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**Motivation toward Physical Education and its relation to
academic stress among Chinese adolescents: A cultural
perspective on Self-Determination Theory**

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A Thesis Submitted for the Degree of Doctor of Philosophy

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To all Jacks who have been always working without play

致所有被占用过体育课的学生

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Preface

As a psychology graduate, the first time I heard the Self-Determination Theory (SDT) was at the course of my master program in 2016, 30 years after the development of the theory by Deci and Ryan (1985). During these years, researchers, like Ryan and Connell (1989), Sheldon and Kasser (1998), have proposed several mini-theories within SDT. There has been a large growth of studies based on the theoretical structure by researchers from various countries (e.g., Aelterman et al., 2012; Bailey et al., 2009; Franco & Coterón, 2017; Viladrich et al., 2013). However, as what happened to many other psychological theories, limited studies of SDT have been conducted in Eastern countries, like China where I come from. When I started my PhD project, after discussion with my supervisors, I decided to focus on SDT-based motivation in Chinese context. I'd like to know whether what happened here (Spain and other western countries) would also occur there (China) and what would be the cause of the difference if there would be.

I spent 16 years learning in China, from primary school to university. Like most of Chinese students, I spent the majority of time in school on main courses like Chinese, Mathematics, English, and Science. Other courses, like Physical Education (PE) and Arts, used to be replaced by the main courses so that students could be more focused on academic performance. Even if we were allowed to participate in PE, many of my classmates preferred to finish their homework instead of practicing sports during PE. Outside school, less time was dedicated to physical activity. The low status of PE in China results from the high academic demands. The principal task of students is to study and study well to obtain high scores. Consequently, teachers, parents, even students themselves pay too much

attention to academic achievement and neglect the importance of physical fitness. Participating in PE and practicing sports have been regarded as waste of time.

During data collection in China, I have talked with some teachers of secondary schools. From the perspective of teachers, the main reasons to practice are the following: (a) to pass the PE exam required by Chinese Ministry of Education to enter high school; (b) to obtain extra points through accreditation of athletes. From the point view of ex-students including myself, we were willing to participate in PE without external force because we could take a rest from academic materials. Most of my friends recognized that PE was one of their favorite courses. However, when we had too much homework or important exam, we'd also concentrate on homework rather than practice sports because we all wanted to be good students. Under this situation, I was confused but also curious about Chinese students' motivation toward PE.

As the first step, I decided to measure motivation toward PE in China by Perceived Locus of Causality Scale which has already been validated in many countries (Study 1). I had opportunity to be engaged in a research project led by my supervisors and funded by the Spanish Ministry of Economy and Competition, which allowed me to collect data from Spain to compare with a Chinese sample to better understand the motivational structure within cross-cultural context. Since motivation toward PE could also be considered as a special type of academic motivation, I decided to examine the relationship between motivation toward PE and academic stress to further explore how SDT-based motivation works in Chinese context (Study 2).

In the process of the investigation, I encountered some measurement difficulties related to Chinese context. With the suggestion of my supervisors on data analyses and

findings of other researchers, I managed to figure out how to deal with my data and obtained some interesting results. However, not all the results corresponded to my hypothesis based on previous studies in similar cultures. These unexpected results made it difficult to explain but at the same time these results also made the study interesting and different from other previous studies. Nevertheless, I found my solution to these difficulties and unexpectedness, and finished this work to present here. I believe that I have answered the questions that I asked at the beginning of the project.

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Abstract

This thesis aimed to explore motivation toward Physical Education and its relation to academic stress among Chinese adolescents through Self-Determination Theory. In study 1 we measured motivation toward Physical Education Scale among Chinese ($n = 1,287$) and Spanish ($n = 1,006$) adolescents through the Perceived Locus of Causality. The results largely supported the reliability and the validity of the scale in both cultures as well as its cross-cultural equivalence except for three problematic items found in the Chinese sample. Moreover, Chinese adolescents scored higher in more self-determined motivation (i.e., intrinsic motivation and identified regulation) and lower in less self-determined motivation (i.e., introjected regulation, external regulation, and amotivation) than Spanish adolescents. In study 2 we measured motivation toward Physical Education through Perceived Locus of Causality Scale and academic stress through Educational Stress Scale for Adolescents among Chinese adolescents ($n = 556$) at the beginning of the semester and 3 months later. Less self-determined motivation was found to be positively related to all academic stress factors except for the negative relationship between amotivation and worry about grade during second data collection. However, more self-determined motivation was found to be negatively related to pressure from study, workload, and despondency, but positively related to worry about grades. In addition, identified regulation positively predicted worry about grades while amotivation positively predicted workload and despondency. Meanwhile, despondency negatively predicted identified regulation. Overall, the findings supported the motivation structure based on Self-Determination Theory in Chinese Physical Education context in line with the universality of the motivation structure. The

problematic items and mean difference between China and Spain suggested that despite of the universal structure, the measurement model may not be the same across cultures which requires further examination and adaptation of the motivation measurement based on Self-Determination Theory. Related to the specific academic context in China, these results supported the generalization of relationship between motivation based on Self-Determination Theory and stress across Physical Education and academic contexts which highlight the importance of motivation in physical education not only in promoting students' physical activity but also in improving academic experiences.

Resumen

El objetivo de esta tesis fue explorar la motivación en Educación Física y su relación con el estrés académico en adolescentes chinos en base de la Teoría de la Autodeterminación. En el estudio 1 se midió la motivación en Educación Física en adolescentes chinos ($n = 1,287$) y españoles ($n = 1,006$) con la Escala de Locus Percibido de Causalidad. Los resultados apoyaron la fiabilidad y la validez de la escala y su equivalencia transcultural con la excepción de tres ítems problemáticos encontrados en la muestra china. Además, los adolescentes chinos obtuvieron puntuaciones más altas en la motivación más autodeterminada (i.e., motivación intrínseca y regulación identificada) y puntuaciones más bajas en la motivación menos autodeterminada (i.e., regulación introyectada, regulación externa y amotivación) que los españoles. En el estudio 2 se midió la motivación en Educación Física con la Escala de Locus Percibido de Causalidad y el estrés académico con la Escala de Estrés Educativo para Adolescentes en los adolescentes chinos ($n = 556$) al principio del semestre y 3 meses después. La motivación menos autodeterminada se relacionó positivamente con los factores del estrés académico con la excepción de la relación negativa entre la amotivación y la preocupación por la nota durante la segunda recogida. Sin embargo, la motivación más autodeterminada se relacionó negativamente con la presión desde estudio, la carga de trabajo, y el desaliento, pero positivamente a la preocupación por la nota. La regulación identificada predijo positivamente la preocupación sobre la nota, asimismo la amotivación predijo positivamente el desaliento. Se encontró también un efecto predictivo negativo del desaliento sobre la regulación identificada. En conclusión, los resultados apoyaron la estructura de la motivación basada en la Teoría de

la Autodeterminación en el contexto de Educación Física en China en línea con la universalidad de la estructura de la motivación. Los ítems problemáticos encontrados en la muestra china y las diferencias de media entre China y España sugieren que, a pesar de la estructura universal, el modelo de medición puede no ser el mismo en todas las culturas, lo que requiere un examen y una adaptación adicionales de la medición de la motivación basada en la Teoría de la Autodeterminación. Respecto al contexto académico específico en China, estos resultados apoyaron la generalización de la relación entre la motivación basada en la Teoría de la Autodeterminación y el estrés en los contextos de Educación Física y académico, lo que destaca la importancia de la motivación en educación física no solo para promover la actividad física de los estudiantes, sino también para mejorar su experiencia académica.

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List of Abbreviations

α	Cronbach's Alpha Coefficient
AM	Amotivation
AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
DE	Despondency
ESSA	Educational Stress Scale for Adolescents
EXR	External Regulation
IM	Intrinsic Motivation
IDR	Identified Regulation
ITR	Introjected Regulation
K	Kurtosis
ω	Composite Reliability Coefficient
PA	Physical Activity
PE	Physical Education
PFS	Pressure from Study
PLOC	Perceived Locus of Causality
ρ	Non-linear Reliability Coefficient
RMSEA	Root Mean Square Error of Approximation
SDT	Self-Determination Theory
Sk	Skewness

S-E	Self-Expectation
SVS	Subjective Vitality Scale
T1	First Data Collection
T2	Second Data Collection
TLI	Tucker-Lewis Index
WAG	Worry about Grades
WL	Workload
WLSMV	Weighted Least Squares Mean and Variance Adjusted

Chapter 1 Theoretical background

Regular participation in Physical Activity (PA) is associated with numerous health benefits in adolescents, such as positive effect on blood pressure, overweight and obesity, and depression (Janssen & LeBlanc, 2010). In addition, PA has positive impact on academic performance and mental health of adolescents (e.g., Biddle & Asare, 2011; Singh, Uijtdewilligen, Twisk, Van Mechelen, & Chinapaw, 2012; Zhang et al., 2017). In order to promote health, World Health Organization (WHO) recommends that children aged between 5 and 17 years should accumulate at least 60 minutes of moderate-to vigorous-intensity PA daily (WHO, 2010). However, globally 80% of adolescents do not reach the recommended levels of PA, which leads to several health problems (Hallal et al., 2012). Such insufficiency of PA occurs across countries, for example overall PA level was found very poor in China, and poor in Spain (Tremblay et al., 2016).

In response to this, Physical Education (PE) classes have been recommended to play a central role in promoting PA among children and adolescents (Ntoumanis & Standage, 2009), as PE is a context where sport and PA are presented to almost all children and adolescents with diverse background and characteristics. Since the first research on motivation toward PE by Wallhead and Ntoumanis (2004), there has been a growing body of studies of motivation toward PE (Hastie, Ojeda, & Luquin, 2011). Motivation toward PE has been demonstrated to be related to positive outcomes, such as concentration, intentions to exercise, and physical fitness in leisure time (e.g., Martínez-Baena, Mayorga-Vega & Viciano, 2016; Taylor, 2017). Consequently, researchers have focused on improving students' PA through motivation in PE (e.g., Aelterman et al. 2012; Behzadnia, Mohammadzadeh, & Ahmadi, 2017; Palmer, Bycura, & Warren, 2018). Identifying

motivation might be a necessary step for both researchers and professionals in educational practice (Owen, Smith, Lubans, Ng, & Lonsdale, 2014).

1.1 Physical Education context

School-based PE classes, a standard course across world, have been found to be related to positive outcomes among students, such as competence and enjoyment during classes, leisure-time PA, academic performance outside PE classes, development of social skills (e.g., Bailey et al., 2009; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Hastie et al., 2011; Kalaja, Jaakkola, Liukkonen, & Digelidis, 2012; Van den Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014). PE offer the context in which students can engage in sport authentically, learn sport skills completely, and gain important and relevant experience (Van der Mars & Tannehill, 2015).

Because of the significant proportion of waking hours spent in school, PE serve as the important way to provide and promote PA among adolescents, especially among those who has limited exposure to PA outside school (Fairclough & Stratton, 2006). Evidence-based PE programs in early adolescence can provide students with positive motivational and affective experiences, which will promote their later engagement in PA (Jaakkola, Yli-Piipari, Watt, & Liukkonen, 2016; Ladwig, Ekkekakis, & Vazou, 2018). Although PE classes have become established as normative, sedentary behavior increases during transition from primary to secondary school (Ladwig, Vazou, & Ekkekakis, 2018). Furthermore, researches have revealed a decline of motivation toward PE among secondary school students (e.g., Barkoukis, Ntoumanis, & Thogersen-Ntoumani, 2010; Ntoumanis, Barkoukis, & Thogersen-Ntoumani, 2009).

1.2 Self-Determination Theory

To investigate motivation, Self-Determination Theory (SDT; Deci & Ryan, 1985) has been widely applied within the PE context (Ryan & Deci, 2017). SDT comprises six mini-theories, each of which explains a set of motivationally based phenomena. In the current study, we will talk about the mini-theories concerning different motivation forms and related basic psychological needs.

According to SDT, all motivated behaviors are accompanied by a sense of why one is doing the behavior, reasons upon which people can report if asked. In other words, all behaviors come with a Perceived Locus of Causality (PLOC). Heider (1958) firstly introduced the concept of PLOC to analyze how one infers the motives and intentions of others, which distinguished between personal causation and impersonal causation. DeCharms (1968) argued that there is a further distinction within personal causation between internal PLOC and external PLOC. Based on these, Deci and Ryan (1985) further proposed that all motivated behaviors can be located on an underlying autonomy continuum, between feeling a complete lack of self-determination (external PLOC or E-PLOC) to feeling completely self-determined (internal PLOC or I-PLOC).

According to SDT, different types of motivation are distinguished by different reasons or goals that give rise to an action, ranging from intrinsic motivation, through extrinsic motivation, to amotivation on the autonomy continuum (Ryan & Deci, 2017). Intrinsic motivation is considered to be the most self-determined form of motivation which locates at the high end of the continuum. Intrinsic motivation occurs when individuals engage in behavior for their own sake because it is inherently satisfying, interesting, or enjoyable.

Extrinsic motivation, a less self-determined form of motivation, occurs when individuals are motivated to behave and obtain separable outcomes. According to the Organismic Integration Theory, a mini-theory of SDT, extrinsic motivation is further divided into different forms: integrated regulation, identified regulation, introjected regulation and external regulation, which are situated along a continuum ranging from high to low self-determination (Ryan & Deci, 2017). When individuals view behavior as personally crucial and consistent with their deeply held values and self-identity, they fall within the form integrated regulation. Identified regulation occurs when individuals consider the separable outcomes of behavior as being personally crucial. Introjected regulation occurs when behavior is performed to avoid feelings such as guilt or shame or to enhance self-esteem. External regulation occurs when behavior is performed to fulfill an external demand, obtain a reward, or avoid punishment. Amotivation, the least self-determined motivation, is characterized by a lack of perceived competence and/or a failure to value the activity or its outcomes. According to Ryan and Deci (2017), factors closer on the self-determination continuum are more strongly correlated with each other than those more distal factors which indicate a simplex-like model of motivation factors.

According to SDT, individuals holding more self-determined motivation, such as intrinsic motivation, will experience more positive cognitive, affective, and behavioral consequences, such as subjective vitality (Ng et al., 2012). More self-determined motivation is also positively associated with several adaptive learning outcomes, both cognitive and non-cognitive, such as academic achievement (Chow & Yong, 2013). In addition, Ryan and Deci (2017) suggested that motivation in certain situations can be generalized to a wider school experience. Results of Skinner, Chi, and the Learning-

Gardens Educational Association (2012)'s research and Ruiz-Gallardo, Verde, and Valdes (2013)'s research implied that intrinsic motivation experienced in garden work could improve students' motivation and experience in regular classroom course.

In SDT all people are viewed as affected by the satisfaction of the basic psychological needs. According to the Basic Psychological Needs Theory, another mini-theory of SDT, there are three basic psychological needs, the satisfaction or thwarting of which is fundamental to the progression of self-determined actions and health (Ryan & Deci, 2017). These are the needs for autonomy, competence, and relatedness. Autonomy refers to the need for self-governance and self-endorsement of behaviors. Competence refers to the need for feeling effective in one's ongoing interaction with the social environment and experiencing opportunities to express one's capacities. Relatedness refers to the need for feeling connected to others, caring for and being cared for by those others, and having a sense of belongingness both with other individuals and with one's community. Satisfaction of these needs has a direct impact on adaptation and well-being. In contrast, environments that thwart basic psychological needs provoke maladaptation and psychological ill-being (Ryan & Deci, 2017). Previous studies in PE have shown that teachers' autonomy support positively predict the satisfactions of autonomy, competence, and relatedness which in turn predict more self-determined motivation toward PE (e.g., Standage, Gillison, Ntoumanis, & Treasure, 2012).

1.2.1 Self-Determination Theory in Physical Education

Students will display more self-determined motivation toward PE if they find their class to be enjoyable and interesting (i.e., intrinsic motivation) or value its personal benefits (i.e., identified regulation). In contrast, students will display less self-determined

motivation toward PE when they perceived pressure from themselves or others. They will put effort in their PE because of the feelings of guilt and contingent self-worth (i.e., introjected regulation). Students will be externally pressured to participate in PE to please their teacher, to obtain good grades, or to avoid criticism (i.e., external regulation). While students are not motivated neither intrinsically nor extrinsically, they demonstrate amotivation toward PE. Specifically, amotivated students invest a minimum amount of effort in PE classes because they experience incapability to perform activities, or because they do not experience a personal value (Ryan & Deci, 2017).

Previous researches have shown that more self-determined motivation toward PE is positively related to adaptive outcomes, such as being more physically involved, greater engagement, and higher concentration (e.g., Aelterman et al., 2012; Chen & Hypnar, 2015; Haerens, Kirk, Cardon, Bourdeaudhuij, & Vansteenkiste, 2010; Ntoumanis, 2005; Shen, McCaughtry, & Martin, 2007; Zhang, Solmon, Kosma, Carson, & Gu, 2011). Furthermore, more self-determined motivation has also been found to predict high levels of reported vitality, positive affect, self-esteem, health-related quality of life, preference for attempting challenging tasks, behavioral persistence, objective achievement/performance, students' intentions to be physically active during leisure-time, and teachers' ratings of students' effort and persistence in PE (e.g., Boiché, Sarrazin, Grouzet, Pelletier, & Chanal, 2008; Gråstén & Watt, 2017; Hagger et al., 2003; Standage, Duda, & Ntoumanis, 2003; Standage, Duda, & Ntoumanis, 2005; Standage, Duda, & Ntoumanis, 2006; Standage & Gillison, 2007; Vlachopoulos, 2012). In contrast to the positive outcomes associated with more self-determined motivation, less self-determined motivation has been found to be associated with negative outcomes, such as boredom and unhappiness, low engagement, fear of exams

and test situations, and less intention to be physically active during leisure-time (e.g., Aelterman et al., 2012; Haerens et al., 2010; Mouratidis, Vansteenkiste, Lens, & Sideridis 2008; Sánchez-Oliva, Marcos, Alonso, Pulido-González, & García-Calvo, 2015; Schaffner & Schiefele, 2007).

1.2.2 Motivation assessment based on Self-Determination Theory

According to SDT, motivation is contextual specific. Consequently, it is important to measure the different forms through scales designed to assess in specific context. Conforming to the simplex-like structure, a SDT assessment reveals whether or not a person believes in his or her own free will to do the behavior (Ryan & Deci, 2017). For example, the Sport Motivation Scale (Pelletier et al., 1995) and the Behavioral Regulation in Sport Questionnaire (Lonsdale, Hodge, & Rose, 2008) measure the motivation toward sport; the Behavioral Regulation in Exercise Questionnaire (Mullan, Markland & Ingledew, 1997) and the Perceived Locus of Causality Scale (PLOC Scale; Goudas, Biddle, & Fox, 1994) measure motivation toward exercise. Compared with the Behavioral Regulation in Exercise Questionnaire which measures motivation toward exercise during leisure time, the PLOC Scale was widely used to assess adolescents' motivation in context of PE (e.g., Wang, Morin, Ryan, & Liu 2016; Taylor, 2017). Each scale was designed to measure motivation in specific context.

On the basis of the Self-Regulation Questionnaire (Ryan & Connell, 1989) and Academic Motivation Scale (Vallerand et al., 1992), Goudas, Biddle and Fox (1994) developed the PLOC Scale which consists of five subscales, measuring intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. In consideration of the fact that the integrated regulation was found problematic to measure

and encountered more often in adults (Vallerand, 1997), this subscale has not been included in the PLOC Scale in most languages (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Vlachopoulos, Katartzi, Kontou, Moustaka, & Goudas, 2011), like what happen to other instruments such as the Sport Motivation Scale (Pelletier et al., 1995) and the Behavioral Regulation in Exercise Questionnaire-2 (Markland & Tobin, 2004). Numerous studies have examined various psychometric aspects of the PLOC Scale scores (Chatzisarantis, et al., 2003), such as invariances across cultures, genders, and grade levels (e.g., Wang, Hagger, & Liu, 2009a; Wang, Pyunn, Kim, & Chatzisarantis, 2009b). Researchers also examined nomological validity of the PLOC Scale through the correlations between PLOC subscales and other related psychological factors, such as subjective vitality (Vlachopoulos et al., 2011).

1.2.3 Self-Determination Theory in Cultural Context

Numerous SDT-based motivation studies have been conducted in Western countries, such as Australia (e.g., Pannekoek, Piek, Kane & Hagger, 2014), Canada (e.g., Beauchamp, Barling & Morton, 2011), Greece (e.g., Vlachopoulos et al., 2011), Portugal (e.g., Teixeira, Monteiro, Carraça & Palmeira, 2018), Spain (e.g., Martínez-Baena et al., 2016), and United States (e.g., McDavid, Cox, & McDonough, 2014). Nonetheless, fewer researches on SDT-based motivation have been conducted in non-Western nations, like Hong Kong (e.g., Zhong, Liu, & Zhang, 2014) and Singapore (e.g., Wang et al., 2016). Since SDT is a social value construct embedded in individualistic cultures, self-determination may not retain same importance in collectivistic cultures (Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011).

According to cultural dimension theory (Hofstede, Hofstede, & Minkov, 2010),

countries may vary from collectivism to individualism according to score ranging from 0 to 100. For example, China (score 20) is regarded as a traditional non-Western country with an extremely collectivistic culture. On the other hand, Spain (score 51) is considered as relatively more collectivistic than Western countries such as Britain (score 89), but more individualist than other regions of the world such as Latin American countries (Goodwin & Plaza, 2000; Hofstede et al., 2010; Merino, Privado & Gracia, 2017). Cultures of consumerism and individualism may focus on social comparisons, status, and outward image instead of relational issues, whereas collectivism culture may compel one to suppress or neglect authentic aspects of self and relationships (Ryan & Deci, 2017). Researchers used to believe that autonomy and autonomy support would not be important in collectivism culture, such as East Asian contexts (e.g., Murphy-Berman & Berman, 2003). In fact, studies have shown that autonomy support within collectivistic cultures facilitates more autonomous internalization of ambient collectivist values (e.g., Jang, Kim, & Reeve, 2012; Taylor & Lonsdale, 2010). However, various elements of culture may have distinct functional significances for cultural members (e.g., Pan, Gauvain, & Schwartz, 2013). For example, psychological control is frequently observed among Chinese relative to Western parents and more accepted as normative by Chinese children (Cheng, Shu, Zhou, & Lam, 2016). Although making individual choices by oneself could foster intrinsic motivation in both European and Asian adolescents, Asian adolescents would be more intrinsically motivated when the trusted-others, like teacher, made choices for them (Hagger, Rentzelas, & Chatzisarantis, 2014). These findings indicate that the influence of autonomy is not restricted to the individualistic cultures. Nevertheless, inherent conflicts may exist between autonomy and relatedness within collective cultures which varies

perception of autonomy (Chirkov, Ryan, Kim, & Kaplan, 2003).

Turning to the PE context, adolescents interpret some motivation forms differently across cultures so that certain motivation forms may not function similarly (Vlachopoulos et al., 2011). Wang et al. (2009a) found that British adolescents tended to score lower in less-determined forms of motivation and higher in more-determined forms of motivation than Singaporean adolescents. In study of comparison between Britain and Hong Kong (Lonsdale et al., 2011), despite the structural invariance across countries, results illustrated measurement difficulties related to introjected regulation and external regulation in Hong Kong sample, which suggested that Hong Kong students might interpret some motives differently. These results indicate that SDT-based motivation structure exist in PE context across countries with distinct cultures. However, because of the cultural influence, some items may not be interpreted in the measurement model may differ so that adaptation of assessments in specific culture would be necessary to conduct research on SDT-based motivation.

1.3 Chinese Context

In China due to highly valued academic achievement in traditional Chinese culture, people have concentrated on main courses, such as Mathematic and English, to obtain high scores and taken the PE as a special subject without importance (Jin, 2016). School and teachers emphasize on academic knowledge class and pay attention to students' academic performance, which results in ignorance of PE in school (Mowling, Brock, Eiler, & Rudisill, 2004). In turn, such emphasis on exam leads to teaching to the test, to excessive stress, and to the lack of intrinsic motivation within school learning (Sun, Dunne, Hou, & Xu, 2013).

1.3.1 Low Physical Education status

In China, the Ministry of Education and the State Council have established national guidelines and standards for providing PE to students (Liang, Walls, & Lu, 2005; Xu & Gao, 2018). The Rules and Regulations of the Work of School Physical Education require primary and secondary schools to ensure that student have an hour doing physical exercises during school time every day. Students are required to obtain a minimum score in PE to advance to the next grade level (Liang et al., 2005). Unfortunately, the attention of the state and education department did not improve the realistic status of PE. With the increase of academic pressure, all the courses which have nothing to do with the entrance exam have become less important, including PE. However, because the result of PE test has been credited to the total score of senior middle school admissions, many schools organize specialized training team of PE for the students of final year, but the practice content of which is limited to the test project. And after the PE test of senior middle school admissions is over in April, all kinds of the PE will be stopped as well. The low status of PE allows students and parents to ignore students' development of PE. Also, students' learning enthusiasm of PE class is not high (Jin, 2016).

According to a national survey, nearly one third of elementary and secondary schools failed to implement the national PE recommendations (National Institute of Education Science, 2009). In another national survey, only 33.2% of Chinese students aged 6-19 years participated in PA at least seven times per week (Chinese Students Physical Fitness and Health Research Group; 2016). In Shanghai's 2016 Report Card on Physical Activity for Children and Youth, about 80% students aged 6-18 years did not meet the PA guideline for at least 60 minutes (Liu et al., 2016). In 2018 Report Card with national representative

samples in China, more than 85% students did not meet the PA guideline and about 30% students achieved fitness standards based on the Physical Fitness and Health Surveillance of Chinese School Students (Liu et al., 2019). In addition, increases in physical inactivity and sedentary behavior have been observed in Chinese school-age children in recent decades (Lu et al., 2017; Chen, Zheng, Yi, & Yao, 2014).

1.3.2 High academic demand

Confucianism has dominated in Chinese traditional culture for a long time and the customs of paying more attention to intelligence and looking down on PE seriously affected the status of sports in people's minds (Jin, 2016). Academic achievement is generally valued and emphasized due to its association with better career prospects, higher income, and enhanced social status (Nyroos et al., 2015). From an early age, students are aware of the fierce competition for the exceedingly few places at colleges and institutes for further education and are under intense pressure to succeed in their exams in order to obtain these desirable places. The centrality of testing in Chinese education has been evident for decades, and Chinese students undergo enormous numbers of exams (Carless & Lam, 2012). In addition, students raised in the Confucian tradition are strongly family-oriented and thus work not only for themselves but also for their family's honor. Children should feel enormous gratitude to their parents for having given them life, and scholastic achievement is believed to be the best way of repaying the associated debt (Carless & Lam, 2012).

Although academic performance has been found to be a major source of stress among adolescents worldwide, this phenomenon seems to be more pronounced in China and other Asian countries (Liu & Lu, 2012). Particularly, students from East-Asian countries, like

China, Japan, and Korea, have been found to spend more time on academic task and perceive more academic stress than students from Western countries such as Sweden and United States (Li, Martin, & Yeung, 2017). In another cross-cultural study, Chinese students have also been found to present higher academic burden and pressure than students from Japan, Korea, and US, Chinese students presented (Zhao, Zhu, & Ma, 2009). Because of the high academic demands, Chinese students are more likely to experience academic stress.

1.3.3 Motivation based on Self-Determination Theory in Chinese context

Recently, SDT has been used to investigate academic motivation in China (e.g., Liu & Flick, 2019; Zhang, Bobis, Wu, & Cui, 2018; Zhang, Li, Li, Li, & Zhang, 2016). The correlation between more self-determined academic motivation and positive outcomes, such as academic performance and school satisfaction, has been found in research conducted in China (Li, Deng, Wang, & Tang, 2018). In addition, SDT-based motivation has also been found to change across time and situations (Li & Hein, 2019). For example, Chinese senior secondary school students reported less self-determined motivation than junior secondary school students (Liu et al., 2013). Besides, researchers also investigated motivation toward PA during leisure time based on SDT and found the relationship between self-determined motivation and positive outcomes (e.g., Liu, Chun, Zhang, & Si, 2015; Wang, 2017).

Respect to PE context, investigations on motivation toward PE have been conducted in other Chinese cultural contexts outside mainland China, like Hong Kong and Singapore (e.g., Wang et al., 2016; Zhong et al., 2014). For example, the PLOC Scale has been adapted in both for adolescents from Hong Kong and Singapore (Lonsdale et al., 2011;

Wang et al., 2009a). Due to immigration, colonization, and globalization, people in China and other Chinese societies like Hong Kong may differ in cultural beliefs and government system (Liu et al., 2015). In addition, government of People' Republic of China published the list of simplified Chinese characters in 1964 to replace traditional Chinese characters which are used in other Chinese society such as Hong Kong and Taiwan. Therefore, although structure and measurement of SDT-based motivation toward PE have been examined in other Chinese cultural contexts, the examination of the structure of SDT-based motivation toward PE among adolescents from mainland China still needs to be conducted.

1.3.4 Academic stress

Due to the influence of high academic demands on PE status in Chinese education context (Jin, 2016), such academic demands may also affect Chinese students' motivation toward PE. Academic demands have been found to be highly related to academic stress perceived by students (Barker, Howard, Villemare-Krajden, & Galambos, 2018). Academic stress is defined as a disturbance induced by a student's appraisal of school-related stressors, a distress that is often manifested through psychological and somatic symptoms (Leung, Yeung, & Wong, 2010). Academic stress that largely comes from work overload, the amount of material to learn, and the need to perform well, becomes an important source of students' everyday stress (Byrne, Davenport, & Mazanoy, 2007).

Yeo and Lee (2017) suggested that academic stress occurs when studying is uncomfortable, difficult, or the student is unmotivated, involving negative emotions, such as anger, anxiety, helplessness, shame, and boredom. Therefore, academic stress will change over time because of various academic demands within semesters (Xiang, Tan, Kang, Zhang, & Zhu, 2017). For instance, students will perceive most academic stress

before the first exam of semester, due to lack of preparation (Xiang et al., 2017). Academic stress, as the most frequent stress perceived by adolescents, has negative impact on emotional states, mental health, and learning abilities (Hollenstein & Loughheed, 2013). Previous studies have found that academic stress is associated with various psychological problems such as unpleasant emotional states, increased social and academic anxiety, internalizing problems, long-term mood disorders and depressed scholastic achievements (e.g., O'Connor, Rasmussen, & Hawton, 2010). On the other side, academic stress can also lead to positive impact if the stress is perceived as opportunity and effective regulatory strategies are used (Sang, Pan, Deng, & Zhao, 2017). The way on how students perceive academic stressors may differ according to interpretation of the stressor (Chua, Ng, & Park, 2018). These interpretations may be influenced by different factors such as inherent cultural values and an individual's adaptive abilities during an experience of a stressful situation (e.g., Keshavarz & Baharudin, 2013).

Besides the mentioned psychological problems, academic stress is also related to students' motivation and attitudes toward classes. Academic stress was found to be negatively related to more self-determined academic motivation, but positively related to less self-determined academic motivation across time (Park et al., 2012; Liu, 2015). In study of academic stress and motivation toward PE, Back (2015) found that academic stress was associated with low participation and negative attitudes toward PE, meanwhile, such uncomfortable psychological state caused by studying could be reduced by intention to participate in PE.

1.4 Purpose

The main objective of this research was to investigate SDT-based motivation toward PE and its relation to academic stress in Chinese context. With this research, we hope to further understand how SDT-based motivation works in various cultures. The first step of this research was to adapt the PLOC Scale into simplified Chinese to measure SDT-based motivation toward PE in Chinese context which still lacks investigation. Regarding that China and Spain vary in individualist-collectivist dimension, we also aimed to compare SDT-based motivation structure and different motivation forms between these two countries to further explore the cultural influences on SDT-based motivation. Once we examined the SDT-based motivation structure, we further explored the relationship between motivation toward PE and academic stress in China. Since both SDT-based motivation and academic stress will change across time, we aimed to explore the change of motivation toward PE and academic stress within semester. Previous studies have examined the relationship between academic stress and academic motivation and the results indicate a reciprocal relationship. As suggested by Ryan and Deci (2017), students' motivation in certain situation can be generalized to other educational situations. Therefore, we hypothesized a similar reciprocal relationship between motivation toward PE and academic stress.

1.4.1 Objective of Study 1

In study 1, we adapted the PLOC Scale into simplified Chinese and examined the validity and reliability of the simplified Chinese PLOC Scale to investigate SDT-based motivation in Chinese PE context. In addition, we also examined the cross-cultural

equivalence and compared different motivation forms between China and Spain to further explore the cultural influences on SDT-based motivation.

1.4.2 Objective of Study 2

In study 2, we measured and compared motivation toward PE and academic stress at two occasions to explore the changes within semester. We also examined the relationship between motivation toward PE and academic stress across time to explore whether SDT-based motivation interact with stress across PE and other academic contexts.

Chapter 2 Study 1

Measuring motivation toward Physical

Education among Chinese and Spanish

adolescents: Adaptation of the simplified

Chinese Perceived Locus of Causality Scale

2.1 Methods

2.1.1 Participants

A sample of 2,293 students from China and Spain participated in the current study. The Chinese sample included 1,287 students (47.54% female), with mean age of 12.29 years ($SD = 0.82$, range: 11-15) from Year 6 to 8 of schools in Shanghai, level 2 in International Standard Classification of Education. The Spanish sample included 1,006 students (49.01% female), with mean age of 13.56 years ($SD = 0.97$, range: 11-16) from course 1 to 3 of secondary schools in Catalonia, level 2 in International Standard Classification of Education.

2.1.2 Instruments

The PLOC Scale (Goudas et al., 1994) was employed to assess students' motivation in PE. The scale consisted of five four-item subscales measuring intrinsic motivation (e.g., "because PE is fun"), identified regulation (e.g., "because I want to learn sport skills"), introjected regulation (e.g., "because I would feel bad about myself if I didn't"), external regulation (e.g., "because that's the rule"), and amotivation (e.g., "but I really don't know why"). After reading the stem "I participate in PE", students were asked to respond on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale was applied in simplified Chinese, adapted from traditional Chinese (Lonsdale et al., 2011), and in Spanish (Moreno-Murcia, González-Cutre, & Chillón-Garzón, 2009).

Subjective vitality was assessed by the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) to examine the correlation of motivation with a theoretically related variable. A five-item version of SVS (Castillo, Tomas, & Balaguer, 2017; e.g. "I feel alive

and full of vitality”) was applied in both Chinese (Song, Fu, & Yang, 2015) and Spanish (Castillo et al., 2017). The SVS was measured on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

2.1.3 Procedure

We adapted the traditional Chinese PLOC Scale (Lonsdale et al., 2011) into simplified Chinese, following the guidelines of questionnaires adaptation (Acquadro, Conway, Hareendran, & Aaronson, 2008; International Test Commission, 2017). Two Chinese linguists adapted items into simplified Chinese. Another bilingual translator translated the obtained version into English. The first author compared the back-translated version with the original version and modified three items (e.g., expression of “yell” was modified to exclude the sense of insulting). Two psychology experts reviewed the items to guarantee that these items were well designed to measure the supposed constructs. Sixty Chinese secondary school students completed scales online to indicate whether the items were understandable. Three students indicated some items understandable but unconformable to their speech habit. After communicating with these students, we determined the final version of the simplified Chinese PLOC Scale.

Ethical approval was obtained from the research ethics committee of the authors’ institution. Permission was obtained from participating schools and teachers and/or department head of PE were contacted to approach the students in classes to seek participation in the study. Conforming to the guidelines of Spanish Psychological Society, informed consent was obtained from parents/legal representatives. Once students decided to participate in study voluntarily and confidentiality was ensured, they completed the scales within 25 minutes at the beginning of PE classes.

2.1.4 Data analysis

We first computed the descriptive statistics and missing values patterns. According to criteria suggested by Rhemtulla, Brosseau and Savalei (2012), we treated the data as ordinal. Regarding the ordinal nature of the data and the presence of missing values (see Results), we used the Weighted Least Squares Mean and Variance adjusted (WLSMV) estimator for Confirmatory Factor Analysis (CFA) to examine the hypothesized five-factor structure of PLOC Scale in each language (Li, 2016). Items were allowed to only load on the hypothesized factor and error terms were not allowed to correlate. The Goodness-of-fit Indices included the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA). For quantitative data, CFI and TLI $\geq .90$, and RMSEA $\leq .08$ indicate acceptable fit while CFI and TLI $\geq .95$, and RMSEA $\leq .06$ indicate good fit (Kline, 2016). For ordinal data, limited criteria have been proposed, for example CFI $> .96$ (Yu, 2002). Following Viladrich and her colleagues' (2013) recommendations, we took all these suggestions into consideration. We calculated both the nonlinear reliability coefficients for ordinal data (Green & Yang, 2009; Viladrich, Angulo-Brunet & Doval, 2017) and the composite reliability coefficients (Hair, Black, Babin & Anderson, 2018) to enable comparing with previous studies. We examined the convergent validity through Average Variance Extracted (AVE; Hair et al., 2018). We also examined the discriminant validity by comparing AVE and squares of inter-correlations among PLOC Scale factors, and the nomological validity through the correlations between PLOC subscales and the SVS score (Hair et al., 2018; Lonsdale et al., 2011). To examine the cross-cultural invariance of the PLOC Scale factor structures, we conducted a multiple-group CFA following the procedures proposed by Kline (2016). We tested the baseline

model with no parameter constraints, followed by models in which factor loadings, thresholds, variances and covariances were sequentially constrained to be equal across two samples. A decrease in CFI larger than .01 and a decrease in RMSEA larger than 0.015 from one model to the next indicated that the more constrained model was not invariant across the samples (Chen, 2007; Kline, 2016). Once measurement invariance was tested, we compared latent factor means between the two samples through latent mean analysis.

2.2 Results

2.2.1 Descriptive results

The responses displayed 2.1% of missing values, with 37 missing patterns in the Chinese sample and 28 in the Spanish sample. The item distributions (see Table 1) showed skewness between 0 and 1.99 in absolute value, and kurtosis between 0.07 and 5.97 in absolute value, indicating non-normality in both cultures. In consideration of the existent floor and ceiling effects in the item distribution, the data were treated as ordinal.

2.2.2 Single group Confirmatory Factor Analyses results

In the Chinese sample, the 20-item model did not fit the data adequately (see Table 2). The standardized factor loadings ranged from -.24 to .89 (see Table 1). Using the modification indices and standardized residual matrix, we found item IDR2 of identified regulation (i.e., “because it is important for me to do well in PE”), item ITR4 of introjected regulation (i.e., “because it bothers me when I don't”) and item EXR2 of external regulation (i.e., “because that's what I am supposed to do”) problematic to measure the supposed factor. This inspection along with content analysis (see Discussion) suggested that these items may not measure what they were meant to measure. Thus, these three items were

Table 1 *Response percentage to each category, univariate normality, and item-factor loadings of PLOC Scale*

Scale	1	2	3	4	5	Sk	K	Load
	China							
Intrinsic								
Motivation								
IM1	6.78	7.94	20.28	22.13	42.87	-0.84	2.67	.79
IM2	4.09	6.25	18.52	19.14	52.01	-1.07	3.19	.89
IM3	7.77	7.39	23.32	21.04	40.47	-0.75	2.55	.79
IM4	4.86	6.16	18.77	19.76	50.46	-1.05	3.14	.88
Identified								
Regulation								
IDR1	2.28	2.89	14.67	21.66	58.51	-1.43	4.54	.86
IDR2	7.38	9.05	28.59	20.76	34.22	0.54	2.34	.45
IDR3	3.20	2.59	14.56	21.42	58.23	-1.48	4.66	.82
IDR4	5.70	4.56	18.02	21.44	50.27	-1.14	3.41	.70
Introjected								
Regulation								
ITR1	25.98	12.26	25.51	15.52	20.82	0.02	1.68	.68
ITR2	23.49	11.75	24.41	16.93	23.42	-0.09	1.67	.56
ITR3	28.28	13.57	27.37	14.25	16.53	0.16	1.78	.76
ITR4	21.99	14.18	33.51	13.34	16.93	0.08	1.95	.47
External								
Regulation								
EXR1	46.14	13.84	19.67	8.55	1.18	0.72	2.18	.71
EXR2	6.20	5.82	21.06	19.37	47.55	-0.95	2.93	-.24
EXR3	56.55	11.05	16.96	6.36	9.09	1.05	2.78	.85
EXR4	25.62	15.04	26.76	13.08	19.50	-0.13	1.75	.56
Amotivation								
AM1	54.39	10.98	21.12	5.26	8.01	0.99	2.79	.66
AM2	58.30	13.77	18.34	3.42	6.16	1.26	3.58	.76
AM3	71.33	12.03	10.59	2.8	3.25	1.92	5.97	.86
AM4	58.83	18.05	14.06	4.69	4.38	1.39	4.02	.82

Table 1 *Response percentage to each category, univariate normality, and item-factor loadings of PLOC Scale (continued)*

	1	2	3	4	5	Sk	K	Load
Scale	Spain							
Intrinsic								
Motivation								
IM1	4.38	6.47	14.03	24.98	50.15	-1.19	3.54	.74
IM2	4.49	7.98	17.35	27.12	43.07	-0.95	3.01	.88
IM3	7.42	8.83	29.79	26.58	27.38	-0.51	2.49	.63
IM4	6.79	11.08	23.45	24.65	34.03	-0.59	2.35	.82
Identified								
Regulation								
IDR1	4.68	8.66	14.63	24.48	47.56	-1.03	3.06	.83
IDR2	5.48	7.58	19.74	27.22	39.98	-0.87	2.89	.78
IDR3	3.88	6.37	14.44	26.59	48.71	-1.16	3.56	.76
IDR4	5.27	8.46	21.59	29.35	35.32	-0.76	2.76	.68
Introjected								
Regulation								
ITR1	13.15	10.36	19.52	21.91	35.06	-0.56	2.05	.67
ITR2	26.45	13.57	19.86	17.56	22.55	0	1.58	.64
ITR3	23.51	16.43	25.10	16.93	18.03	1.99	0.07	.69
ITR4	25.12	17.75	16.95	16.95	15.65	0.14	1.79	.54
External								
Regulation								
EXR1	29.35	12.84	16.72	16.32	24.78	.02	1.48	.60
EXR2	8.16	8.16	18.51	24.58	40.60	-0.84	2.63	.55
EXR3	43.13	13.55	13.45	12.05	17.83	0.50	1.69	.69
EXR4	23.71	13.05	21.02	16.14	26.10	-0.09	1.60	.71
Amotivation								
AM1	52.86	11.43	16.35	8.02	11.33	0.88	2.36	.70
AM2	57.77	14.14	11.85	7.97	8.27	1.15	2.98	.76
AM3	64.40	12.60	10.40	6.90	5.70	1.43	3.81	.89
AM4	44.28	14.63	18.51	11.74	10.85	1.98	0.64	.66

Note. IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; Sk = skewness; K = Kurtosis.

Table 2 *Confirmatory Factor Analyses model fit indices*

Model	χ^2	<i>df</i>	CFI	Δ CFI	TLI	RMSEA	Δ RMSEA	90% CI RMSEA
Single group model								
Chinese 20-item model	3836.06	160	.83		.80	.13		[.13, .14]
Spanish 20-item model	994.79	160	.94		.93	.07		[.07, .08]
Chinese 17-item model	550.74	109	.98		.97	.06		[.05, .06]
Spanish 17-item model	509.36	109	.97		.96	.06		[.06, .07]
Multi-group model								
Baseline model	1052.21	218	.97		.97	.06		[.05, .06]
Loadings constrained model	1178.90	230	.97	.00	.96	.06	.00	[.06, .06]
Thresholds constrained model	1618.53	276	.96	-.01	.96	.07	.01	[.06, .07]
Variances/covariances constrained model	2096.71	291	.95	-.01	.95	.07	.00	[.07, .08]
Mean comparison model	1618.53	276	.96	—	.96	.07	—	[.06, .07]

Note. *df* = degrees of freedom; CFI = Comparative Fit Index; Δ = difference with the previous model; TLI = Tucker-Lewis Index; RMSEA = Root Mean Squared Error of Approximation; CI = Confidence Interval.

removed from further analysis. After excluding these items, the 17-item model fit the data well. In the Spanish sample, we found a nearly acceptable fit of the 20-item model (see Table 2). To compare the two samples, we also tested the 17-item model in the Spanish sample, which fit the data well.

The nonlinear reliability coefficients of intrinsic motivation, identified regulation and amotivation were greater than .70 in both cultures (see Table 3), indicating an acceptable internal consistency. In the Chinese sample, the reliability coefficients of introjected regulation and external regulation were .66 and .72. In the Spanish sample, the reliability coefficients of introjected regulation and external regulation were .67 and .68. These values are considered to be slightly low (Hair et al., 2018). The values of composite reliability coefficients were similar to the nonlinear reliability coefficients that values of introjected regulations and external regulations were lower than other subscales.

Table 3 *Internal consistency and mean differences of subscales scores*

Subscale	China				Spain (reference)				SE	p
	ρ	ω	AVE	M	ρ	ω	AVE	M		
IM	.87	.91	.84	0.22	.81	.85	.76	0	.04	< .001
IDR	.76	.84	.79	0.36	.79	.81	.77	0	.05	< .001
ITR	.66	.71	.67	-0.26	.67	.70	.66	0	.05	< .001
EXR	.72	.78	.73	-0.41	.68	.67	.64	0	.06	< .001
AM	.83	.86	.78	-0.18	.78	.83	.74	0	.06	.008

Note. IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; ρ = non-linear reliability coefficient (Green & Yang, 2009); ω =composite reliability coefficient; AVE=Average Variance Extracted.

The hypothesized simplex-like structure was also found (see Table 4). As expected, factors closer on the self-determination continuum were more correlated than more distal factors. For example, external regulation was correlated more positively with amotivation than introjected regulation. However, identified regulation was correlated more negatively with amotivation than intrinsic motivation did.

Table 4 *Correlations of PLOC factors and SVS in Chinese (above the diagonal) and Spanish (below the diagonal) samples*

Factor	1	2	3	4	5	6
1 IM	—	.94***	.07*	-.48***	-.72***	.55***
2 IDR	.96***	—	.14***	-.45***	-.73***	.57***
3 ITR	.52***	.64***	—	.27***	.69***	.08*
4 EXR	-.09*	-.02	.67***	—	.75***	-.32***
5 AM	-.46***	-.48***	.09*	.59***	—	-.49***
6 SV	.81***	.75***	.45***	-.05	-.36***	—

Note. IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; SV=Subjective Vitality.

* $p < .05$, ** $p < .01$, *** $p < .001$

All AVE values of subscales were higher than 0.5, supporting the convergent validity (see Table 3). Moreover, AVE values of most subscales were higher than these two factors in both groups, which supported the discriminant validity of introjected regulation, external regulation, and amotivation scores. The inter-factor correlations less than .90 also regulation (see Table 4; Kline, 2016). these two factors in both groups, which supported the discriminant validity of introjected regulation, external regulation, and

amotivation scores. The inter-factor correlations less than .90 also supported the discriminant validity of subscales except intrinsic motivation and identified regulation (see Table 4; Kline, 2016). The correlations between factors of PLOC and subjective vitality are presented in Table 4. As expected, intrinsic motivation, identified regulation and introjected regulation were positively related to subjective vitality, meanwhile, amotivation and external regulation were negatively related to subjective vitality.

2.2.3 Multi-group Confirmatory Factor Analyses results

The 17-item model fit the data well independently in each sample (see Table 2). The baseline multi-group model with no parameter constraints fit the data well. When we sequentially constrained the factor loadings, thresholds, variances and covariances, the CFI and the RMSEA did not exhibit sizeable change. These results indicated configural, scalar, metric and structural invariance across the two samples.

To conduct latent mean analysis, we constrained the thresholds of the observed variables to be equal and fixed the latent factor means to zero for the Spanish sample as the reference group. The model showed an acceptable fit to the data supporting the scalar invariance between countries. Moreover, the Chinese sample demonstrated significantly higher scores in intrinsic motivation and identified regulation than the Spanish sample. Meanwhile, the Chinese sample presented significantly lower scores in introjected regulation, extrinsic motivation and amotivation than the Spanish sample (see Table 3).

Chapter 3 Study 2

**Examining the relationship between
motivation toward Physical Education and
academic stress among Chinese adolescents**

3.1 Methods

3.1.1 Participants

A sample of 556 Chinese secondary school students (47.84% female) from Year 6 to Year 8 of schools in Shanghai, with mean age of 12.55 years ($SD= 0.78$, range: 10-15) participated in the study at the beginning of the first semester and three months later. Among them, 463 students completed the questionnaires at both time points, 34 students were absent at the First Data Collection (T1), and 49 students were absent at the Second Data Collection (T2).

3.1.2 Instruments

The adapted simplified Chinese version of PLOC Scale (Goudas et al., 1994) was employed to measure students' motivation in PE like we did in study 1. Students were asked to respond on a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

The Educational Stress Scale for Adolescents (ESSA; Sun, Dunne, Hou, & Xu, 2011) was used to measure students' educational stress. The scale contained five dimensions which are positively inter-correlated. These dimensions are measured by 16 items, including four items of pressure from study (e.g., "I feel a lot of pressure in my daily studying"), three items of workload (e.g., "I feel there is too much homework"), three items of worry about grades (e.g., "I feel that I have disappointed my teacher when my test/exam results are not ideal"), three items of self-expectation (e.g., "I feel stressed when I do not live up to my own standards"), and three items of despondency (e.g., "I am very dissatisfied with my academic grades"). Students were asked to respond on a five-point Likert scale

ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

3.1.3 Procedures

The questionnaires were completed prior to the PE classes and lasted between 10 to 25 minutes. Students completed the questionnaires of motivation and educational stress at two time points. T1 was at the beginning of the semester when students were not well prepared from holidays to school lives. T2 was three months later when students were preparing for the final exam one month later. To enable data matching over time without the need for names, ID code lists were used.

3.1.4 Data analysis

We treated the data as ordinal in consideration of descriptive statistics and missing values patterns (Rhemtulla et al., 2012). We studied the measurement model of each subscale separately due to the fact that the sample size was not powerful enough to conduct an analysis including simultaneously all items and factors (Appelbaum et al., 2018; Prinsen et al., 2018). We examined the uni-dimensionality structure of each scale using the WLSMV estimator. We calculated both alpha and nonlinear reliability coefficients for ordinal data (Green & Yang, 2009) to examine the internal consistency coefficients. Then we calculated and compared the mean of each subscale between T1 and T2 with paired t-test. To examine the relationship between academic stress and motivation in PE, we conducted cross-lagged panel analysis freely estimating all paths between T1 and T2 using robust maximum likelihood estimator. We used the same Goodness-of-fit Indices of study 1.

Table 5 *Uni-dimensional model fit indices per subscale*

Model	χ^2	<i>df</i>	CFI	TLI	RMSEA	90% CI RMSEA
Motivation						
IM	6586.708	28	.983	.968	.117	[.099, .137]
IDR	2696.182	15	.999	.996	.038	[.000, .078]
ITR	1375.465	15	.997	.992	.036	[.000, .076]
EXR	1487.126	15	.995	.984	.054	[.019, .091]
AM	2806.614	28	.992	.984	.053	[.033, .075]
Academic stress						
PFS	5962.433	28	.999	.998	.028	[.000, .053]
WL	9961.146	15	1	1	.019	[.000, .065]
WAG	7313.348	15	1	.999	.026	[.000, .069]
S-E	1445.034	15	.991	.974	.067	[.034, .103]
DE	1116.031	15	.999	.996	.023	[.000, .067]

Note. IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; PFS = pressure from study; WL = workload; WAG = worry about grade; S-E = self-expectation; DE = despondency; *df* = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Squared Error of Approximation; CI = Confidence Interval.

3.2 Results

3.2.1 Descriptive results

The responses displayed 3.52% missing during T1 and 3.22% missing during T2, which did not require special missing data treatment (Graham, 2009). Table 5 presents the model fit indices of uni-dimensional models. CFI and TLI of all unidimensional factor

model were above 0.90, and most of RMSEA were less than 0.08 except for intrinsic motivation, which supported the uni-dimensionality of subscales.

Table 6 *Descriptive statistics and internal consistency coefficients of subscales scores of PLOC Scale and ESSA*

Scale	T1				T2				Mean Difference
	<i>M</i>	<i>SD</i>	ρ	α	<i>M</i>	<i>SD</i>	ρ	α	
Motivation									
IM	3.84	1.04	.88	.90	4.04	0.99	.88	.92	-0.21***
IDR	4.10	0.89	.78	.83	4.10	0.97	.84	.89	0
ITR	2.91	1.09	.69	.72	2.84	1.09	.69	.70	0.07
EXR	2.39	1.07	.74	.77	2.1	1.00	.77	.81	0.29***
AM	1.89	0.92	.84	.86	1.76	0.89	.85	.87	0.13*
Academic stress									
PFS	2.83	1.03	.83	.85	2.63	1.11	.89	.91	0.20**
WL	2.62	1.14	.91	.90	2.25	1.06	.92	.91	0.38***
WAG	3.76	1.01	.84	.85	3.68	1.06	.86	.86	0.07
S-E	2.96	1.02	.71	.74	2.87	1.07	.76	.79	0.1
DE	2.35	0.91	.67	.70	2.48	0.96	.70	.71	-0.13*

Note. IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; PFS = pressure from study; WL = workload; WAG = worry about grade; S-E = self-expectation; DE = despondency; ρ = non-linear reliability coefficients (see text); α = Cronbach's alpha coefficient.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Cronbach's alpha coefficients of all subscales were more than 0.7 at the same time most of non-linear internal consistency coefficients were more than 0.7 except for those of introjected regulation and despondency which were nearly 0.7, which supported the internal consistency of the subscales of PLOC Scale and ESSA (see in Table 6; Hair et al., 2018). Intrinsic motivation and despondency increased significantly while external regulation, amotivation, and pressure from study decreased significantly from T1 to T2 (see in Table 6).

3.2.2 Results of cross-lagged panel analysis

Table 7 presents the correlation coefficients obtained from cross-lagged panel analysis. At both T1 and T2, we found positive correlation between intrinsic motivation and identified regulation and positive correlations among introjected regulation, external regulation, and amotivation. Both intrinsic motivation and identified regulation were negatively correlated with introjected regulation, external regulation, and amotivation. Respect to academic stress, all five factors were positively correlated at both T1 and T2. Regarding relationship between motivation and academic stress, intrinsic motivation and identified regulations were positively related to worry about grades, but negatively related to pressure from study, workload, and despondency. Introjected regulation, external regulation, and amotivation were positively associated with almost all academic stress factors except that the amotivation was negatively related to worry about grades at T1.

Figure 1 presents the model with standardized path loadings. Turning to influence of motivation on academic stress, we found positive effect of identified regulation on worry about grades ($\beta=.17$, $p<.05$, 95% CI [.04, .30]), and positive effect of amotivation on workload ($\beta=.11$, $p<.05$, 95% CI [.00, .22]) and despondency ($\beta=.15$, $p<.01$, 95% CI

Table 7 Pearson correlation coefficients among subscales scores of PLOC and ESSA (T1 above diagonal and T2 below diagonal)

Subscale	1	2	3	4	5	6	7	8	9	10
1 IM	—	.73***	.16***	-.28***	-.51***	-.12**	-.15**	.16***	.06	-.11*
2 IDR	.83***	—	.20***	-.29***	-.51***	-.20***	-.27***	.20***	.06	-.17***
3 ITR	.11*	.17***	—	.40***	.13**	.28***	.23***	.31***	.25***	.10*
4 EXR	-.32***	-.23***	.42***	—	.52***	.39***	.38***	.12**	.16***	.19***
5 AM	-.41***	-.36***	.19***	.51***	—	.33***	.32***	-.10*	.06	.21***
6 PFS	-.14**	-.09*	.26***	.35***	.36***	—	.71***	.22***	.37***	.48***
7 WL	-.23***	-.19***	.18***	.36***	.35***	.72***	—	.06	.19***	.34***
8 WAG	.13**	.18***	.28***	.18***	.10*	.33***	.15**	—	.39***	.10*
9 S-E	.01	.04	.24***	.21***	.18***	.43***	.28***	.48***	—	.30***
10 DE	-.15***	-.11***	.19***	.31***	.41***	.61***	.50***	.27***	.43***	—

Note. IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; PFS = pressure from study; WL = workload; WAG = worry about grade; S-E = self-expectation; DE = despondency.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

[.04, .25]). Meanwhile, we found negative effect of despondency on identified regulation ($\beta = -.13, p < .01, 95\% \text{ CI} [-.22, -.03]$).

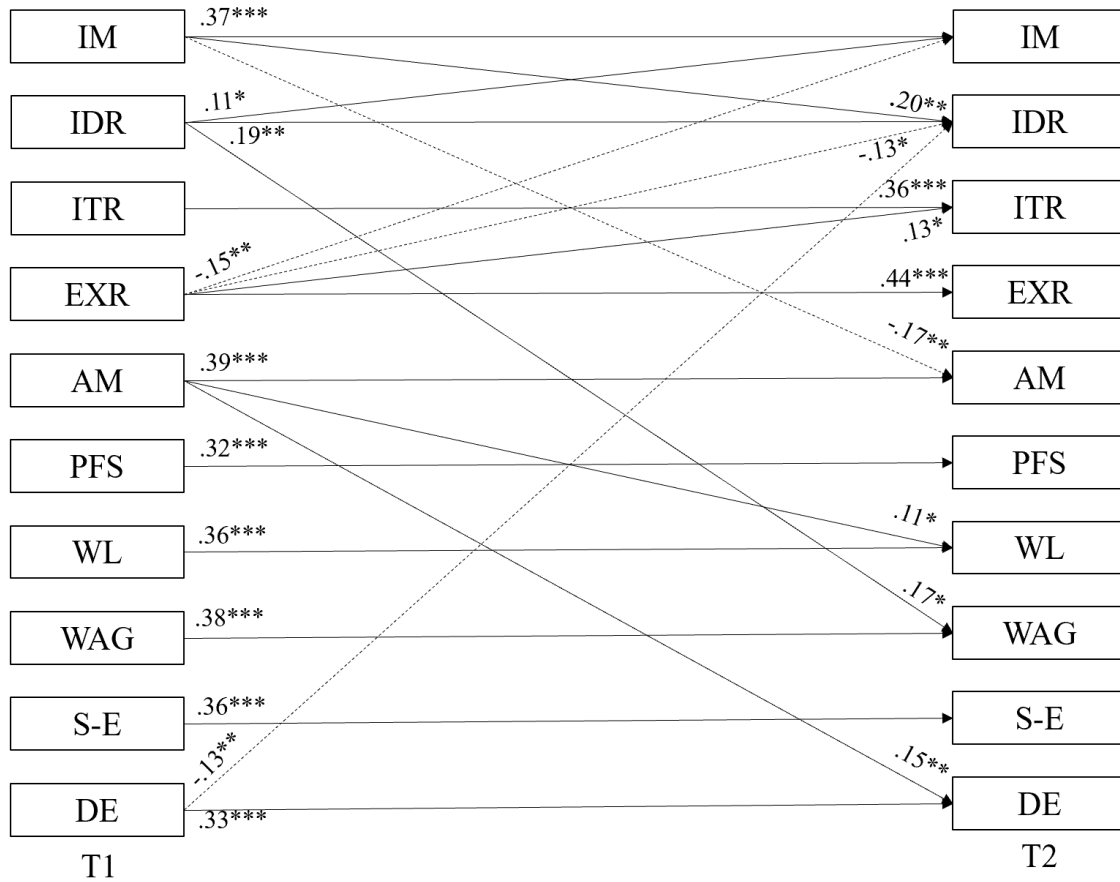


Figure 1. Cross-lagged model of relationship between motivation and academic stress

Note. Dashed lines depict negative path loading; IM = intrinsic motivation; IDR = identified regulation; ITR = introjected regulation; EXR = external regulation; AM = amotivation; PFS = pressure from study; WL = workload; WAG = worry about grade; S-E = self-expectation; DE = despondency.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Chapter 4 Discussion

The objective of this work was to investigate SDT-based motivation toward PE and its relation to academic stress among Chinese adolescents. The first study aimed to adapt the PLOC Scale into simplified Chinese to measure SDT-based motivation toward PE among Chinese adolescents and compare it with Spanish adolescents. The results largely supported the validity and reliability of the simplified Chinese PLOC Scale in the intended population as well as the universality of the SDT-based motivation structure. However, the problematic items encountered among Chinese adolescents and the mean differences between Chinese and Spanish adolescents highlighted that the measurement model and the motivation levels may differ across cultures. The second study included academic stress as related variable in educational context to further understand how SDT-based motivation toward PE works in Chinese academic context. Both self-determined motivation and academic stress of students improved within semester. The results of cross-lagged panel analysis revealed a negative relationship between self-determined motivation and most academic stress factors except for worry about grade.

4.1 Psychometric properties of the simplified Chinese Perceived Locus of Causality Scale

Consistent with previous studies (e.g. Lonsdale et al., 2011; Moreno-Murcia et al., 2009; Zhong et al., 2014), our results provided evidence of the PLOC Scale five-factor structure in both cultures except for three problematic items encountered in the Chinese sample. Turning to reliability, three subscales showed acceptable values in both groups. However, the internal consistencies of introjected regulation and external regulation scores were low in both Chinese and Spanish adolescent scores. Similar results were also found

in previous studies (Ferriz, González-Cutre, & Sicilia, 2015; Lonsdale et al., 2011; Teixeira et al., 2018). This may be explained by the fact that items of both subscales measure various aspects of each regulation, which results in inconsistency. For example, introjected regulation includes both motives to avoid low contingent self-worth and to enhance contingent self-worth.

The inter-correlations of subscales and correlations between different motivation forms and subjective vitality supported the simplex-like structure and nomological validity of the scale, consistent with theory and previous studies (e.g. Martínez-Baena et al., 2016; McDavid et al., 2014; Vlachopoulos et al., 2011). However, similar to scales in other languages (e.g. Lonsdale et al., 2011; Moreno-Murcia et al., 2009; Teixeira et al., 2018), the discriminant validity between intrinsic motivation and identified regulation cast doubt. Identified regulation was defined as one's willingness to act to express values although the behavior may not be enjoyable for its own sake (Sheldon, Osin, Gordeeva, Suchkov, & Sychev, 2017). When adolescents do not feel unpleasant when participating in PE, they may not distinguish identified regulation from intrinsic motivation.

We found three problematic items which did not measure the supposed factor. The item IDR2 (i.e., "because it is important for me to do well in PE") signifies motives to express personal value and the item ITR4 (i.e., "because it bothers me when I don't") signifies motive to avoid low contingent self-worth. Both items represent the importance of PE to adolescents. However, in China people pay too much attention to traditional academic achievement and consider PE to be replaceable by other important classes (Jin, 2016). Therefore, students may not consider participation in PE as important to express self-worth or personal value, which would explain why these items did not measure

supposed regulation. The item EXR2 (“because that’s what I am supposed to do”) is supposed to measure external regulation. But it may be recognized as introjected regulation, when interpreted as motives to promote contingent self-worth (Lonsdale et al., 2011). Previous studies in Hong Kong also found some problematic items (Lonsdale et al., 2011; Zhong et al., 2014), two of which (i.e., ITR4 and EXR2) were also encountered in our study.

4.2 Comparison of motivation between China and Spain

Measurement and structure invariance across Chinese and Spanish adolescents indicated that adolescents from diverse cultures possess motivation in a similar structure (Lonsdale et al., 2011; Wang et al., 2009a). Previous findings showed that Chinese-speaking adolescents tended to score lower in more self-determined motivation and higher in less self-determined motivation than British students (e.g., Lonsdale et al., 2011). These results were discussed as being consistent with British culture endorsing more individualistic values. Contrarily, in the current study Chinese students scored higher in more self-determined motivation, but lower in less self-determined motivation than Spanish students. This may be due to the smaller difference on the individualism dimension between China (score 20) and Spain (score 51), compared with the large difference between Hong Kong (score 25) and Britain (score 89; Hofstede et al., 2010). Since Spain is relatively more collectivistic than Britain, the difference of collectivistic-individualistic dimension may not be the only factor of cultural difference in motivation. Additionally, because of the globalization and colonization, Hong Kong and Britain share similar education system which differ across China and Spain. Thus, another possible reason is the

specific influence of the academic values on education system in China. In China, academic achievement has been seen as primary task for students (Jin, 2016), consequently students perceive more pressure to enroll in main courses (e.g., Mathematics) rather than a “recreational” course (e.g., PE). Chinese students will not be forced to practice, but free to take a break in PE. Thus, they will be motivated by their own interest rather than external pressure to participate in PE.

4.3 Changes of motivation and academic stress

Previous research on long-term change of motivation found that more self-determined motivation decreased, and less self-determined motivation increased across middle school years accompanied with decline of perceived competence, relatedness, and teacher support (Ullrich & Fox, 2014). In short-term, we found the reverse pattern, an increase of more self-determined motivation (i.e., intrinsic motivation) and a decrease of less self-determined motivation (i.e., external regulation and amotivation) within the semester. Such increase of self-determined motivation in short time may be associated with establishment of relationship with teachers and classmates within semester. More self-determined motivation has been found to be related to satisfaction of basic psychological needs, such as autonomy and relatedness (Ryan & Deci, 2017; Standage et al., 2012).

We also found that academic stress factors, like pressure from and workload declined within semester. As suggested by Xiang and colleagues (2017), at the beginning of the semester, students lack time to adapt well from holiday to school lives and academic activities seem difficult to them. Therefore, students perceived most stress at the beginning of the semester compared with preparation period before mid-exam or final-exam.

4.4 Relationship between motivation and academic stress

Previous study found that high participation and positive attitudes toward PE were negatively related to academic stress (Back, 2015). In the current study, we found a similar relationship between motivation toward PE and academic stress. In particular, intrinsic motivation and identified regulation were negatively associated with pressure from study, workload, and despondency, while introjected regulation, external regulation, and amotivation were positively associated with pressure from study, workload, and despondency, and self-expectation. However, the more self-determined motivations were positively related to worry about grades and amotivation was negatively related to worry about grades at T2. In previous studies (Sun et al., 2011; Sun et al., 2013), worry about grades, unlike other academic stress factors, was not found to be related to negative consequences, such as suicidal thoughts, low efficacy, and poor health status. Since academic stress could also lead to a positive impact (Sang et al., 2017), worry about grades could be considered as one positive source of academic stress to motivate students to strive for achievement.

Both motivation toward PE and academic stress were found to have impact on each other, which implied a reciprocal relationship between these two variables as we hypothesized. High participation and positive attitudes toward PE were reported to have a positive effect on learning attitudes, such as confidence and concentration (Back, 2015). In the current study, we found positive effect of identified regulation on worry about grades and positive effect of amotivation on workload and despondency. Torrijos-Nino et al. (2014) suggested that motivated students may strive for achievement in both academic

subjects and physical fitness. Therefore, students with high identified regulations are motivated not only to participate in PE, but also to seek high academic achievement. On the contrary, students who lack motivation in PE also lack confidence and concentration in academic subjects. Respect to influence of academic stress on motivation in PE, we found negative effect of despondency on identified regulation, which suggested that despondency might be the main source of stress that impairs intention to participate in PA (Stults-Kolehmainen & Sinha, 2014).

4.4 Implications

In the current study, we adapted and validated the simplified Chinese PLOC Scale to measure SDT-based motivation toward PE among adolescents from mainland China. Along with researches in similar culture, like Hong Kong and Singapore (Lonsdale et al., 2011; Wang et al., 2009a), the universality of SDT-based motivation structure in PE context has been proved. The specific measurement difficulty in China and motivation level difference between China and Spain suggested that besides different perception of autonomy (Hagger et al., 2014; Lonsdale et al., 2011), the beliefs about PE related to academic culture and educational system may also affect SDT-based motivation toward PE.

People from countries with high academic demands, such as China, tend to consider PE as replaceable in spite of being obligatory course prescribed by the government (Jin, 2016), in order to improve academic achievement. However, PE has been found to have positive impact on academic outcomes, such as learning attitudes, concentration, and confidence (Ekblom-Bak, Ekblom, Andersson, Wallom, & Ekblom, 2018). The influence

of motivation toward PE on academic stress found in the study also implied that promoting students' motivation toward PE can not only benefit in physical health, but also in academic factors. Our findings provided evidence that the impact of motivation toward PE, as a special academic motivation can be generalized to other educational situations (Ryan & Deci, 2017).

Previous studies used to treat data as quantitative with corrections for non-normality such as bootstrap. In the present study, we treated data as ordinal to examine SDT-based measurement structure, which was recommended for data with five categories but showing floor and ceiling effects (Remthulla et al., 2013; Viladrich et al., 2017). Nevertheless, the main results we obtained were congruent with those previous studies, which highlights the opportunity to investigate SDT-based structure and replicate previous empirical results with alternative statistical techniques. When investigating the relationship between motivation in PE and academic stress, we found it difficult to examine the model directly with observed items. We turned to treat factors as observed variables through calculation of means. However unidimensional structure of each factor should be examined prior to mean calculation to guarantee the validity and reliability to treat items as a unique factor (Appelbaum et al., 2018; Prinsen et al., 2018).

4.5 Limitations and future investigation

The current work only measured motivational variables from the mini-theory, Organismic Integration Theory. To further understand how SDT-based motivation works in China, motivation related variables from other mini-theories, such as Basic Psychological Needs Theory, should also be taken into account. In particular, as one of the

most collectivistic cultural country, autonomy may play a different role in students' motivation compared with other students (Hagger et al., 2014). Furthermore, future research should not only focus on exploring variables like basic psychological needs but also aim to provide help for PE teachers and professionals to improve PE climate such as intervention on basic psychological needs satisfaction climate (e.g., Franco & Coterón, 2017).

Although motivation toward PE has been found to be related to subjective vitality and academic stress in two studies, the influence of motivation toward PE on students' well-being remains unclear. For instance, in the first study, Chinese students scores higher in more self-determined motivation and lower in less self-determined motivation than Spanish students. However, more self-determined motivation was more positively associated with subjective vitality among Spanish adolescents than it did among Chinese adolescents. Therefore, whether the motivation encountered in the current study reflected adolescents' participation in PE and its impact on well-being remain doubtful. We recommended to include other consequent variables to explore the influence of SDT-based motivation toward PE in China.

Chapter 5 Conclusions

To promote students' PA participation, researchers have focused on SDT-based motivation toward PE. As SDT is concerned with the social-contextual influences on motivation and human flourishing, researchers have been interested in verifying whether and how does culture exert influences on the dynamics in motivation. On the basis of SDT, the current work aimed to adapt PLOC Scale into simplified Chinese to explore motivation toward PE among Chinese adolescents, to compare it with Spanish adolescents, and to examine the changes and interaction of motivation toward PE and academic stress among Chinese adolescents.

Firstly, our findings provided evidence of the reliability and the validity of simplified Chinese PLOC Scale. The invariance of measurement and structure between China and Spain provided evidence of the universal structure of SDT-based motivation structure in PE context across cultures varying in individualist-collectivist dimension.

Secondly, we found three problematic items when administrating simplified Chinese PLOC Scale, which may be related to students' attitudes toward PE. We also encountered that Chinese students scored higher in more self-determined motivation and scored lower in less self-determined motivation than Spanish adolescents. The difficulties in the measurement among Chinese students and mean differences between Chinese and Spanish students suggested that despite of the universal structure of SDT-based motivation, the measurement model of SDT-based assessment might differ not only due to differences in the dimension individualism-collectivism but also due to the cultural influence related to educational system and beliefs about PE.

Thirdly, we found increase of more self-determined motivation toward PE and decrease of less self-determined motivation toward PE and academic stress within semester,

which may be related to academic demands and the connection with teachers and classmates at different time period of semester.

Fourthly, we found a reciprocal relationship between motivation toward PE and academic stress that more self-determined motivation toward PE could reduce academic stress, meanwhile, academic stress would lead to less self-determined motivation toward PE. However, worry about grades did not cause less self-determined motivation, which suggested that not all academic stress factors would be related to negative outcomes.

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Appendix A

Simplified Chinese Perceived Locus of Causality Scale

我参与体育课...	完全不同意			完全同意	
EX1 因为不参加的话,我就会有麻烦	1	2	3	4	5
IJ1 因为我想让老师认为我是一个好学生	1	2	3	4	5
ID1 因为我想学习运动技能	1	2	3	4	5
IM1 因为体育课有趣	1	2	3	4	5
AM1 但我真的不知道为什么	1	2	3	4	5
EX2 因为这是我应该做的	1	2	3	4	5
IJ2 因为不参与的话,我会觉得自己很糟糕	1	2	3	4	5
ID2 因为对我来说在体育课上表现良好很重要	1	2	3	4	5
IM2 因为我享受学习新的技能	1	2	3	4	5
AM2 但我找不到我们要有体育课的原因	1	2	3	4	5
我参与体育课...	完全不同意			完全同意	
EX3 这样老师就不会吼我	1	2	3	4	5
IJ3 因为我想让其他同学觉得我很好	1	2	3	4	5
ID3 因为我想在体育上有进步	1	2	3	4	5
IM3 因为体育课使人兴奋	1	2	3	4	5
AM3 但我觉得上体育课是在浪费我的时间	1	2	3	4	5
EX4 因为这是规矩	1	2	3	4	5
IJ4 因为我不参与时会觉得烦恼	1	2	3	4	5
IM4 因为学习新技能时的乐趣	1	2	3	4	5
AM4 但我看不出我从体育中得到了什么	1	2	3	4	5
ID4 因为我可以学到一些在生活中用得着的技能	1	2	3	4	5

Note. We recommend excluding item IDR2, IJR4, and EXR2 when administrating Chinese

PLOC Scale.