile_ that we don't have * yeah_ we have\ **But not so high technology like here_ so it takes a lot of time to do some experiments_ so here you have everything in your hands_**

you know/ You don't have to wait or to was& waste time_ and yeah\

Researcher: So you think * you think things are quicker here_

Paola: Yes\

Researcher: =or faster because of the technology/=

Paola: =Yes\ totally\= Yeah\

Researcher: +ah+ okay\

Paola: Also the experience of the people_ they know a lot of * it's always why * why I decided to learn everything here

Researcher: Okay\ So people know more here\ Are more expert\

Paola: Yes\

In these excerpts, Giulia and Paola compare research in Group G with their past experience in their country of origin, Italy and Chile, respectively, where 'it takes a lot of time to do some experiments' (Paola) due to the lack of certain resources, like 'space', 'machinery' or 'technology', 'bright people' and 'competences', whereas in Germany they found it 'much easier to do research' (Giulia). Note also the relevance given by both practitioners to the knowledge exchange they feel they have access to in their research institute in Germany. This difference in resources between RGs and between different national contexts was also described by Vince (Group A) referring to an institute in England where he had worked in the past [see excerpt 256].

Excerpt 256: Interview with Vince [Senior res. – Group A] – 'The infrastructure in England was fantastic\'

Researcher: In the three laboratories where you have worked_ what differences do you think exist/ (…)	**Investigadora:** En els tres laboratoris on has treballat_ quines diferències creus que hi ha/ (…)
Vince: No_ of course_ The infrastructure in England was fantastic** Right/ I mean_ this_ * **It all depends on the centre\ right/ It was a [object of study] research center\ Only\ Well the infrastructure was adapted\ XX greenhouses\ This already_ (…) **Laboratories_ machines available_ space_** And this really facilitated_ * **for example there was there was * an * internal store** If you needed_ for example_ a chemical product_ of the laboratory_ you went there_ and they had stock\ I mean_ **things that facilitated the * the * the * the * life \ I mean \ To save time** (…) And now Diana	**Vince: No_ clar_ La infraestructura a Anglaterra era fantàstica** No/ Vull dir_ això_ * **Tot depèn del centre\ No/** Era un centre de recerca per [objecte d'estudi]\ Únicament\ Doncs la infraestructura era adaptada\ XX hivernacles\ Això ja_ (…) **Laboratoris_ màquines disponibles_ espai_** I això era molt facilitat per_ * **per exemple hi havia allà hi havia una * una botiga interna** Si necessitaves_ per exemple_ un producte químic_ de laboratori_ anaves allà_ i tenien un estoc\ Vull dir_ **coses que facilitaven la * la * la * la *la vida\ Vull dir\ Per guanyar temps** (…) I ara la

| (…) is now there_ and she told me_ man_ this is fantastic \ (…) **The coordination is super good** | Diana (…) ara està allà_ i m'ha dit_ home_ es fantàstic\ (…) **La coordinació és súper bé** |
| | [original in Catalan] |

This excerpt shows how Vince described the consequences of having more resources like 'infrastructure' in similar terms to those used by Giulia and Paola, that is as 'making life easy there'. Following Vince, the infrastructure 'depends on the [research] centre'.

In line with Giulia's and Paola's observation of the advantageous characteristics of Group G's institute in terms of infrastructure, Andrei (Group G) acknowledged this advantage and added also the 'organisation' to it, which he described as being nation-specific and lab-specific, in this case depending highly on the group leader [see excerpts 257 and 258].

Excerpt 257: Interview with Andrei [Postdoc res. from Bulgaria – Group G] – 'I think this is nationally specific'

Researcher: What are the good things here/

(…)

Andrei: From the professional point of view_ there are some advantages_ +uh··+ some advantages_ I mean_ **I mean technical equipment_ good organisation_ which can be even improved more_ +uh+ ***

Researcher: By organisation_ what do you mean/

Andrei: +uh+ organisation_ **I mean these administrative procedures_ that {(?) belong} to * to planning some activities_ some experiments_ to have_ I mean_ the technical support\ Logistic support** Something like this\ So to have these\ But **I think this is nationally specific_ but I think this also depends on the * on the lab itself** I mean_ XXX XX XX\ For example_ in the Netherlands_ this lab was very well organized\ **Because this * this professor came back from the United States**

Excerpt 258: Interview with Andrei [Postdoc res. from Bulgaria – Group G] – 'similarities are much more than the dissimilarities\'

Researcher: What things do you think are common in every country_ or what things are different/

Andrei: You can find also differences here in Germany\ I mean_ among groups here in Germany\

(…)

Researcher: So would you * would you say that it's a matter of country/ Or mainly it's matter of the person who heads * who is heading the lab/ or_

Andrei: Everywhere where you go XX +uh+ you see some national influence I mean_ **The national culture of the country itself X affects to the lab\ But in nowadays_ in this modern world_ I * I can say that similarities are much more than the dissimilarities**

> **That's why there are so many EU projects_ because they end at bringing the people together_** and so benefit from the different multi& * +uh+ intercultural * I mean_ how to say/ features of other_ yeah\

Andrei based his observations on his past working experience in different laboratories and countries, like Bulgaria (his country of origin), the UK and the Netherlands. In the first excerpt (257), Andrei attributes the good organisation of the lab where he had worked in the Netherlands to the work culture of its leader, which he deems in turn conditioned by the country of origin or of past working experience ('Because this * this professor came back from the United States\'). Despite having noticed 'some national influence' (excerpt 258) in all the laboratories or institutes where he has worked, Andrei contends that 'similarities are much more than the dissimilarities\', which he deems the cause of the existence of 'so many EU projects'. This way, Andrei seems to be positive as regards the homogenisation of 'labs' and of the scientfici practice worldwide.

As stated by Paola in excerpt 255, certain technological resources help researchers not to 'waste time'. This idea of time saving was mentioned also by Rita (Group G) in relation to human resources [see excerpt 259].

Excerpt 259: Focus group with postdocs [Group G] – 'you need someone else to work on the project\'

> **Rita:** It's the project that allows having a technical assistant\ What is not always possible for a lot of other projects\
>
> **Researcher:** So it is important to have one\ A technical assistant\
>
> **Sonja:** Yes\
>
> **Rita:** To make XX * it {(?) changes} work\ Then we have more time to {(?) think} and to read_ and *
>
> **Franziska:** I mean_ Also * yeah_ **also we are expected XX XXX_ to publish three publications a year_ which is really a lot_** for plant XX XXX_ **And if you want to publish at least once a year or something_ then you need someone else to work on the project** usually a =XX XX_=
>
> **Sonja:** =To generate= the data\
>
> **Franziska:** So you just * the& **there must be several people working on project\ Otherwise you don't get enough data because * yeah\ to publish something nice** and XX XXX\
>
> **Rita:** But usually our projects last three years_ and there's only one postdoc there_ and then you don't have any chance of having a technician XXX\

In this excerpt, Rita, Sonja and Franziska coincide in claiming the need for a 'technical assistant' in their projects in order to 'have more time to read' (Rita), 'generate the data' (Franziska) and 'get enough data to publish something nice' (Sonja). The three practitioners regret the general lack of resources to hire a technical assistant in their projects.

This impact of limited human resources on research was also described by Pere (Group B's leader) though in different terms. In the next excerpt, Pere complains about the obligation of teaching that scientists working at certain public universities in Spain have, which he related with their status as universities (in contrast with research centres) as well as with their (economic) resources (different among universities) [excerpt 260].

Excerpt 260: Interview with Pere [Group B's leader] – 'I would also like to have the same resources they have\'

Pere: … but here * here it is important to a certain extent the * that is to say_ for example_ **in the CSIC centers_ to say something_ the only job they have is research_ they don't have teaching\ They don't have academia** Okay/ I mean_ these sessions of {(Eng) lab meetings} _ weekly * sessions are totally compulsory\ totally compulsory\ And it's normal\ And it's normal\ Because they're for science_ **just science_ and that's it\ They're not to go and explain I don't know what\ You know/ Here_ well_ we try to do it with * because it can be done_ but well_ there are days and there are weeks when_ well_ that_ with the teaching_ head of department_ I don't know what_ and management_ you say_ no\ No**	**Pere:** … però aquí * aquí és important en certa manera la * és dir_ per exemple_ **en els centres del CSIC[95]_ per dir algo_ que l'única feina que tenen és investigar_ no tenen docència\ No tenen acadèmia\ D'acord/** És dir_ aquestes sessions de {(Ang) lab meetings}_ de * setmanals_ són sí o sí\ Són sí o sí\ I és normal\ I és normal\ Perquè estan per la ciència_ **només ciència_ i prou\ No estan per anar a explicar no sé què\ Saps/ Aquí_ pues_ intentem fer-ho amb * perquè es pot fer_ però hosti_ hi ha dies i hi ha setmanes que_ bueno_ pos que_ entre la docència_ cap de departament_ no sé què_ i gestió_ dius_ no\ No**
Researcher: Teaching absorbs you = XX =	**Investigador:** Que la docència us absorbeix =XX=
Pere: = Well_ = Quite a lot\ Quite a lot\ It's not that we're collapsed_ but well_ there are times when we are\ There are times that we are\ = XXX = (…) Of course_ for example I * I have friends at the [Catalan university 1] \ okay/ +uh+ and when I tell them I'm teaching sixteen credits they say_ {(Sp) you're crazy}/	**Pere:** =Home_= Déu n'hi do\ Déu n'hi do\ No no no és que estiguem allò col·lapsats_ però home_ hi ha èpoques que sí\ Hi ha èpoques que sí\ =XXX= (…) Clar_ per exemple jo * jo tinc amics a la [universitat catalana 1]\ vale/ +eh+ i quan els hi dic que faig setze crèdits diuen_ {(Esp) tú estás loco}/

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[95]The CSIC (*Consejo Superior de Investigaciones Científicas*) is a State research agency attached to the Spanish Ministry of Education and Science, but with economic and functional autonomy, which aims at promoting, developing and disseminating multidisciplinary scientific and technological research.

Researcher: It's a lot\	**Investigador:** És una bestiesa\
Pere: And I say_what about you/ {(Sp) five or six}\ +oh+ then I * {(?) I help}\ so the [Catalan university 1] is always in the rankings where it is	**Pere: I dic_ tu què/ {(Esp) Cinco o seis}\ +ah+ així jo * {(?) jo ajudo}\ per això la [universitat catalana 1] sempre està en els rànquings on està**
Researcher: But how do they do this/ I don't understand it\	**Investigador:** Però com ho colen això/ Jo no ho entenc\
Pere: Well_ how they do it\ They already worried at that moment of * of * of\ **They had a policy of signings that the other universities could not do\ Okay/ Because they had money to do it** A··nd the ratio professor student well it is good\ of course\ A·nd well_ well_ (…) Of course_ and you say_ well_ +m+ it's amazing +uh+ \ **I'd definitely like your resources too\ I mean_ I'd defintiely like five credits a year\ I'd definitely like it\ It would be noticed [in its research]**	**Pere:** Hombre_ com ho colen\ Ja es van preocupar en el seu moment de *de * de\ **Tenien una política de fitxatges que les altres universitats no podien fer\ Vale/ Perquè tenien diners per fer-ho** I·· la ràtio professor estudiant pos és bona\ clar\ I· bueno_ tios que_ (…) Clar_ i dius_ home_ +m+ té collons això +eh+ \ **Jo ja voldria els teus recursos també\ Vull dir_ ja voldria cinc crèdits a l'any\ Ja voldria\ Algo es notaria**
	[original in Catalan]

In this excerpt, Pere links the reduced teaching load of a given Catalan university with its high economic resources and with its high position in evaluation rankings, while arguing that if his RG had the same resources and he had the possibility of teaching only five ECTS[96] (instead of sixteen) 'it would be noticed [in its research]'.

Even in environments with enough resources, like Group G's institute, these could be missed due to the lack of effective communication [see excerpt 261].

Excerpt 261: Focus group with junior researchers [Group G] – 'the cross-talk between these groups is not so good as it could be\'

Researcher: Could it be possible that you needed to * to do a technique or to use a machine and you asked_ I don't know_ somewher& someone in other * in another university and then you learned that this is done here/ Would it be possible/

Inge: Yeah\ It would be possible\

Researcher: Because maybe even your supervisors don't know that\

Inge: Yeah_ So if this speaks * I think we are two hundred and fifty workers here_ and four

---

[96]ECTS is the acronym of the European Credit Transfer and Accumulation System and designates credit units that equate to a certain amount of teaching hours in European higher education insitutions. As a basis_ 60 ECTS correspond to a full university year. This system was designed to support student mobility within the European Higher Education Area.

> or five different groups_ and with different financing_ and +uhm+ so **the cross-talk between these groups is not so good as it could be**\ So definitely this could happen\ That one kind of technique_ **you need some machine_ and you don't know that it's here_ or that the know-how is here as well**\ So that somebody has * few years ago maybe as well_ **in another company worked on this_ and but you don't know you can ask him**\ For example\

Following this excerpt, bad cross-group communication could imply drawing on other RGs' and institutes' resources despite having them available in one's RG/institute. This evidences the increasing need for communication when there is a lack of mutual engagement in a common practice among scientist practitioners even within one same RG.

This section has presented an overview of diverse elements alluded to by participants as being important for the attainment of individual and/or group success in science. These include individual aspects, like a certain attitude, time investment, and networking and PR skills, as well as more structural aspects, like the RG's strategy and trajectory, and the resources available to practitioners in their working milieu. Not only these elements and some of their conditioning factors have been described, but also several critical stances have been set forth that suggest their facet of imposed norms, laden with ideologies, and triggered by political interests. Also the role of communication in scientists' definition and attainment of success has been addressed, as is the case of the conception of publications as a general measure of success, the importance of external exposure through scientists' participation in out-group communicative events like talks, presentations of their research, newsletters and reports, networking and PR, and the impact of the availability of different kinds of resources on the quantity and quality of scientists' publications. The next section will delve more in depth into the social, political and economic dimensions of science.

8.3. Science as a social, political and economic instrument

As has been demonstrated in the previous section, science is connected with political, social and economic circumstances, like practitioners' ideologies on the definition of science and of success in science, institutions' policies and value system, practitioners' socialisation experiences as scientists, their recognition by others, their rank, and RGs' human, economic and material resources. These affect not only the RGs' strategies but also the discourses that scientists draw on and (re)produce. These discourses may originate in policy-making institutions officially designated and recognised by the agents involved. The next excerpt, taken from Tània's PhD defence, illustrates this influence of policy-making agencies and global agents on scientists' communication [excerpt 262].

Excerpt 262: Tània's PhD defence [Group A] – 'EFSA reports to European member states'

The European Food Safety Authority is responsible for preparing and adopting guidances to assess this risk\ Once it was assessed_ **EFSA reports to European member states and European Comission who finally will decide on the [scientific object]** (…) The European Food Safety Authority recommends a [type] study in [object] if the composition of [object] is modified substantially\ **This guidance is based on +uh+ internationally agreed protocols** (…) This is an important * this is the first step to be analysed before performing the [type] study_ as EFSA recommends\

This excerpt demonstrates how present the 'European Food Safety Authority' was in Tània's discourse. She made reference to it several times throughout her PhD defence to describe the pathway that certain decisions on her object of study followed: from the EFSA 'to European member states and European Comission'. In this excerpt, the relevance of the international dimension (like through 'internationally agreed protocols') on Tània's local practices, in this case, is evidenced.

In the next three excerpts, extracted from an official act that took place in Group B's institute to announce its recognition by a leading state research institution, three main discourses can be distinguished that will be shown to be present also in scientists' communication: (a) a discourse of science as pursuing social welfare and social justice, (b) a discourse of science as an engine of the economy and the industry, and (c) a discourse of science as a component of globalization [excerpts 263, 264 and 265].

Excerpt 263: Official act at Group B's institute – Speaker: external institution's director – 'globalization has changed the reality of research in the global context in a very significant way\'

Pep Dalmau: … precisely this adventure that you are living as regards the accreditation process comes at a very special time\ It comes at a time when in our immediate surrounding **in the European continent there has been a very serious reflection on where * where research must go in Europe** You know that European research is organized_ is structured_ in large four-year research plans_ which until now was known as Marc programs\ Well_ **a few years ago the European Commission made an analysis_ and said that from 2014 the European continent had to give a new * a new direction to its way of doing**	**Pep Dalmau:** … just aquesta aventura que esteu vivint al voltant del procés d'acreditació arriba en un moment molt especial\ Arriba en un moment en el qual en el nostre entorn immediat **en el continent europeu s'ha fet una reflexió molt seriosa de cap on * cap on ha d'anar la recerca a Europa** Vosaltres sabeu que **la recerca Europea està organitzada_ està estructurada_ en grans plans quadriennals de recerca_** el que fins ara es coneixia com programes Marc\ Bé_ ja **fa uns anys la Comissió Europea va fer una anàlisi_ i va dir que a partir de l'any 2014 el continent europeu havia de donar una nova * un nou rumb a la seva manera de fer recerca** (…) Ha d'anar d'una manera

research\ (…) It must work differently because globalization has changed the reality of research in the global context in a very significant way** +Uh+ Horizon 20-20 suggests that **the future of research in Europe must be structured on three +uh+ fundamental strategic elements** The first_ **to foster the search for excellence** More than ever it is necessary **that the research that is done in the European continent is the best** And this is necessary **so that it is competitive in a global context** (…) +uh+ this consequence of globalization has had +uh+ a very important effect on the global economic fabric_ and it is the fact that as you know_ **the European economy has lost competitiveness** We always talked_ and you will remember this expression that was used of emerging markets\ Well_ these emerging markets have emerged_ and we run the risk of being submerged\ And now we have real and very powerful competitors in countries like Brazil_ like the Philippines_ like India_ and so on \ So_ **the European economic fabric has to fight to survive_ and to be able to develop the European society** In order for the * the * the European economy's capacity to grow_ they **need European companies to be able to innovate_ to be able to create new and competitive things\ And that's why research is a key element\ That is why the European Commission has decided that one of the pillars of * the * future strategy e& * in * in organizing research in this 2020 horizon will be **that research is able to create wealth in the {(?) productive} fabric** Now more than ever innovation_ the ability that what we generate serves among other things to create wealth for our society_ is now more important than ever\ and then there is a third fundamental pillar\ and this is that European citizens have raised their voices loud and clear_ saying they want the research done with their taxes_ to solve their problems\ (…)The challenges that the

diferent perquè la situació de la globalització ha fet canviar d'una manera molt significativa la realitat de la recerca en l'entorn global** +Eh+ Horitzó 20-20 planteja que **el futur de la recerca a Europa s'ha d'estructurar sobre tres +eh+ elements estratègics fonamentals** El primer_ **fomentar la recerca d'excel·lència** Més que mai és necessari **que la recerca que es fa en el continent europeu sigui la millor** I això és necessari **perquè sigui competitiva en entorn global** (…) +eh+ aquesta conseqüència de la globalització ha tingut +eh+ un efecte molt important sobre el teixit econòmic global_ i és el fet de que com sabeu_ **l'economia Europea ha perdut competitivitat** Sempre parlàvem_ i recordareu aquesta expressió que utilitzaven dels mercats emergents\ Pues bé_ aquests mercats emergents han emergit_ i correm el risc de que ens submergeixin a nosaltres\ I ara tenim autèntics competidors molt potents en països com el Brasil_ com a Filipines_ com a la Índia_ etcètera\ Per tant_ **el teixit econòmic europeu ha de lluitar per sobreviure_ i per ser capaç de desenvolupar la societat Europea\ I això no es pot fer sense la recerca** Per què la * la * la capacitat de creixement de l'economia Europea continuï endavant_ **necessita que les empreses europees siguin capaços d'innovar_ que siguin capaços de crear coses noves i competitives\ I per això la recerca és un element fonamental\ Per això la Comissió Europea ha decidit que un dels pilars del * de l'estratègia de futur e& * en * en organitzar la recerca en aquest horitzó de l'any 2020 serà **que la recerca sigui capaç de crear riquesa en el teixit {(?) productiu}** Ara més que mai la innovació_ la capacitat de que el que nosaltres generem serveixi entre altres coses per crear riquesa per la nostra societat_ ara és més que mai important\ i després hi ha un tercer pilar fonamental\ i és que els ciutadans europeus han aixecat la seva veu alta i clara_ dient que volen que la recerca que es fa amb els seus impostos_ solucioni els seus problemes\ (…) Els reptes que té la societat

590

European society faces\ The challenges in health_ in transport_ in telecommunications_ those needs that each and every one of us has on our daily basis\ And it's this the triumvirate that will organize the roadmap of the * of European research in the coming years\ **The know& * the production of excellence_ the promotion of competitive industries_ and that we are able that the wealt& that the research we do makes a better society_ more equitable_ and more supportive\ And with these principles the Horizon 20 20_ in Spain_ the research roadmap was organized_ which is valid for the next four years_ in the period 2013 2016_ which is known as the State Research Plan te& * +uh+ scientific and technical research plan**	Europea\ Els reptes en salut_ en transport_ en telecomunicacions_ aquelles necessitats que tots i cadascú de nosaltres tenim en el nostre dia a dia\ I és aquesta el triumvirat que organitzarà la fulla de ruta de la * de la recerca Europea en els pròxims anys\ **El coneix& * la producció de l'excel·lència_ el foment de les indústries competitives_ i el que siguem capaços de que la riques& que la recerca que fem faci una societat millor_ més justa_ i més solidària\ I amb aquests principis l'Horitzó 20 20_ a l'estat espanyol_ es va organitzar la fulla de ruta de la recerca_ que es vàlida en els pròxims quatre anys_ en el període 2013 2016_ que es coneix amb el nom de plan Estatal de recerca te& *+eh+ científica i tècnica** [original in Catalan]

Excerpt 264: Official act at Group B's institute – Speaker: external institution's director – 'we_ in Spain_ will do exactly the same

It is a historic decision\ Because for the first time we have done something we had not dared to do until now\ **We have taken the way to strategically orient research in Europe_ and we have said_ we_ in Spain_ will do exactly the same**	És una decisió històrica\ Perquè per primera vegada hem fet algo que no ens havíem atrevit fins ara a fer\ **Hem agafat la manera d'orientar estratègicament la recerca a Europa_ i hem dit_ nosaltres_ a l'estat espanyol_ farem exactament el mateix** [original in Catalan]

Excerpt 265: Official act at Group B's institute – Speaker: external institution's director – 'how to adjust our own strategic agenda to that of this global agenda\'

Well in this reflection process_ we have considered how to restructure in this global framework_ how to prioritize_ and **how to adjust our own strategic agenda to that of this global agenda** And we have built a new strategic action_ that will be working from 2013_ until 2016_ throughout all this national Plan\	Pues en aquest procés de reflexió_ nosaltres ens hem plantejat com reestructurar en aquest marc global_ en com prioritzar_ i **com ajustar la nostra propia agenda estratègica a la d'aquesta agenda global** I hem construït una nova acció estratègica_ que serà funcionant des de l'any 2013_ fins a l'any 2016_ al llarg de tot aquest Pla nacional\ [original in Catalan]

These excerpts present research policies as being framed within a threefold framework. Following a discourse that conceives science as pursuing social welfare and social justice: 'that we are able that the wealt& that the research we do makes a better society_ more equitable_ and more supportive\'' [excerpt 263]; aligning with a discourse of science as an engine of the economy and the industry: 'that research is able to create wealth in the {(?) productive} fabric\'' [excerpt 263], 'the production of excellence_ the promotion of competitive industries_' [excerpt 263]; and resonating with a discourse of science as a component of globalization: 'that the research that is done in the European continent is the best\ (…) so that it is competitive in a global environment\'' [excerpt 263]; 'We have taken the way to strategically orient research in Europe_ and we have said_ we_ in Spain_ will do exactly the same\'' [excerpt 264], 'how to adjust our own strategic agenda to that of this global agenda\'' [excerpt 265].

With reference to the first discourse, praising science as seeking social welfare and social justice, in the following three excerpts Agus (Group A) acknowledges its penetration in the communication of his RG, but criticises it as being exaggerated and to some extent superficial [excerpt 266].

Excerpt 266: Interview with Agus [PhD res. – Group A] – 'a mi no em sembla que hi hagi una voluntat real'

Researcher: Yes_ I have the same feeling_ right/ That you all start like with this idea of the [object of study] to end famine_ (…) +Ehm+ you have this important humanitarian goal which is so important_ right/ a·nd so yours_ +uh+/ But in reality what are the probabilities that what you do in your * your * in your bench_ for instance_ experimental bench_ will reach the* the harvest in South Africa / or i··n *	**Investigadora:** Sí_ aquesta també és la meva sensació_ no/ Que tots comenceu una mica amb com aquesta idea de pos les [objecte d'estudi] per salvar la fam_ (…) +Ehm+ teniu com aquest objectiu humanitari tan important_ no/ i· tan vostre_ +eh+/ Però en realitat quines probabilitats hi ha de que el que fas tu al teu * a la teva * al teu banc_ diguéssim_ d'experiments_ arribi a * a la collita de Sudàfrica/ o de·· *
Agus: I think very few The * our bosses say it's basically for regulation and so on_	**Agus: Jo crec que molt poques** Els * els nostres caps diuen que és bàsicament per la regulació i tal_
(…)	(…)
There is no mention of poverty_ or inequality_ or the need to change the core system So it seems to me that **this is used more as a patch_ than as * than as a solution that derives from a real willingness to change * to improve the life of these people** And then +pf+ I mean_ I	**No es menciona ni la pobresa_ ni les desigualtats_ ni la necessitat de canviar el sistema de base** Aleshores em sembla que **això s'utilitza més com un parxe_ que com * que com una solució que deriva d'una voluntat real de canviar * de millorar la vida d'aquesta gent** I aleshores +pf+ vull dir_ no em sento massa còmode\ (…) i·· * i

don't feel much comfortable\ (…) a··nd * and I don't think that the [object of study] will end world hunger either_ because that's what I'm telling you_ I'm not * **I'm not an expert_ but it seems to me that right no&** ***** **right now world hunger is not a technical problem_ but an economic and political problem** And giving technical solutions to economic and political problems does not seem to me the most intelligent solution\ (…) so **to me there does not seem to be a real willingness to·· * +nst+ it's what it seems to me_ I do not know\ To improve the life of these people**

tampoc crec que els [objecte d'estudi] acabin amb la fam al món_ perquè és lo que et dic_ no * **jo no soc cap expert_ però a mi em sembla que ara me& * ara mateix la fam al món no és un problema tècnic_ sinó que és un problema econòmic i polític** I donar solucions tècniques a problemes econòmics i polítics no em sembla la solució més intel·ligent\ (…) pos llavors **a mi no em sembla que hi hagi una voluntat real de·· * +nst+ és el que em sembla a mi_ no sé\ De millorar la vida d'aquesta gent**

[original in Catalan]

Excerpt 267: Interview with Agus [PhD res. – Group A] – 'many political claims are disguised with science\'

Researcher: But you also realized that = XXX = \

Agus: = Yes \ of course_ of course\= Exactly\ In fact_ now I read the {(Ang) reviews} that I have written_ and **there are many things that I totally disagree with_ and that I would not write again** (…) Then_ I don't know_ in this sense +pf+ I do look at what I have written_ and I don't * I don't feel comfortable with myself\ **Because I also think that many political claims are disguised with science\ A···nd I mean_ I don't know_ like I think that these two things should be distinguished** Or in case political statements are made_ make it clear\ That they are_ well this_ +m+ +nst+ +m+ well this_ political statements\ a···nd * and that they are not the result of scientific research\ **It seems that if it's written by some scientists it is already supported by science_ and it's no·t _ in reality it doesn't have to be that way**

Investigadora: Però d'això també te n'has adonat =XXX=\

Agus: =Sí\ clar_ clar\= Exacte\ De fet_ ara em llegeixo els {(Ang) reviews} que he escrit_ i **hi ha moltes coses amb les quals estic profundament en desacord_ i que no tornaria a escriure** (…) Llavors_ no sé_ en aquest sentit +pf+ sí que miro el que he escrit_ i no * no em sento còmode amb mi mateix\ **Perquè també crec que disfressat de ciència es fan com moltes afirmacions que són polítiques\ I··· vull dir_ no sé_ com que crec que s'haurien de diferenciar les dos coses** O en cas que es facin afirmacions polítiques_ deixar-ho clar\ Que són_ doncs això_ +m+ +nst+ +m+ doncs això_ frases polítiques\ i··· * i que no són fruit d'una recerca científica\ **Que sembla que si ho escriuen uns científics ja estigui avalat per la ciència_ i no·_ en realitat no té per què ser així**

[original in Catalan]

Excerpt 268: Interview with Agus [PhD res. – Group A] – 'this kind of vicious circle_'

Agus: …It's like * it's a bit related to the idea I've got that in the end **the main goal of the**

Agus: …És com * va una mica relacionat amb la idea que m'he quedat de que al final

groups is not to do things that make society evolve_ o···r * right/ **The sermon that is written when you apply for a project\ Instead it is to publish articles so that they give you the following project\ I mean_ so that the next yea& * in the second call they give you more money_ and to be able to continue with your work** And I think that_ well yes_ you enter this circ& **this kind of vicious circle_** in which in the end all you are looking for is that they give you money to keep doing research_ but you don't care about what comes out_ if they give you more money to keep doing research\ This is the feeling I have\ Maybe it's not\ Maybe it's not correct_ but_	**l'objectiu principal dels grups no és fer coses que facin avançar la societat_** o··· * no/ **La parrafada que es fica quan demanes un projecte\ Sinó que és treure articles per a que et donin el següent projecte\ Vull dir_ per a que l'any se& * a la segona convocatòria et donin més pasta_ i poder seguir amb la teva feina** I jo crec que_ doncs sí_ s'entra amb aquest cer& * **mena de cercle viciós_** en què al final l'únic que busques és que et donin pasta per seguir investigant_ però t'és igual una mica lo que surti_ mentre et donin més pasta per seguir investigant\ Aquesta és la sensació que m'he quedat jo\ Potser no\ Potser no és correcta_ però_
	[original in Catalan]

In these excerpts, Agus expresses his discontent with the discourse adopted in Group A that argues that its practice aims at helping poor peoples of Africa. He criticises that '[n]either poverty, nor inequality, nor the need to change the core system is mentioned' and that intending to give 'technical solutions to economic and political problems' reflects a false willingness to solve the problem. Agus even regrets having reproduced certain discourses in his publications and having contributed to making 'political claims' 'disguised as science'. Agus acknowledges the power of science as warrant of many (non-scientific) claims, which he argues 'should not be like this'. In the third excerpt, Agus claims that the underlying true intention of RGs is merely to obtain publications and thus funding, instead of any social impact, despite 'the sermon that is written when you apply for a project\' in this sense.

Regarding the second discourse, positioning science as an economic instrument that should be ever more connected to the industry, the next two excerpts show some consequences of this relation (science-industry) [excerpts 269 and 270].

Excerpt 269: Focus group with junior researchers [Group G] – 'you miss these small things that you need for publication'

Researcher: Okay_ so you feel that you cannot spend time writing your papers/
Inge: Yeah_ I'm not as much * and the focus is not on * on writing a pap& * I think_ so_ if you write a paper you need some experiments_ and +uh+ if the reviewer says_ okay you need these controls as well_ you have to take your time to just_ yeah_ do these small things_ to get

the paper done\ **And I think that most of the time +uhm+ the focus is not here to produce your results_ to do a publication_** so you leave out these +uhm··+ yeah_ these controls[97] and things like these_ just to focus on your thesis\ And on the whole thing\ **So you want to get these results_ you get further_ and further_ and further_ but you miss these small things that you need for publication\ And because of this I think there's so much data that could be published_ but there's always some thing missing to really publish it**

Paola: @ Yes\

Inge: Yeah_ it's most of the time here\ **And I don't know why the focus is so confused_** I don't know\

Paola: Now they are pushing more in * in * to make more publications

(…)

Inge: And here always {(?) that here} is that the publication really has to be a big thing

Paola: Yeah\

Inge: For me_ I decided * for example_ the things from my Masters' thesis_ I have published_ all of them said_ you cannot publish this_ it's not enough\ And you can publish everything\ But this is not communicated here\ So they always say_ it has to be really new_ it has to * yeah_ the practical application afterwards_ and +uh+ they always want an impact factor higher than six or seven_ but for us_ as a PhD student_ an impact factor of three is enough to publish\ (…) And I think that the expectation of what your publication should be is too high here\

Paola: It's too high\ **Also they are very focused in patents\ So ha& * to have a patent\ More than publications**

Inge: Yeah_ that's because in [institute's name] it's applied science\ So_ there should be an outcome afterwards to go to industry\ And then you need a patent\ (…) I think_ because_ if you already have published things_ other people can do it as well\ And this * so we always have to be safe that there is a patent_ so that you can sell it afterwards to a company\ If it's published_ they will say_ +wo··+_ we can do it on our own\

Excerpt 270: Interview with Diana [postdoc – former member of Group A] – 'if they want you to publish_ you will publish_'

Researcher: What kind of center is this one_then/	**Investigadora:** Quin tipus de centre és aquest_ llavors/
Diana: for [object of study]\ Only for [object of study]\	**Diana:** D'[objecte d'estudi]\ Només d'[objecte d'estudi]\
Researcher: But it is a private center_ o··r is it a University/ What is it/	**Investigadora:** Però és un centre privat_ o·· és una Universitat/ Què és/
Diana: (…) It has {(?)part} of the financing	

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[97] The same result must be obtained three times so that it can be considered 'a good result' (reliable) and accepted by journal reviewers. These are 'control' experiments.

from companies_ and XX XX\ But it is not a university\ XX XX\ Like the CSIC_ for instance\ All these centers like that\ And the other way round_ I guess_ the CSIC_ where they have a publich part and a private part\ Because the public part comes with money from scholarships that they get from public funding\ But they also collaborate with companies and things like that\

Researcher: And does this collaboration with companies affect your work in some way/

Diana: Not to me\ Because I have a public grant\ But for example_ there are people who have a contract through a company\ Of course_ and you can do a postdoc_ but the company is the one who pays you\ And you work on what they tell you\ right/ Make a detergent\ For instance\ Or something like that\ So it's different\ It's X XXX\ (…) You're in a lab\ What you do the project for them\ (…) Of course_ it's hard\ **If you work in a private company_ don't sa& * you won't divulge your work** know what I mean/ It's more * **if they want you to publish_ you will publish_ but if they don't_ you won't\ Because they finance you\ That is XXX they can say_ no_ this won't be published**

Diana: (…) Té {(?) part} del finançament d'empreses_ i XX XX\ Però no és una universitat\ XX XX\ Com el CSIC_ per dir algo\ Tots aquests centres així\ I al revés_ suposo_ el CSIC_ que tenen part pública i part privada\ Perquè la part púbica ve amb diners de beques que aconsegueixen ells de finançament públic\ Però també col·laboren amb empreses i coses així\

Investigadora: I aquesta col·laboració amb empreses afecta d'alguna manera el teu treball/

Diana: A mi no\ Perquè tinc beca pública\ Però per exemple_ hi ha gent que té contracte a través d'empresa\ Clar_ i tu pots fer un post-doc_ però l'empresa és qui et paga\ I tu treballes en el que et diuen ells\ No/ Desenvolupa un detergent\ Per dir algo\ O algo així\ Llavors és diferent\ És X XXX\ (…) Tu estàs a un laboratori\ El que tu fas el projecte per ells\ (…) Clar_ és difícil\ **Si treballes en una empresa privada_ no di& * no divulgaràs la teva feina** M'entens/ És més * **si ells volen que tu publiquis_ publicaràs_ però si no_ no\ Perquè ells te financien\ És a dir XXX ells poden dir_ no_ no es publica això**

[original in Catalan]

These excerpts illustrate the contradictory position in which scientists may find themselves whereby in order to be valued as competent or successful practitioners, they are required to publish their results, while at the same time they may be urged to push their results further, focus on patents and comply with funding bodies' directives.

The third discourse, that of the globalisation of science reflected in excerpts 263, 264 and 265, concerned the 'strategy' followed by research institutions and by national governments as regards research, which should adjust to supranational and arguably 'global' mandates and trends. One of these trends, which is part of internationalisation policies of HE institutions worldwide is the mobility of practitioners, in this case of scientists. This issue will be tackled in the next section given that many of the participants had certainly been mobile scientists and that it emerges as a significant theme in the data.

8.4. Communication, mobility and employment in science

The data analysed in this section suggest that mobility was not exactly an option for science practitioners, but was felt by them as an obligation to continue with their career after their PhD. This is illustrated in the next three excerpts [excerpts 271, 272 and 273].

Excerpt 271: Interview with Tània [PhD res. – Group A] – 'the situation doesn't allow you to really decide'

Researcher: And after the thesis_ or after finishing the doctorate_ *	**Investigadora:** I després de la tesi_ o després d'acabar el doctorat_ *
Tania: Yes_ if you want to continue in science_ in fact it's almost * well_ **you either go out_ o···r * or they don't give you scholarships to later come back here_ or stay here**	**Tània:** Sí_ si vols continuar en ciencia_ de fet és casi * bueno_ **o vas fora_ o··· * o no te donen beques per després tornar aquí_ o seguir aquí**
Researcher: So_ it's like a value that *	**Investigadora:** O sigui_ que és com un valor que *
Tania: Yes \ It's like an asset\ Yes\ **It is an asset to leave and then apply for more scholarships** In * research_ yes\ I know few people who have been able to continue in science without having left\ actually_ people who are·· old now_ I mean_ they're about to retire_ like people who are now forty\ Few people\ Few people have been able to do science and public research by staying here\	**Tània:** Sí\ És com punts\ Sí\ **Te dona punts marxar per després demanar més beques** En * en investigació_ sí\ Poca gent conec que hagi pogut seguir en ciència sense haver marxat\ Ja et dic_ de gent que are és·· gran_ vull dir_ està apunt de jubilar-se_ com gent que ara té quaranta anys\ Poca gent\ Poca gent ha pogut fer ciència i investigación pública quedant-se aquí\
Researcher: Then_ you see it as you will have to do it / Or_	**Investigadora:** Llavors_ ho veus com que ho tindràs que fer/ O_
Tania: It depends_ if I want to keep doing research or not\ Well_ it depends on whether I want to continue or not\ Continuing_ I would like to continue_ but I have to consider different things\ (…)	**Tània:** Depèn_ sí vull seguir en investigació o no\ Bueno_ depèn de si vull seguir o no\ Seguir_ a mi m'agradaria seguir_ però he de valorar diferentes coses\ (…)
Researcher: Would you like not having to leave?	**Investigadora: T'agradaria no haver de marxar_ pues/**
Tania: Yes\ I mean_ staying\ Yes** Then_ of course_ if I have to give up things_ Well it depends\ **The thing is that if X I don't find anything either_ well the situation doesn't allow you to really decide_ oh_ I want this_ and I want to have this\ XXXX_ XXX\ No\	**Tània: Sí\ Vull dir_ quedar-me\ Sí** Llavors_ clar_ si he de renunciar a coses_ Bueno depèn\ **És que si tampoc X no trobo res_ és que les coses tampoc no están com per anar decidint_** ai_ vull això_ i vull tindre això\ XXXX_ XXX\ No\ No pots dir re_ perquè potser m'hauré de menjar les

You can't say anything_ because maybe I'll have to eat my words\	paraules\ [original in Catalan]

Excerpt 272: Interview with Fina [PhD res. – Group B] – 'I was thinking of looking for a job in Europe_'

Fina: Of course_ now what I wanted * in theory what I wanted to do was_ finish_ rest_ because it's been long since I had a long vacation_travel a little bit_ I have it pending_ a···nd * and I wanted to look for a job somewhere else\ Then_ **I was thinking of looking for a job in Europe_ because of course_ my CV is good_ but not* I don't have a spectacular CV to get scholarships** I could get one_ +uh+/ **but if the group is good_ it also helps**	**Fina:** Clar_ jo ara el que volia * jo en teoria el que volia fer era_ acabar_ descansar_ perquè fa molt temps que no agafo vacances llargues_ viatjar una mica_ que ho tinc pendent_ i··· * i volia buscar feina a algun altre lloc\ Llavors_ **jo pensava buscar a Europa_ perquè clar_ el meu currículum està bé_ però no * tampoc tinc un currículum espectacular per conseguir beques** Que en podria aconseguir_ +eh+/ **però si el grup és bo_ també et dona punts això**
Researcher: And the group is not good enough/	**Investigadora:** I el grup no és prou bo/
Fina: Which one/	**Fina:** Quin/
Researcher: Yours\	**Investigadora:** El teu\
Fina: Mine/ **The thing is that scholarships penalize you\ That is_ you can not apply for a post-doc where you did your doctorate** So it is very difficult\	**Fina:** El meu/ **És que les beques te penalitzen\ O sigui_ moltes beques no pots demanar de post-doc on has fet el doctorat** Llavors és molt difícil\
(…)	(…)
Researcher: +Mhm+ Very good\ Okay\ And why Switzerland or Germany/	**Investigadora:** +Mhm+ Molt bé\ Vale\ I per què Suïssa o Alemanya/
Fina: Because that's where there's a lot of money_ like for research\ And the good centers\ In Switzerland I liked it more_ because there's some center that's quite into metabolism_ that's what I like\	**Fina:** Perquè és on hi ha molts diners_ així per investigació\ I els centres així bons\ A Suïssa m'agradava més_ perquè hi ha algun centre que és molt així de metabolisme_ que és lo que m'agrada a mi\
Researcher: +Mhm+ do you know any specific group/	**Investigadora:** +Mhm+ coneixes algun grup concret/
Fina: Yes_ some groups that have come to give a talk here_ o··r * or that when you read something_ you said_ look_ that's cool\ Or	**Fina:** Sí_ algun grup que ha vingut a fer alguna xerrada aquí_ o·· * o que quan t'has llegit algo_ has dit_ mira_ que xulo\ O

because someone in another conference told me_ well_ if you work on this_ these groups are good\	perquè algú en algun altre congrés m'ha dit_ hosti_ pos si treballes amb això_ aquests grups són bons\ [original in Catalan]

Excerpt 273: Interview with Vince [Senior res. - Group A] – 'it's a requirement\'

Researcher: Is this important in your profession/ this thing of going abroad_ and being in laboratories in another country_	**Investigadora:** És important a la vostra professió/ això de marxar fora_ i estar a laboratoris d'un altre país_
Vince: Yes\ It's important	**Vince: Sí\ És important**
Researcher: Why/ Is it not possible = that you always stay = *	**Investigadora:** Per què/ No és possible =que et quedessis sempre= *
Vince: = No_ no_ no\ = It's very important to see other things\	**Vince:** =No_ no_ no\= És molt important de veure altres coses\
Researcher: What * does this bring to you/	**Investigadora:** Què * què t'aporta això/
Vince: First_ differ& * **life experience\ another country_ another culture_ the language_ a different way of doing things_ right/ different +uh+ way of working_** this is very important in our case_ how to do the same thing in a different place\ someone can do it better_ someone does it maybe so well_ but in a different way_ right/ This is very important to see other things\ You know/ (…) But maybe_ +m+ +uh+ +m+ if you go to another country_ it will surely be all * I mean_ +nst+ it's hard to explain\ They have maybe * they have been used to doing things * +nst+ for a long time\ It's another country_ other products_ +uh··+ there will also be * there will probably be people from other countries_ too\ Well_ all this involves doing something different\	**Vince:** Primer_ difer& * **experiència de vida\ un altre país_ una altra cultura_ la llengua_ manera de fer diferent_ no/ diferent +eh+ manera de treballar_** això és molt important en el nostre cas_ com fer la mateixa cosa en diferent lloc\ algú ho pot fer millor_ algú ho fa potser tan bé_ però d'una altra manera_ no/ Això és molt important de veure altres coses\ Saps/ (…) Però potser_ +m+ +eh+ +m+ si vas a un altre país_ segur que serà tot * vull dir_ +nst+ és difícil d'explicar\ Tenen potser * estan acostumats a fer coses * +nst+ fa temps\ És un altre país_ altres productes_ +eh··+ també allà hi haurà també * segur que hi haurà gent d'altres països_ també\ Doncs_ tot això participa a fer una cosa diferent\
(…)	(…)
Researcher: But it is not an obligation_	**Investigadora:** Però no és una obligació_
Vince: No·· \	**Vince:** No··\
Researcher: So_ someone could decide_ look_ I stay in this lab all my life_ I'm fine_ I like it_ and_	**Investigadora:** O sigui_ algú podria decidir_ mira_ jo em quedo a aquest laboratori tota la vida_ estic bé_ m'agrada_ i_
Vince: No_ no\	

Researcher: I don't need to leave\	**Vince:** No_ no\
Vince: No_ that's not good\ **It's recommended_ alright/**	**Investigadora:** No necessito marxar\
Researcher: But it is valued in your curriculum/	**Vince:** No_ no és ben bé això\ **És recomanat_ no/**
Vince: Yes\ Yes\ Yes\ * there are * **I think most people in order to have a postdoc grant_ if they haven't left out of their laboratory_or from the country_now I don't remember * the thing is that this changes every year_ +uh+/ +Uh+ it's a requirement**	**Investigadora:** Però sí es valora a nivell de currículum/
	Vince: Sí\ Sí\ Sí\ Sí hi ha * hi ha * **crec que ara la majoria per tenir una beca de· post-doc_ si no ha marxat a fora del teu laboratori_ o del país_ ara no ho recordo_ * és que canvia cada any_ +eh+/ +Eh+ és un requisit**
	[original in Catalan]

In the first excerpt, Tània acknowledges that mobility is compulsory to obtain a scholarship 'to come back here afterwards' or even 'to keep doing science'. Although she would prefer not to leave her country, she is uncertain of having this option due to the difficult situation of the labour market. In the second excerpt, Fina argues that 'there aren't many grants that allow you to work as a postdoc in the same place where you have done your PhD'. Consequently, since she did not have a 'spectacular curriculum', she decided to look for a job 'in Europe' and specifically in two countries 'where there is much money': Switzerland and Germany, and where there are strong RGs that could compensate for her CV. In the same line, in excerpt 273, Vince confirms the need to work abroad in order to get a postdoc scholarship ('it's a requirement') but emphasises other advantages of it, like 'life experience\', 'the language_' and 'a different way of doing things_'.

Despite the fact that research policy-making bodies urged scientists to work abroad, an added difficulty was faced by those scientists who, like Fina, decided to do so, as illustrated in the next excerpt from an interview with Mara (Group A) [excerpt 274].

Excerpt 274: Interview with Mara [PhD res. – Group A] – 'if it isn't transmitted by word of mouth'

Researcher: After the {(Ang) defence}_ and after the doctorate_ how is life after/	**Ερευνήτρια:** Μετά τη {(Αγγ) defence}_ και μετά το διδακτορικό_ πώς είναι η ζωή μετά/
Mara: Life after [that] is_ basically there's none\ @@ I am [receiving] the unemployment fund_ I have started looking for a postdoc_ as I told you_ **As I understand it is a bit difficult this specif&**	**Μάρα:** Η ζωή μετά είναι_ βασικά δεν είναι\ @@ Βρίσκομαι στο ταμείο ανεργίας_ Έχω ξεκινήσει να ψάχνω για μεταδιδακτορικό_ όπως σου είπα_ **Απ'ο,τι έχω καταλάβει είναι λίγο δύσκολο η συγκεκρι& * το συγκεκριμένο_ να βρεις κάτι κάπου_ αν**

* this specific [issue]_ to find something somewhere_ if it isn't transmitted by word of mouth_ In America_ for instance_ there is no money\ They tell you_ if you can [come]_ with your own * with your own money_ we accept you_ otherwise they don't\ that is_ they expel one_ they get one\ If you're lucky_ and get there just in that one one_ and **it's usually like this_ they ask some professor_ to recommend someone_ I don't know what_** So far I have sent ten [CVs] I think/ But nothing\	δεν *πάει από στόμα σε στόμα_* Στην Αμερική_ ας πούμε_ δεν υπάρχουνε λεφτά\ Σου λένε_ αν μπορείς_ με δική σου * με δικά σου λεφτά_ σε δεχόμαστε_ αλλιώς δεν\ δηλαδή_ διώχνουν έναν_ παίρνουν έναν\ Αν είσαι κολόφαρδος_ αν πετύχεις εκείνο το ένα ένα_ και *συνήθως πάει_ ρωτάνε κάποιο καθηγητή_ για να προτείνει κάποιον_ δεν ξέρω εγώ τι_* Μέχρι στιγμής έχω στείλει γύρο στους δέκα νομίζω/ Και τίποτα\ [original in Greek]

As recounted by Mara in this excerpt, finding a job in science may depend to a great extent on word of mouth and specific recommendations from local high-status practitioners, which may hinder scientists' mobility abroad.

Cecília also narrated that certain string-pulling for setting known or referenced people up in jobs existed in Spain, and that although some granting policies promoted by Catalan agencies, like the ICREA programme[98], intended to avoid these practices, there were local circumstances that challenged the effectivity of these policies [see excerpt 275].

Excerpt 275: Interview with Cecília [Senior res. – Group A] – 'we still have a little bit the problem of the sponsors_'

Researcher 2: And that Chinese girl_ Lian_ **Researcher 1:** She found a job\ = I found out today\ = **Researcher 2:** =She has returned_= and found a job in China as a researcher/ in China_ now_ there must be a lot of offers_ right/ **Researcher 1:** Well_ she had * she wasn't sure_ +uh+/ that she would get one\ She was very scared\ She says it's very competitive and that it wasn't easy\ **Cecilia:** (…) In China_ if you work_ you find a job\ And in India_ as well\ And here_ in this	**Investigador 2:** I la noia xinesa aquella_ la Lian_ **Investigadora 1:** Ha trobat feina\ =Me n'he assabentat avui\= **Investigador 2:** =Se n'ha tornat_= i ha trobat fenya a la Xina com investigadora/ Si és que a la Xina_ ara_ hi deu haver molta oferta_ no/ **Investigadora 1:** Bueno_ ella tenia * no ho tenia clar_ +eh+/ Que n'aconseguiria\ Tenia molta por\ Diu que és molt competitiu i que no era fácil\

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[98] ICREA (the Catalan Institution for Research and Advanced Studies) is a foundation supported by the Catalan Government that offers permanent, tenured positions in Catalonia to excellent researchers from all over the world. Source: https://www.icrea.cat/

country_ if you work a lot_ also\

Researcher 2: Right\

Cecília: But here you have to work a lot\ **The thing is that here we still have a little bit the problem of the sponsors_ and of the·· * of whom you know_ and who··· * All this_ here_ in this country_ still * in Catalonia_ + uh+/ All * the whole territory**

Researcher 2: Perhaps in Catalonia more than in Spain\

Cecília: Everywhere\ Everywhere\ Everywhere\ Because here_ with the ICREA program_ * **the ICREA program in part has to put an end to this\ And there are INCREA scholars who are having a very bad time_ +uh+/ That the departments don't accept them**

(…)

Cecília: Like everywhere\ Well now imagine_ if you come from abroad_ and someone accepts you_ and they tell you that yes_ and then you encounter the whole situation\

Cecília: (…) A la Xina_ si treballes_ trobes fenya\ I a la Índia_ també\ I aquí_ en aquest país_ si treballes molt_ també\

Investigador 2: Ja\

Cecília: Però aquí has de treballar molt\ **És que aquí encara tenim una mica el problema dels padrins_ i dels··· * d'a qui coneixes_ i d'a qui··· * Tot això_ aquí_ en aquest país_ encara * no a Catalunya_ +eh+/ Tot * tot lo territori**

Investigador 2: Potser a Catalunya més que a Espanya\

Cecília: A tot arreu\ Tot arreu\ Tot arreu\ Perquè aquí_ amb lo programa ICREA_ * **lo programa ICREA en part ha de trencar això\ I hi ha ICREES que ho passen molt malament_ +eh+/ Que als departaments no els accepten**

(…)

Cecília: Com a tot arreu\ Pos ara imagina't_ si arribes de fora_ i un t'accepta_ i et diuen que sí_ i llavons te trobes tota la situació\

[original in Catalan]

As Cecília explains in this excerpt, the dynamics in the local context might be contrasting with top-down policies, like the rejection that ICREA awarded scientist might face in their new departments, where they are sometimes 'not accept[ed]'.

Still at the local level, individual scientists might also look for ways for challenging the mobility norm that they feel has been imposed on them [see excerpt 276].

Excerpt 276: Focus group with junior researchers [Group G] – 'for me I have decided it's not necessary\'

Researcher: Do you think that in your job it is important to do a stay abroad/

Inge: I think it is_ but for me I have decided it's not necessary Because I think if you have enough papers_ and have good results_ and a good thesis_ I think this should be enough for your +uh+ new +uh+ {(Ger) Arbeitgeber}/

Researcher: Employer/

Inge: Yeah_ for the company where you work_

In this excerpt, Inge presents her plan for resisting the pressure to work abroad, which consists in compensating it with publications so that her curriculum be still competitive and valued by employers.

As mentioned by Vince in excerpt 273, scientists' mobility implies their coming across other languages and language policies, and their consequent decisions as regards language learning and use, based on their language ideologies (see Woolard & Schieffelin, 1994). The diverse language ideologies that arouse in the data will be presented in what follows.

First, Hao (Group A), who had worked in different countries, like China (his country of origin), Japan, the UK and Germany, before Catalonia (Spain), declared that 'language is very important', referring not only to English but also to the local languages [see excerpts 277 and 278].

Excerpt 277: Interview with Hao [Senior res. – Group A] – 'then that guy liked me very much'

Researcher: Don't you think that * that it would be good * +eh+ that English is enough to * =to * to * to communicate/ Or to work/=

Hao: =No\ No\ No\= I don't think so\ I think lan& * +uh+ for me_ I go to different countries_ I think language is very important\ Even Spanish and Catalan_ now I cannot speak very well_ but I think it's very important\ If you * if for example_ I work in Japan_ first time before I went to Japan I studied Japanese in China for ten months_ and a teacher from Japan_ a Japanese teacher to teach me * to teach me +uh+ Japanese_ When you go to Japan_ if you can speak Japanese_ then you can very easily to use for the life * in the life\ You know/ In Japan most people cannot speak +uh+ English\ They can read\ They can write\ But they * they * they don't know to speak\ @@ Therefore you * when you go to the meetings_ Like me_ I go to the meetings_ First time I finished my PhD_ back to China\ Then when I go to Japan again_ when on the mee& * in the * +uh+ in the XXX meeting I met one famous scientist in Japan_ **then I talked with him in Japanese_ then that guy liked me very much_ then he invited me to go to his research centre to do postdoc\ I think it's very important**

Researcher: So *so language can open you doors_ for instance\

Hao: Of course\ Can\ If suddenly you speak +uh+ your native language that makes your distance very close\ You can make very good friends if you work in the same field\ Yeah\ Not only Japanese_ and German_ of course\ Even if you don't use it in your research\ But if you speak German_ then you are very easily to make friends with Ger& * +uh+ with Germany * German\ You know/

Excerpt 278: Interview with Hao [Senior res. – Group A] – 'for my case I think I should study Spanish\'

Researcher: So_ you think that language is important_

Hao: It's important_ yeah_ yeah\

Researcher: +Ehm+ why didn't you learn Catalan/ For instance\ Because you said that you * here * Catalan here * it's easier to hear Catalan than Spanish here_

Hao: No\ Catalan_ because for * **for my case I think I should study Spanish\ For example_ if I go to Madrid_ for sightseeing or for XXXX_** I cannot_ like my kids_ study Spanish and at the same time I study Catalan\ I don't think so\

Researcher: +Mhm+ so you would like first to study Spanish_ and then maybe Catalan\

Hao: Yeah\ Yeah\ Yeah\

Researcher: So first Spanish because * because you are in Spain/

Hao: Yeah\ Yeah\ Yeah\ Yeah\ Yeah

In the first excerpt, Hao emphasises the advantages of learning others' 'native language', like bringin people 'very close', 'mak[ing] good friend[s]' and 'easily use for the life'. He narrates an anecdote about how he was invited by a 'famous scientist in Japan' to do a postdoc in his research centre because he liked the fact that Hao could speak Japanese. Despite deeming the learning of local languages 'very important', in the second excerpt Hao declares that in his case he believes that it would be more adequate to learn Spanish rather than Catalan, since he would be able to use the first in case he went to Madrid for sightseeing or for other purposes. Hao agrees with the researcher's assertion that Spanish goes first because he is in Spain, evidencing this way the relevance of the official framework of the nation-state for decisions related to language learning. A similar stance to Hao's was that of Mara (Group A, originary from Greece), who insisted that her aim was to learn Spanish and not Catalan, arguing that the former could be of use in other parts of the world, like Latin America or America (meaning the U.S.) [see excerpt 279].

Excerpt 279: Interview with Mara [PhD res. – Group A] – 'I wanted to learn Spanish\'

Mara: I did not learn Catalan on my own initiative Because from the [direction] they wanted to··· * Cecília had some pressure_ let's say_ to bring a teacher to [the faculty]\ Why we had to go to [another district]\ To take lessons\ And we told Cecília that if you bring * if s/he comes here_ we can take lessons\ Then everyone wanted Spanish\ Nobody wanted Catalan\ Lian_ Navil_ me_ Who	**Μάρα: Καταλανικά δεν έκανα από πρωτοβουλία μου** Γιατί θέλανε από [τα κεντρικά] να··· * η Σεσίλια είχε κάπως πίεσε_ ας πούμε_ να φέρουνε καθηγητή [στη σχολή]\ Γιατί εμείς έπρεπε να πάμε [σ'άλλη περιοχή]\ Για να κάνουμε μαθήματα\ Και της είπαμε στη Σεσίλια ότι άμα φέρεις * αν έρθει εδώ_ μπορούμε να κάνουμε μαθήματα\ Μετά όλοι θέλανε Ισπανικά\ Κανείς δεν ήθελε Καταλανικά\ Η Λιαν_ ο Ναβίλ_ εγώ_ Ποιος

else was there/ Enough had said so * enough guys\ And not only from our laboratory\ From··· everywhere\ But to··· * **since everyone wanted Spanish_ they forced us to do Catalan first\ It was like {(Eng) fused lesson}\ Which was half Catalan_ half Spanish**	άλλος ήτανε/ Το είχαμε πει αρκετά * αρκετά παιδιά\ Και όχι μόνο απ'το δικό μας το εργαστήριο\ Από··· παντού\ Αλλά για να··· * **επειδή όλοι θέλανε Ισπανικά_ μας υποχρέωσαν να κάνουμε πρώτα Καταλανικά\ Ήτανε σαν {(Αγγ) fused lesson}\ Το οποίο ήτανε μισό Καταλανικό_ μισό Ισπανικό**
Researcher: From the [direction] this/	**Ερευνήτρια:** Από [τα κεντρικά] αυτό/
Mara: From the [direction]\ And free\	**Μάρα:** Από [τα κεντρικά]\ Και δωρεάν\
Researcher: And they brought you a teacher\ Let's say\	**Ερευνήτρια:** Και σας φέρανε καθηγητή\ Ας πούμε\
Mara: And they brought us a teacher\ Which was a free course_ but you had to buy all the books in Catalan\ And all the books in Catalan * what is XXX/ It a CD_ with * that's much money\ At that time I didn't have any money\ And I did not want to buy a Catalan book\ **I wanted to buy a Spanish book\ I wanted to learn Spanish\ Catalan what would it help me with/ At least_ +uh+ Latin America_ or even in America_ I do not know_ XXX is * you can use it\ You say okay**	**Μάρα:** Και μας φέραν καθηγητή\ Το οποίο ήτανε δωρεάν το μάθημα_ αλλά ήσουνα υποχρεωμένος να αγοράσεις όλα τα βιβλία στα Καταλανικά\ Και όλα τα βιβλία το κανονικό_ με το {(Αγγ) hard copy}_ με σι-ντι_ με τα * είναι αρκετά λεφτά\ Εγώ εκείνη τη στιγμή δεν είχα λεφτά\ Και δεν ήθελα να αγοράσω ένα Καταλανικό βιβλίο\ Εγώ ήθελα να αγοράσω ένα Ισπανικό βιβλίο\ **Ήθελα να μάθω Ισπανικά\ Τα Καταλανικά πού θα με βοηθήσουνε/ Τουλάχιστον ρε παιδί μου_ +ε+ Λατινική Αμερική_ ή ακόμη στην Αμερική_ δεν ξέρω εγώ_ XXX είναι * μπορείς να τα χρησιμοποιήσεις\ Λες εντάξει**
	[original in Greek]

In this excerpt, Mara narrates how she and other colleagues were forced by their university to take Catalan-Spanish 'fused lessons' although they all wanted to learn Spanish only. Once again, the local language, in this case the most limited one in terms of the number of speakers and geographical coverage, is perceived as an obstacle, which generates rejection of the language policies supporting its learning.

With similar arguments, Andrei (Group G, from Bulgaria) explained why he 'never had as an objective to learn Dutch' when he worked in the Netherlands [see excerpt 280].

Excerpt 280: Interview with Andrei [Postdoc – Group G] – 'I never had as an objective to learn Dutch\'

Researcher: And when yo& you worked in all these countries_ you had to *to learn the * the national language/
Andrei: +Uh···+ **I never had as an objective to learn Dutch** @ Yeah\ Because of two reasons_ XXX * I mean_ the * the * the population of the Netherlands is about sixteen

> million_ XXX also about the same number of people who live outside this country\ I mean_ these are the former colonies of the * the Netherlands\ So_ I think most of the white population in the South African Republic is * they're talking a kind of Ne& Netherlandish_ or Dutch language_ which is called Afrikaans\ +Uh·+ Also there are some * I mean_ countries in the Latin America_ like +uh+ Curaçao_ XXXX talking * +uh+ speaking in +uh+ Dutch_ and also part of * in a small part of Indonesia_ which is also a former Dutch colony_ one of the largest XXX Dutch speaking_ (…) **XXX a language which is spoken by twenty-five_ thirty million people_ not very * I mean_ how to say/ Feasible\ So_ And second_ the people there_ I mean_ +uh+ all they are speaking quite decent forms of English language\ Adults people\ So_ for me it doesn't make sense to_**

In this excerpt, Andrei gives two reasons why he did not aim to learn Dutch: the small number of speakers of this language around the world ('twenty-five_ thirty million people'), which makes its use 'not very…feasible', and the fact that in the Netherlands people speak 'quite decent forms of English language' and thus Dutch was felt as not indispensable for him. On the contrary, while living in Germany, Andrei did deem it important to learn German, as he did. And this same sensation had Vince (Group A) and Giulia (Group G), as is described in the following two excerpts [excerpts 281 and 282].

Excerpt 281: Interview with Vince [Senior res – Group A] – 'Because none of them knew [English]\'

Vince: It's more complicated in Germany\ +uh+/ We took a basic German course_ +uh+ / I remember_	**Vince:** A Alemanya és més complicat\ +eh+/ Vam fer un curs d'alemà bàsic_ +eh+/ Me'n recordo_
Researcher: Yes/ Everyone/ Everyone in the group/ Or how/	**Investigadora:** Sí/ Tots/ Tots els del grup/ O com/
Vince: Yes\ Yes_ **it was * that was indispensa& indispensable\ +uh+/ Because none of them knew [English]** And XXX_ imagine_ [they] didn't speak English\ I mean_ yes_ there were maybe two or three people * no_ two members of the administration staff who tried to communicate in English\ Right/ When there were problems\ But if not_ at the beginning there weren't\ **But then you had to speak German\ Right/**	**Vince:** Sí\ Sí_ era * **això era impredisci& imprescindible\ +eh+/ Perquè ningú en sabia\ I XXX_ imagina_ no parlava anglès** Vull dir_ sí_ potser hi havia dos o tres persones * no_ dos persones de l'administració que intentaven comunicar en anglès\ No/ Quan hi havia problemes\ Però si no_ Al principi no\ **Però després s'havia de parlar en alemà\ No/**
Researcher: And at a professional level_ was there any problem for not knowing German/	**Investigadora:** I a nivel professional_ hi havia algun problema per no saber alemany/
Vince: No_ because the other groups knew a little bit of * no_ that was not a problem\ It	**Vince:** No_ perquè els altres grups sabien una mica de * no_ això no\ No era un problema\ Perquè hi havia * vull dir_ ho

wasn't a problem\ Because there was * I mean_ they knew how to speak English\ But they didn't like it \	sabien parlar anglès\ Però no els agradava\ \ [original in Catalan]

Excerpt 282: Interview with Giulia [Senior res. – Group G] – 'it's a different life\'

Researcher: When you arrived here the first time_ did you learn German/ Did you need to/

Giulia: @ I couldn't speak any word of German when I arrived_ And actually I wasn't thinking to stay so long_ so I took classes_ I mean_ after working in the evening_ at the {(?Ger) After-Work-Schule}\ It's like the free-time unive& * people of university_ or something like this_ and +uhm+ *

Researcher: Because you had this motivation to learn German/

Giulia: Yeah_ because I thought_ I mean_ since I'm here_ I should +uh+ just give it a try_ It was very hard_ @ It was very hard because already I was working the whole day in English_ which is not my mother +uh+ language_ and +uh+ * so_ after a couple of courses * +uh+ classes I gave up\ I never ever spoke German_ I was always sticking to English_ but +uh+ yeah_ I was * in the end_ as I said_ I stayed three years_ and in the end_ **in the long run I regretted that I hadn't learned German\ Because with English you * well_ in the lab_ it's no problem_ in * also in everyday life you survive very well_ but it's * as I say_ it's a surviving_ it's not a living\ Yeah_ and when you * when there are the social events_ or events_ or even just at luch breaks_ yeah_ everybody switched to * to German_** as is natural_ and then if you're not able to follow the conversation_ you feel like cut out and you can't interact_ and in the long run it really * it really makes a difference\ So when I came back to Germany for the second time_ after going bak to Italy after my PhD_ **I really started learning German much better_ and * I mean_ and with the perspective of staying here_** and now I speak German_ I mean_ it's full of mistakes_ but I @ can * can manage_ {(?) during} a conversation_ I understand pretty much everything_ and +uh+ it's * **it's a different life** @

In the first excerpt, Vince (originary from France) explains why he felt the learning of German 'indispensable' when he was working in Germany. Vince contends that in Germany 'nobody knew' English out of his working environment and even at work Germans 'did not like' speaking English. Unlike Mara with Catalan, Vince shows a positive stance towards the learning of this language. In Giulia's case, we can observe an evolution as described by her in the second excerpt. She had worked in Germany in two different periods, with different perspectives each time. The first time, she had the will to learn German to 'just give it a try', but 'was always sticking to English' and gave in after two lessons. On the second occasion, in contrast, Giulia had 'the perspective of staying' in Germany, took up German lessons 'much better', and finally succeeded. This gave her the opportunity to take active part in social events,

where German language predominates, giving place to a 'different life' for her that consists in 'living' instead of only 'surviving'.

Although English was perceived as being the working language in Group G's institute, its use was not devoid of difficulties, as declared by Elvira (Group G's institute) in the next excerpt [excerpt 283].

Excerpt 283: Interview with Elvira [Responsible of PhD Programme and cooperation with Latin America – Group G's institute] – 'it sometimes still is a problem'

Researcher: Did you see differences +eh+ in the level of English of PhD students depending on the * their nationality/

Elvira: Yes\ Yeah\

Researcher: What would you say that *

Elvira: I would say within the European range_ +uh+ people from the Netherlands_ Sweden_ Norway_ Denmark_ I never had some experience with people from Finland_ so I'm not * I'm not quite sure_ **but all these countries where English is +uhm+ much longer part of daily life_ +uhm+ English is no * no problem** While +eh+ for the Eastern European countries_ +uh+ **it sometimes still is a problem_** and often they start * also for some of the German students_ that they know how to read_ it's not a problem_ **but speaking_ due to lack of experience_ lack of options_ lack of whatever_** +uhm+ *

Researcher: +Mhm+\ so Germans could have problems as well\ +Mhm+\ And out of Europe/

Elvira: And out of Europe_ +uhm+ we had some people from Iran_ Iraq_ Iran_ Iraq_ **that was problematic_** Yeah_ the Eastern countries\ Yeah\

In this excerpt, Elvira relates English language skills with the nationality of scientists working in her research centre, which according to her correlates with the presence of English in 'daily life'. The skills are thus variable and might be 'problematic' sometimes, especially as regards speaking.

In this line, it was precisely the absence of English as an 'active language' in Chile and Brazil, where Elvira's research centre had collaborations, which made Elvira an essential actor in the relations with the Chilean and the Brazilian counterparts due to her language skills in Spanish and Portuguese [see excerpt 284].

Excerpt 284: Interview with Elvira [Responsible of PhD Programme and cooperation with Latin America – Group G's institute] – 'in Brazil it's quite easy'

Researcher: Is it you who decides if you want to collaborate with Brazil_ for instance_ or Chile_ or_

Elvira: No_ it's me suggesting_ +eh+ there's chance to get some money from somewhere_

> or it is the researchers already having some contacts with Brazilians_ or Chileans_ or whatever_ and then coming to me_ +uh+ could you help us/ **And in Brazil it's quite easy because I'm able to speak the language_ and that's much easier\ Because in * in Chile_ as well as in Brazil_ much of the communication is still +uh+ either in Spanish or in Portuguese** (…) day to day_ within the labs or within the groups it's still Spanish\ While here quite a lot of the groups at the [name] institute or at the university * the group language_ the institute language_ the department language_ often is English\ But_ for example_ the +uh+ PhD meetings here are always in English\ If we do have a PhD seminar_ it's in English\ In Chile_ as well as in Brazil_ it's * except for the universities like the University of Sao Paulo_ +uhm+ it will be in Portuguese\ Or in Spanish\ Even if we are invited to some of the project meetings_ some of the people are giving their talks +uh+ in Spanish or in Portuguese\ (…) **They're not used to speak Enlgish\ They're used to writ& * +uh+ to write it and to read it_ but as an active language_ forget it\ They're not used to that**

In this excerpt, Elvira defends that establishing collaborations with Brazil is 'quite easy' given that she can 'speak the language', which shows an opportunity for languages other than English. Elvira's mastery of different languages became in this case a valued cultural capital, easily convertible into social and economic capital.

The prevalence of the local language, as Spanish in Chile, may be supported by policies like the government 'not accepting English reports' [see excerpt 285].

Excerpt 285: Interview with Elvira [Responsible of PhD Programme and cooperation with Latin America – Group G's institute] – 'they are not accepting +uh+ English +uh+ reports'

> **Researcher:** Okay_ so you coordinate_
>
> **Elvira:** Yeah\
>
> **Researcher:** What does this mean/ What do you do/
>
> **Elvira:** Well_ what * +pf··+ +ehm·+ like I'm coordinating all the +eh+ legal work_ (…) and then we are interfacing with the Chilean colleagues_ This is one part of my work\ Then_ another one is to coordinate reporting_ so the Chileans +ehm+ have to +ehm+ deliver a report every six months to the Chilean funding body_ (…) And we need to contribute to this as we have joined a project\
>
> **Researcher:** +mh+ so you too have to give a report to them *
>
> **Elvira:** Yeah\ And I'm coordinating this here_ and then in Chile the pro& * +uh+ report will be translated to Spanish_ and then it's coming back as a Spanish report_ @@ {(@) and we have to proofread the Spanish version}_
>
> **Researcher:** +ah+ okay_ so you * you send your version in =English=_
>
> **Elvira:** =The English version_= Yeah\
>
> **Researcher:** They receive it and have to translate it for the Ministry =of the government=_
>
> **Elvira:** =Yeah_ that's it\= Yeah_ that's it\ Because +uh+ well_ **Spanish is the official**

language in Chile_ and they are not accepting +uh+ English +uh+ reports as long as Chilean governmental money goes into the project

Researcher: So they translate it_

Elvira: Yeah\

Researcher: And before giving it to their government_ they need to send it back to you_

Elvira: =Yeah_ that's it\

Researcher: For you to check that everything's right\

Elvira: Yeah\ And we try to check it_ I lived two years in Brazil_ So I'm able to read Spanish_ but most of our researchers of course are not familiar with Spanish\ **They can understand all the scientific words_**

Researcher: So it's you who gives the okay it's fine\

Elvira: Yeah_ they also ha& * if I do have any kind of problems_ I go back to the researchers and ask +uh+ whether they might have a look and say it's okay or not\

Researcher: But they can't\ Because it's in Spanish\

Elvira: Yeah_ it depends on whether it's scientific language_ then it's quite easy_ and if you do have_ the English version and the Spanish_ it's okay to check it\

Here, Elvira describes the chain of revisions and translations of a joint report that scientists in her institute in Germany and their Chilean collaborators have to deliver to the Chilean government (in Spanish). The report is first written in English by the German group, then translated into Spanish by the Chileans, proofread in Spanish by the German scientists, who 'can understand all the scientific words', with Elvira's help, and again in Spanish by the Chileans. It becomes evident that Elvira's ability to understand Spanish is crucial in this process. In this regard, Elvira declared that without her knowledge of Spanish and Portuguese languages 'it would be much more difficult' to work with the Chileans and the Brazilians [see excerpt 286].

Excerpt 286: Interview with Elvira [Responsible of PhD Programme and cooperation with Latin America – Group G's institute] – 'in Brazil I wouldn't survive\'

Researcher: How important is your knowledge of Portuguese for your work/ Portuguese and that you can read Spanish\

Elvira: +Uh+ Very very very important_ I couldn't do the * of course I could do the PhD +uhm+ thing without any knowledge of Spanish or Portuguese_ But +uh+ **for the work with the Chilean or the Brazilian researchers and partners_ without knowing it would be much more difficult_ and in Brazil I wouldn't survive\ Not on the long term** I think\ {(?) Well}_ Some researchers speaking very good English_ no problem_ but there are quite a lot of researchers and people in the funding agencies not * who are not familiar to speak English\

(…)

> **Researcher:** And how important is English for you/
>
> **Elvira: Without English I wouldn't survive\ Nor here_ nor in Brazil_ nor in Chile\ @@@**

In this excerpt, Elvira acknowledges that knowing Spanish and Portuguese is important for the collaborations with scientists in Chile and Brazil, to the extent that 'in Brazil [she] wouldn't survive\' 'on the long term'. Yet, English is perceived by Elvira as indispensable for her work everywhere, in Brazil, in Chile and in Germany. There seems hence to be a language hierarchy as well as specialization. Languages are presented as a working tool valued to the extent that they are required by funding agencies or by collaborators. As stated by Elvira, languages other than English are not always needed [see excerpt 287].

Excerpt 287: Interview with Elvira [Responsible of PhD Programme and cooperation with Latin America – Group G's institute] – 'you need somebody speaking the language'

> **Researcher:** But in a way maybe the * the fact that you can speak Portuguese has determined or helped in these new projects with Brazil/ You think so/
>
> **Elvira:** Yeah\
>
> **Researcher:** So maybe_ if you could speak other languages_ you could do these
>
> **Elvira:** Yeah\ Definitely\ Yeah\
>
> **Researcher:** collaborations with other countries\
>
> **Elvira:** Yeah\ (…) **I think you need somebody speaking the language if you're planning strategic things in a different country\ If it's only for one project_ yeah_ you don't need it**

In this excerpt, Elvira defends that knowing the local languages is important for long-term strategical collaborations ('if you're planning strategic things') but not for specific projects, for which 'you don't need' them. Different languages are thus used for specific purposes or according to different circumstances.

This section has presented an analysis of the data as regards the effects of scientists' international mobility on their communication and language ideologies. Communication has been presented as relevant for both, observing the mobility norm (i.e. by getting positions through word of mouth) and resisting it (i.e. by compensating the lack of mobility with more publications). As regards language, different ideologies have been shown that gave place to different decisions and practices concerning language learning and use. The next section will be devoted to the discussion of results and to the drawing of relevant conclusions.

8.5. Discussion and conclusions

In this chapter, I have attempted to answer the research sub-question *What is the influence of the IoHE on scientists' communication regarded as a socio-cultural practice?* I have approached issues related to the macro level of data analysis, understanding communication as a socio-cultural practice framed within a broader context of discourses, ideologies and power relations in science, beyond the RG. The macro dimension has been approached through the entry concept of scientists' *success*, and the prevailing ideologies, discourses and norms related to this idea. Section 8.1 has focused on how scientific publications (a form of *communication*) are valued as a measure of scientists' success; section 8.2 has offered an overview of diverse elements that are conceived as contributing to scientists' attainment of success (the 'means for success'), some of which are directly connected with communication; section 8.3 has shown how science is often constructed as a social, political and economic instrument, which affects also scientists' communication; section 8.4 has tackled some effects of scientists' international mobility on their communication; and the present section (8.5) will discuss the findings presented in this chapter in the light of the relevant literature. In this chapter, theoretical concepts from Bourdieu's (1977) *theory of practice* and Giddens' (1984) *structuration theory* become especially relevant for the understanding of the phenomena analysed.

A review of the literature shows that scientists' success can be described in terms of different facets, like achieving an expected outcome or following instructions faithfully (Amerine & Bilmes, 1988), an attitudinal accomplishment (Martin & Meyerson, 1998; Beaufaÿs, 2012), the achievement of academic career positions (Lühe, 2014), complying with meritocracy (Mawela, 2014), a combination of relationships, usefulness of research and overcoming challenges (Leahey & Cain, 2013), or a combination of career achievements (e.g. wage, status, job positions), satisfaction and relative comparative status with colleagues (Abele & Wiese, 2008). Most of these aspects are either abstract states or final ends for which intermediate processes and actions need to be executed in a certain tuned way. Also, the role of some communication can be glimpsed in some of these features of success, as in the case of complying with meritocracy, in relationships and in the usefulness of research. But it needs to be further concretised for a more thorough understanding of the communicative side of science, that is, of how scientists' communication as a social practice plays an important role in scientists' attainment of success. This has been the goal of the present chapter.

The data analysis has revealed that scientific publications in a specific field are one of the main measures of scientists' success globally, as perceived by the participants, to the point that they feel forced to publish their results (the 'publishing norm') in order to maintain their status as

scientists. This implicit norm, "[t]he dictum of 'publish or perish'", has been identified as ruling all scientific disciplines (Crysler, 2003: 9). In this vein, a scientists' publications are a reified form of two types of *capital* (Bourdieu, 1986): *cultural capital*, in the sense that they account for the individual's knowledge in the *field* or domain of activity (Hilgers & Mangez, 2015b) and her abilities in the scientific practice, and *symbolic capital*[99] since the "quality" or value attributed to scientists' publications endorse their recognition by the community of experts of their field of interest. Scientific publications have been attributed so much relevance that they have been deemed the 'commodities' (Smith, 2000) or 'products' (Canagarajah, 2002) with which science operates. Accordingly, they are the final object (objective and reified entity) of scientific practice. From this insight follows the concept of 'productivity' applied to science (i.e. Conn *et al.*, 2005), meaning the quantification of the outcomes of scientific practice in terms of quantity of reified products and their relative quality (Bristow, 2012). This economic simile, which has been observed in the data (i.e. excerpts 213 and 215) may very plausibly respond to a global trend identified in HE, the 'corporatization of the university' (Crysler, 2003), whereby education is being approached as an economic sector; and this has influenced the discourses reflected in texts issued by HE institutions (Fairclough, 1992, 1993). In this context, scientific journals have been equated with 'institutions' (Crysler, 2003), among which international journals are highest in the hierarchy (Paasi, 2005; Hyland, 2015). Along with publications, other measures of scientists' success appearing in the data are the projects carried out, again as a sign of *cultural capital*, the 'results' presented in written or oral format (in the PhD thesis, in reports, in conferences, etc.) (*cultural capital*), and the prestige of the RG where the scientist has worked (*symbolic capital*). All these 'measures' of success imply the dissemination of scientists' work to an external audience, the scientific community of their *field* and thus involve scientists' strategic communication in order to gain recognition (*symbolic capital*) that they can convert into *economic capital* (directly exchangeable for money). This conversion game that governs science has been described by Bourdieu (1975), who regards science as a "market in scientific goods" regulated by laws that "have nothing to do with ethics" (Bourdieu, 1975: 26).

If we consider the goal-oriented nature of scientific practice and the communicative dimension of such practice, the scientific community of one's field becomes not only an *epistemic community* – a group of agents who work on the same area of knowledge and who acknowledge the same 'procedural authority' (Creplet *et al.*, 2001) –, but also a *discourse community* – a group of agents defined by their broadly common goals, mechanisms of intercommunication

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[99] Following Bourdieu (1986), Knorr-Cetina (1981: 72) describes scientists' 'symbolic capital' as "operationally defined by some notion of recognition, credit or credibility through publications, citations, educational record, institutional affiliation, or control over relevant social relations".

and common own genre/s and lexis (Swales, 1990). The successful publishing of scientific papers has been attributed in the data to two factors: to the good planning of experiments – in the sense that they are conducive to telling a relevant story (see Rober in excerpt 215 and Fina in excerpt 233) – and to the papers' linguistic adequacy (see Hao's words in excerpt 213 and Giulia's words in excerpt 214). Both features assume the existence of three elements: certain standards of quality (evaluation norms), a validating community of powerful social actors, and a community of actors that legitimises the power of those gatekeepers. As observed by Bourdieu (1975: 25), in science, as in any field of class relations, authorities are not detached from the struggle for legitimacy "because there is no judge who is not also a party to the dispute". And hence these three elements (the evaluation norms, the validating actors and the community that legitimises them) cannot be deemed objective nor impartial, but interested pieces of the conversion game of science.

Indeed, gatekeeping – the frequent assessment of agents at different moments – has been judged essential in science (Merton & Zuckerman, 1973). Regarding linguistic adequacy, the supervision by a scientific writer who is a native speaker of English has been presented in the data as a requirement, especially when aiming at highly-ranked journals. This reflects a language ideology that presupposes a standard linguistic requirement by highly-ranked journals based on the much debated ideal of the 'native speaker' (i.e. Davies, 2003; Widdowson, 1994). As has been argued, far from being flawed, this dominant ideology among scientists may be due to their own past experiences (Minakova & Canagarajah, 2020). The biased linguistic evaluation of many English-medium (highly-ranked) journals has been widely denounced in the literature (i.e. Canagarajah, 2002; Duszak, 1997; Lillis & Curry, 2006; Strauss, 2019), and calls have been made for more specific norms that provide 'non-native' authors resources to adjust their texts to the linguistic standards required (Strauss, 2019) as well as for a balanced representation of 'native' and 'non-native' editors in journal editorial boards (Flowerdew, 2001). (Non-native) English-speaking scientists' accumulation of failures to attain the linguistic ideal required by journals may have contributed to the creation of the 'English native' *halo* in science, a generalised sense of the existence of 'nativeness' as a demographic characteristic that is hence unattainable through training or practice. This has been shown in the data in the reliance of all RGs on an English "native" language editor as an indispensable service.

English is so closely linked with science as a general ideology – being it deemed 'the language of science' (Giulia, in excerpt 214) – that some participants related scientific quality with the "good" command of English, which may have been defined, at least partially, by the linguistic criteria of journal editors. The generalisation of certain linguistic criteria among the journals of a field may give place to the 'scientific (English) language' that was referred to in the data and

614

is recognised in the literature as "International Scientific English, or ISE, the variety of scientific English used by scientists around the world of any linguistic background" (Wood, 2001: 81 in Swales, 2004: 54). Yet, the pervasiveness of English in the academia affects not only the language used and the specific form and style of this language allowed – which often serve as a pretext covering ideological prejudices (Lillis & Curry, 2010) –, but also the 'culture' reflected in most English-medium journals. According to this, writing in English differs from writing in other languages in features like learning techniques, the perspectives taken, the scholarly traditions followed, the audiences addressed, the publishing process, the consideration of what is valued as relevant, the assumed universality of what is presented, and the contextual elements integrated in texts (Mauranen, 1993; Casanave, 1998; Lillis, Magyar & Robinson-Pant, 2010). This has been deemed a type of 'colonisation' of academia (Castano Rodriguez, 2015). Also, the dominance of English appears to be endorsed by the IoHE in two ways. First, international scientists – those who were born in a different country from the one where they work and those who have returned from a foreign country – tend to rely on their international networks for work (in cross-national projects, collaborations, etc.) (Scellato, Franzoni & Stephan, 2015), which may trigger the use of "the *lingua franca* of most scientific fields" (Ponds, 2008: 79), namely English. Second, HE institutions' urge for international credit may be motivating scientists' participation in international conferences, where English also predominates (Ventola, Shalom & Thompson, 2002), and the increase of publications in international journals, most of which are Anglophone (Lillis, Magyar & Robinson-Pant, 2010).

Apart from the challenges that the imposition of English might pose to non-English-L1 scientists, the imposition of the 'publishing norm' has elicited resistances and criticisms of diverse kinds. A critical voice was raised by Agus (Group A), who questioned publications as 'a reliable indicator' of quality (excerpt 219), and who, like Carol (Group A), suggested that not only the end but also the trajectory of experiments should be considered in the evaluations of scientists (excerpts 219 and 230). Both participants defended that scientific publications reflect a made-up science, in which transgressions slip in (Carol, in excerpt 230) and failure is omitted (Agus, in excerpt 221). The tendency in science of the deliberate omission of 'negative or contradictory data', especially in public written texts (Young, Ioannidis, & Al-Ubaydli, 2008), science's lack of reflexivity and self-criticism, as well as its dismissal of uncertainty and ambivalence (Wynne, 1992) have been denounced in the literature. In the case of the participants in this study, they had to face a dissonance between their identity as scientists (of which the public refusal of failure was presented as an intrinsic feature) and their own moral and ethical beliefs that challenged such practice. This corresponds to the concept of 'sociological ambivalence' whereby "social institutions reflect potentially conflicting sets of norms" (Mitroff,

1974: 579) and social actors have to handle conflicts of norms, values and roles that fit in such ambiguous institutions (Bucchi, 2015). *Sociological ambivalence* has been identified in science as encompassing contradictions like scientists' unwillingness to publish certain parts of research results, their attachment to preconceived hypotheses, and their tendency to be influenced by their own opinion of other scientists when judging their claims (Bucchi, 2015; Merton & Barber, 1963). This phenomenon might prevent scientist practitioners from attaining "a strong identification with the competence of a community and see it as a desirable part of [their] trajectory" and hence to "try to find [their] identity somewhere else" (Farnsworth, Kleanthous, & Wenger-Trayner, 2016: 17). This might have been the case of Agus and Carol, who showed hesitation regarding their willingness to continue their career in science. In order to prevent this, a new model of scientific discourse may be needed in which the principles of honesty and transparency fit without threatening credibility (see Millstone & Van Zwanenberg, 2000).

Some effects of the 'corporatisation' of science can be observed in the content and form of texts (scientific publications). The malleability of scientists' discourse according to market demands was already denounced in the early 80s (i.e. Collins, 1981; Law & Williams, 1982). This is of course a plasticity "within authorised limits" of the field (Bourdieu, 1975: 30). Once more, *sociological ambivalence* arises, generated by the contradictory trends of treating academic/scientific discourse as a marketing tool and calling for the development of university students' critical thinking so that they can "innovate, challenge, resist or reshape the discourses of their own academic community" (Bruce, 2008: 1). The limitation of scientist practitioners' agency within a framework of market logics and capitalist norms – which are a priori alien to science – may generate a sense of non-belonging in them, as described above.

From this observation of the tension between agency and structure in science arises the idea that its internationalisation affects not only the form of (scientific) texts – which may be standardised and therefore imposed globally –, but also and perhaps especially the imposition of the frame of evaluation of these texts. The solidification over time of assessment criteria introduced and sponsored by international agents of the *field* might make these criteria self-evident and thus invisible, giving place to Collins' (1975) 'enculturational model' of science, whereby scientific knowledge is a culturally constructed artefact. The justification by scientists of social actions as being dictated by natural laws has been deemed "[a] special kind of expertise" that is key "in the justification of the contemporary neo-capitalist world order" (Van Leeuwen, 2005: 57). This 'rhetoric of reality' (Kemp, 2014), which is determined by some field standards of acceptability and value, for Knorr and Knorr (1978) the 'field/market of demands', permeates scientists' texts, contributing to maintaining a sense of 'authenticity' (Ziman, 2000) or 'scientificness' (Dimopoulos, Koulaidis and Sklaveniti, 2003). This is explained by Bourdieu

616

(1975: 23) as the "stuggle for scientific authority" or "competence", that is, actors' struggle to "impose the definition of science", in terms of "the problems, methods and theories" that are valid in the field, and to occupy the highest position possible in a "hierarchy of scientific values" by creditting to themselves the most valued features, like a certain training, affiliation with a given institution, publications in specific journals, etc. The IoHE takes this struggle to another dimension, the international dimension, with centre-periphery dialogues taking place around the globe (Oleksiyenko, 2014, 2016; Paasi, 2005; Zajda & Rust, 2009).

In line with Sismondo's (2014: 17) argument that technoscience's success is partly due to its ability to create "the societies that accept, use, and validate" facts and artifacts, in order to be successful, scientists need to learn the 'epistemologies', value systems and power relations typical of the discourse of their field (Badenhorst *et al.*, 2015, with reference to 'successful academic writers'). As put by Koutsantoni (2004: 169), "[w]hether a method is novel, a result accurate, or a structure has been demonstrated successfully, ultimately depends on what the particular disciplinary community considers novel, accurate or successful, in accordance with its standards and ideals". Success thus lies in imposing an 'obligatory passage point' (Callon, 1984) on others; in enforcing a given sense of value with certain features attached and in being able to create (and in actually creating) texts (in the case of communication) that are faithful to these features and hence recognised and valued by a community (Law & Williams, 1982). HE institutions may also be acting as the reification of such social legitimacy, "as sources of credibility and legitimation" of beliefs (Harvey, 1981: 125), by performing as quality warrants of the scientists affiliated with them. They may thus be a reified symbolic capital.

The data analysis has pointed at another problematic aspect of publications ('productivity') as the prevailing evaluation system, which is the fact that it favors men over women (by not compensating for mother leave periods and assuming that women and men scientists have the same working conditions, which entails ignoring women's higher family burden). Although quantitative studies are inconclusive in this regard, the negative impact of motherhood on scientific productivity inequalities between men and women has been decried in qualitative (or mixed-method) approaches (e.g. Armenti, 2004; Grant, Kennelly, & Ward, 2010; Mawela, 2014; Sonnert & Holton, 1995). As shown in the data analysis, women scientists may have to deal with the decision of choosing between their professional career and the balancing of work and family, especially as regards taking up managerial positions. This finding goes in line with Aisenberg and Harrington (1988); Davis and Astin (1990); Gmelch, Willse and Lourich (1986); Grant, Kennelly and Ward (2010); Hensel (1991); and McElrath (1992), among other studies. As suggested in the data analysis, communication appears as part of the solution to the work-life balance issue. Sonja's (Group G) testimony (in excerpt 224) suggests that an effective

communication in the workplace is key in making family and work compatible for it may facilitate the collaboration between practitioners with different schedules due to family demands. From this follows that the feminisation of science, that is, the participation of women scientists under the same conditions as men scientists, may depend on considering communication as a significant part of any relevant policies.

Different factors have been mentioned in the data as determining the attainment of the results necessary to give place to successful publications; that is, the 'means for success'. While some participants underscored practitioners' agency as more relevant than structure, others pointed at structural factors as more determinant. Diverse aspects of practitioners' agency have been referred to by the participants as relevant. One such aspect is practitioners' individual attitude, like 'arrogance' and willingness to be a scientist and to become 'the best in the world' (excerpt 226). Also corresponding to agency, working hard and many hours were mentioned. This stance that emphasises individual agency as conditioning success was adopted by Frank and Cecília (Group A), who related the hard-working culture with a certain nationality, and it was transmitted by them to the other members of their RG. Frank's and Cecília's (excerpt 228) power position in the RG contributed to positioning this stance as a dominant discourse in the RG and consequently as (implicitly) mirroring a dominant discourse in science more generally. As a consequence, other group members reflected it in their accounts and positioned themselves in relation to it. For instance, Diana (former Group A) argued that in competitive RGs practitioners 'work a lot', 'a lot of hours' and 'don't stop', and pointed at the group leader as the responsible agent for motivating practitioners (excerpt 229). Also Carol (Group A) evaluated her 'attitude' as potentially not matching with such a demanding job in terms of working hours, using a generalising expression that implicitly assumes Frank's and Cecília's ideology as the truth: 'the way things are set (in science)' (excerpt 230). This suggests an important influence of group leaders' and old-timers' indeologies on novice scientists. Challenging this belief but framed within a different RG, Fina (Group B) denied that investing work time and success in science correlated, arguing that quality of results was not implicit in quantity (excerpt 233). In fact, the literature investigating the predictors of scientific productivity point at a variety of factors (see Albert, Davia, & Legazpe, 2015; Kahn & Scott, 1997; Kwiek, 2016), none of which, to the knowledge of this researcher, is the time invested. Other personal attributes presented in the data as contributing to scientists' success are 'eagerness' for science – which might potentially compensate frustration because of failures –, expertise, knowledge of the research field, curiosity and being methodical. The importance of the discourses that novice practitioners come across with has been suggested by Rankin, Nielsen and Stanley (2007: 33), who contend that assimilating certain beliefs on how to succeed at work, such as "work '24/7',

not having a family, spending more time in the lab to do better-quality work, and accepting that current demographics of the STEM workforce reflect a meritorious selection process" may discourage practitioners (especially women) "from pursuing tenure-track careers". Against this prevalence of agency over structure, some structural factors have been stressed in the literature as influencing scientists' productivity and thus success at the PhD stage, like financial support, an active faculty (Brewer *et al.*, 1999) and the characteristics of the supervision they receive (Gatfield, 2005).

Other personal features contributing to success but at the same time connected with an external impact are networking and PR skills. These allow scientists' and RGs' accomplishments to be recognised and valued by external actors, which are judged key for securing new contracts, projects, funding and prestige for RGs and institutions. This can be considered a means for the capitalisation of results through communication (talks, presentations, publications, newsletters and reports) for the RGs' subsistence. Exchanges with external actors may also provide ideas and feedback on one's work (intellectual enrichment). As suggested in the data, these are communication practices more often attributed to senior researchers, who engage more in office work and travelling (i.e. excerpts 238, 239 and 240). Indeed, success in science has been linked with the construction of a career detached from laboratory activity (Latour & Woolgar, 1986 [1979]). Practitioner identity in science is thus closely linked with typical practices of which communication is a relevant part, especially as seniority increases. However, like the participants in this project, doctoral students have been found to lack the training necessary for these kind of activities, such as fundraising and publishing (Mitchell, 2007) or budgeting and managing resources (Lean, 2012). This might generate identity crises as scientists' career progresses, giving place to practitioners rejecting communication tasks or not feeling skilled enough to execute them successfully. The data suggest that access to relevant networks may depend on scientists' identity features, like power positions in the institution, gender and personality (in the sense of being adept on a selling discourse style). All three variables have been identified as determining the creation of *social capital*. In this sense, it is important to bear in mind the work of Burt (2001) and Lin (2000) regarding the relation of networking and social position; Cross and Armstrong (2008), Hitchcock *et al.* (1995), Ibarra (1993), Rankin *et al.* (2007), and Stenken and Zajicek (2010) with reference to the gendered character of professional networking, and Tulin *et al.* (2018), Burt *et al.* (1998), Fang *et al.* (2015) and Kalish and Robins (2006) on how personality traits like extraversion, openness to experience and emotional stability affect networking. Despite the more or less essentialist nature of some of these factors, claims have been made about the need for specific training on professional networking to help pactitioners overcome some of these obstacles (i.e. Rankin *et al.*, 2007) and benefit from the

professional advantages of developing relevant networks, like getting access to information, counselling, posts and resources of different kinds (Coleman, 1988; Field, 2003; Flap & Volker, 2004; Lin & Erickson, 2012).

As has been shown in this chapter, a great part of RGs' success consists in obtaining economic resources for their subsistence. A core source of funding for Group A and Group B were research project grants, and winning them was often deemed the result of the RG's strategy – of which communication was a part –, that is, of strategic decisions made (and communicated) in anticipation of what might be valued by the granting bodies (i.e. excerpts 242 and 243). Consequently, two features that the participants considered that might be valued as assets in project proposals were mentioned in the data as means for success. Such features were (a) innovative ideas, for which knowledge of the field – what has been done and what is being done – acquired through reading the relevant literature was necessary, and (b) experience in a particular topic – demonstrated through related publications and past funded projects. In both cases communication was key. Two conditioning aspects of the latter feature, as suggested in the data analysis, were the size of the RG (excerpt 246) and the extent to which the RG depended on funding from the industry (excerpt 247), whereby it would be more difficult for bigger and more industry-linked RGs to focus on one topic.

Other strategic decisions related with group productivity and success, apart from its size, the source of its funding and the topic of its projects, involved the RG's management (e.g. the task specialisation of group members so that some can focus on supervision of experimental work, others on bureaucracy and others on teaching) (excerpt 243), the establishment of a role-hierarchy in terms of decision-making (excerpt 249), and the existence of regular meetings (excerpt 249). Scientists' facet as politicians and strategists was already identified by Latour and Woolgar (1986 [1979]: 213), who argued that an important part of scientists' work consisted in the "political calculation of assets and investments", and that "[t]he better politicians and strategists they are, the better the science they produce". In project proposals, such strategic decisions take the form of a pre-designed discourse of identity that RGs construct for themselves whereby once more they claim legitimacy and competence in the project's topic and endeavour. The written project proposal is the reified instance of the accumulation of scientific credit or *scientific capital* by the members of the RG that will potentially trigger its conversion into *economic capital* (through the achievement of the grant pursued) and this will in turn be converted into *material* and *human capital* (resources of diverse kinds), invested by the RG for the successful achievement of the results defined in the written project proposal.

Resources like 'money', 'machines', 'technology' and 'people' were considered by the participants in this study to make research 'easy' and hence to facilitate the faster achievement of competitive results and the generation of time for writing and publishing (i.e. excerpts 250 and 260). The availability or absence of resources have been argued in the data to affect laboratory work (in the sense that the practitioner has to decide what is feasible and not accordingly) as well as the RG's strategy (e.g. in situations of availability of funding, the group may focus on lab work, and in times of shortage, on writing publications). Resource inequalities were attributed by the participants to the RGs, to the research centres, and to the national contexts. The data analysis has also suggested the intuition of the *Matthew effect* – the crediting of higher recognition to scientists who already hold prestige (Merton, 1968) – by some participants, who defended that resources of diverse types would potentially bring other resources and thus success (i.e. excerpts 220 and 260). This has been also identified in the literature as "a kind of winner-take-all phenomenon typical of mass markets" (Geiger, 2004: 264), in this case with reference to American universities. The consequences of the *Matthew effect* for science and for scientists have two interpretations. On the one hand, it has been found to be positive for science as a system, since it facilitates resource allocation processes, but on the other hand, it undermines more novice, peripheral or less awarded actors, and at the same time it proves that the unequal and pyramidal distribution of resources is intrinsic in science (Bucchi, 2015). Institutional policies and/or national laws may mark the type, quality and quantity of resources available for RGs. An example is the limitation in most Catalan universities of the time devoted to research by compelling scientists to combine research with teaching. Diversely equipped RGs might be classified into different categories of competitiveness, whereby the 'less competitive' ones act as training units for scientists before they can work in 'more competitive' RGs (i.e. excerpt 23). Given the structural relevance of the resources avaiable in the RG and in the institution where research is conducted, Travaille and Hendriks' (2010: 425) assertion that "[t]he success of an institute is both a component of the individual success of scientists and an enabling condition for gaining and enhancing success" proves pertinent.

The RG's success has also been related in this chapter to its efficient 'organisation', which has been argued to depend highly on the group leader's work culture, and this might be in turn nation dependent (excerpts 257 and 258). Therefore, the RG as an organised research unit serves as a key actor for seeking funding, for handling the recruitment of scientists, and for managing research resources, among other endeavours (Geiger, 1990; Sá & Oleksiyenko, 2010); and its character and charisma appears to be highly dependent on the group leader. This statement aligns with Casanave's (1998) and Geertz' (1983) argument that local factors, like specific

interactions, pratircular settings and immediate contacts, are highly influential on the evolution of academic practitioners' texts, identities and ideologies. Consequently, the relation between agency and structure in science appears to be mediated by the RG's culture or in-group 'rules of social life' (Giddens, 1984).

The data analysis has also revealed three discourses that construct science as a social, political and economic instrument, which may originate in policy-making institutions and permeate individual scientists' communication (and potentially also their ideologies). These three discourses identified in the data are: (a) a discourse of science as seeking social welfare and justice, (b) a discourse of science as an economic instrument, necessarily linked to the industry, and (c) a discourse of science as an essential piece of globalisation. With reference to the first, Agus' (Group A) dissenting voice denounced the use of the power of science to make political statements – utilising the 'cultural authority of science' (Gauchat, 2012; Blank & Shaw, 2015) – as well as the existence of hidden interests disguised in philanthropy and disinterested social service. From this follows that science seems to insist in concealing its politicised tenor despite the multiple voices that have denounced it (i.e. Blume, 1974; Collins, 1981; Latour, 1999). This is problematic not only because one of the four founding principles of science described by Merton (1973), *disinterestedness,* appears to be dangerously threatened, but also, and most importantly, because scientists seem to take shelter behind it by drawing freely on this discourse in their texts.

As regards the second discourse, the relationship between science and industry is problematic because it is defectively defined. This discourse positions scientists in an ambivalent situation according to which they must devote their efforts to satisfying the mandates of companies and funding bodies and, at the same time, comply with the rules of (academic) science. Accordingly, RGs and research centres seem to have the need "to be accountable to disparate sets of actors" (Sá & Oleksiyenko, 2010: 369), like funding bodies, the university to which they are ascribed and the epistemic community of their field of expertise, thus making their agency very complex. The industrialisation of HE and of science has in fact raised a great deal of concern among experts in five directions: (a) regarding the instrumentalisation and to some extent potential manipulation of university by industry and the progressive abandonment of basic research for more applied topics (changes in the research agenda) (Geuna, 2001; Vavakova, 2014) – "the 'skewing' of academic research" (Florida & Cohen, 1999: 593) –, (b) the threat to academic independence (Behrens & Gray, 2001; Blumenthal *et al.*, 1986), (c) dilemmas of resource investment when limited resources (time, materials, etc.) have to be devoted either to university duties or to collaborations with industry (Faria, 2002; Calderini, Franzoni and Vezzulli, 2007) – the 'complementarity role thesis' (Rebne, 1989) –, (d) the retraction of open knowledge

dissemination (Nelson, 2004) – the problem of 'academic secrecy' (Florida & Cohen, 1999: 599) – or its delay (Geuna, 2001), and (e) the decrease in productivity in terms of publications (Agrawal & Henderson, 2009).

With reference to the two latter aspects, which are the most directly related with scientists' communication, while the industrialisation of science seems to be of benefit to research centres (universities and institutes) and national economies (Gornitzka & Maassen, 2007) by injecting private funding to them, it might be detrimental for individual scientists whose career depends highly on publications (e.g. to be valued as successful practitioners and to have access to prospective job vacancies). In this regard, the dependence of RGs on industry was also found by some participants as an obstacle for scientists' possibilities of publishing their work (i.e. excerpt 247). In this case, the expectations of these two communities to which scientists belong (the scientific and the industrial communities) seem to conflict (Nygaard, 2015). This entails a double career for the scientist, who must find and manage efficiently the resources necessary for both missions: accommodating to the demands of their funding bodies (private companies), and at the same time presenting themselves to the scientific community of their field and accumulating reified capital (publications) to remain competitive. How these conflicts of interest and of identity could be solved ethically in an industrialised science, that is, intending to keep the ethical values of science, if it is attempted to be preserved as such, needs to be addressed by policy-making actors.

The dependence of scientific results on industry could also be claimed to compromise the principle of *universalism* traditionally attached to the 'scientific ethos' (Merton, 1973), as well as scientists' credibility (Ziman, 2000). The increasing economic reliance of the university sector on funding agencies and private foundations, and the stimulation of university-industry cooperation in Europe, mirroring the worldwide sovereign (Geiger, 2004) American research system, may bring European universities to a 'paradox' whereby while they may get "greater resources, better students, [and] a far larger capacity for advancing knowledge", they may also find their autonomy and their mission of social service reduced and their "privileged role as disinterested arbiters of knowledge" (Geiger, 2004: 265) threatened. The increasing promotion of the industrialisation of science may increase these ambivalent positions in which conflicting interests have to be negotiated, like whether to devote time and resources to experiments/controls that provide publications or to those that provide patents, industry funding, and commercial products. The practice of the RG is framed within these dilemmas and contradictions, which appears to generate an ambiguous sense of identity between unit of economic production and nucleus of thought and educational, intellectual and/or professional enrichment.

In this regard, the literature presents contrasting results. On the one hand, evidences of publication delays due to university-industry collaboration have been found (Blumenthal *et al.*, 1996; Thursby & Thursby, 2002) as well as proofs of increased secrecy (Campbell *et al*., 2002; Louis *et al.*, 2001). On the other hand, multiple studies support the opposite, that is, that university-industry relations increase productivity (Breschi, Lissoni, & Montobbio, 2007; Buenstorf, 2006; Carayol, 2007; Gulbrandsen & Smeby, 2005; Lowe & Gonzalez-Brambila, 2007; Magerman, Van Looy, & Debackere, 2015; Stephan *et al.*, 2007; Van Looy, Callaert, & Debackere, 2006; Zucker & Darby, 1996). It has also been claimed that secrecy may be discipline (Hong & Walsh, 2009), institution and nation dependent (Walsh & Huang, 2014) and that it can be counteracted by HE institutions (Brooks & Randazzese, 1999). These contradictory results could be explained by the existence of several intervening factors not considered in all studies, such as (a) the share of industry funding (high predominance of industry funding may lead to productivity decrease) (Blumenthal *et al.*, 1996), (b) the length of the relations with industry (long relations may affect productivity negatively) (Goldfarb, 2008), (c) either the profit-driven nature of the projects (non-profit projects may increase productivity while for-profit projects may hinder it) (Czarnitzki, Glänzel & Hussinger, 2009) or the commercialisation ends of the projects (which slow down productivity) (Buenstorf, 2006), (d) scientists' personal circumstances (i.e. age and motivation) (Levin & Stephan, 1991), and (e) discipline specificities (productivity increase might be exclusive of engineering researchers) (Calderini, Franzoni & Vezzulli, 2009). The omission of these (and potentially other) factors may explain the inconsistent conclusions in this regard. More refined research in this topic may be necessary in order to better understand how the industrialisation of HE and of science affects scientists' communication.

Regarding the other concerns about this phenomenon, which are more related to HE policies, like the nature of research, its aims and agenda, there is a need for more specific policies that contemplate explicitly the "shift" in the university mission from a supplier of knowledge for society to a core economic drive (Blumenthal, 2003; Philbin, 2008). If HE institutions' answer to the urge for the creation of new knowledge and the diversification of funding sources that the higher costs of new research demand (Ankrah & AL-Tabbaa, 2015) is their increasing industrialisation, this new paradigm should be supported by tools that help practitioners and policymakers deal with the increased complexity that this new scenario demands. 'Post-academic Science 2.0' (Bucchi, 2015) adds pressures to all stakeholders in two directions: by fostering collaborations with industry and by promoting international collaborations. As a result, HE institutions and practitioners need to handle new cultural and normative impediments (Ponds, 2008), which should be considered by policy-making bodies at all levels in order to

suport the actors facing difficulties. HE institutions should devote some efforts to the clear and straightforward definition of their mission in this new context of increasing industrialisation, and decide what their governing principles are in order to protect them explicitly through policies. If the new ethos of science is different from the market of goods, it should be unequivocally and noticeably defined as such.

The third discourse, which constructs globalisation as an independent force of which science is a key component, urges national governments, HE institutions, research centres and RGs to accommodate to supposed international directives and trends, evidencing that "[c]hanges in territorial boundaries of markets and political systems" affect "the boundaries of research and higher education" (Gornitzka, 2008: 4). This mandate of adjustment acts as an underlying, implicit norm, whose consequences in the middle and long term are omitted in scientists' daily communication. Sá and Oleksiyenko (2010) have identified 'organized research units' (centres, institutes, and laboratories) as key actors in the accommodation of an international/global agenda into the local context. The hierarchical and scalar process that such accommodation follows (from international entities, to national governments, research centres/universities and RGs) contrasts with the idea of the *universality* of knowledge arguably intended by science and by globalisation in the sense that the local context plays a relevant role in this layered accomodation (Gornitzka, 2008).

The international mobility of scientists has appeared in the data as a very pervasive trend and is part of internationalisation policies of HE institutions worldwide, as shown in the literature (Altbach & Yudkevich, 2017; Khattab & Fenton, 2015; Richardson & McKenna, 2003; Welch, 1997). Although it might seem an individual decision, the fact that mobility was a requirement in most grant calls gave it a sense of concealed policy that the participants assumed in spite of their resistances (i.e. excerpts 271 and 272). In fact, international faculty recruitment has been identified as "not just an institutional policy, but part of a national competitiveness building strategy" (Gress & Ilon, 2009: 184), and a variable considered in international university rankings (Altbach & Yudkevich, 2017). Despite the personal and professional enrichment that, according to some participants, international experiences might provide (i.e. excerpt 273), the data suggest that the generalisation of international mobility might potentially trigger *brain drain* from which richer states could benefit by attracting the best scientists with promises of better conditions and rewards (Horvat, 2004; Giousmpasoglou & Koniordos, 2017). As has been argued in the data analysis, these top-down internationalisation policies might sometimes find local resistance through practices like string-pulling in job vacancies (i.e. excerpt 274) (in line with Casanave, 1998, about Japan), the rejection of international newcomer practitioners by local agents (i.e. excerpt 275), and scientists intending to compensate their refusal of mobility

625

through an extra effort to publishing their work (excerpt 276). Concerning these aspects, there is a strand of research dealing with a variety of integration problems for foreign/international university faculty, such as bureaucratic obstacles, conflicts between international and local faculty, disenchantment of international faculty for local rules (Altbach & Yudkevich, 2017) as well as for the marginal role in the institution attributed to them (Brotherhood, Hammond & Kim, 2020), the closed nature of the local academic market and the unwelcoming institutional atmosphere (Huang, Daizen & Kim, 2019).

In relation to scientists' communication, a potential type of enrichment for individual scientists provided by international mobility is encountering (and potentially learning and using) other languages. The data analysis has evidenced different ideologies among participants with some international experience that may have affected their decisions as regards their language learning and use abroad. Although English was deemed the language of science, indispensable for work in Group G's institute and in Group A, there seemed to be some opportunities for other languages, as an asset in networking and obtaining job posts (see excerpt 277), as an instrument in long-term strategic international relations with other partners (see excerpts 286 and 287), and as a requirement for socialising out of work and 'live' instead of just 'survive' abroad (see excerpt 282). In this sense, past experiences of international mobility and the language/s acquired after those may be valued as an important *capital* for the generation and management of resources in science.

Nonetheless, scientists are not always motivated to learn local languages. What, following the data, contributes to supporting their learning and use of languages other than English is their sense of need for those languages (e.g. whenever the general population is not an active user of English; and when government bodies do not accept communication in English) as well as the perspective of permanent or very long stays in the new country. Even when they are learned, these languages may be relegated to the private domain and/or to non-professional interactions, which may result in the association of English with (professional) success and the consideration of other languages as accessory and annoying. Despite the revitalising and invigorating intention of policies forcing the learning of local languages, the data analysis indicates that these might generate or reinforce scientists' rejection of these languages. In cases where there are more than one official local languages, as in Catalonia, with Catalan, Aranese and Spanish as official languages in all its territory, some phenomena may favour the learning of the "largest" language over the "smallest" one/s, in a process of certain *capitalisation of language learning*, whereby scientists may prefer to learn the language with the largest number of speakers or the most geographically spread in order to make their effort more profitable. Once more, as professionals and strategists, scientists may opt for capitalising their investments (in terms of

626

time, effort, etc.) by choosing to learn the language with the highest probability (for them) to be used in the future. From this view, language learning may be understood as part of the strategy of "continuous economic capitalization of the self" (Rose, 1999: 161) that modern societies require. In this sense, scientists may prefer to learn the national language of the whole nation-state (like Spanish) – thus taking the nation-state as a 'frame of reference' (Allport, 1940) – even when the other language is more present in their immediate environment (like Catalan in HE institutions in Catalonia). The IoHE could potentially imply the redefinition of the *frame of reference* taken by scientists from the national to the international context, from locality to globality and from parochialism to cosmopolitanism, and accordingly their preference for global languages (like English, Chinese, Spanish, etc.) over (perceived) local languages.

Apart from the considerations that the learning and use of local languages might require, the use of English as a *lingua franca* in scientific communication might also be problematic due to the variable abilities of practitioners in this language or to the peculiarities in the form of users' outputs. This again might favour practitioners with "better" (meaning "according to the norm") English language skills, who might be perceived as more competent scientists, often coming from certain countries where English is more present. Although some 'culturalisation' or 'localisation' in academic English texts written by multilingual scholars has been identified, whereby some local traits permeate international texts (Canagarajah, 2006), these need to be negotiated with powerful gatekeepers, like journal editors, who have the power to accept or reject them, and thus to shape the characteristics of the (English) language used in science. For the language and the texts of science to be international in the richest and most democratic sense of the term, their gatekeepers should regard those as opportunities for the interaction of diverse traditions from different geographical origins (Rodríguez-Pose, 2004).

In conclusion, success in science is highly reified in terms of publications and impact factors ('productivity'). The definition of the means to achieve success is often based on scientists' ideology, which at early stages of scientists' career may be highly influenced by the ideologies of the leader of the RG, and later on by powerful members of their epistemic community, like gatekeepers. As demonstrated in this chapter, the internationalisation of science, often framed within the IoHE, affects not only communicative resources, but also many structural components of scientific practice (e.g. setting, materials, values), which tend to follow international conventions and which ultimately affect also the structural aspects of scientists' communication. In this sense, sites of power or imposition/domination mechanisms that affect scientists' communication are standardisation processes, the imposition of 'points of passage' (Callon, 1984) by legitimised actors, the race for recognition of one's position in the field, and the accumulation of credit and prestige (by already credited actors), among others. Yet, although

communication for success in science consists of very conventionalised practices, there seems to be a general lack of explicit norms, which generates frustration, misunderstandings, contradictions and identity crises. Also, the lack of explicit and thorough (internationalisation) policies from relevant agents may be the reasons why the RG constitutes a very significant context shaping agency, and the group leader has become a very significant local policymaker, filtering mandates and trends from international actors into the RG, and marking strongly group members' (communication) practices. However, the fact that the group leader is neither guided nor advised by the institution in terms of internationalisation policies might result in the RG and the institution acting in different directions. Also, science as an institution as well as HE institutions as key actors in it appear to be ambiguous and very little straightforward regarding their mission, principles and goals, which hinders the traditional characterisation of science (and of scientists) as disinterested, altruistic, trustworthy and universal.

Finally, the framing of science as a culture, with its idiosyncratic norms and values that are imposed without the need for clarification (like a *dogma*), increases power asymmetries in it. In this chapter, some resistance to norms has been presented, like scientists' questioning of the evaluation system of science, their avoidance of international mobility, and their nonacceptance of international colleagues, among others. Yet, in a context in which agents' identity (as scientists) is defined by their practice (doing experiments, publishing in scholarly journals, etc.), which is in turn validated by the same community that affords the practice (the RG, the institution, the epistemic community of the field), resistance to norms appears as a marginalising practice in itself, as noted by Bourdieu (1975). And this reinforces the status quo of the power structure of science. A science that deems itself 'democratic' – in line with democratic science communication models like the 'participation model' (Trench, 2008) – should intend to embrace these dissenting stances and arguments, to consider and to value them as a valid facet of *universal* science. If the democratisation of science (Davies & Horst, 2016; Kurath & Gisler, 2009) is a sincere move, intellectual pluralism and critical stances should be embraced, and "the rules of legitimacy construction" (Bristow, 2012: 235) in science, which currently consist in "loveless instrumental demands" (Clarke, Knights, & Jarvis, 2012: 13) should be redesigned.

Chapter 9: Conclusions

The final chapter of this thesis will summarise the *raison d'être* of the project, that is, its initial motivation, as well as its main findings, following the order of the analytical chapters (meso-micro-macro-level findings). Next, the thesis' core contributions to the literature will be underscored, and some practical implications of our work will be suggested. Finally, several limitations of the research project will be presented together with some ideas for further research.

This work stems from an interest in the current worldwide internationalising trend in HE, which in recent years has become a very popular concept in Spain (and in Catalonia), being it referred to in many policy documents concerning HE. The IoHE, here defined as "the process of integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education" (Knight, 2003: 2), remains a vague concept in institutional documents, often used as a hallmark of excellence and competitiveness for universities. Theoretically, it has been described as consisting of university 'strategies' that materialise in 'activities' of diverse kinds (i.e. the internationalisation of the curriculum at home, student and staff mobility, the development of international networks, etc.) (see De Wit, Rumbley, & Vélez-Ramírez, 2017; Van Damme, 2001). As regards science, the IoHE has been linked with the creation of multinational research groups (at home), the international mobility of scientists, and the international collaboration between scientists, among other activities. Yet, despite the relevance of communication in most of these activities, its characteristics and effects on them remain under-researched.

This thesis responds to the necessity to study the 'informal' aspects of the strategies concerning the IoHE, as are "patterns of power and influence, personal views of organizational and individual competencies, patterns and groupings of interpersonal relations and communication systems" (Knight, 1997: 17), specifically in relation to scientists. We have deemed these aspects to be comprised in scientists' daily communication and this has been the object of study of this project. This work was thus intended to contribute to the understanding of the phenomenon of the IoHE and to the improvement of internationalisation policies of higher education institutions, specifically as regards communication, as well as of the wellbeing of scientist practitioners. To this aim, we have investigated the impact of the process of the IoHE on the daily communication of scientists. Accordingly, the first and foremost research question of this research project was: *In what ways does the process of the internationalisation of higher education that prevails nowadays influence scientists' daily communication?*

629

This phenomenon has been approached here from a qualitative perspective, by adopting an ethnographic methodology and by offering a holistic explanation of it. Methodologically, this work aligns with case-study research, for the research group was chosen as the social unit – the 'case' – to be analysed. Two RGs were selected as the main cases investigated (Groups A and B); and additional data and/or insights were collected from other two RGs (Groups G and I), which have been contrasted with the data and insights obtained from the focal RGs. Considering that multinational RGs are a sign of the IoHE, related with international mobility, two multinationa RGs were selected to be the focus of the study, which were composed of 13-16 and 12-15 members variably. Their work belonged to the natural sciences; and both RGs were based at a Catalan university, and were thus framed within the context of the increasing internationalisation, Europeanisation and globalisation of Spanish/Catalan HE.

Scientists' daily communication has been operationalised here as corresponding to the RG's multimodal communication policy, consisting of practices, beliefs and management in relation to multimodal communication, following Spolsky's (2004) notion of language policy. Once the communities to be studied had been defined, we sought the identification of the means of communication, the patterns of communication and the rules of appropriate communicative behaviour of the RGs studied in order to unveil hints of internationalisation in these. In the case of Catalan HE institutions, their adaptation to the IoHE concerning scientists' communication has materialised in the modification of language policy plans to embrace multilingualism and especially the use of English. Given the preponderance attributed to language by these institutions, being it the most explicit (if not the only) reference to communication in internationalisation policy documents, in this thesis language has been given special consideration as part of scientists' communication. Catalonia has been deemed an interesting setting to study the impact of the IoHE on scientists' communication due to the sensitivity for language policy at all levels of higher education as well as the explicit commitment of the Catalan government and of all Catalan state universities with internationalisation.

Apart from its empirical objective, summarised in the main research question, this thesis had also a theoretical objective. It was intended to design and prove a theoretical framework adequate for the exploration of the phenomenon studied, holistically (at different levels of analysis). Following Wenger-Trayner's (2013) suggestion of the 'plug-and-play' between theories, the proposed theoretical framework is an articulated model that combines different theories that were judged appropriate for the exploration of different aspects of scientists' communication. The community of practice (Lave & Wenger, 1991) helped the exploration of issues related with learning, identity and socialisation in the RG and the role of communication in these. The ethnography of communication (Hymes, 1964) provided concepts for the

exploration of communication in communities. Multimodal social semiotics (Kress, 2010) guided the micro-analysis of specific 'texts' (communicational events or inscriptions). Also, concepts from Bourdieu's (1977) theory of practice and Giddens' (1984) structuration theory aided the interpretation of the phenomena related with scientists' communication at the macro-social level. How these can be combined in order to conform an articulated framework has been shown in chapter 2. After having designed the theoretical framework, we have tested it by using it as the etic coding scheme for the data analysis and as the guideline for the interpretation of the phenomena observed.

The analysis of the data has followed thematic and content analytical methods, as well as (multimodal) critical discourse analysis, in the light of the theoretical framework designed. Fairclough's (1992) 3-D model of critical discourse analysis has inspired the distinction of three dimensions (or levels) of discourse analysis: the meso dimension (addressing the consumption, production and distribution of texts), the micro dimension (addressing the 'texture' or text form) and the macro dimension (considering communication as a socio-cultural practice). These dimensions have guided the chapters of data analysis. Departing from the meso level, to which the RG – understood as a mid-level social aggregate – pertained, chapter 5 has proved the correspondence of the CoP model with the characteristics of the RGs studied, and chapter 6 has presented multiple aspects of the production, consumption and distribution of texts within the two main RGs, with a special emphasis on their language policy. Approaching the micro level of analysis, chapter 7 has shown how the IoHE influences the formal features of a range of texts produced by some of the participants. Finally, regarding the macro level of analysis, in chapter 8 diverse socio-cultural aspects of the RG's communication have been approached, such as the relevance of publishing for scientists' success, the elements set as means to attain success, and the relations established between science and certain social, political and economic discourses that permeated the texts produced by some participants. The main findings of each chapter will be summarised in what follows, with an emphasis on their contribution to the literature.

The meso level of analysis has been approached in chapters 5 and 6 with two different aims. First, in chapter 5, to validate and characterise the CoP theory as a suitable theory to study communication in RGs. Second, in chapter 6, to explore the communication patterns of the two core RGs studied as regards the production, distribution and consumption of texts by their members, and to detect the connections between these practices and the IoHE.

Regarding the validation of the CoP theory as suitable for the study of RGs, in chapter 5 we have argued that it appears as a convenient departing model to study the situated practice of scientists, given that it provides concepts that help the study of communication in RGs at the

meso level of analysis, such as forms of participation, centrality-peripherality of practice and boundary objects and practices. The CoP theory has allowed us to identify the role of communication in the social practice of a RG, like in the situated learning and in the construction of identity by its members. In fact, the CoP model and the RGs studied share some core features. As in CoPs, the members of the RGs engage together (*mutual engagement*) in communicative events such as group meetings, lab mentorships and spontaneous interactions in the workplace, in the pursuit of the *joint enterprise* of 'doing science' and more precisely of 'generating new knowledge to develop their field of research'. This *common practice* gives place to a *shared repertoire* of common resources, like artifacts and communicational resources. Also, participation in the RGs studied entailed a learning trajectory regarding how to do science, specifically within the RG's scientific *domain* of specialisation. And it also involved an identity trajectory for scientist practitioners, evolving from novices to expert scientists.

However, these common features proved more nuanced than they are defined in the CoP model. Regarding group members' *mutual engagement*, it was common in the context of the RG's headquarter laboratory, especially at the initial stages, but there was a progressive detachment from all colleagues, while bonds were usually established with out-group individuals in sometimes very relevant ways for the participants. The data analysis has unveiled a set of factors that facilitated the *mutual engagement* of group members in their working environment. These were: (1) the sharing (or not) of a working space, the headquarter laboratory, as well as of a lounge area; (2) having a common (or different) object of study and/or a similar project, which might imply applying similar techniques and facing common difficulties; (3) having the same schedule at work; (4) character affinity (or disparity); (5) having (or not) the same nationality and/or L1; (6) mutually engaging (or not) in extra-work activities, like going to the gym together, to foreign language lessons, to dinners or to parties; (7) the different (or same) nature of their daily practice depending on their status (group leaders and senior researchers used to engage in office work and almost never in lab work); (8) the perception of (un)relatedness of their individual projects; (9) the fragmentation (or not) of their working space, which expanded beyond the headquarter lab to other rooms, offices and spaces; and (10) the (ir)relevance of extra-group collaborations and interactions. The majority of these conditioning factors have been identified in the literature; yet, they have never been presented as a list of influencing variables.

Concerning the *joint enteprise*, a homogeneous joint enterprise of all group members could only be defined in very general terms as 'doing science' and 'generating knowledge to develop their research field'. Beyond that, their enterprises were neither unanimous nor stable, but rather individual and sometimes changing throughout practitioners' trajectory in the RG. Furthermore,

most often they were set by another agent, the group leader, and were thus sometimes alienating. The *domain* corresponded greatly with the group leader's recognised specialisation. But newcomers seemed to be less attached and committed to it the more incipient their career was. This has been hypothesised here to be due to the hybrid nature of these RGs as learning communities and also as socio-economic units. Participation in the RG-CoP was at the same time a means for scientist practitioners to gain the necessary skills as well as a means to acquire the capital (Bourdieu, 1986) needed to 'survive' as working individuals. As regards the *shared repertoire* of the members of the RGs, the analysis of the data has helped the documentation of a wide range of elements composing it. These shared resources were elements present in their working space, some communicative and linguistic elements, like a specialised linguistic repertoire of their *domain* and a group jargon, a set of 'techniques' for doing experiments, and a range of specialised images, graphs and symbols, among other resources. It constituted a kind of *learning curriculum* that needed to be 'learned' in order for practitioners to become recognised members of the RG, of the institution and/or of the *domain*. The international or internationalised nature of many of these elements could be deemed a type of internationalisation of the curriculum, in this case in research.

Although the members of the RGs studied shared a *domain* of activity (their research field and their laboratory), their *practice* (a defining feature of CoPs) was not the same for all of them, and 'exactly the same' for none of them. Instead, they carried out *coinciding practices*, some of which they had learned from other group peers through their *sporadic mutual engagement*. Through these practices, they attempted to achieve their *individual enterprise*, which again might or might not coincide with that of other group members. This involved their collaboration with other co-members most frequently in dyads or small subgroups. And hence, group members' engagement was neither 'mutual' for all of them nor all of the time. In contrast with the original description of a CoP, in the RGs observed transactional interest predominated over the sense of group unity, uneven relations prevailed over symmetrical relations of all group members, and instability (of members, of practices and of relations) dominated over durability.

The boundaries of the RGs were not only based on their core practice but they were also highly institutionalised. We have also raised questions as regards the centrality of the members of the RG, which did not seem to coincide with their mastery of the core practice of 'doing experiments'. On the one hand, it could be argued that the core participants of the RG-CoP were the lab-workers (BA, MA, PhD students and postdocs), since they were the ones who had more sustained contact with one another while engaging daily in the core practice of 'doing experiments', as a result of which they mastered this practice more than the RG's office-workers (old-timers). Yet, on the other hand, other senior researchers, who did not engage in

doing experiments, were formally recognised as expert practitioners, the main exponent being the group leader. She also held power over all the practices carried out by the other members of the RG and was the identity marker of the RG. Centrality in the CoP thus did not correspond with hierarchical authority nor with institutional recognition. Also worth noting was the importance of *boundary (learning) trajectories* for the members of the RGs studied. An interesting case of this was the group leader, who, despite being a core member in it, used to devote a lot of time to boundary practices, like participating in international meetings and in international evaluation panels.

Also regarding the management of boundaries, one of the main goals of their practice was producing *boundary objects* (publications) that would transcend the RG and impact other practitioners of their *domain*. Likewise, the use (consumption) of *boundary objects* was key for their practice, given that they needed to engage in the negotiation of the meaning of imported scientific publications. Moreover, most group members engaged in brokering practices as part of their professional practice. They carried out *peripheral participation* (i.e. through collaborations, internships, joint projects, etc.) in other communities, sometimes based abroad. These contacts created *constellations of practices* (Wenger, 1998) around the world, and this corresponds with a form of internationalisation: developing international networks (see Scellato, Franzoni, & Stephan, 2015). This generated their hybrid identity as members of more than one community, and in some cases their sense of belonging to these remote communities rather than to their own RG.

Considering the commonalities and the differences described between the CoP and the RGs explored, we have suggested its blending with other concepts like knowledge networks (see Skyrme, 1999) and epistemic communities (see Creplet *et al.*, 2001), which may provide helpful insights in order to better understand some aspects of RGs, like the importance in these of the creation, accessing and sharing of knowledge, as well as of having a procedural authority, a common intepretation framework and a common language. We have underscored that the practice of science is multifaceted, being it a situated practice and, at the same time, an intellectual activity beyond space-time constraints, a discourse and a market. We thus coincide with Amin and Robert's (2008) claim that the dynamics of epistemic, professional and knowledge formation communities (among others) do not coincide completely with that of the communities studied by Lave and Wenger (1991) and Wenger (1998). The inherent innovative nature of science, bonded with the ever-changing technology (i.e. of lab machines), may prevent it from being the practice that CoPs develop. The practice of science, always evolving, may never stay the same, and a CoP's practice may need to be stable and repetitive for it to be

teachable by old-timers and for learning trajectories in the CoP to be inbound, which was not so in the RGs studied.

Besides its combination with other concepts referring to communities, we have also suggested the need for the development of the CoP model in other directions, if it were to be used for the study of scientists' communication. The role of communication is not particularly addressed in the CoP model, despite its evident relevance in situated learning. For this reason, we have proposed its combination with other communication theories, like the EoC and MMSS. This can be deemed a contribution of our study, in which multiple sites where the participants' communication was required or fostered during their professional practice as members of the RG have been identified. The EoC (Hymes, 1964) has proved useful in contrasting and characterising communicative practices, conceptualised as communicative events and their components. Some concepts of this model have been supported also by concepts from genre theory (Chandler, 1997). In contrast, the CoP theory has enabled the understanding of social processes that took place in the RGs studied, conceptualised as learning communities, and that were relevant for this study. Some such processes were situated learning, legitimate peripheral participation, forms of participation, and boundary practices. Finlly, relying on MMSS for the micro-level analysis has allowed us to observe a wide range of elements (communicative modes and resources) that intervene in scientists' communication and that are influenced by the IoHE.

Chapter 6 had two interrelated objectives, phrased in the following two guiding research questions: *What kind of multimodal communication policy does the group abide by?* And *how is this multimodal communication policy influenced by the internationalisation of higher education?* As regards the first question, this thesis has presented several major findings. First, the data analysis has revealed that communication plays a preeminent role in scientists' daily professional practice. It is not only intrinsic in most practices, but also a key aspect of their success as scientists. These findings are in line with works on scientific representation (e.g. Knorr & Knorr, 1978; Liu & Owyong, 2011; Lynch & Woolgar, 1988), on multimodal communication among scientists (e.g. Mondada, 2005; Alač, 2005), on academic literacies (e.g. Casanave & Vandrick, 2003; Prince & Archer, 2014), as well as on success in science (e.g. Leahey & Cain, 2013; Travaille & Hendriks, 2010).

Another original finding of this study is the identification of 'doing experiments' not only as a communicative event but also as a *central* communicative event. Most participants devoted most of their working time to it; it was the topic of most interactions (either to report on it, to negotiate its characteristics, to learn the procedures involved in it or to export its outcomes); and it acted as a legitimising resource for those texts aiming to transcend the RG as well as a source

635

of recognition (or lack of it). It could be argued that 'doing experiments' was higher in a hierarchy of communicative events, which resonates with the notion of 'genre hierarchy' (Paltridge, 2012) in genre analysis.

Also relevant as regards the characterisation of the multimodal communication policy of the RGs studied is the identification of more than 80 (prototypical) communicative events that constituted the communicative repertoire of the RGs. This is, to our knowledge, the most comprehensive list of communicative events in which scientists might participate as part of their professional practice. This adds to the academic literacies literature, which has identified some of these, like the letter (Bhatia, 1993; Swales, 1996), the lecture (Thompson, 1994; Lee, 2009), the academic essay (Creme, 1996), the research report (Nwogu, 1991), the dissertation (Paltridge & Woodrow, 2012), the research talk, the research article and the PhD defense (Swales, 2004) – see also in Swales and Feak (2000) more than 15 '(academic) genres' identified. This also opens up the potentiality of connecting the academic literacies field with that of scientists' multimodal communication, in line with Prince and Archer (2014). This way, claims for the integration of multimodality into academic literacies (i.e. Archer, 2006; Lea & Street, 2006) may be to some extent satisfied. This finding also proves the plausibility of "plugging" the CoP theory with the EoC, that is, by reformulating the shared repertoire (of communal resources) of the CoP model as containing a shared communicative repertoire, which is composed in turn by a set of (prototypical) communicative events. This hence constitutes a point of connection between these two approaches. The CoP theory could be further developed to include communication by introducing the notion of (shared) communicative repertoire, composed of (prototypical) communicative events.

Another original contribution of this study is the consideration of three types of prototypical communicative events of the RG and/or their inscribed outputs ('inscriptions'), instead of the two types of 'research genres' set by Swales (2004): 'open' and 'occluded or supporting' genres. While the former type would correspond to those events/inscriptions that were public, the latter would encompass the events/inscriptions that were exclusive of the members of the RG. Yet, a third composition of participants was documented in this study: there were some events/inscriptions that offered a restricted access but involved both in-group and out-group individuals. We have proposed the label 'restricted' events/inscriptions to characterise them. This third type corresponds to those events/inscriptions with merged features of the other two types, like being partially public and visible and/or audible by a restricted audience (half-open), and unpublished and aimed to support other events/inscriptions (half-occluded and supporting). The importance of these events lies in their key role in the development of constellations of practices among RG-CoPs, many of which are international. Methodologically, they are

interesting because they offer cues on the often 'occluded' events/inscriptions because they are more easily observable (they have less access restrictions) and provide insights on the practices that support 'open' events/inscriptions.

Equally important concerning the production, distribution and consumption of texts is the consideration that the participants' rank and seniority in the RG determines the ways in which they participate in the diverse communicative events and how they interact with each other, in line with Latour and Woolgar's (1986 [1979]) notion of the multiple identities of scientists. This has also been acknowledged to some extent in academic literacies works that have looked at identity construction in academic texts. For instance, Lea and Street (1998) analysed the correcting feedback on undergraduate students' written assignments, and noted that different identities (e.g. of tutor and of trainee) are performed in these texts in order to mark the participants' status and authority. Also, Flowerdew (2001) found that the construction of authorial voice differed among scientists depending on their seniority.

Similarly, corrective feedback, together with supervisors' guidelines and the imitation of old-timer members of the RG were the mechanisms for teaching and learning the practice of science and the norms of communication in the RG. Although the first two mechanisms are based on explicit indications and the third one on implicit cues, all of them relied on (multimodal) communication. Accordingly, we have underscored the importance of 'learning by communicating' besides 'learning by doing' (Wright, 2008) in scientists' acquisition of competence and expertise. In this thesis, we have argued that there were some communicative events whose ends were specifically to make the 'tacit knowledge' (Polanyi, 1958) explicit, like 'group meetings' and 'mentoring'.

The RG has been identified as a site conceived to afford such learning and thus the acquisition of competence and expertise of scientists, that is, as an intentionally-shaped learning environment (see Billett, 2004). This has been framed as a process of situated learning (Lave & Wenger, 1991) or learning through socialisation along a learning trajectory, whereby newcomer members are given access to their legitimate peripheral participation (Wenger, 1998) in the RG-CoP. The analysis of the data has revealed the relevance of the local context in this process of competence acquisition and especially of the knowledge, skills and ideologies of mentors (old-timers) and ultimately of the group leader, that is, of 'knowledgeable' (Giddens, 1984) *and* 'acknowledged' agents, to shape those of trainees. Recognition and hierarchy have proved paramount features of domination in this process. And both imply the interplay between the local and the global contexts given that recognition may be claimed in the local environment of the RG as having been attained in the global milieu of the domain of practice (their specific

637

scientific field of expertise). These two contexts – the RG and the domain – have been deemed here two authority frameworks of which scientists need to learn the norms for competent membership – through two distinct learning trajectories – in order to succeed.

Consequently, the management of the RGs' multimodal communication policy relied greatly on the group leaders. They acted as models and gatekeepers of the rules of appropriate communication in both contexts. And the form of their own communicative performance and of their guidelines followed their personal beliefs and ideologies. They were multifaceted agents, acting as supervisors, *domain* experts, conveyors of communication rules, field gatekeepers and policymakers, among other roles. They were key actors in, and the ultimate responsible agents for, the perpetuation of a given social order, through what has been named here the 'politics of communication conventions', following Kress' (1996) 'politics of aesthetics'. Their performance of authority permeated the texts produced by them, through a style that gathered the principles of the scientific discourse (see Wynne, 1992): formulating absolute statements, without any hint of hesitation, giving direct instructions, and using evaluative words. Any concession to the negotiability of the rules set or conveyed by the group leader within the RG would take place in an unbalanced relation with lower-status members. Successful practice in this context was equated with what was deemed adequate by the group leader, and thus consisted in what complied with the rules set or conveyed by her.

In relation to the RGs' language policy, and specifically to the management of language use, two different stances or responses to the IoHE were observed, probably based on the language ideologies and on the linguistic repertoire of the group leader. In Group A there seemed to prevail an international 'reference framework' (Allport, 1940) only, while in Group B there appeared to predominate both, a local and an international reference framework, depending on the kind of event/inscription. In Group A, the management of language use seemed to have adopted a market-oriented stance, whereby English was seen as an indispensable working tool that would facilitate the access to international funding agencies and audiences. English was deemed the language of science by Group A's managers, being science necessarily international; and other languages were perceived as a burden or a problem by some group members. English was hence the language imposed by the group leader as the lingua franca of the RG and as the language used in almost all professional written texts. The positive consequence of this measure was that it facilitated the acquisition of (scientific) English by group members. Yet, the lack of explicit norms as regards when and how other languages were "permitted" triggered uncertainty and some tensions.

Group B followed its leader's twofold stance: on the one hand, a 'laisser faire' stance for in-group events/inscriptions, and, on the other hand, a market-oriented stance for out-group (or international) events/inscriptions. This resulted in a *de facto* diglossia (Ferguson, 1959), whereby Catalan was used in most in-group oral interactions and English was used in most written, formal (out-group) events/inscriptions. This policy framed the scientific field into two different dimensions: the local and the international, each of which was perceived as requiring a different strategy, at least in terms of language use. The consequences of this policy were the group members' higher development of written than oral skills in English, and the generation of awareness of the Catalan language by some foreigner group members as well as of the belief that its learning could be positive for the practice of science in Catalonia.

The international dimension of science seemed to be acknowledged by both group leaders and hence impacted the language policy of both RGs through the adoption of English as the international language of science. And this may have been the reason why both RGs coincided also in their reliance on an 'English native' as a language editor, be this decision based on the group leaders' past experiences or on their ideologies. As has been shown, the language policy in the local dimension of the RG varied according to the group leader's linguistic repertoire and management, as well as depending on the linguistic repertoire of the RG. Although in Group B the aspiration of the Catalan government to combine the English with the Catalan language materialised, it did not seem to respond to a purposeful endeavour, but to the contingencies of the RG. This may be the reason why some of our findings differ from those of Vila, Bretxa and Comajoan (2012), like the predominance of Catalan and Spanish in in-group communication (which was of Catalan mainly in Group A and of English in Group B), or the preference for the learning of Spanish over Catalan by foreign scientists (which did not apply in the case of the Indian members of Group B).

These findings point to the need for specific language policies as regards what the language management at university should be like so that it accomplishes the apparently contradictory mandates to introduce English, embrace multilingualism and preserve Catalan. But there is also need for strategies and planned practices that lead this transition so that the responsibility is not given to group leaders and scientist practitioners themselves, who are not language specialists nor are they trained in these issues. At the same time, the practices carried out by the institution in which the RGs were based with the aim to promote Catalan, like the imposition of Catalan language lessons together with Spanish lessons, proved to be inadequate and even potentially counter-productive; and this suggests that these should be reconsidered. As suggested by our data analysis, any potential new policies, strategies and practices might benefit from the consideration of five levels of language policy: (1) 'from above' (corresponding to the

639

management of the institution) and (2) 'from below' (corresponding to practitioners' practices), as put by Mortensen (2014), as well as (3) the *management of the group leader*, in a level in-between the two former levels, (4) the level of the nation-state, above the institutional level, and (5) the level and impositions as regards language of a *globalised science* (or international level).

Apart from these hints of internationalisation in the language policy of the RG, other hints were identified in scientists' communication, which was the second research question guiding the analysis in chapter 6. Other hints of the IoHE at the meso level were: (1) collaboration bonds with practitioners working abroad, (2) scientists' use of international communication platforms (i.e. Youtube) for information seeking; (3) the mobility of scientists across national borders; (4) the import and adoption in the RG of foreign experimental protocols (from private companies or laboratories based abroad); (5) the import (in the RG) and the use of foreign materials and artifacts; (6) the adoption of (international) conventions in communicative events/inscriptions; (7) the production of texts aimed at international audiences (like scientific articles written for international journal editors and the journals' international readership); (8) the compliance with an internationally set reward system for scientists, based on publications and journal impact factors; and (9) the accommodation to the Anglo-American rhetorical tradition, in addition to (10) the use of English as the international language of science, as mentioned before. These could be deemed internationalisation 'activities' concerning research. And this list shows that the IoHE regarding research is much more complex than the "major subthemes" described in the IoHE literature: "internationalisation of curricula, quality of international programmes, internationalisation at home, the role of foreign language knowledge and teaching and learning in a foreign language, and joint and double degree programmes" (Kehm & Teichler, 2007: 265).

As has been argued in this thesis, these international norms and conventions regarding these 'activities' were imposed on scientist practitioners through a chain of authority from the international dimension of international policies, through national regulatory frameworks, institutional (university) policies, and ultimately by the group leader, who was the local authority and the local gatekeeper of these norms. Besides this vertical, scalar trajectory, these norms have also been found to follow a centre-periphery trajectory worldwide, from central to peripheral regions (Bennett, 2014c), that is, through the dissemination and imposition of Western standards on areas with a different tradition. Despite this all-pervasive centripetal power of central regions, the data analysis has shown potential opportunities for alternative movements, like the development of horizontal networks among practitioners or the existence of open access platforms that facilitate the democratic communication among them. Yet, the power of the group leader as a moulder of local practices and as perpetuating a certain social order should not be dismissed.

640

When looking at the form of texts, that is, at the micro level of analysis, in chapter 7 we also found that all the texts analysed combined internationalising or standardising traits with local traits of variable types and proportions. This suggests that not only texts with an international scope, but also texts with a local scope were influenced by internationalisation; and these internationalising traits framed them within an internationally relevant scientific field.

Hints of the IoHE identified in the 'texture' of the texts produced, distributed or consumed by the participants are: (1) the framing of the texts within a certain field and research strand through the selection of a specific topic and object of study; (2) their accommodation to some standardised formal features that gave them a 'scientific' tenor (i.e. the specialised use of communication modes and resources, and a given rhetorical style); (3) the internationalised framing (configuration) of the laboratory (with imported international textual and material artefacts); (4) the use of (specialised) English; (5) the use of other international codes (i.e. numeric information and internationally recognisable gestures); (6) the texts' reliance on 'scientific thinking' (assuming the practitioners' deduction and induction skills as well as their ability of abstraction and concretion) and on 'scientific vision' (presuming that scientists' perceptions are determined by paradigms, rules, standards and research traditions); (7) the appearance of universalism by abstracting local practices and contingencies into standardised processes, substances and codes; and similarly, (8) the appearance of objectivity, by omitting agency in international(ising) texts; (9) the progressive simplification of scientific observations along 'cascades of inscriptions' (increasing their international mobility); (10) the performance of internationally recognisable (identity) roles and categories; and (11) the import into the local context of the international centre-based evaluation style (i.e. the local gatekeeping practice through categorical and authoritative corrective feedback).

In all these threads between the local and the international dimensions, the RG and its members acted as mediators by importing and adapting features from the international dimension into the local context and vice versa. An important aspect of scientists' situated learning in the RG consisted in acquiring a sense of the validating criteria of their domain. The 'mentoring' communicative event was a key local process of induction into the RG as well as into the (international) scientific community that was overseeing this system of norms. The source of these norms, including manifold norms of communication, was outside the RG. And they were conveyed to the individual scientist implicitly, through her consumption of texts validated by (international) authorities in the scientific domain, and explicitly, through the guidance of old-timer practitioners of their own RG or of other RGs.

As we have put forward, the literature addressing the micro level of analysis of the texts produced, distributed and consumed by scientists is fragmented. It tackles diverse matters, like the consensual validation of scientific knowledge (Knorr-Cetina, 1999; Latour & Woolgar, 1986), the identity construction of scientists (Hakala, 2009; Holley, 2009), the strategic rhetoric of scientific textual discourse (Bazerman, 1981; Lynch, 1988; Mody, 2014), the use of English as a lingua franca in the academia (Bennett, 2014c; Lillis & Curry, 2006, 2010), the multilingual practices of scientists (Mondada, 2005; Uzuner, 2008) and the particularities of scientific representation (Amann & Knorr-Cetina, 1988; Suchman, 1988). These works rarely make explicit reference to the relation between these facets of scientists' communication and the IoHE. This is thus a major contribution of this thesis, which goes beyond the description of scientists' micro-level communication in order to present also the ways in which it relates with the IoHE.

The influence of the IoHE on scientists' communication has been explored also at the macro level of analysis, that is, considering scientists' communication as a socio-cultural practice that develops in a context of discourses, ideologies and power relations beyond the RG. This dimension has been tackled through the entry point of 'success', which synthesises the professional aspirations of scientist practitioners. Our focus has been on the role of communication in scientists' pursuit of success and the ways in which it relates with the IoHE.

The data analysis has revealed the predominance of a capitalist approach to science. Accordingly, science is treated as an international market in which internationally legitimised products in central zones, like articles published in international (anglophone) journals, have a higher conversion potential. This way, communication is reified and marketed: articles are inscriptions that act as boundary objects among RGs internationally, and as reified cultural capital that, once it has been recognised by journal editors as valid, takes on a new tenor as symbolic capital. The latter increases as the article is being valued by other recognised members of the epistemic community (i.e. through their citation). Recognition is hence the desired reward of out-group communication, easily convertible into other types of capital (i.e. higher citation rates might entail obtaining a post or a grant). As is usual in capitalism, the quality, the originality and the significance of scientific accomplishments are reduced to numbers, in this case mediated by communication (through publications). For the relevance of scientific practice to be measured, a scientist's publications are counted, in absolute terms, as well as measured considering the journals' citation rates, and the citations of the published article itself. The accumulation of these measures composes the scientist's 'productivity', a symbolic capital convertible into networks (social capital) and money (economic capital).

Despite the apparent objectivity and transparency of numbers, the market of science is dominated by most powerful actors, who act as gatekeepers and policymakers, and is thus not egalitarian. One example of the inequalities that this system promotes is the gender bias it reinforces. The system favours men over women through policies and mechanisms, like its lack of compensation for mother leave periods, and its presupposition that both, women and men scientists, have the same working conditions. As a consequence, women scientists may face difficulties in balancing work and family, and may often have to choose between their professional career and their personal aspirations, especially when it comes to accepting managerial positions. The data analysis has suggested that efficient communication could potentially be key in helping scientist practitioners balance their work and their personal life.

The data analysis has suggested that in science the distinction between central and peripheral zones is more nuanced than this, considering the resource inequalities among RGs and institutions in one same country (like Spain). Such inequalities, inherent in the capitalist struggle, are also self-perpetuating through intrinsic resource-allocation mechanisms based on unequal departing conditions among competing actors (like RGs), which end up by benefitting those who already had more. This way, success brings about more success.

The ideology of capitalism seems not only to be penetrating the practice of academic science, but also to be pulling whole HE institutions and research centres towards purely capitalist dynamics (i.e. collaborations with industry and the treatment of the university as an economic actor). The 'corporatisation of university' (Crysler, 2003) is becoming a global trend that is also affecting Catalan HE institutions and research centres. Institutions' discourses in this direction link the IoHE and discourses of international competitiveness with the industrialisation of HE and of science. We have found this to contradict the university's traditional mission of social service and the 'disinterestedness' main value of science (Merton, 1973). This capitalist approach entails that the academic/scientific discourse is increasingly being used as a marketing tool. It is adapted to market demands and has the aim to "sell", to persuade the audiences. This again challenges the discourse that praises an education system that trains critical individuals/citizens (see Ryan & Hellmundt, 2005; Volet, 2003), and may create a sense of non-belonging, confusion, frustration among scientist practitioners.

Another consequence of the capitalist approach to science is the importance that designing a strategical discourse of the self has gained. As has been shown in the data analysis, obtaining economic resources depended greatly on the RG's strategy, of which communication was a part. The formulation of innovative ideas (that stood out in the light of the literature), claiming authority in a field, and reporting on one's extensive experience in a particular topic were

communicative strategies that, once reified in communicative outputs (like research grant applications), could potentially lead to the obtention of (symbolic and economic) capital.

The current study has also proved the existence of a dominant discourse positioning science as an essential piece of globalisation. This discourse encourages HE institutions and RGs to accommodate to hypothetical international mandates and trends. One of these is the international mobility of scientists. It is incentivised through its inclusion as an evaluation criterion in rankings and grant calls. This is a national competitiveness strategy, a policy, concealed as a given rule of the game. As we have argued, it may benefit the richest and most powerful countries offering the best conditions for individual scientist; and generate brain drain in less powerful ones. In terms of language policy, the trend of international mobility may encourage scientists' most efficient strategy through the *capitalisation of language learning*, whereby they may intend to capitalise their language learning efforts by learning the language with the largest number of speakers or most geographically spread among those languages found in their (imagined) environment. We underscore the notion of it being 'imagined' since it might not correspond with the actual sociolinguistic environment but to their perception of it mediated by their ideologies. Following this perception of an imagined sociolinguistic environment and the tendency towards the capitalisation of language learning efforts, scientists may take the nation-state in which they are working as a 'frame of reference' (Allport, 1940) and learn its official national language despite having other (regional) languages more present in their immediate milieu.

Besides the favouring of central regions by the discourse and the policies of globalisation, our findings suggest that also the Anglo-Saxon culture (and language) as well as their representatives are especially favoured by the discourse of globalisation in relation to science. In a context in which English is the dominant global language, incentivising international communication (i.e. in international conferences, international projects, etc.), far from being ideologically neutral, implies incentivising the use of English. As a consequence, actors based in Anglo-Saxon nations (mainly the US and the UK) are taken as models to be followed, in terms of linguistic performance, but also as regards the experimental techniques to be learned, the perspectives to be taken, the scholarly traditions to be followed, etc. Especially relevant is also what we have named the 'English native halo', meaning the authority (power) attributed to practitioners (perceived to be) born in central, officially Anglophone regions (the 'natives'). These are hired as language experts, and deemed indispensable for the success of scientific publications (to achieve the linguistic standards of international journals). Moreover, practitioners with "better" (meaning "according to the norm imposed by international

gatekeepers") English language skills, often equated to the English 'natives', might also be perceived as more competent scientist practitioners.

An important process in science that also affects scientists' communication internationally is the one conceptualised as the 'enculturational model' of science (Collin, 1975). According to it, the internationally legitimised scientific knowledge and the frame of evaluation of valid knowledge in a given scientific domain are imposed through the international dissemination of 'self-evident' criteria and implicit norms. Therefore, it has to do with the content of the discourses as well as with the style of the texts that reflect them. At the macro level of analysis, identified imposition/domination mechanisms that affect scientists' communication are: (1) the standardisation of processes, (2) the imposition of 'points of passage' (Callon, 1984) by legitimised actors, (3) the recognition of one's position in the field, and (4) the accumulation of credit and prestige. These imposition mechanisms are subtle, and the norms derived from them are mostly implicit or presented as general and unquestionable. These have been proven to influence the 'texture' of scientists' texts (at the micro level of analysis). Science is thus a site of struggle for actors who aim to impose their authority and criteria onto others in order to be valued as the highest in a hierarchy of practitioners, RGs and institutions. In this system, RGs and HE institutions may act as reified social legitimacy by symbolising the quality warranty (symbolic capital) of the practitioners affiliated with them. The IoHE takes this struggle to the international dimension, in which it intertwines with worldwide centre-periphery dynamics. Those who fail in this struggle are urged to accommodate to the rules dictated by the powerful ones in order to take part. An important part of the learning trajectory of scientist practitioners, which often begins as part of their practice in a RG, consists in learning these dominant norms, the mechanisms of the scientific culture, and in acquiring the skills necessary to engage in this struggle.

The ideologies of dominant actors or groups permeate HE institutions and are imported by leading agents into the local context. To put it another way, those who succeed are inevitably those who comply with the norms and even those who adopt the ideologies that underlie these norms as their own. This way, the dominant discourses that derive from these ideologies are passed on from successful, legitimised practitioners, like group leaders, to newcomer practitioners, who are especially susceptible to these. And whether these discourses stress agency over structure or the other way round may affect scientists' consequent performance. For instance, beliefs on how to succeed at work, like the need to work many hours, to renounce to personal aspirations, as well as beliefs that science is a fair system governed by a merely meritorious selection, may discourage practitioners (especially women) from seeking a scientific career whenever their performance, their aspirations or their achievements do not

match with this description. For instance, the attribution of the scientist's gained social capital (relevant professional social networks) to either her abilities in networking and PR (agency) or to structural features like her rank, seniority or gender, as suggested in the data, may influence the practitioner's reaction: she might try to acquire the necessary skills, try to act on the structural features of science, or presume that the structure is too immobile and renounce to her aspirations.

The participants of this study found themselves in a difficult position in which they intended to frame their practice within a global framework from a local context. They aimed at attaining internationally accepted success by being trained in a locally defined RG and institution. The opposing forces, contrasting norms and their derived dilemmas were transmitted to all the agents involved, including RGs and individual scientists, who had to decide, for instance, whether to leave their country for an international professional experience or to stay, whether to devote most of their time to work or to look for the balancing of work and family life, etc. The fact that Catalonia/Spain is not in the centre of the international scientific scene added to this complexity; and this placed the practitioners working in this context in a (semi-)peripheral position from which they probably had to make an extra effort to keep up with the demands of international competition. This sometimes reinforced the indecision of some group members on whether they were willing to engage in such an effort or not. And this could be compensated by the central position of the group leader in the international field.

Against the established norms and the dominant discourses, some resistances have been observed in the data. A few participants questioned the structural fairness of science (i.e. in terms of its evaluation criteria and system) and proposed some modifications, like the fact that the trajectory of experiments (how they were executed and their results obtained) should be considered in their evaluation, that international immobility – that is, not becoming a mobile professional – could be compensated by other achievements, and the need for failures to be accepted as interesting results. Yet, the fact of presenting science as a dogma may discourage any attempt of resistance to norms. Furthermore, any dissenting agents may be marginalised by the very structure of science, which is defined by its conventions, norms and validity criteria. Whatever does not comply with the norms is dismissed for being unscientific. This is described by Bourdieu (1975: 29-30) as a "struggle between the dominant and the newcomers":

> The dominant are committed to conservation strategies aimed at ensuring the perpetuation of the established scientific order to which their interests are linked. (...) newcomers who refuse the beaten tracks cannot "beat the dominant at their own game"; unless they make additional, strictly scientific investments from

> which they cannot expect high profits, at least in the short run, since the whole
> logic of the system is against them.

This absence of negotiability is likely to produce frustration, confusions, conflicts and identity crises, as has been observed in the data. In fact, the practitioners that showed the most critical view of the structure of science were those who showed more reluctance to continue their career as scientists, consistent with Farnsworth, Kleanthous and Wenger-Trayner (2016).

We have made an effort here to, first, compile aspects of the scientific practice within a RG in which communication plays a relevant role, and second, identify the ways in which these are influenced by the IoHE and the globalisation of science. In fact, the literature lacks works of this kind that approach communication as a significant object of study in relation to the IoHE. As has been noted in this thesis, communication is present in different facets of scientists' attainment of success, like in the established meritocracy, in the reification of one's merits (e.g. in CVs, in publication records, etc.), in the competition for resources (e.g. grant calls and grant call applications), among others. Yet, more studies like this one are needed that intend to provide a thorough understanding of the social and political dimension of scientists' communication, beyond language policies.

The analysis of the data has revealed that the revision of language or language accuracy were not deemed a significant problem for scientist practitioners; these issues were largely solved by hiring the services of a (native) language editor. However, this does not mean that the same happened with communication. It could be argued that most (if not all) the investments (in money, resources and efforts) of RGs were devoted to achieving the elements necessary for the construction of communicative events/inscriptions that would be valued by the epistemic community of their domain. This proves the importance of communication in the practice of science, and it should be considered by policymakers, also regarding the IoHE.

As has been shown, scientists' daily communication is a complex phenomenon. And this may be evident in the multiplicity of research strands that have addressed some of its aspects. Yet, despite the existence of thorough laboratory ethnographies that offer a detailed picture of some facets of scientists' daily activity, no other work, to our knowledge, has addressed specifically scientists' communication holistically, having scientists' (multimodal) communication as its object of study and exploring it at different levels. Moreover, the learning of science differs in many aspects from other types of education, and therefore requires a particular approach, in which the agency of the actors (researchers) is highlighted. This is achieved in the present study through the perspective of the community of practice (Lave & Wenger, 1991) and social semiotics (Hodge & Kress, 1988). Likewise, the IoHE is also a multifaceted process, which

involves many actors, and many practices not explicitly related to this process. Approaching it, thus, requires discovering and anlysing these practices so that the process of the IoHE can be properly defined and characterised. Furthermore, although international communication is key in scientists' professional endeavour and success, as has been shown in this work, the effects of communication on the IoHE and vice versa have not been widely studied, apart from the increasing use of English, nor have these been explored taking scientists' daily communication as the object of study.

This study has contributed to the related body of research in different ways. It has contributed to the narrow body of research on scientists' informal communication, including their unpublished practices (see Searle, 2013); it has also provided insights to the field of 'academic literacies', by adding to the literature that considers the multimodality of academic texts (i.e. Archer, 2006, 2010), though in our case analysing a variety of text types and situating them along a discourse trajectory; and we have responded to the claims of some scholars (i.e. Lillis, 2008) for the need to relate texts and context. Also relevant is our focus on scientists, an under-researched population in this field, and the wide range of text types we have collected. Finally, it is worth noting that neither the importance of discourse nor that of the 'ways of talking' within the CoP were developed in Lave and Wenger's (1991) and in Wenger's (1998) work. Many of the reflections presented here and several of our findings coincide with other works, but our main contribution is having put them in relation with one another and thus offering a holistic picture of scientists' daily communication in relation with the IoHE.

As has been claimed, this thesis carries also practical implications in relation to the role of scientists' communication in the IoHE and vice versa, as is the nature and aim of applied sociolinguistics (Shuy, 1984). This way, we aim to contribute to the understanding of the IoHE and to the improvement of the internationalisation policies of HE institutions and of scientists' professional experiences. As has been claimed, by taking a critical stance, we aim to propose empowering mechanisms for the actors affected by the IoHE.

In this work we have demonstrated that the effects of the IoHE are more varied and pervasive than affecting the languages used in HE and in science only. Accordingly, internationalisation policy documents should include many more aspects than the incorporation of English in HE institutions. We have argued that the lack of specific policies, strategies and actions regarding the transition towards an international university results in the legitimisation of the domination of centre regions, as well as the imposition of capitalist dynamics, of the Anglo-Saxon culture and of the English language in HE. Consequently, peripheral and semi-peripheral regions could possibly have their traditions, culture, and languages displaced. Furthermore, considering the

increasing corporatisation of HE, it is also necessary to mention that products from companies in (semi-)peripheral regions may also be displaced. In this regard, specific long-term strategies are needed from HE institutions in peripheral and semi-peripheral zones that decide actively and purposely what the role of their traditions, cultures and languages (and possibly also products) should be in their HE institutions, as well as the design of concrete actions to achieve the desired goals. HE institutions and the stakeholders involved should decide what model of internationalisation they prefer: one based on the oligarchy of the Anglo-Saxon centre or one based on the interaction of different traditions, cultures and languages, with more equitable opportunities for all actors.

In the case of the 'English native halo', some actions that could counteract it have been suggested in the literature, and referred to in this work, like balancing the representation of 'native' and 'non-native' editors in journal editorial boards (Flowerdew, 2001) and providing resources to 'non-native' authors to accommodate their texts to the linguistic standards required by international journals (Strauss, 2019). Also, the creation of warranty seals by article editing companies may counteract the preponderance of the 'English native speaker' as the only language quality hallmark. Favouring non-central journals in evaluation rankings might also help the incorporation of alternative criteria in the international scientific scene.

This thesis has shown how the IoHE as regards research is much more rich and complex than consisting in, for instance, researcher mobility, the use of English in research, international joint projects and international work placements. It comprises processes like the establishment of interpersonal collaboration bonds among scientists, their purchase and use of internationally produced artifacts, their use of international communication platforms, and their accommodation to the Anglo-American scientific rhetorical tradition, among many other processes described in this work. University internationalisation policy documents should be based on empirical research like this study, and policymakers should design strategies that consider all these aspects. Our claim that more specific and informed policies, planned strategies and adequate activities concerning internationalisation are needed in Catalan HE institutions coincides with Rumbley's (2012: 222) claim regarding 'the universities of Spain', which in order to engage "in solid, sustainable internationalization", "can no longer avoid engaging in relevant, comprehensive, and well-managed planning, review, and reinforcement activities". The author defends that the current complexity of the IoHE requires serious strategic planning instead of "amateurish and/or ad hoc planning and evaluation exercises", which in the case of research in Catalan universities is even non-existent. Considering the three ways to confront globalisation and internationalisation pressures by local forces described by Kress (1996): (1) opposing them in a reactionary way, (2) yielding to them with cultural nostalgia, and

(3) trying to contribute productively with adapted, local cultural values, Catalan HE institutions seem to have opted for an alternative way. They appear to be yielding to globalisation and internationalisation pressures without any resistance nor cultural nostalgia, but by pretending that they do not exist beyond the increasing use of English.

As has been shown in this thesis, in the local context, the highest authority, the person who manages these mechanisms, is the group leader. The lack of explicit and thorough (internationalisation) policies from relevant agents and institutions give her a high degree of legitimacy and power as a local policymaker. Yet, the group leader does not receive any support in this regard. And thus, in the local context, the institutional policies blur. The communicative policy of the RG is left in the hands of group leaders, who are legitimate practitioners and experts in their scientific domain but who lack training and knowledge on communicative policy. The RGs studied did not have support nor guidance from the institution in this regard. Consequently, we claim that more support from the institutions to the *de facto* policymakers (like group leaders) and to the practitioners is needed at all levels, in order to carry out a sustainable (seemingly unavoidable) transition towards the internationalised university and science that guarantees excellence in all practices and the well-being of all practitioners. For instance, the creation of the position of the internationalisation expert acting in the level in-between the institution's management and scientists' practices could potentially solve some of the tensions identified in the data, like giving clues on what the means for international success are, the importance of agency in it, and the role of languages other than English in the RG. The same or a different expert (or office) should act as a mediator between practitioners and leaders and/or managers, in order to give support in conflict management. Also, training and guiding group leaders on these issues could have positive outcomes. Concentrating efforts on these mid-level agents may be an effective strategy given the relevance and high impact of these agents in the definition of legitimacy and authority in the daily practice of scientists.

The practice of (international) science has shown itself to be too limiting, being it constrained by a rather stable system of norms that allows for very little negotiation by (semi-)peripheral actors. This has been demonstrated to potentially generate frustration and alienation among practitioners. In this regard, there should be a higher degree of negotiability of norms and increased opportunities for the practitioners' agency to be permitted and fostered. This could be accomplished by creating democratic structures and participation mechanisms through which the voice of all practitioners could be heard and considered by others. Listening to the voices of novice practitioners could supply freshness to science, and listening to the most critical voices about the structures of science (e.g. the omission of failures and the gender bias) could provide ground-breaking ideas for the improvement of the international science of the future. The

international dimension should afford the participation of more actors and hence the dialogue among the largest ever number of them. A self-legitimising scientific field that marginalises dissenting voices is contrary to cutting edge and innovation. The universalist, communist and disinterested science (following Merton, 1973) should necessarily be democratic, pluralistic and critical. Therefore, such a dialogue could either follow a capitalist logic, whereby the strongest prevails, or a democratic logic, whereby all voices are valued. HE institutions and stakeholders should acknowledge this, be overt about their preferences and act explicitly in accordance with their positioning.

This critical view should be encouraged at all levels, to help practitioners assess their potentialities as scientists, as well as the constraints and limitations they may have to deal with. In this sense, at the level of text production, consumption and distribution, it might be advisable to train practitioners and provide them with tools to foster their agency, like tools for the effective communication at work to deal with the balancing of work and family, and adequate training that underscores the structural factors that condition networking, as well as tools that help them develop relevant professional networks considering their circumstances. Also, at the level of discourse, a new model of scientific discourse should be fostered that favours honesty and transparency over secrecy and competitiveness.

If the IoHE inevitably involves the increasing industrialisation of HE and of science, the mission of HE should be redefined accordingly and communicated straightforwardly to all stakeholders, and supported explicitly through policies. In the case of Catalan state universities, if they are to acquire a hybrid (public-private) nature, this complex identity needs to be defined and the implications of it communicated overtly to the practitioners. Concerning science, its industrialisation may require the redefinition of the measure of success, now based on publications, which the data analysis has revealed not to be the most relevant feature for the interests of private companies.

As long as the national context is relevant in the shaping of HE and of the IoHE (like by means of granting systems, scholarships, national accreditation agencies, etc.), national governments and institutions should take an active role in it. They should also be active in urging EU managers to ensure the accomplishment of the aims of the creation of the European Higher Education Area, like the interplay of national identities, the attainment of common interests and the improvement of European institutions' competitiveness (Curaj *et al.*, 2015). Yet, this study has revealed that the IoHE does not place any emphasis on culture; that it lacks mechanisms to protect the national cultures of Europe; and that it does not incur in practice in the preservation of a diversity of any kind. On the contrary, the capitalist approach is concealed in EU's official

documents behind claims about the (vague and homogeneous) promotion of employability and development, without showing knowledgeability regarding the inequalities among European countries nor among their citizens. As long as policymakers use cliché and slogans to sell as a cultural achievement what is a covert economic strategy, research works like this one will be of little aid in the improvement of the IoHE. Whether the IoHE responds to 'market interests' (Tilak, 2011) or to a 'public interest' (Giroux *et al.*, 2001) needs to be clarified.

This study did not develop without difficulties and flaws, some of which have been presented in chapter 3, section 3.2, in relation with issues faced during the data collection. This study's limitations affect, first, the research design, which resulted to be rather ambitious given that it involved the observation of many events and the collection of an overwhelming amount of data from a too large amount of participants by only one researcher. This has entailed, on the one hand, the unavoidable neglect of some events going on in the field while the researcher was observing other events, and, on the other hand, the lengthening of the treatment, analysis and interpretation of the data, and consequently of the generation of results. This in turn has hindered the timely return of the findings to the participants. Moreover, dealing with so many data may have forced us to tackle some aspects only superficially. And this means that the time and efforts could have been managed more efficiently. Having focused on only one level of analysis, on specific communicative events, and/or on only one RG could have avoided some of these problems.

Second, the access to the data was not homogeneous in terms of RGs nor of participants. The practices of lab-workers were much more accessible than those of office-workers. And Group A was more accessible than Group B and much more than Group G. This entailed that it was easier to comprehend and maybe also to empathise with the view of lab-workers. And that the understanding of the multimodal communication policy of Group G was not an ethnographic accomplishment but only glimpsed superficially from interviews and focus groups. Despite the inconveniences and evident drawbacks of this unbalanced exploration, I consider that the benefits of gathering data from three different RGs are more than the disadvantages.

A third limitation is typical of case study and ethnographic research. Although these allow for the understanding of the complexities and the mechanisms of the phenomena studied, it does not give clues concerning the generalisation of findings. We have tried to compensate for this here by referring to other studies that have published similar results.

Fourth, the specialised tenor of the communication explored, alien to the researcher's field and knowledge, has been an obstacle for her understanding of the details of what was being communicated. This has been counteracted to some extent by inquiring the participants on these

aspects, in formal and informal interviews as well as in the two stimulated recall sessions. Also, a more extended presence in the field and adopting a participant-observer role could have aided in this regard, but was not possible in this project considering the resources available.

Finally, I acknowledge that the 'consensual validation' (Eisner, 2017) of this work is limited, since it has been reviewed by very few experts. This could be solved in future projects by sharing the results with more experts, and potentially also with the participants or with practitioners with a similar status. This could improve the reliability and the richness of the project's findings.

Despite answering many questions, this thesis may also lie the basis for further inquiry. Having proved that the IoHE concerning research goes beyond language choice raises the need for more research exploring scientists' communication in all its complexity. The findings presented here could be complemented and developed further by studies centred in the perspective of RGs' office-workers (often most senior researchers), by projects focusing on RGs working in scientific domains different from the RGs studied here, as well as by large-scale studies that allow for the assessment of the reach and consistency of our findings. In order to shed light on the complex phenomenon of the IoHE, and to contribute to its future successful evolution, research like the current study, coming from diverse disciplines, contexts and institutions, may be needed.

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