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**Scaling up promotion of physical activity among Chinese college students:
A theory-driven approach based on the transtheoretical and
trans-contextual models**

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1 Introduction

The Toronto Charter for Physical Activity states:

“Physical activity promotes well-being, physical and mental health, prevents disease, improves social connectedness and quality of life, provides economic benefits and contributes to environmental sustainability. Communities that support health-enhancing physical activity, in a variety of accessible and affordable ways, across different settings and throughout life, can achieve many of these benefits.” (Global Advocacy Council for Physical Activity International Society for Physical Activity and Health, 2010, p. 1)

Physical activity is probably one of the most rewarding and practical investments in health, society, economy and sustainability. However, throughout the world, our modern way of busy lifestyles, urbanization, sedentary working environments, automobile-based transport, etc. have effectively taken much physical activity out of our daily lives. The Lancet Physical Activity Series Working Group even labeled the global lack of physical activity as a “pandemic” to highlight the urgency of the issue (Das & Horton, 2012). Taking into consideration the prevalence, global extent, and health effects of physical inactivity, there is a strong need for research on population-based approaches to promote physical activity. The present dissertation examines the effect of two theory-driven approaches to promote physical activity - the transtheoretical model and the trans-contextual model - in Chinese college students. Firstly, the dissertation briefly introduces the problem of physical inactivity of Chinese students. Secondly, the selection of a behavioral epidemiological and ecological framework for studying the problem is described. The theoretical background is then explicated, leading to the derivation of hypotheses that were tested in three empirical studies. Three articles which have been published in international peer-reviewed journals are subsequently described, which is followed by a discussion and conclusion in the end.

1.1 Inactivity pandemic and the “sedentary generation”

Physical inactivity is a widespread global pandemic with far-ranging health, social and economic consequences (Hallal et al., 2012). From the public health perspective, according to the World Health Organization (WHO, 2010), inadequate physical activity was ranked as the fourth leading cause of global mortality in 2009. It is associated with an increased risk for various chronic diseases and such health conditions as hypertension, obesity, coronary heart disease, type II diabetes, colon and breast cancer, metabolic syndrome, osteoporosis and premature death (Matthews et al., 2012; Dishman, Heath, & Lee, 2013). Recent population estimates suggested that as many as 5.3 million deaths from non-communicable diseases could be prevented each year if people were physically active in line with recommendations (Lee et al., 2012). From the economic point of view, the massive financial burden of physical inactivity on public medical expenditure is also evident. In a recent global analysis involving 142 countries published in *The Lancet*, the direct cost of physical inactivity was estimated to have reached 53.8 billion US dollars worldwide in 2013, whereas the indirect costs stood at 13.7 billion (Ding et al., 2016).

In spite of such huge negative consequences of inactivity and much well-documented empirical support for the benefits of regular physical activity (e.g., Li & Siegrist, 2012; Schulz, Meyer, & Langguth, 2012; Gerber & Pühse, 2009), high rates of physical inactivity are rampant around the globe. According to The Lancet Physical Activity Series Working Group report based on data from 122 countries (representing 89% of the world's population), as much as 31% of the adult population worldwide is physically inactive (Hallal et al., 2012). When looking at the temporal trend of physical activity patterns around the globe, a consistent trend of dramatically declining physical activity levels can be observed over the past decades (see Ng & Popkin, 2012; Knuth & Hallal, 2009; for comprehensive statistics from different countries). Moreover, contrary to the common belief that youth are active compared to other age groups, there is strong evidence that the younger generation, especially college students,

do not engage in sufficient physical activity to accrue health benefits (e.g., Haase, Steptoe, Sallis & Wardle, 2004; Irwin, 2004; Keating, Guan, Piñero, & Bridges, 2005). A recent survey with 17,928 students from 23 countries revealed that, when using the WHO (2010) physical activity recommendations as a criterion, up to 41% of college students are physically inactive (Pengpid et al., 2015). Unfortunately, the inactivity pandemic seems to be even more prevalent and is burgeoning more rapidly in developing countries than Western industrialized nations (Hallal et al., 2012; Haase et al., 2004). In China in particular, a country that has been undergoing swift socio-economic transitions, rapid modernization and urbanization in recent decades have brought about dramatic changes in people's lifestyles with a huge decline in physical activity levels. An astonishing decrease by 32% in average weekly physical activity has been observed in China from 1991 to 2006 (Ng, Norton, & Popkin, 2009). Especially among Chinese college students, up to 37% do not meet international physical activity guidelines (Pengpid et al., 2015).

Generally speaking, physical activity levels decrease with age (Hallal et al., 2012). Yet, the fact that the prevalence of adequate physical activity is relatively high in children and adolescents, but substantially lower in adults (Currie, Hurrelmann, Settertobulte, Smith, & Todd, 2000; Guthold, Ono, Strong, Chatterji, & Morabia, 2008) suggests that maybe late adolescence and early adulthood is a critical period of transition. Longitudinal surveillance studies have supported this assumption (Kwan et al., 2012; Johnston et al., 2010). Kwan et al. (2012) followed up on a group of 640 adolescents for 12 years and found that the steepest decline in physical activity levels occurred during late adolescence and young adulthood, i.e., during their college years. Because behavioral patterns established during this period have a carry-over effect and often continue into adulthood, thereby affecting long-term health outcomes, addressing the issue of insufficient physical activity among college students is therefore of great importance. However, influencing health behaviors among young people is commonly regarded as an infamously difficult task due to their perception of being immortal

or immune to health problems in their prime years. This is reflected in the finding that health practitioners do not always succeed in promoting health behavior in this specific demographic group (Hagger & Chatzisarantis, 2005), thus indicating that there is lots of room for improvement. In 2014, there were 25.5 million college students in China, making it the largest student population in the world (National Bureau of Statistics of China, 2015). Given their numbers and future societal roles, their healthy development will have a huge impact on all of society. A better understanding of successful strategies for promoting physical activity therefore seems to be indispensable.

1.2 The behavioral epidemiological and socio-ecological frameworks

Sallis and Owen (1999) proposed a five-stage behavioral epidemiological framework of physical activity (Figure 1), in which the physical activity-health relationship and the measurement of physical activity lead to an understanding of the determinants of physical activity. Those determinants then affect the development of interventions, which are subsequently translated into practice. As shown in Figure 1, the sequence of these relationships is not linear, but displays a dynamic and interactive nature.

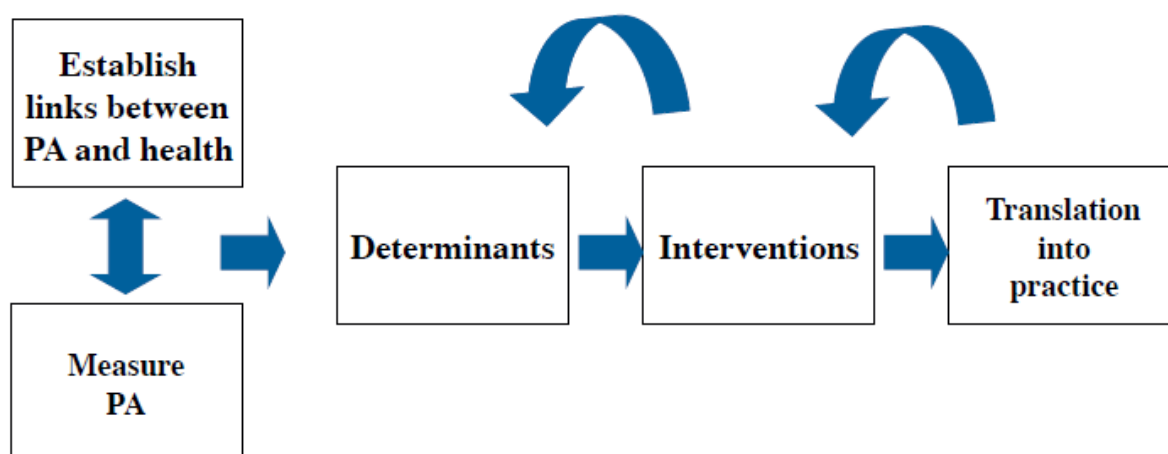


Figure 1. Behavioral epidemiological model of physical activity (Biddle, Mutrie, & Gorely, 2015, p. 7)

In processes of the behavioral epidemiological framework, the link between physical activity and health is well documented and widely acknowledged (Lee et al., 2012; Dishman et al., 2013). At the same time, better measures of physical activity behavior have been developed over the years, hugely advancing the development of the field (Biddle et al., 2015). Researchers have also successfully identified various determinants of physical activity and have attempted to map the mechanisms through which these factors influence physical activity behavior change (Bauman et al., 2012). Beyond the individual (intra-personal) factors such as demographics, psychological and biological aspects, the socio-ecological framework (Sallis et al., 2006) has taken a broader view of physical activity behavior causality, advocating that the social environmental (inter-personal), physical environmental and policy factors should also be taken into account (Figure 2). The framework highlights the manifold influences on physical activity that multiple dimensions of factors interact dynamically with each other across different levels, resulting in a rather complex picture (Bauman et al., 2012). Successful identification of the determinants has led to the development of effective theory-based intervention programs (Gourlan et al., 2016). In the process of their successful translation into practice, considering that physical inactivity is a large-scale problem in China due to its huge population base, it necessitates scalable solutions that can reach out to a larger audience (Reis et al., 2016).

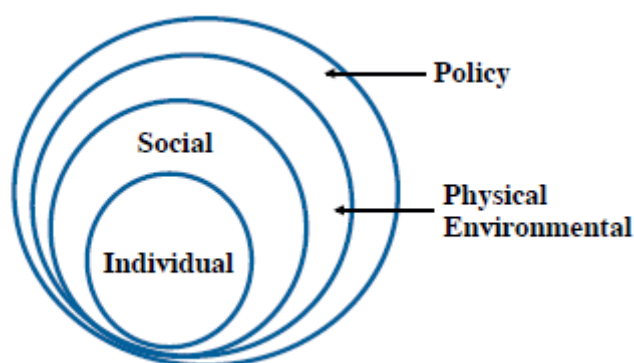


Figure 2. Simplified socio-ecological framework of physical activity (Biddle et al., 2015, p. 8)

1.3 Scalable solutions

The Toronto Charter for Physical Activity (Global Advocacy Council for Physical Activity International Society for Physical Activity and Health, 2010, p. 2) has outlined frameworks for action to support health-enhancing physical activity to build healthier, active, environmentally sustainable communities. In its guiding principles for population-based approaches to physical activity, the Charter has highlighted the importance of advocates to press decision makers to increase their political commitment to physical activity. At the same time, it underscores the importance of ensuring cultural sensitivity and adapting strategies to encompass varying “local realities”, contexts and resources. In the present dissertation, based on such “local realities” in China, physical activity guidelines and physical education (PE) were considered as two potential platforms for further promotion of physical activity at the population-level.

One of such potential scalable solutions may initially lie in the policy area. Health organizations such as the American University of Sports Medicine (Pate et al., 1995) and the WHO (2010) have long published their guidelines for physical activity in an effort to increase people’s awareness of required physical activity levels to benefit health and avoid risk from sedentary lifestyles. The WHO (2010), for example, has recommended that a total of at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity per week (or an equivalent combination of both), with at least 10 minutes of duration in each session, is necessary for an adult’s healthy functioning. Regrettably, no such physical activity guidelines have been officially published in China up to now. A supportive policy framework is necessary to achieve sustainable changes in society by providing direction, support and coordination for the various stakeholders involved in facilitating physical activity. Official publication of China’s national guidelines for physical activity and wide dissemination to the larger public may provide an effective avenue for scalable promotion of physical activity in China.

Secondly, PE may offer another feasible platform for scalable promotion of physical activity, particularly among young people in China, because PE is compulsory from primary school to college: Virtually every student can be reached through the PE context (Li, Chen, & Baker, 2014). Researchers have long investigated the potential role of PE in promoting students' participation in leisure-time physical activity (e.g., Standage, Gillison, & Treasure, 2007). Positive experiences in PE settings have been found to be helpful for students in the adoption of physically active lifestyles outside of PE scenarios (Sallis et al., 2012). Therefore, if utilized properly, PE could serve as another important avenue for promoting physically active lifestyles in China.

Based on the two identified scenarios above, comprehensive theories are indispensable in order to develop effective intervention programs and successfully translate them into practice (Craig et al., 2008). Valid theories not only provide solid frameworks for understanding, explaining and predicting behavior, but also serve as an effective guideline for the design, implementation and evaluation of successful intervention programs.

1.4 Theory-driven approaches

Without exception, almost every protocol for the development of successful interventions has featured the great importance of theory-driven approaches (e.g., National Institute for Health and Clinical Excellence, 2014; Michie et al., 2011; Craig et al., 2008). This is further highlighted by systematic reviews of intervention studies which have demonstrated that interventions guided by theories are significantly more effective than interventions that are not based on theories (e.g., Greaves et al., 2011; Ogilvie et al., 2007). Given the challenges of altering longstanding physical inactivity, health educators have been calling for effective theoretical models to encourage programs to change behavior. The advantages of theory-driven approaches include, but are not limited to, (1) targeting those constructs that have been proven to lead to behavior change in the interventions, (2)

examining the mechanisms as to why an intervention was (or was not) effective in producing the anticipated results, which helps to refine the theory in turn, and (3) synthesizing evidence across different settings, populations and behaviors (Michie & Prestwich, 2010). In the present dissertation, based on the guiding principles of the Toronto Charter and the “local realities” in China, as well as the specificity of the research goal in question, the transtheoretical model (Prochaska & DiClemente, 1983) and the trans-contextual model (Hagger, Chatsizarantis, Culverhouse, & Biddle, 2003) were chosen as the two theoretical frameworks to guide the empirical investigations.

1.4.1 Transtheoretical model. The transtheoretical model (Prochaska & DiClemente, 1983) was developed to explain how behavior change takes place. The model proposes that behavior change is a dynamic process in which individuals need to go through different stages over time to finally change their behavior. In particular, individuals first work through cognitive and affective processes leading to the adoption of a new behavior, and then move to using behavioral strategies to establish the new pattern of behavior. Based on the model, Marcus, Rossi, Selby, Niaura, and Abrams (1992) described five distinct stages involved in the process of physical activity behavior change: Pre-contemplation, contemplation, preparation, action and maintenance (see Table 1). The pre-contemplators are those who are physically inactive and have no intention of becoming active. Contemplators are also physically inactive, but are considering becoming physically active, although no actual action has yet been taken. Preparers are physically active, but not at the recommended levels. Individuals in the action stage are physically active at the recommended levels, but have been active for less than six months. Finally, individuals in the maintenance stage are physically active at the recommended levels and have been active for six or more months (Marcus et al., 1992). The transtheoretical model has been considered to be one of the most important frameworks for explaining the adoption and maintenance of physical activity behavior (Biddle et al., 2015). Prior research has firmly supported the validity of the stage paradigm towards

physical activity, which has framed many successful studies (see Spencer, Adams, Malone, Roy, & Yost, 2006 for a systematic review). Therefore, this model may provide an important lens to examine the potential role of publishing China's physical activity guidelines in promotion of physical activity.

Table 1

Five stages of physical activity behavior change

Stage	Current level of PA	Intention to meet PA guideline?
Pre-contemplation	Physically inactive	No
Contemplation	Physically inactive	Yes
Preparation	PA level below guidelines	Yes
Action	PA level has met guidelines for less than 6 months	Yes
Maintenance	PA level has met guidelines for more than 6 months	Yes

Note. PA = physical activity

Physical activity guidelines (e.g., WHO, 2010) were developed with the underlying hypothesis that the publication of the guidelines influences people's knowledge, which subsequently influences their physical activity behavior (Bauman, Craig, & Cameron, 2005). The ultimate goal of these guidelines is to encourage people to be physically active by increasing their awareness and understanding of the required physical activity level to benefit health and avoid health risk from sedentary lifestyles. However, prior research on the relationship between the awareness of physical activity guidelines and actual physical activity behavior has shown mixed results. For example, Cameron, Craig, Bull, and Bauman (2007) and Plotnikoff et al. (2011) found that awareness of physical activity guidelines predicts the level of physical activity. In contrast, Morrow, Krzewinski-Malone, Jackson, Bungum and

Fitzgerald (2004) found no significant associations between the two. Similarly, findings from intervention studies that have informed participants about physical activity guidelines are inconsistent. Loughlan and Mutrie (1997) found a significant increase in the level of physical activity after the intervention, whereas Plotnikoff et al. (2007) reported no significant change. These discrepancies raise questions regarding the usefulness of publishing physical activity guidelines. A possible explanation for the inconsistencies in the literature may come from the dichotomous approach that previous studies had adopted towards physical activity behavior. Physical activity is usually considered an all-or-none phenomenon without a middle ground, whereas most intervention studies also failed to consider the complex nature of physical activity behavior change and simply categorized individuals into stagnant, active or inactive groups (Spencer et al., 2006). Such an arbitrary dichotomous methodology may have failed to recognize the different phases and therefore may have ignored the different shifts experienced by individuals in the process of adoption and maintenance of physical activity. Unlike other behavioral models that often involve the study of one-shot behaviors, the transtheoretical model of Prochaska and Diclemente (1983) took a different path and considered behavior change as a dynamic process in which one goes through a range of cyclical phases that stand for various levels of motivational readiness (see Figure 3). That is, it is possible that individuals who are inactive may still have intentions to initiate again and, at the same time, individuals who are currently physically active may also step back into inactivity after some period of time (Sonstroem, 1998). Looking at physical activity behavior from a stage of change perspective may provide a different angle into the inconsistencies in the previous literature. Although knowledge of physical activity guidelines may not differentiate those with high or low physical activity levels, it may be able to distinguish people in different stages of physical activity behavior change.



Figure 3. Dynamic cyclical stages of physical activity behavior change (Biddle et al., 2015, p. 253)

1.4.2 Trans-contextual model. PE has long been recognized as a useful existing network to support the adoption of health-related physical activity among young people (Standage et al., 2007). In China, students take a 1.5-hour PE class per week (Li, Chen & Baker, 2014), which is insufficient to meet the physical activity guidelines. The gap between the recommended level of physical activity and the limited PE curriculum highlights the important role that PE should play in the generalization of physical activity outside of the PE scenario. Therefore, one line of inquiry in research has been for investigators to try to bridge the gap between PE and leisure-time physical activity (e.g., Green, 2014; MacNamara et al., 2011; Standage et al., 2007). Research on the determinants of physical activity has identified motivation as one of the most important individual-level factors associated with physical activity (Bauman et al., 2012). Thus, understanding the motivational factors and processes that underlie this connection may be useful for the development of effective intervention programs to promote physical activity beyond the PE setting. An important question that emerged from this work was therefore whether the PE teaching that influences students'

motivation in a PE setting can be transmitted to increase students' motivation towards leisure-time physical activity.

Proceeding from the self-determination theory (Ryan & Deci, 2000) and Vallerand's proposition of a motivational sequence (1997), the trans-contextual model (Hagger et al., 2003) outlined the processes through which autonomous motivation in a PE class setting lead to autonomous motivation towards physical activity in an out-of-school context. Specifically, Hagger et al. (2003) proposed that students' perceptions of the motivational climate in the PE settings as being autonomy-supportive predict autonomous motivation in PE. Autonomous motivation in PE will in turn enhance students' internal perceived locus of causality in their leisure-time physical activity contexts. At the same time, it has also been put forward that perceived autonomy support in PE will have an indirect effect on autonomous motivation towards leisure-time physical activity mediated by autonomous motivation in PE (Figure 4. All in all, this transfer of motivation is responsible for the extension of students' autonomous motivation beyond the boundaries of PE and provides a useful theoretical framework for an understanding of the underlying motivational mechanisms through which PE could be used to develop effective intervention programs to promote physical activity in China.

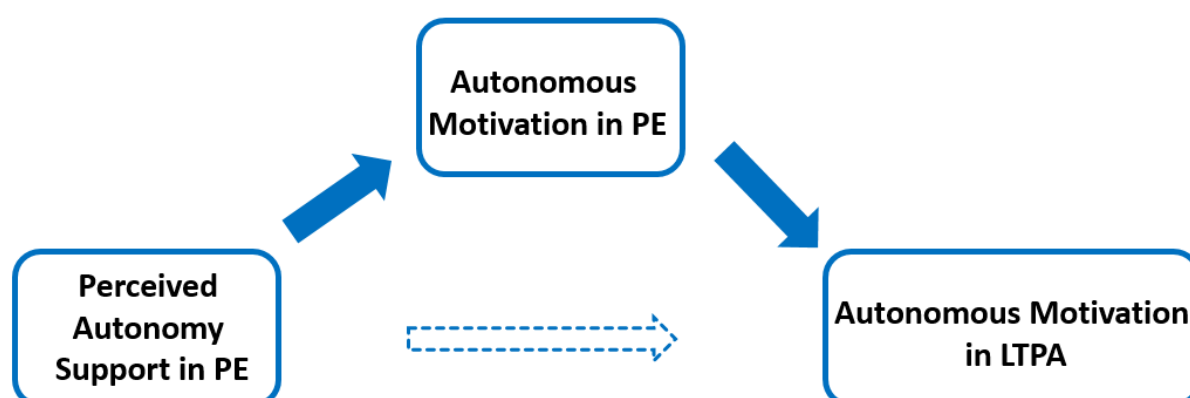


Figure 4. Trans-contextual motivational transfer of the trans-contextual model.

Note: PE = physical education, LTPA = leisure-time physical activity.

However, while the model emphasizes the central role of autonomous motivation, researchers who have investigated the influence of cultural factors on motivation have questioned the universality of the propositions of the model. Indeed, individuals develop their unique values and attitudes from their own cultures (Brickman & Miller, 2001). Similarly, motivation is formulated in a cultural context and must be interpreted within the cultural setting in which it occurs (Xiang, Li & Shen, 2001). Despite the persuasive support for the universal importance of autonomy needs (e.g., Chirkov, 2009; Nagasaku & Arai, 2005; Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009; Vansteenkiste, Zhou, Lens, & Soenens, 2005), cross-cultural scholars have argued that the positive effect of autonomy may be dependent on the degree to which the prevailing cultural norm endorses individualism or collectivism (Iyengar & Lepper, 1999). People in more individualist cultures, such as those from Western Europe or North America (e.g., white Americans) refer to themselves as independent, self-sufficient, and autonomous units and are therefore more differentiated from others (Oyserman, Coon & Kemmelmeier, 2002). This is assumed to be in contrast to people in more collectivist cultures such as those from East Asia (e.g., Chinese) who tend to adopt a more socially-oriented identity and perceive themselves as less differentiated, more interdependent and socially sensitive (Markus & Kitayama, 1991). People in Western individualistic cultures who emphasize the need for autonomy, therefore may benefit especially from autonomy support, whereas this might be less relevant for people in Eastern collectivistic cultures where group needs are more relevant than individual needs (Markus & Kitayama, 2003; Schwartz, 1994). For example, Iyengar and Lepper (1999) observed that intrinsic motivation in collectivistic cultures was undermined when individuals were offered the freedom to choose (indicative of autonomy support), but increased when significant others made the choices for them (indicative of obedience). In a strict experimental laboratory setting, Hagger, Rentzelas and Chatzisarantis (2014) also found that only when an individualistic group norm was prescribed, did the participants who were provided personal

choice exhibit stronger intrinsic motivation; however, when a collectivistic group norm was prescribed, participants who were not given a choice exhibited greater intrinsic motivation.

Research on this topic has been under ongoing debate and the results have remained inconclusive, especially among Chinese samples where only few studies examining the role of autonomous motivation in PE have been conducted so far (e.g., Taylor & Lonsdale, 2010; Wang, 2017). Although cross-cultural validation of the trans-contextual model (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005) and evidence from less individualistic cultures (e.g., Singapore, Poland and Greece) have provided backing for the universality of autonomy support and the motivational transfer across contexts, it is not clear whether or not these same implications can also be drawn for the Chinese PE setting with its unique characteristics. Moreover, one key limitation of current literature has been the absolute dearth of experimental evidence among the Chinese population. Intervention studies that attempt to manipulate the determinants to facilitate behavior change offer much stronger evidence. Therefore, testing the applicability of the model in China with an experimental study may be a worthy area of study to provide support for the usefulness of the PE platform to promote physical activity on a population level.

2 The dissertation research

Three separate research articles involving five studies and 11,342 participants in total have been written. In the first article, I translated the Physical Activity Stages of Change Questionnaire (Marcus & Simkin, 1993) from English into Chinese and tested its psychometric properties in a group of Chinese college students. This was a necessary step for the research reported in the second article.

In the second article, I investigated whether people's awareness of physical activity guidelines was associated with an enhanced level of physical activity among college students in China. Because no physical activity guidelines have been published in China so far, and because no efforts have been made to widely disseminate the health message of the

international physical activity guidelines either, the aim was to explore the impact of knowledge of physical activity guidelines on the physical activity stages of change and the levels of physical activity behavior among the Chinese college students using the transtheoretical model framework (Prochaska & Di Clemente, 1983). Two studies were conducted; Study 1 used a retrospective, cross-sectional design and Study 2 employed a prospective, experimental design.

In the third article, I examined the role of autonomy-supportive PE teaching style on fostering students' autonomous motivation towards leisure-time physical activity. Based on the trans-contextual model (Hagger et al., 2003), the goal was to test the motivational transfer from PE to a leisure-time physical activity context in an effort to examine the potential role of utilizing the Chinese PE platform to promote physical activity in China in a scalable way. Again, two studies varying in design (cross-sectional and experimental) were conducted.

3 Methods

3.1 Article 1

Article 1 is a validation study. The Physical Activity Stages of Change Questionnaire (Marcus & Simkin, 1993) was translated from English into Chinese and the translation was verified by three independent experts. A pilot test with 15 Chinese students was conducted to test the feasibility of the items. 298 college students (45% women, $M = 20.9$ years, $SD = 2.04$) were recruited and provided data on their stages of physical activity behavior change and self-reported physical activity level. The Chinese version of the Physical Activity Stages of Change Questionnaire was administered twice with a one-week pause between the separate data collections in order to examine its test-retest reliability. A one-way analysis of variance (ANOVA) was conducted to examine the concurrent validity of the questionnaire, i.e., whether it is able to discriminate between individuals with different levels of physical activity. The intra-class correlation coefficient was calculated to examine the one-week test-

retest reliability. Further details on the participants, measures and procedure are stated in the original article.

3.2 Article 2

Article 2 consisted of a cross-sectional and an experimental study. In the cross-sectional study, Chinese college students were surveyed on their stages of physical activity behavior change, their awareness of the WHO (2010) physical activity guidelines, and their current level of physical activity using a mega-trial. A mega-trial is a term borrowed from medical literature that indicates a study of unusually large sample size. With the help of online questionnaires, and paper and pencil questionnaires, a total of 9,826 college students (58% female, $M = 21.0$ years, $SD = 2.13$) participated in the study. Since there was no prior research in this field in China, descriptive statistics were first conducted to examine the proportion of students who were aware of the international guidelines on physical activity. Then Chi square analyses were used to test whether students who are and students who are not aware of the WHO recommendations are at different stages of physical activity behavior change, whereas Cramer's V was used to explore the association between knowledge of the guidelines and the level of physical activity. Because increased awareness promotes the intention for physical activity (Marcus et al., 1992), it was hypothesized that students who are aware of the recommendations are at later stages of physical activity behavior change compared to students who are not aware of the WHO recommendations.

In the experimental study, 279 participants (53% female, $M = 20.9$ years, $SD = 1.90$), who as a prerequisite had to be unaware of the international physical activity recommendations, were recruited. The study consisted of two distinct phases, a pretest and a posttest after four months. In the pretest, all of the participants provided data on their knowledge of physical activity guidelines, their stages of physical activity behavior change, and their current level of physical activity. Participants were then randomly allocated to either

the experimental or control group. A simple intervention was implemented, in which the experimental group participants were provided with written material that contained information on the international physical activity guidelines (WHO, 2010), whereas the control group participants received no information. In the posttest that was conducted after a period of four months, the participants' level of current physical activity and their stages of physical activity behavior change were measured for the second time. Chi square analyses and the McNemar test for correlated proportions were used to test a potential change in stages of physical activity behavior change. A 2×2 (Group \times Phase) repeated measures ANOVA was used to examine the change in the level of physical activity in both groups over the two phases. Further details on the participants, measures and procedure are stated in the original article.

3.3 Article 3

Similarly, Article 3 consisted of a cross-sectional and an experimental study. In the cross-sectional study, 681 Chinese college students (52% female, $M = 19.8$ years, $SD = 1.59$ years) provided data on their perceived autonomy support from PE teachers, autonomous motivation in PE (motivation within the educational context) and autonomous motivation towards leisure-time physical activity (motivation outside of the educational context). It was hypothesized that perceived autonomy support would predict autonomous motivation in PE and in leisure-time physical activity contexts; at the same time, autonomous motivation in PE would mediate the relationship between perceived autonomy support and autonomous motivation towards leisure-time physical activity. The number of constructs in the analyses was reduced by calculating a relative autonomy index (RAI; Ryan & Connell, 1989). Descriptive statistics and correlation analyses for the perceived autonomy support and the RAI composites were conducted. Subsequently, a hierarchical regression analysis was used to test the mediation hypothesis.

In the experimental study, a sample of 10 experienced PE teachers (2 females and 8 males, $M = 40.3$ years, $SD = 8.82$) and their 258 students (53% female, $M = 19.9$ years, $SD = 1.87$) were recruited. The study consisted of two distinct phases; a pretest and a posttest after the intervention program. In the pretest, students provided data on their perceived autonomy support, autonomous motivation in PE and leisure-time physical activity contexts using the same instruments as in the cross-sectional study. Next, the 10 PE teachers were randomly assigned to either an intervention or a control group. The teachers in the intervention group participated in the three-wave intervention program during the semester (16 weeks), while teachers in the control group were asked to teach their courses with their usual teaching style. The autonomy-supportive teacher training program was developed based on prior interventions in PE (e.g., Reeve, 2009; Reeve, 2011; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Cheon & Reeve, 2013; Cheon, Reeve, & Moon, 2012; Tessier, Sarrazin, & Ntoumanis, 2008). The posttest was conducted at the end of the semester and the student participants in the experimental and in the control group completed the same questionnaires as in the pretest. A 2×2 (Group \times Time) repeated measures ANOVA was conducted for perceived autonomy support as a manipulation check for the intervention program. Two separate 2×2 (Group \times Time) repeated measures ANOVAs were conducted with autonomous motivation in PE and autonomous motivation for physical activity in leisure-time contexts to examine the impact of the intervention program. Further details on the participants, measures and procedure are stated in the original article.

4 Publications

4.1 Article 1

Authors: Kahar Abula, Jürgen Beckmann, Kai Chen, & Peter Gröpel

Title: Validation of the Chinese version of the physical activity stages of change questionnaire

Journal: Cogent Psychology, 2016, 3:1228509

Doi:10.1080/23311908.2016.1228509

Summary:

In the present article, the Chinese version of the Physical Activity Stages of Change Questionnaire (Marcus & Simkin, 1993) was validated among a group of Chinese college students. The transtheoretical model of behavior change (Prochaska & Di Clemente, 1983) provides a useful framework for the understanding of physical activity behavior adoption and maintenance. However, the application of the model in the domain of physical activity in China has been limited due to the lack of a valid questionnaire to examine different stages of physical activity behavior. Cross-cultural validation of the questionnaire is necessary because physical activity may be perceived differently in China (Keating et al., 2005). The questionnaire was translated from English into Chinese, and its internal consistency, one-week test-retest reliability and concurrent validity were tested. The results indicate good reliability and concurrent validity of the questionnaire and it may be used with confidence to identify individuals at different stages of physical activity behavior.

The study and the article were mainly conducted, planned, executed, analyzed and written by the first author. Substantial support from co-authors was appreciated. The article was submitted in July 2016 and was accepted in August 2016 by Cogent Psychology. It is an international, peer-reviewed journal dedicated to the advancement of psychological sciences.

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**Validation of the Chinese version of the Physical Activity Stages of Change
Questionnaire**

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Abstract

Background/Objective: Sharp decline in physical activity has been observed among Chinese youth in recent decades. The transtheoretical model of behavior change (TTM) provides a useful framework for developing effective intervention programs. Yet the application of the TTM in China has been limited due to the lack of a valid TTM-based questionnaire to examine different stages of physical activity behavior. Therefore, the purpose of the present study was to translate the Physical Activity Stages of Change Questionnaire (PASCQ), which is a well-validated scale based on the TTM, into Chinese and to test the psychometric properties of this Chinese version.

Methods: The PASCQ was translated from English into Chinese and its internal consistency, one-week test-retest reliability and concurrent validity were tested in a sample of Chinese university students.

Results: Both the internal consistency and the test-retest reliability satisfied psychometric standards. The Chinese version of the PASCQ also successfully discriminated between individuals with different levels of physical activity, which indicated a good concurrent validity. In particular, participants in the action and maintenance stages reported significantly higher energy expenditure than participants in the precontemplation, contemplation, and preparation stages.

Conclusions: The results indicate good reliability and concurrent validity of the Chinese version of the PASCQ. The questionnaire may be profitably used to identify individuals at different stages of physical activity behavior, which may help in physical activity promotion programs among Chinese college students.

Keywords: physical activity; transtheoretical model; stages of change

Introduction

Regular physical activity is not an all-or-none phenomenon but an ongoing process of change (Marcus & Forsyth, 2003; Marcus, Rossi, Selby, Niaura, & Abrams, 1992). That means, individuals who are currently inactive may still have the intentions to start exercising again in the future and, at the same time, individuals who are currently physically active may step back into inactivity after some time. However, most intervention programs for physical activity promotion failed to consider the complex, dynamic nature of physical activity behavior and simply categorize individuals into either an active or inactive group (Spencer, Adams, Malone, Roy, & Yost, 2006). Such an arbitrary way of all-or-none dichotomy may impair the effectiveness of the intervention program due to ignoring motivational shifts in the process of adoption and maintenance of physical activity behavior.

The transtheoretical model of behavior change (TTM; Prochaska & DiClemente, 1983) was developed to help explain how people change their behavior. In the TTM, behavior change is considered as a dynamic rather than “all-or-none” phenomenon, which means that people go through change as a process over time. In particular, individuals first work through cognitive and affective processes leading to adoption of a new behavior, and then they move to using behavioral strategies to establish a new pattern of behavior. Although the TTM was initially developed to treat addictive behaviors, it has also been widely used as a theoretical framework to change people’s physical activity behavior (Sonstroem, 1988). Marcus et al. (1992) were the first who applied the TTM in the field of physical activity behavior. Marcus et al. argued that, like other health behaviors, physical activity behavior is also an ongoing process and people need to move through different stages to finally alter their physical activity behavior.

Based on the TTM, Marcus et al. (1992) describe five distinct stages involved in the process of exercise behavior change: precontemplation, contemplation, preparation, action

and maintenance. Precontemplators are those who are not physically active and have no intention to become active. Contemplators are also physically inactive but are thinking about becoming active, though no actual action has yet been undertaken. Preparers are physically active, but their physical activity is not at the recommended level (i.e., 150 minutes of moderate to vigorous physical activity per week; WHO, 2010). Individuals in the action stage are currently physically active at the recommended level but have been active for fewer than six months. Finally, individuals in the maintenance stage are currently physically active at the recommended levels and have been active for six or more months.

Marcus et al. (1992) have also identified a number of cognitive and behavioral strategies used throughout the stages of change (see also Marcus & Lewis, 2003). Cognitive strategies include increasing knowledge, being aware of risks, caring about consequences to others, comprehending benefits and increasing healthy opportunities. Behavioral strategies include substituting alternatives, enlisting social support, rewarding yourself, committing yourself and reminding yourself. Notably, these strategies are not equally relevant when processing through the stages of change; cognitive strategies typically peak in the preparation stage, whereas behavioral strategies typically peak at the action stage. From an applied perspective, individuals at different stages therefore require different intervention strategies to adapt and maintain physical activity behavior (Marcus & Forsyth, 2003; Marcus & Simkin, 1993). Indeed, a number of studies supported that delivering stage-targeted interventions was more effective in increasing participants' physical activity than delivering general, non-targeted interventions (Marshall & Biddle, 2001).

To test the stages of physical activity behavior change, Marcus and Simkin (1993) developed the Physical Activity Stages of Change Questionnaire (PASCQ). The PASCQ consists of four items that categorize individuals into the five different stages of physical activity behavior change: precontemplation, contemplation, preparation, action and

maintenance (for details, see the Method section). For construct validity of the scale, Marcus and Simkin compared various types of exercise-staging algorithms and found that the five-stage model best defined the study population. The staging algorithm also discriminated those in the action and maintenance stages from those in the preaction stages (i.e., precontemplation, contemplation, preparation) in the level of self-reported exercise, indicating good concurrent validity (Sarkin, Johnson, Prochaska, & Prochaska, 2001).

Although there is enough evidence for acceptable validity of the PASCQ (see Spencer et al., 2006, for a review) and the scale was previously translated into other languages and used in different countries, for example France (Romain et al., 2012) and Brazil (Dumith, Gigante, & Domingues, 2007), yet most of the previous validation and intervention studies are limited to Western countries. Thus, it is not clear whether the PASCQ also applies to different, non-Western cultures. The Chinese represent a distinct cultural, social, and ethnic population compared to those in Western countries, and physical activity may thus be perceived differently. There are some kinds of physical activity such as Tai Chi, Wu Shu, stair climbing, and Qi Gong which are very prevalent and common in China but not in Western countries. Moreover, no national physical activity guidelines have been published in China so far, neither are there sufficient mass media health promotion campaigns which would make people more aware of physical activity benefits. Whether or not the PASCQ can be reliably used in China is thus unknown.

Therefore, the purpose of the present study was to translate the PASCQ into Chinese, and to examine reliability and concurrent validity of the Chinese version of the PASCQ in a sample of Chinese college students. The existence of a valid instrument to measure physical activity behavior change may help to effectively apply physical activity programs among the Chinese student population. The PASCQ (Marcus & Simkin, 1993) was translated from English into Chinese by the first author and the translation was verified by three independent

experts in exercise psychology. To obtain test-retest reliability, the Chinese version of the PASCQ was administered twice: at the beginning of the study and one week later. The one-week interval was chosen because, unlike traits, physical activity behavior is a dynamic process which may change within weeks. A longer time-period might thus be inappropriate for testing test-retest reliability. To test concurrent validity, we compared the PASCQ with the participants' current level of physical activity (see Marcus & Simkin, 1993, for a similar procedure). It was expected that individuals in action and maintenance engage in physical activity more than individuals in precontemplation, contemplation and preparation. No differences were expected between individuals in action and maintenance as they should only differ in how long they regularly exercise, with those in action exercising regularly for fewer than six months and those in maintenance for more than six months (Marcus et al., 1992). Similarly, individuals in both the precontemplation and the contemplation stages are currently physically inactive and they should therefore not differ in the level of physical activity.

Method

Participants

298 college students (133 women and 165 men) voluntarily participated in the study. Their age ranged from 17 to 26 years ($M = 20.9$ years, $SD = 2.04$). The study was approved by the ethic board of the Peking University. All participants provided informed consent before taking part in this study.

Procedure

The PASCQ was translated from English into Chinese by the first author and the translation was verified by three independent experts, one of them working in the USA and two of them working in China, who were all fluent in both English and Chinese. Based on the experts' feedback, Wu Shu, Qi Gong, stair climbing and Tai Chi were added to the examples

of physical activity that are defined in the questionnaire instructions. A pilot test with 15 Chinese students supported the feasibility of this version of the PASCQ. The Chinese version of the PASCQ was administered twice: at the beginning of the study and one week later.

Instruments

Two self-reported scales were included. First, the PASCQ (Marcus & Simkin, 1993) was translated into Chinese and used to test the different stages of exercise behavior (the Chinese version of the PASCQ is presented in the Appendix). The PASCQ consists of four items with a binary type (yes/no) response format: “I am currently physically active”, “I intend to become more physically active in the next 6 months”, “I currently engage in regular physical activity”, and “I have been regularly physically active for the past 6 months”. Participants were classified into the five different stages by the following scoring algorithm (Marcus & Simkin, 1993): “I am currently not physically active (1/no), and I am not thinking of doing so for the next 6 months (2/no)” (precontemplation); “I am currently not physically active (1/no), but I am thinking of doing so in the next 6 months (2/yes)” (contemplation); “I am currently physically active (1/yes), but I do not exercise regularly (3/no)” (preparation); “I exercise regularly (1 & 3/yes), but I have been doing so for less than the past 6 months (4/no)” (action); and “I currently exercise regularly, and I have done so for longer than 6 months (1, 3, & 4/yes)”.

As a second step, the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) was employed to assess participants’ level of physical activity. We used the well-validated Chinese version of the IPAQ (Qu & Li, 2004). In this questionnaire, participants recall the frequency and the duration of walking, moderate, and vigorous physical activity (in minutes) in the last seven days across all life domains (e.g., work, leisure-time, transport). The IPAQ consists of seven items. An example item is “During the last 7 days, on how many days did you do such vigorous physical activities as heavy lifting, digging,

aerobics, or fast bicycling?” Scoring was conducted according to the IPAQ protocol (see <http://www.ipaq.ki.se>) and the total energy expenditure (metabolic equivalent of task; MET) was calculated as followed: MET minutes per week = 8.0*vigorous-intensity minutes*vigorous-intensity days + 4.0*moderate-intensity minutes*moderate days + 3.3*walking minutes*walking days.

Results

The Chinese version of the PASCQ showed sufficient internal consistency; the Cronbach's alpha was .71 in both administrations. The one-week test-retest reliability was also sufficiently high; the intraclass correlation coefficient was 0.91 (95% CI, 0.89-0.93). Men and women were equally distributed across the PASCQ stages, $\chi^2(4) = 4.23, p = .38$.

A one-way analysis of variance (ANOVA) revealed significant group differences in the total energy expenditure (MET) across the PASCQ stages, $F(4, 293) = 34.47, p < .001, \eta_p^2 = 0.32$. Means and standard deviations are presented in Table 1. Post hoc comparisons (Tukey HSD) showed that, as expected, individuals in both action and maintenance had higher total energy expenditure than individuals in all other stages (all $ps < .001$, Cohen's $ds > 1.08$). Individuals in preparation were slightly more active than those in precontemplation and contemplation, but these differences were not significant ($ps > .13$, Cohen's $ds < .52$). Individuals in action and maintenance did not differ from each other ($p = .73$, Cohen's $d = .19$). Similarly, the MET was the same in precontemplation and contemplation ($p = .93$, Cohen's $d = .22$).

Discussion

The results of this supported the reliability and the concurrent validity of the Chinese version of the PASCQ. Both the Cronbach's alpha and the one-week test-retest reliability were in accordance with psychometric standards. Moreover, the questionnaire successfully

discriminated between individuals with different physical activity levels. Individuals in action and maintenance reported significantly higher energy expenditure in the last 7 days than individuals in precontemplation, contemplation, and preparation. These results are in line with similar validation studies in Western countries (Hausenblas, Dannecker, Connaughton, & Lovins, 1999; Hausenblas, Dannecker, & Downs, 2003).

Potential benefits of the validated Chinese version of the PASCQ include both diagnostics and intervention. According to Prochaska and DiClemente (1983), people in different stages generally use different strategies for behavior change. For example, individuals in the preaction stages (i.e., precontemplation, contemplation, and preparation) typically use more cognitive and fewer behavioral strategies than individuals in the more active stages (i.e., action and maintenance). In particular, those in precontemplation and contemplation benefit especially from increasing knowledge of physical activity effects, providing tips for everyday life, and setting specific physical activity goals, whereas those in preparation especially value self-monitoring devices such as pedometers and exercise apps. Further, people in action and maintenance need strategies to prevent relapse and continue being physically active, which may include keeping the physical activity interesting by varying the route, inviting friends, or rewarding oneself (Reed et al., 1997). The identification of individuals that are classified in different stages, such as by using the PASCQ, thus helps to deliver stage-matched intervention programs, thereby contributing to successful behavior change.

Better diagnostic of physical activity behavior change is also necessary when considering the rapid decline in physical activity behavior among Chinese in recent decades (Ng & Popkin, 2012). The average level of physical activity per week has fallen by 32% from 1991 to 2006, and merely 13.2% of Chinese men and 8.4% of Chinese women reported of engaging in leisure-time exercise in 2006 (Ng, Norton and Popkin, 2009). Notably, the

PASCQ contributes to better understanding of who is at which stage of physical activity behavior change and, consequently, what intervention strategies should be applied (Suminski & Petosa, 2002). This may in turn help delivering effective intervention programs to reverse the trend of declining physical activity in China.

To sum up, the present work extends the existing literature by translating the PASCQ into Chinese and providing support for the validity of this version. However, the present results are limited to Chinese college students. Whether or not the results of the present study can be generalized to other age and education groups is unknown. Researchers are welcomed to replicate the present study with different age and education samples, and in different regions in China.

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Table 1

Means (and standard deviations) of the total energy expenditure (MET) across the stages of physical activity behavior

	n	%	Total Energy Expenditure	
Precontemplation	33	11.1	1,113.83	(785.01)
Contemplation	103	34.6	962.18	(605.10)
Preparation	73	24.5	1,305.79	(726.28)
Action	27	9.1	2,673.19	(1,616.68)
Maintenance	62	20.8	2,402.86	(1,297.89)

Appendix: The Chinese version of the Physical Activity Stages of Change Questionnaire

体力活动阶段变化量表

请仔细阅读以下题目，并在**是**或者**否**上打钩。

体力活动包括快速行走，跑步，骑自行车，游泳，或者任何需要付出同样强度的努力的活动。

1. 我目前参加体力活动。 是 否

2. 我打算在接下来的 6 个月参加更多的体力活动。 是 否

有规律的体力活动是指，每周至少 5 天，每天至少 30 分钟的中高等强度的体力活动。比如，你可以在一天内一次性地走路 30 分钟或者把它分三次，每次走 10 分钟以达到总共 30 分钟的目标。

3. 目前我参加有规律的体力活动。 是 否

4. 在过去 6 个月中我一直在参加有规律的体力活动。 是 否

计分方法：

前预期阶段：第一题 = 否，第二题 = 否

预期阶段：第一题 = 否，第二题 = 是

准备阶段：第一题 = 是，第三题 = 否

行动阶段：第一题 = 是，第三题 = 是，第四题 = 否

维持阶段：第一题 = 是，第三题 = 是，第四题 = 是

4.2 Article 2

Authors: Kahar Abula, Peter Gröpel, Kai Chen, & Jürgen Beckmann

Title: Does knowledge of physical activity recommendations increase physical activity among Chinese college students? Empirical investigations based on the transtheoretical model

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Summary:

In an effort to examine the potential role of publication of China's physical activity guidelines, the present article mainly addressed whether the knowledge of physical activity guidelines has an impact on the stages of physical activity behavior change and physical activity level among Chinese college students. Two separate (one cross-sectional and one experimental) studies were conducted. The results of the cross-sectional study revealed that those who were aware of the guidelines were in later stages of physical activity behavior change and were significantly more physically active than those who were not aware of the guidelines. The results from the experimental study demonstrated that the knowledge of physical activity guidelines was able to help the participants progress in their stages of physical activity behavior change, although no significant shift in physical activity level was observed.

The studies and the article were mainly conducted, planned, executed, analyzed and written by the first author. Substantial support from the co-authors was appreciated.

The article was submitted in June 2016 and was accepted in October 2016 by the Journal of Sport and Health Science. It is an international, peer-reviewed scholarly journal dedicated to the advancement of sport, exercise, and health sciences.

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Does knowledge of physical activity recommendations increase physical activity among Chinese college students? Empirical investigations based on the transtheoretical model

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Abstract

Background: Based on the transtheoretical model, the current study investigated whether awareness of physical activity (PA) recommendations had an impact on the stages of PA behavior change and levels of PA among Chinese college students.

Methods: In Study 1, with a cross-sectional study design, 9826 students were recruited and their knowledge of international PA recommendations, PA stage distribution and self-reported PA level were surveyed. Pearson's chi-squared test was used to test whether participants aware and not aware of PA guidelines were equally distributed across the stages of PA behavior, and independent *t*-test was conducted to test the group difference in the actual levels of PA. In Study 2, 279 students who were not aware of the PA recommendations were randomly allocated into either an intervention group or a control group, and only those in the intervention group were presented with international PA guidelines. In both groups, students' PA stages and PA level were examined before the test and then 4 months posttest. McNemar test for correlated proportions and repeated measures ANOVA were conducted to examine the changes in PA stage membership and PA level after the intervention.

Results: Study 1 results revealed that only 4.4% of the surveyed students had correct knowledge of PA recommendations. Those who were aware of the recommendations were in later stages of PA behavior, $\chi^2(4) = 167.19, p < .001$. They were also significantly more physically active than those who were not aware of the recommendations, $t(443.71) = 9.00, p < .001$, Cohen's $d = .53$. Study 2 results demonstrated that the intervention group participants who were at the precontemplation and contemplation stages at the pretest each progressed further in the PA stages in the posttest, $\chi^2(1) = 112.06, p < .001$, and $\chi^2(1) = 118.76, p = .03$, respectively, although no significant change in PA level was observed, $t(139) < 1, p = .89$.

Conclusions: The results showed that awareness of the PA recommendations was associated with higher stages and levels of PA behavior and a brief educational exposure of PA recommendations led to improved stages of PA behavior but no change in the levels of PA

among Chinese college students. More effective public health campaign strategies are needed to raise the awareness of and promote PA recommendations in the Chinese student population.

Keywords: physical activity guidelines, stages of change, transtheoretical model, public health policy

1. Introduction

Numerous studies show that regular physical activity (PA) benefits health and well-being.¹⁻³ Yet, for the majority of the population worldwide, a significant drop in PA level in recent decades has been reported.⁴ Health organizations such as the American College of Sports Medicine or the World Health Organization (WHO) published their recommendations on PA for health, suggesting at least 150 minutes of moderate to vigorous intensity PA throughout the week.^{5,6} However, little effort has been taken to educate people about these guidelines. For example, Kay et al. found that only 36% of the national survey responders were aware of the PA recommendations in the USA.⁷ Similarly, the recommendations were correctly recalled by only 15% of responders in the UK.^{8,9} Thus, it is not clear whether or not the published guidelines actually affect people's PA behavior.

To the best of our knowledge, until now no official PA guideline has been published in the People's Republic of China. In an effort to provide guidance to public health authorities, the present study investigated whether people's awareness of PA guidelines is associated with enhanced levels of PA.

Although awareness and knowledge of behavioral recommendations are important prerequisites for actual behavior and behavioral change,^{10,11} prior research on the relationship between awareness of PA recommendations and actual PA shows mixed results.¹²⁻¹⁴ Cameron, Craig, Bull and Bauman, as well as Plotnikoff et al. found that awareness of PA recommendations predicted the level of PA, with those who were aware of the

recommendations being significantly more physically active than those who were not aware of the recommendations.^{12,13} In contrast, Morrow, Krzewinski-Malone, Jackson, Bungum and Fitzgerald found no association between awareness of the recommendations and the actual level of PA.¹⁴ Similarly, the results of intervention studies that increased participants' awareness level are also inconsistent. Loughlan and Mutrie found a significant increase in the level of PA after the intervention,¹⁵ whereas Plotnikoff et al. reported no significant change.¹³

A possible explanation for the inconsistent results is that awareness of PA recommendations does not directly affect behavior; people must first develop intentions to exercise. Marcus, Rossi, Selby, Niaura and Abrams argued that individuals need to move through different stages to finally alter their PA behavior.¹⁶ Marcus et al. applied the transtheoretical model of health behavior change,^{17,18} which defines behavior change as a dynamic, stage-based process. In this model, individuals first work through cognitive and affective processes leading to adoption of a new behavior, and then they move to using behavioral strategies to establish a new pattern of behavior. Based on this model, Marcus et al. proposed five distinct stages involved in the process of PA behavior change: precontemplation, contemplation, preparation, action, and maintenance. Precontemplators are physically inactive and have no intention to become active. Contemplators are also inactive, but are thinking about becoming active, though no actual action has yet taken place. Preparers are physically active but not at the recommended level. Individuals in the action stage are physically active at the recommended level, but have been active for less than six months. Finally, individuals in the maintenance stage are physically active at the recommended level and have been active for six or more months.

Prior research supports the validity of the stages of PA behavior.¹⁸ Marcus et al. have also identified a number of cognitive and behavioral strategies used throughout the stages of change.¹⁶ Cognitive strategies, such as increasing knowledge, being aware of risks or comprehending benefits, typically peak in the preparation stage; whereas behavioral strategies

such as enlisting social support, rewarding oneself or reminding oneself typically peak in the action stage. Accordingly, for a successful behavior change, increasing awareness of PA recommendations may only apply to precontemplation, contemplation and preparation stages.¹⁹ Therefore, awareness of PA recommendations is especially likely to increase intentions to take part in PA regularly. Regarding actual behavior, awareness of the recommendations may not automatically increase the level of PA as the behavioral strategies are of higher relevance in action and maintenance stages.¹⁶

To test this proposition, we measured the awareness of the international (WHO) PA recommendations, the stages of PA behavior change and the level of PA among Chinese college students. Research evidence indicates that PA level throughout life declines most dramatically from late adolescence to early adulthood, i.e. during college years.²¹⁻²³ Investigating college students may therefore have important implications for active lifestyle and health promotion among the population; and China has the largest college student population in the world, 25.5 million in 2014.²⁰

Two separate studies were conducted. In Study 1, we tested the associations between awareness of PA recommendations, the stages of PA behavior change and the current levels of PA. In Study 2, we tested whether increased awareness of PA recommendations resulted in a shift from earlier to later stages of PA behavior change and an increase in actual PA at the same time. As far as we know, the present study is the first attempt to assess the impact of PA recommendations on stages of PA behavior and PA level in China.

2. Study 1

Study 1 addressed the awareness of PA recommendations. As there has been no prior research in this field in China, we were first interested in the proportion of students who were aware of the international (WHO) recommendations on PA for health. For descriptive reasons, awareness of the recommendations was also measured among physical education (PE) teachers, a sample of ‘professionals’ that one would typically expect to have this

knowledge. Furthermore, we tested whether students who were and who were not aware of the recommendations were at different stages of PA behavior. Finally, Study 1 also explored the association between awareness of the recommendations and the current level of self-reported PA.

2.1. Methods

2.1.1 Participants. 9,826 college students (5,652 women and 4,174 men) completed the survey. Participants were recruited across universities in Beijing, Chengdu, Wuhan, Ürümqi, and Kashgar. Their ages ranged from 16 to 30 years ($M = 21.0$ years, $SD = 2.13$). In addition, 251 PE teachers (109 women and 142 men) were surveyed on their awareness of PA recommendations. Teachers were on average 39.5 years old ($SD = 5.07$, Range 26 to 55 years). The study used a cross-sectional research design. The study was approved by the ethics board of Peking University and all participants provided informed consent before taking part in this study.

2.1.2 Instruments. Stages of PA behavior were measured with the Physical Activity Stage of Change Questionnaire (PASCQ).²⁴ In particular, we used the previously validated Chinese version of the PASCQ.²⁵ The questionnaire consists of four items that group individuals into one of the five stages of PA behavior. An example item is “I intend to become more physically active in the next six months”. The participants’ levels of PA were measured by the short version of the International Physical Activity Questionnaire (IPAQ).²⁶ We used the Chinese version of the IPAQ which was previously validated among the mainland Chinese college students and demonstrated good psychometric properties.²⁷ In this questionnaire, participants recall the frequency and the duration of walking, moderate and vigorous PA in the last seven days across all life domains. An example item is, “During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?” To assess the awareness of PA recommendations, participants were asked, “Do you know what the international recommendations are for taking

part in PA, in terms of minutes per week of moderate to vigorous intensity PA?"⁹ Participants who responded 'no' were labeled as 'don't know'. Participants who responded 'yes' were then asked "What are the international PA recommendations?" Answers of 150 minutes a week, which are in line with current PA recommendations,⁶ were considered correct. Participants with answers of greater than 150 minutes a week were labelled as over-estimators and those giving answers of less than 150 minutes a week were labelled as under-estimators.

2.1.3 Statistical Analyses. Descriptive analyses were conducted to examine the proportion of students and teachers who had accurate knowledge of PA guidelines. Pearson's chi-squared test was used to test whether participants aware and not aware of PA guidelines are equally distributed across the stages of PA behavior and Cramer's *V* was calculated to test the association between awareness of the recommendation and stages of PA behavior. Finally, independent *t*-test was conducted to test the difference in PA levels among those who are aware and those who are not aware of the guideline. The total energy expenditure (metabolic equivalent of task; MET) was calculated as an index of actual PA as follows: MET minutes per week = 8.0*vigorous-intensity minutes*vigorous-intensity days + 4.0*moderate-intensity minutes*moderate days + 3.3*walking minutes*walking days (<http://www.ipaq.ki.se>).

2.2. Results

The PA recommendations were accurately reported by 4.4% of students while 3.8% overestimated, 10.9% underestimated, and 80.9% reported not being aware of the recommendations (Table 1). PE teachers had better knowledge, with 14.7% of them correctly reporting; 13.2% overestimating, 22.3% underestimating and 49.8% who did not know. No gender differences were found except that there were more male students (12%) than female students (10%) who underestimated the PA guidelines, $\chi^2(1) = 10.29, p = .001$.

Table 1

Awareness of PA recommendations in samples of college students and physical education teachers

	Students		Teachers	
	<i>n</i>	%	<i>n</i>	%
Correct	428	4.4	37	14.7
Overestimate	377	3.8	33	13.2
Underestimate	1,074	10.9	56	22.3
Don't know (no guess)	7,947	80.9	125	49.8

Among the students, we compared the individuals who had correct knowledge of the PA recommendations with those who did not know the recommendations (no further differentiation in underestimators and overestimators was considered). Individuals aware and not aware of the PA recommendations were unequally distributed across the stages of PA behavior, $\chi^2(4) = 167.19, p < .001$. In particular, those who were not aware of the recommendations were over-represented in the pre-contemplation and contemplation stages, but under-represented in preparation, action and maintenance, as indicated respectively by the positive and negative values of the residuals (Table 2). Awareness of PA recommendations was significantly associated with later stages of PA behavior, Cramer's $V = .14, p < .001$. Those who were aware of the recommendations were significantly more physically active (MET-minutes per week: $M = 1,766.32, SD = 1,255.82$) than those who are not aware of the recommendations ($M = 1,214.85, SD = 753.59$), $t(443.71) = 9.00, p < .001$, Cohen's $d = .53$.

Table 2

Awareness of PA recommendations and the stages of PA behavior

	Aware (<i>n</i> = 428)		Not Aware (<i>n</i> = 7,947)		Residuals
	<i>n</i>	%	<i>n</i>	%	
Precontemplation	2	0.5	1,005	12.6	49.5
Contemplation	105	24.5	3,012	37.9	54.3
Preparation	126	29.4	2,162	27.2	-9.1
Action	65	15.2	667	8.4	-27.6
Maintenance	130	30.4	1,101	13.9	-67.1

2.3. Brief Discussion

These results indicated a low awareness of the international (WHO) PA recommendations (4.4%) among college students in China. PE teachers, who are regarded as ‘professionals’ in the domain of PA, had a similar level of knowledge (14.7%) to samples of ‘non-professionals’ in such Western countries as the UK.^{8,9} This might be explained by the fact that no national PA guidelines have been published in China so far, nor have the international guidelines on PA for health been disseminated to the general public. This highlights the need for an intervention study to test whether increasing awareness of the guidelines brings benefits for PA behavior.

The results of Study 1 are promising in this regard since participants with knowledge of PA recommendations were more physically active than those without such knowledge. Increasing awareness of PA guidelines may thus contribute to increased PA behavior. Study 2 was designed to test this hypothesis.

3. Study 2

Individuals who were not aware of the international PA recommendations were either educated on these recommendations or assigned to a control group. After a period of four months, we tested whether or not the educated participants would report a shift from earlier to later stages of PA behavior and a higher level of PA.

3.1. Methods

3.1.1. Participants. A new sample of 350 students was recruited at the Kashgar University in Western China. 302 persons did not know the international PA recommendations. Of these, 23 did not complete all assessments at two time points, thus resulting in the final sample of 279 participants (148 women and 131 men). The participants' ages ranged from 17 to 25 years ($M = 20.9$ years, $SD = 1.90$). The study was approved by the ethics board of Peking University. All participants provided informed consent before taking part in this study.

3.1.2. Procedure. The study used a pre-post comparison group design to examine the differential change in pre-post stages of PA behavior and PA levels for the intervention group relative to the control group. In the pretest, at the beginning of the semester in September, participants provided data on the awareness of PA recommendations, the stages of PA behavior, and the current levels of PA using the same instruments as in Study 1. Participants were then randomly (by drawing lots) allocated either to the intervention group or the control group, but the study assessors were not blinded to group allocation. Control group participants were thanked for completing the questionnaires and dismissed. They received no further instructions. Intervention group participants were gathered together in a big classroom and provided with written materials which contained information on the international PA recommendations along with its health-related benefits and examples of moderate to vigorous intensity PA. Very briefly, the intervention group participants were encouraged to adopt the international PA guidelines. In the posttest, at the end of the semester in December, both

group participants' stages of PA behavior and self-reported PA level were measured for the second time.

3.1.3 Statistical Analyses. Chi-squared test and McNemar test for correlated proportions were administered to examine the changes in stage distribution after the intervention. Repeated measures ANOVA was conducted to test the change in self-reported PA level, with the PA level being the dependent variable and the time and group being the independent variables.

3.2. Results

The proportion of individuals across the stages of PA behavior is presented in Table 3. Chi square analyses showed no significant group differences at pretest, $\chi^2(4) = 7.28, p = .12$, but significant differences at posttest, $\chi^2(4) = 28.90, p < .001$. A McNemar test for correlated proportions indicated that there were significantly fewer persons in the precontemplation stage after the intervention, $\chi^2(1) = 112.06, p < .001$. For those in the intervention group who were in the precontemplation stage at pretest, 85.2% advanced to the contemplation stage and 14.8% advanced to the preparation stage at posttest, whereas only 4.2% of control participants advanced to a later stage (preparation). Similarly, the test indicated significant changes in the contemplation stage, $\chi^2(1) = 118.76, p = .03$. For those in the contemplation stage at pretest, 38.7% of intervention participants advanced to the preparation stage and 6.5% advanced to the action stage at posttest, whereas the proportion of control participants remained the same. No further significant differences were observed.

Table 3

The number of intervention and control participants and the percentage of sample in each stage of PA behavior before and after the intervention

	Intervention Group (<i>n</i> = 140)				Control Group (<i>n</i> = 139)			
	Pretest		Posttest		Pretest		Posttest	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Pre-contemplation	27	19.3	0	0.0	24	17.3	23	16.5
Contemplation	31	22.1	46	32.9	51	36.7	51	36.7
Preparation	43	30.7	46	32.9	33	23.7	34	24.5
Action	15	10.7	21	15.0	12	8.6	12	8.6
Maintenance	24	17.1	27	19.3	19	13.7	19	13.7

We conducted a 2 × 2 (Group × Time) repeated measures ANOVA to examine the current level of PA (MET) in both groups over the two test phases. The analysis revealed no effect of time ($p = .74$), no effect of group ($p = .41$) and no interaction ($p = .59$). Paired *t*-tests showed that the level of PA of the intervention group at posttest ($M = 1,764.32$, $SD = 1,490.57$) was not significantly higher than in the pretest ($M = 1,740.77$, $SD = 1,665.76$), $t(139) < 1$, $p = .89$. Similarly, the level of PA of the control group was about the same at posttest ($M = 1,601.63$, $SD = 1,190.28$) as in the pretest ($M = 1,701.34$, $SD = 1,212.63$), $t(138) < 1$, $p = .48$.

3.3. Brief Discussion

In accordance with Marcus et al.,¹⁶ the present results suggest that increasing awareness of PA recommendations may be an effective cognitive strategy to develop and strengthen intentions to PA behavior. A significant proportion of participants who were in

precontemplation and contemplation at pretest advanced to a later stage following the educational intervention. However, the actual level of PA did not change, which supports the notion that behavioral rather than cognitive strategies are more relevant for regular PA.¹⁶ An alternative explanation may be that, after exposure to the recommendation, the intervention group participants may have refrained from exercising more because of upcoming exams and wintertime, as the posttest was conducted at the end of the semester in December.

4. General Discussion

The present article presents the first findings regarding the awareness of international PA guidelines, the impact of PA recommendations on the stages of PA behavior and the actual level of PA among the Chinese student population. We found that students who were aware of the international PA recommendations were at later stages of PA behavior and more physically active than those who were not aware of the recommendations (Study 1). Furthermore, increasing awareness of the recommendations through an educational intervention resulted in stronger intentions to exercise, but did not change the actual levels of PA during the test period (Study 2).

The results are in line with previously reported evidence that awareness of PA recommendations and the actual level of PA are significantly associated.^{12,28} However, the present work also shows that simply providing knowledge of the guidelines is not sufficient for a more active lifestyle. In particular, intervention group participants in Study 2 who were educated about the PA recommendations did not report an enhanced level of PA four months later, but they had developed an intention for PA. However, only individuals in the precontemplation and contemplation stages advanced to a later stage, but not those in preparation, action and maintenance stages. This is in line with the findings of Prochaska and DiClemente who proposed that cognitive processes such as increasing knowledge especially play a role in earlier stages of PA behavior.^{16,17,29}

The present work also found that only 4.4% of Chinese college students had correct knowledge of PA recommendations. The vast majority of Chinese students thus lack the proper knowledge of how much PA they need in everyday life. Results also indicated a low prevalence of that knowledge (14.7%) within the sample of Chinese PE teachers. A plausible explanation is that no national PA guidelines have been published in China so far, nor are there sufficient mass media health promotion campaigns which would make people more aware of the international PA guidelines and its benefits for healthy life. In addition, the PE system in China should to some extent be held responsible for the low awareness of PA recommendations. Chinese PE is generally designed for learning a sports skill rather than focusing on PA promotion.^{30,31}

It is necessary to be cautious when interpreting the results of Study 2, because PA behavior change is multifactorial and has aspects of information, motivation, behavior, social environment and policy. Students' knowledge of how much PA is needed to accrue health benefits does not guarantee an actual behavior change, which may explain why the intervention was not successful in increasing PA. However, the present findings regarding the significant association between awareness and PA level in Study 1, and the significant progress in PA stages among the intervention group students in Study 2, still suggest the urgency of officially publishing China's national guidelines for PA to increase people's awareness of the recommendations, which may be effectively done by way of such mass media campaigns.³² In addition, PA guidelines and their health-related benefits should be addressed more in college PE curricula because the level of PA declines most dramatically from high school to college.²¹⁻²³ Physical educators have the opportunity to proactively challenge the physical inactivity problem. The results of Study 2 seem promising in this regard, given that helping people to advance just one stage further can double the probability of improved health behavior in the future.³³

Finally, the present findings suggest more integration of the stages of PA behavior model into the research on PA behavior.¹⁶ We found that people aware of PA recommendations were more physically active than those not aware of the recommendations (Study 1), but increasing awareness of the recommendations did not result in higher levels of PA (Study 2). The stages of PA behavior model helps to resolve these seemingly inconsistent findings by showing that making people aware of PA recommendations primarily affects the intention for PA.¹⁶ Consequently, increasing awareness of PA guidelines may be considered an effective cognitive strategy to promote PA behavior, even if effects on the actual level of PA are not yet visible. On the other hand, the finding that increasing awareness of PA recommendations primarily affects intentions to perform PA also implies limitations of such educational interventions. Developing intentions is a prerequisite for a new PA behavior; however, it alone is not sufficient for long-term maintenance of that behavior.¹⁹ To foster PA adherence, therefore, physical educators and health promoters should employ behavioral strategies such as enlisting social support, and rewarding or enriching sports or other PA environments.^{16,34,35} Combining cognitive and behavioral strategies may contribute significantly to improving people's health and quality of life.

Some limitations deserve mention. First, the present results are limited to student populations. Second, the educational intervention in Study 2 included information on benefits and examples of activities in addition to information on the guidelines. It is thus possible that the combination of this information and not the sole providing guidelines resulted in stronger intentions to exercise. In addition, the educational intervention was rather brief and represented a simple public health message intervention. In order to achieve a successful PA behavior change, future studies should consider designs that involve both cognitive and behavioral change components.

To conclude, we primarily investigated whether PA recommendations increase PA. Individuals who knew about the recommendations were more physically active than those

without that knowledge base, but educating those who were unaware of the guidelines did not result in higher levels of PA. However, it did facilitate development of PA intentions and higher stages of PA behavior change. There was no follow-up after the posttest in Study 2, which would allow for testing a long-term effect on behavior change. The long-term effect on behavior and the generalizability of the present results are thus an avenue for future research.

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Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JB is the Principal Investigator of the research project. KA conceived the idea for the article and designed the research. KC and KA collected the data. PG analyzed and interpreted the data. KA and PG wrote the first draft of the article. KC edited and formatted the manuscript. PG and JB critically revised and reviewed the manuscript. All authors read and approved the final manuscript.

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4.3 Article 3

Authors: Kahar Abula, Jürgen Beckmann, Zhongkai He, Chengwa Cheong, Fuquan Lu, & Peter Gröpel

Title: Autonomy support in physical education promotes autonomous motivation towards leisure-time physical activity: Evidence from a sample of Chinese college students

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Summary:

In this article, which was based on the trans-contextual model (Hagger et al., 2003), two studies addressed whether autonomy-supportive PE teaching promotes autonomous motivation towards leisure-time physical activity among Chinese college students. No study to date has tested the propositions of the motivational sequence of the trans-contextual model with a Chinese sample. There is also a dearth of experimental evidence for the generalizability of autonomous motivation in China. Therefore, in addition to the cross-sectional Study 1, an experimental Study 2 was conducted in which PE teachers received an autonomy-supportive intervention program. The results from both studies demonstrated that perceived autonomy support in PE predicted higher autonomous motivation in PE, which in turn predicted higher autonomous motivation towards leisure-time physical activity. The findings indicate that PE may serve as an effective platform to promote an active lifestyle among Chinese college students when teachers provide students with an experience of autonomy.

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Autonomy support in physical education promotes autonomous motivation towards leisure-time physical activity: Evidence from a sample of Chinese college students

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Abstract

Purpose: Based on the trans-contextual model, two studies aimed to test whether autonomy-supportive physical education (PE) promotes autonomous motivation towards leisure-time physical activity among Chinese college students. **Methods:** Study 1 was conducted in September 2015 and used a cross-sectional design. Participants were students who provided data on perceived autonomy support and motivation for physical activity. Regression analysis was used to analyze the data. Study 2 took place from September to December 2015 and employed an experimental design. Participants were PE teachers and their students. The teachers were randomized to either an intervention or a control group and those in the intervention group received a 3-month-long autonomy-supportive intervention program. Their students provided data on motivation. The data were analyzed with repeated measurement ANOVA. **Results:** 681 students aged 16 to 26 years participated in Study 1. Perceived autonomy support predicted autonomous motivation in PE ($\beta = .18, p = .001$), which in turn predicted autonomous motivation towards leisure-time physical activity ($\beta = .51, p = .001$). Ten PE teachers (28 to 53 years) and 258 students (16 to 26 years) participated in Study 2. Students who were educated by the intervention teachers had significantly stronger autonomous motivation towards leisure-time physical activity than students educated by the control teachers after the intervention, ($F = 12.41, p = .001$). **Conclusion:** The results suggest that PE may serve as an effective platform to promote an active lifestyle among Chinese college students when teachers provide students with an experience of autonomy.

Keywords: health promotion; motivational transfer; autonomous motivation; trans-contextual model; physical education; leisure-time physical activity

Introduction

With the socio-economic development and urbanization, the level of physical activity in China declined dramatically during the last decades (Ng *et al.*, 2009), contributing to an increase in health complaints among the younger generations (Ng and Popkin, 2012). Physical education (PE) has long been recognized as a useful existing network to support the adoption of health-related physical activity in young people (Hagger and Chatzisarantis, 2015; Standage *et al.*, 2007). One should expect China to especially benefit from the PE platform as it is compulsory for students from elementary school to college and everyone can be reached through the PE platform (Li *et al.*, 2014). In 2014, the number of Chinese college students reached 25.5 million, making it the largest student population in the world (National Bureau of Statistics of China, 2015). Prior research indicates that the level of physical activity declines most dramatically from high school to college (Kwan *et al.*, 2012; Johnston *et al.*, 2010). Because of limited time allocated to PE in the curricula and the huge academic pressure in the Chinese education system, the recommended level of moderate to vigorous physical activity of at least 150 minutes per week (World Health Organization, 2010) cannot be reached through PE programs alone. Therefore, the compulsory PE at the universities should promote physical activity outside of the educational context. Understanding the underlying motivational factors and processes may help reverse this trend of dramatically declining physical activity through the development of effective intervention programs to promote a physically active lifestyle beyond the university setting.

Based on the self-determination theory (Ryan and Deci, 2000), Hagger *et al.* (Hagger *et al.*, 2003) developed the trans-contextual model that outlines the motivational processes through which educational activities in a classroom setting lead to motivation towards similar activities in out-of-school contexts. This model proposes a central role of autonomous motivation, which is considered the type of motivation that individuals have integrated into

their sense of self. In other words, people who are autonomously motivated feel like they are behaving in accordance with their own interests and wishes and, as a consequence, are more likely to maintain the behavior without any external reward or punishment (Ryan and Deci, 2000). According to the trans-contextual model, perceived autonomy support in PE should instigate autonomous motivation inside the educational context. An increased autonomous motivation inside the educational contexts should subsequently predict autonomous motivation towards physical activity in leisure-time contexts (Hagger *et al.*, 2003). Hence, the more a teacher supports students' autonomy, the higher the students' autonomous motivation should be both inside and outside of the classroom.

The trans-contextual model has been consistently supported in both cross-sectional and experimental settings. Hagger and Chatzisarantis's (Hagger and Chatzisarantis, 2016) meta-analysis showed that perceived autonomy support students received from their PE teachers predicted students' autonomous motivation in PE, which in turn predicted the motivation towards leisure-time physical activity. In other words, students who were autonomously motivated in the classroom also sought out similar activities outside of school in their leisure time. This implies that improving PE teachers' skills to be autonomy-supportive, through training or intervention programs (Su and Reeve, 2011), could increase their students' motivation for physical activity behavior.

Hence, the trans-contextual model provides a useful theoretical framework for an understanding of the underlying motivational mechanisms through which PE could be used to promote leisure-time physical activity. While this has been shown in several societies (Hagger and Chatzisarantis, 2016), it is not clear whether or not the same implications can be drawn for the Chinese PE setting with its specific conditions. On the one hand, self-determination scholars argue that the benefits of autonomy support are universal across cultures (Chirkov and Ryan, 2001). In line with this, Hagger *et al.* (Hagger *et al.*, 2005) found that autonomy support predicted autonomous motivation both in typical individualistic countries such as

Great Britain and in less individualistic countries such as Singapore and Greece. Taylor and Lonsdale (Taylor and Lonsdale, 2010) reported a significant relationship between perceived autonomy support from PE teachers and students' effort during the classes among a group of Chinese adolescents from Hong Kong. Wang (Wang, 2017) also found that autonomous motivation predicted leisure-time physical activity among Chinese adolescents.

On the other hand, some cross-cultural scholars argue that the positive effect of autonomy is dependent on the degree to which the prevailing cultural norm endorses individualism or collectivism (Iyengar and Lepper, 1999). Therefore, they claimed that people in Western individualistic cultures that emphasize the need for autonomy may especially benefit from autonomy support, whereas this might be less relevant for people in Eastern collectivistic cultures where group needs are superior to individual needs (Markus and Kitayama, 2003; Schwartz, 1994). The collectivistic culture in China is based on the Confucian values of obedience and showing respect to seniors rather than autonomy (Chao and Tseng, 2002). Many teachers in China use a controlling teaching styles and the Chinese education system is very structured and assessment-driven (Zhou *et al.*, 2009). Indeed, Chen and Liu (Chen and Liu, 2008) observed that the controlling teaching style was the dominant teaching method in Chinese classrooms, where students were asked to strictly follow teachers' orders during their lessons, with little autonomy being given to them. Iyengar and Lepper (Iyengar and Lepper, 1999) observed that, in collectivistic cultures, intrinsic motivation was undermined when individuals were offered the freedom to choose (indicative of autonomy support), but increased when significant others made the choices for them (indicative of obedience). In a strict laboratory experimental setting, Hagger *et al.* (Hagger *et al.*, 2014) also found that only when an individualistic group norm was prescribed, the participants who were provided personal choice exhibited stronger intrinsic motivation; however, when a collectivistic group norm was prescribed, participants who were not given a choice exhibited a greater intrinsic motivation.

Past work is thus inconclusive. Although some cross-cultural researchers are doubtful that students from collectivistic cultures such as China will benefit from the autonomy support from their PE teachers, yet more recent studies (Wang, 2017; Taylor and Lonsdale, 2010) indicated the opposite. However, neither Wang nor Taylor and Lonsdale examined the motivational transfer from the educational context to the leisure-time context. Therefore, the present research extends the previous research by testing autonomy support and students' motivation both inside and outside of educational settings. Two separate studies varying in design (cross-sectional and experimental) were conducted. Study 1 tested whether the predictions of the trans-contextual model (Hagger *et al.*, 2003) regarding the motivational transfer could be replicated in a sample of Mainland Chinese college students. We hypothesized that perceived autonomy support would predict autonomous motivation within PE, which would in turn predict autonomous motivation towards leisure-time physical activity. Study 2 included an intervention. We trained a sample of Chinese PE teachers in creating an autonomy supportive motivational climate in their PE classes and subsequently assessed the students' motivation towards leisure-time physical activity. We hypothesized that the motivation would increase from before to after the intervention.

Study 1

Methods

Study design. A cross-sectional design was used. Data was collected on students' perceived autonomy support from PE teachers, autonomous motivation in the PE classes (motivation inside the educational context), and autonomous motivation towards leisure-time physical activity (motivation outside the educational context).

Participants. The participants were Chinese college students. Inclusion criteria were: student at a university in Beijing, Chinese nationality, the willingness to participate in the data collection, and the ability to fill out paper and pen questionnaires in Chinese. Exclusion criteria included impairments that impede the participation in PE and leisure-time physical

activity. Participants were recruited across five universities in Beijing and all the data collection was administered by the authors in the PE classrooms during the period from the beginning of September 2015 to the end of October 2015. Methods and protocol were approved by the institutional review board of the Department of Sports and Health Sciences of the Technical University of Munich, attesting that the study was conducted according to the Declaration of Helsinki. All participants provided informed consent before taking part in this study.

Instruments. Three questionnaires were administered. First, the Chinese version of the Perceived Autonomy Support in Physical Education Scale (Liu and Chung, 2016) was used to assess perceived autonomy support. This scale comprises six items (e.g., “My PE teacher encourages me to ask questions”) that have been adapted from the Health Care Climate Questionnaire (Williams *et al.*, 1996). Responses were measured on 7-point Likert-type scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Good psychometric properties were reported for the scale (Liu and Chung, 2016). In the present study, the internal consistency (Cronbach’s alpha) of the scale was .92.

Second, the Chinese version (Chung *et al.*, 2014) of the Perceived Locus of Causality in Physical Education Scale (PLOC; Goudas, Biddle and Fox, 1994) was employed to assess students’ autonomous motivation in their PE classes. The scale begins with a common stem “I take part in this PE class” followed by 17 items that measure intrinsic motivation (e.g., “because PE is fun”), identified regulation (“because it is important for me to do well in PE”), introjected regulation (“because I will feel bad about myself if I do not”), external regulation (“because I will get into trouble if I do not”), and amotivation (“but I really do not know why”). Responses were measured on 7-point Likert-type scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Good psychometric properties were reported for the scale (Chung *et al.*, 2014). In the present study, the internal consistencies were .82, .72, .73, .75,

and .65, for intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation, respectively.

Third, the Chinese version (Liu *et al.*, 2015) of the Behavioral Regulation in Exercise Questionnaire (BREQ-2) (Markland and Tobin, 2004) was used to measure autonomous motivation towards leisure-time physical activity. Participants were asked “Why do you participate in active sports and/or vigorous physical activities in your spare time?” followed by 19 items that measure intrinsic motivation (e.g., “I exercise because it is fun”), identified regulation (“I value the benefits of exercise”), introjected regulation (“I feel guilty when I do not exercise”), external regulation (“I exercise because other people say I should”), and amotivation (“I do not see why I should have to exercise”). Responses are measured on 5-point Likert-type scales ranging from 0 (*not true for me*) to 4 (*very true for me*). In the present study, the internal consistencies for intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation were .86, .76, .71, .78, and .93, respectively.

Data analysis. A relative autonomy index (RAI) was calculated from the PLOC constructs and the BREQ-2 constructs by weighting intrinsic motivation (+3), identified regulation (+2), introjected regulation (-1), external regulation (-2), and amotivation (-3) scores (Vallerand *et al.*, 2008). The RAI thus reflected participants’ level of autonomous motivation (Ryan and Connell, 1989). The relationships between perceived autonomy support and the RAI composites of PLOC and BREQ-2 were examined by Pearson’s product-moment correlation coefficients. Furthermore, a series of path analyses were used to test the motivational transfer (mediation) from the educational to leisure-time context: a hierarchical regression analysis was conducted for autonomous motivation towards leisure-time physical activity with perceived autonomy support entered in block one, and the autonomous motivation in the PE was entered in block two. Evidence of mediation would be shown if (1) perceived autonomy support predicted autonomous motivation in the educational context, (2) perceived autonomy support predicted autonomous motivation towards leisure-time physical

activity when entered into the regression equation alone (i.e., without mediator), and (3) this effect was eliminated after the mediator (autonomous motivation in the educational context) was entered into the equation (cf. Baron and Kenny, 1986). Normal probability plots of the standardized residual and scatterplots of residuals were generated to test normality, linearity, and homoscedasticity. The non-autocorrelation assumption was also met (Durbin-Watson-test; $1.5 < d < 2.5$ for all regression models). No serious multicollinearity problems among the predictor variables of the model were found (all variance inflation factor statistics < 4.0). All analyses were performed using SPSS 24.0 (IBM Corp.; Armonk, NY). The level of significance was set at $p \leq .05$ (two-tailed). Sobel's test was conducted to test the indirect effect of predictor on criterion through the mediator variable, and Cohen's f^2 was used as an indicator of effect size. By convention, effect sizes of 0.02, 0.15, and 0.35 are considered small, medium, and large, respectively.

Results

A total of 681 college students (351 females and 330 males) participated in the study. They were in average 19.8 years old ($SD = 1.59$, Range 16 to 26 years).

Descriptive statistics and inter-correlations for the perceived autonomy support and the RAI composites of the PLOC and the BREQ-2 are presented in Table 1. Descriptive statistics of the PLOC and the BREQ-2 latent factors are displayed in the supplementary material (S1 Table). Perceived autonomy support in PE was significantly related to autonomous motivation in PE as well as autonomous motivation towards leisure-time physical activity. Autonomous motivation in PE was also significantly related to autonomous motivation towards leisure-time physical activity.

[insert - Table 1. Descriptive statistics and inter-correlations among study variables (Study 1)

- here]

Regression analysis revealed that perceived autonomy support predicted autonomous motivation in the educational context, $\beta = .18$, $t(679) = 4.84$, $p = .001$. Similarly, perceived

autonomy support predicted autonomous motivation towards leisure-time physical activity, $\beta = .24$, $t(679) = 6.32$, $p = .001$. Finally, when perceived autonomy support and autonomous motivation in the educational context were simultaneously regressed on autonomous motivation towards leisure-time physical activity, motivation in the educational context had a significant effect, $\beta = .51$, $t(678) = 15.73$, $p = .001$, and the effect of perceived autonomy support became smaller, $\beta = .14$, $t(678) = 4.38$, $p = .001$. Sobel test of mediation revealed that the mediation effect was significant, $Z = 4.63$, $p = .001$. Effect size analysis demonstrated a large mediating effect of autonomous motivation in the PE context when added to the regression model, Cohen's $f^2 = .36$.

Study 2

Methods

Study design. An experimental design was used. PE teachers were randomized to either an intervention group or a control group (receiving no intervention). Based on prior autonomy-supportive interventions in PE (Chatzisarantis and Hagger, 2009; Cheon and Reeve, 2013; Cheon *et al.*, 2012; Tessier *et al.*, 2008), we developed an autonomy-supportive intervention program which fits to the Chinese PE context. Data was collected from the teachers' students and included perceived autonomy support, autonomous motivation in the PE classes, and autonomous motivation towards leisure-time physical activity. By comparing students who were taught by the intervention teachers with students taught by the control teachers, conclusions can be drawn about the value of autonomy support in promoting motivation for physical activity.

Participants. PE teachers and their students from a large university in Beijing participated in the study. Inclusion criteria for the teachers were: certified PE teacher, full-time employment at the university, the willingness to complete the autonomy-supportive teaching intervention program, the consent for data collection from his/her students in the PE classes, and Chinese nationality. Inclusion criteria for the students were: student at the

university, Chinese nationality, the willingness to participate in the data collection, and the ability to fill out paper and pen questionnaires in Chinese. Exclusion criteria included impairments that impede the participation in PE and leisure-time physical activity. Methods and protocol were approved by the institutional review board of the Department of Sports and Health Sciences of the Technical University of Munich, attesting that the study was conducted according to the Declaration of Helsinki. All participants provided informed consent before taking part in this study.

Procedure. The study consisted of two distinct phases, a pretest and a posttest after the intervention program. In the pretest, at the beginning of the winter semester in September 2015, students provided data on perceived autonomy support, autonomous motivation in PE and leisure-time physical activity contexts using the same instruments as in Study 1. Next, teachers were randomly assigned to either an intervention or a control group. The teachers in the intervention group participated in the three-wave intervention program during the semester (16 weeks), whereas teachers in the control group were asked to teach their courses with their usual teaching style. The posttest was conducted at the end of the semester in December 2015. Students completed the same questionnaires as in the pretest. The data was collected by the authors in the PE classrooms.

Autonomy-supportive intervention program. The autonomy-supportive intervention was based on the work of Reeve *et al.* (Reeve *et al.*, 2004, 2009, 2011, 2012). It was conducted by the first and the fourth author, under the supervision of the third and fifth authors. The first author is experienced in the self-determination theory and has previously completed training in how to promote autonomy-supportive teaching in PE. The fourth author is a successful table tennis player with experience in teaching and training. The third and fifth authors are PE teachers and researchers with at least 20 years of teaching experience.

The intervention program consisted of three parts. Part 1 was a workshop-like experience. A PowerPoint presentation was used to discuss the nature of student motivation, teachers' motivating styles toward students (autonomy supportive and controlling), benefits of teacher-provided autonomy support, and practical examples of autonomy-supportive teaching which emphasized (1) nurturing inner motivational resources, (2) providing explanatory rationales, (3) using informational and non-controlling language, (4) acknowledging and accepting negative affect, and (5) demonstrating patience. In addition, a 14-minute-long video clip of Edward Deci's TED talk on autonomous motivation (<https://ed.ted.com/on/nmtVnbPW>) and a set of strategies about how to apply autonomy-supportive teaching principles into the practice (Tessier *et al.*, 2008) were included. Part 1 concluded with a group discussion about the feasibility, specific "how to" ideas, and potential obstacles the teachers might encounter while implementing the autonomy-supportive teaching skills.

Part 2 took place four weeks later, beginning with a warm-up activity in which teachers were presented with two individual cases, one describing a typical controlling method of teaching and the other describing an autonomy-supportive style. They then discussed how well these teaching scenarios described their own teaching. A brief PowerPoint presentation of autonomy-supportive teaching was presented that reinforced the presentation in Part 1. Thereafter, teachers discussed their strategies to implement autonomy-supportive teaching in the specific context of the Chinese PE settings, with each teacher presenting his/her individual teaching plans, the autonomy-supportive principles he/she had used so far, and which student reactions they had observed.

Part 3 took place four weeks later and consisted of a group discussion that mainly focused on sharing ideas on how to be autonomy supportive during PE teaching, what worked best for them so far, and what did not work so well. It also included a role-play exercise, in which useful feedback from the group was provided.

For all three parts of the autonomy-supportive intervention program, teacher attendance and acceptance of the training program was excellent: except one teacher who did not participate in Part 1 no other teachers missed any of the three sessions. For the absent teacher, the first author visited the teacher the following day to provide the materials and to communicate what was discussed and suggested during the group discussion.

In addition to the three intervention parts, the teacher participants in the intervention group were contacted by phone by a member of the research team once a week throughout the semester to discuss their autonomy-supportive teaching experiences, their potential concerns and answer their questions. A member of the research team also visited each teacher's course three times during the semester so that they could offer some individualized feedbacks and suggestions based on the on-site observation after the class.

Instruments. The same instruments as in Study 1 were employed.

Data analysis. As in Study 1, RAIs were calculated from the PLOC constructs and the BREQ-2 constructs to provide a composite score of autonomous motivation for physical activity in educational and leisure-time context, respectively. The relationships between perceived autonomy support and the RAI composites of PLOC and BREQ-2 were examined by Pearson's product-moment correlation coefficients. A 2×2 repeated measures analysis of variance (ANOVA) with Group as the between-subject factor (2 groups: students taught by the intervention teachers vs. students taught by the control teachers) and Time as the within-subject factor (2 repeated measures: pretest vs. posttest) was conducted for perceived autonomy support as a manipulation check for the intervention program. Furthermore, two separate 2×2 (Group × Time) repeated measures ANOVAs were conducted with autonomous motivation in PE and autonomous motivation for physical activity in leisure-time contexts to examine the impact of the intervention program. In case of significant results, we used independent sample *t*-tests to assess the differences between the study groups at the pretest and the posttest. Normality was assumed due to the large sample size, and the homogeneity of

variance was assessed with Levene's test. All analyses were performed using SPSS 24.0 (IBM Corp.; Armonk, NY). The level of significance was set at $p \leq .05$ (two-tailed). Partial eta squared (η_p^2) was used as an indicator of effect size for ANOVA calculations, and Cohen's d was used for t -tests. Partial eta squared of .01 indicated a small, .059 a medium, and .138 a large effect size, respectively. For Cohen's d , values of .20 indicated a small, .50 a medium, and .80 a large effect size, respectively.

Results

A total of 10 experienced PE teachers (2 females and 8 males) and their 261 students participated in the study. The teachers were on average 40.3 years old ($SD = 8.82$, Range 28 to 53 years). Among the ten teachers, one taught racquetball, two of them taught table tennis, two taught tennis, one taught yoga, two taught Tai Chi, one taught soccer, and one taught body-building classes. Three students did not complete all assessments, resulting in a final sample size of 258 students (136 women and 122 men). Students' age ranged from 16 to 26 years ($M = 19.9$ years, $SD = 1.87$).

Intercorrelations of the perceived autonomy support and the RAI composites of the PLOC and the BREQ-2 are presented in Table 2. Descriptive statistics of the PLOC and the BREQ-2 latent factors are displayed in the supplementary material (S2 Table). As in Study 1, perceived autonomy support was significantly related to autonomous motivation for physical activity in both the educational and leisure-time contexts.

[insert - Table 2. Intercorrelations among study variables (Study 2) - here]

Table 3 shows means and standard deviations of the study variables for the two study groups. The overall perceived autonomy support significantly improved from before to after the intervention, $F(1, 256) = 43.41$, $p = .001$, $\eta_p^2 = 0.15$. The main effect of Group was also significant, $F(1, 256) = 24.88$, $p = .001$, $\eta_p^2 = 0.09$. Most importantly, there was a significant Group \times Time interaction, $F(1, 256) = 18.27$, $p = .001$, $\eta_p^2 = .07$. Subsequent t -tests demonstrated that the intervention and the control groups did not differ at the pretest ($p = .68$),

but the intervention group perceived significantly higher autonomy support than the control group at the posttest, $t(256) = 6.37, p = .001$, Cohen's $d = 0.79$. These results indicate the effectiveness of the intervention program.

[insert - Table 3. Means (and standard deviations) of study variables (Study 2) - here]

Furthermore, autonomous motivation in PE significantly improved after the intervention, $F(1, 256) = 31.31, p = .001, \eta_p^2 = 0.11$. The main effect of group was not significant ($p = .76$), but there was a significant interaction, $F(1, 256) = 9.76, p = .002, \eta_p^2 = .04$. Subsequent t -tests revealed that the groups did not differ at the pretest ($p = .08$), but the intervention group reported higher autonomous motivation than the control group at the posttest, $t(256) = 2.44, p = .02$, Cohen's $d = 0.30$.

Finally, students' autonomous motivation towards leisure-time physical activity significantly improved after the intervention, $F(1, 256) = 21.33, p = .001, \eta_p^2 = 0.08$. The main effect of group was significant, $F(1, 256) = 8.88, p = .003, \eta_p^2 = 0.03$. Notably, there was a significant interaction, $F(1, 256) = 12.41, p = .001, \eta_p^2 = .05$. Subsequent t -tests showed that the intervention group reported higher autonomous motivation towards leisure-time physical activity than the control group at the posttest, $t(256) = 5.50, p = .001$, Cohen's $d = 0.68$, but not at the pretest ($p = .83$).

General Discussion

To the best of our knowledge, this is the first study that tested the motivational transfer from the PE context to leisure-time physical activity as proposed by the trans-contextual model (Hagger *et al.*, 2003) in Mainland China. This model originates in the individualistic, Western culture and proposes that supporting students' autonomy in PE leads to autonomous motivation both inside and outside of the educational context. Some researchers have doubted the cross-cultural generalizability of this model, arguing that, because group needs are superior to individual needs in collectivistic cultures, people in China may have a weaker need for autonomy and may therefore benefit less from autonomy support (Pomerantz and

Wang, 2009; Markus and Kitayama, 2003). The results of the present research contradict this view. In accordance with the propositions of the trans-contextual model, perceived autonomy support in PE was found to be associated with higher autonomous motivation in the educational context, which in turn predicted higher autonomous motivation towards leisure-time physical activity (Study 1). Moreover, the experimental Study 2 results showed that improving teachers' autonomy-supportive skills increased the students' autonomous motivation during PE classes and also resulted in higher motivation to be physically active during the students' free time.

Our findings appear to be quite robust. We found the same pattern in both studies despite substantial changes in the research design. Study 1 used a cross-sectional design and showed that students who perceived high teacher-provided autonomy support also reported higher motivation both inside and outside the educational context. Study 2 employed an experimental design with repeated measurements. Over a period of four months, we trained a group of PE teachers to support their students' experience of autonomy. This training was effective as indicated by a significant increase in students' perception of teacher-provided autonomy support when compared with the pretest and with the control group. Again, the improved autonomy support led to higher autonomous motivation both inside and outside of PE.

These findings may have important implications for both theory and practice. First, a validation of the trans-contextual model in Mainland China is attained. As Biddle (Biddle, 1997) pointed out nearly two decades ago, sport and exercise psychology literature has been strongly biased towards the study of samples from the Western cultures. The present results indicate that the motivational transfer proposed by the trans-contextual model is also valid in a more collectivistic culture such as Mainland China. Second, the present research supported the effectiveness of theory-driven intervention programs to support people's autonomy (Reeve *et al.*, 2004, 2009, 2011), which subsequently led to higher autonomous motivation

both inside and outside of the PE context. Practical implications thus point to the inclusion of autonomy-supportive training programs in teacher education. As the level of physical activity declines most dramatically from high school to college (Kwan *et al.*, 2012), physical educators at universities could significantly reverse this trend by effectively promoting an active lifestyle among their students.

Study 2 findings also emphasize that Chinese PE teachers can be successfully trained in autonomy-supportive skills and this training pays off in terms of increasing students' motivation towards leisure-time physical activity. We found this despite the existing predisposition to a controlling teaching style and the compulsory nature of PE (Zhou *et al.*, 2009). At Chinese universities, there is a 2-hour PE class per week and students have no choice but to attend in order to graduate. This is a significant difference compared with the voluntary, elective PE typical for universities in Western countries. Per definition, having no choice impairs autonomous motivation (Ryan and Deci, 2000), and thus the compulsory system may be less beneficial in terms of promoting motivation. However, our results indicate that strengthening teachers' skills to provide students with the experience of autonomy in otherwise compulsory education can compensate for the compulsory, rather controlling system. Hence, both elective and compulsory PE may represent a powerful platform to promote an active and healthy lifestyle. It should also be noted that the teachers who received the autonomy-supportive skills training highly welcomed and accepted the training.

To support students' perception of autonomy, a number of suggestions and strategies have been offered and tested in the literature (Cheon *et al.*, 2012; Ntoumanis and Mallet, 2014; Reeve, 2011). One of the central strategies is to provide students with choice of activities. Choices offered by the teacher should set specific rules, be relevant to the students' goals and interests, and meet the students' psychological needs. If necessary, meaningful rationales should be offered, especially for uninteresting or repetitive behaviors. Furthermore, teachers should demonstrate that they value students' opinion and initiative, for example by

setting challenging tasks and encouraging students to provide some input or problem solving. When difficulties arise, teachers should avoid discouragement and instead promote motivation by acknowledging the difficulties and negative feelings, and by providing better rationales or more choices. Further strategies include constructive feedback, a non-judgmental language, and patience with students' progress, ideally involving a growth orientation (Dweck, 2006).

Although there are many strengths in the present research, including the use of both cross-sectional and experimental designs, a large sample size, and a theory-driven intervention, there are also limitations that warrant attention. First, the present research did not include a measurement of actual physical activity behavior. Although participants reported being more motivated towards leisure-time physical activity after the intervention in Study 2, we cannot be sure whether or not they were actually more active than before the intervention. Future researchers should include measures of physical activity such as the International Physical Activity Questionnaire (IPAQ; Craig *et al.*, 2003) or pedometers. Second, the fidelity of the intervention was tested only indirectly by comparing how much autonomy support students perceived from their teachers before and after the intervention program, rather than directly by collecting data on the teachers' teaching behavior. A direct test of fidelity, for example, through videotaping and behavior coding might be beneficially used in future research. Third, in Study 2, there were only two measuring time points and there was no follow-up afterwards. Future researchers should include more measurements in addition to the pretest and posttest to examine potential long-term effects even after the PE period is over. Finally, on a conceptual level, this study only focused on autonomy support in promoting physical activity. Other relevant factors that affect physical activity either directly or indirectly through increasing motivation include environmental and policy factors (e.g., providing opportunities to exercise; Sallis *et al.*, 2006), self-efficacy (Bauman *et al.*, 2012), attitudes and norms (Hagger and Chatzisarantis, 2016), social support (Marcus and Forsyth, 2003), achievement orientation (Gröpel *et al.*, 2016), and the awareness of benefits of and

recommendations for physical activity (Abula et al., 2018). A broader picture of determinants of physical activity may be needed to develop more complex and targeted interventions.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Table 1

Descriptive statistics and intercorrelations among study variables (Study 1)

	<i>M</i>	<i>SD</i>	1	2	3
1. Perceived autonomy support	5.70	1.17	-		
2. Relative autonomy index (PE)	5.69	7.72	.18***	-	
3. Relative autonomy index (LT)	12.94	8.89	.24***	.54***	-

Note. PE = physical education context; LT = leisure-time context. *** $p < .001$.

Table 2

Intercorrelations among study variables (Study 2)

	1	2	3	4	5
1. Perceived autonomy support (pretest)	-				
2. Perceived autonomy support (posttest)	-.02	-			
3. RAI pretest (PE)	.20**	-.15*	-		
4. RAI posttest (PE)	.11	.07	.10	-	
5. RAI pretest (LT)	.16**	-.01	.44***	.10	-
6. RAI posttest (LT)	-.09	.18**	-.07	.29**	.05

Note. RAI = Relative autonomy index; PE = physical education context; LT = leisure-time

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

Table 3

Means (and standard deviations) of study variables (Study 2)

	Intervention Group		Control Group	
	Pretest	Posttest	Pretest	Posttest
Perceived autonomy support	5.29 (1.01)	6.62 (0.57)	5.22 (1.58)	5.50 (1.90)
Relative autonomy index (PE)	10.48 (8.82)	16.75 (7.85)	12.48 (9.45)	14.26 (8.59)
Relative autonomy index (LT)	12.55 (9.10)	18.00 (5.09)	12.80 (8.83)	13.53 (7.76)

Note: PE = physical education context; LT = leisure-time context.

5 Discussion and conclusion

The present dissertation addresses a theory-based promotion of physical activity in a scalable way via two diverse settings of public health policy and a compulsory PE platform in Chinese college students. In this section, the conducted research will initially be discussed in depth, some general implications and limitations of the dissertation will subsequently be put forward, which will be followed by a synthesis and conclusion in the end.

5.1 General discussion

5.1.1 Validation of the Physical Activity Stages of Change Questionnaire. Because of no prior existence of a valid questionnaire for the stages of physical activity behavior change in China, in Article 1 Marcus and Simkin's (1993) Physical Activity Stages of Change Questionnaire was translated and validated in a sample of Chinese college students. The results demonstrated good psychometric properties for the questionnaire. The Cronbach's alpha and the one-week test-retest reliability were in accordance with psychometric standards; the questionnaire also successfully discriminated between individuals with different levels of physical activity, demonstrating the good concurrent validity of the questionnaire.

The Chinese represent a distinct cultural, social, and ethnic population compared to the populations in Western countries. The sports system in China is also unique in its own way, in that physical activity may be perceived differently. Compared to the terms sports and exercise, physical activity is a relatively new concept for most Chinese people and has not been widely used among the general population (Keating et al., 2005). There are some types of physical activity (e.g., Tai Chi) that are popular and common in China, but not in Western countries. Therefore, whether or not the Physical Activity Stages of Change Questionnaire can be reliably used in China was unknown and validation of it was warranted. The findings

from the present study added further evidence to the cross-cultural validity of the questionnaire.

According to the transtheoretical model (Prochaska & Di Clemente, 1983), the identification of stages of physical activity behavior change is helpful to better understand who is ready to change their physical activity behavior. From an epidemiological perspective, this baseline data of physical activity stages of change is an indispensable first step (Spencer et al., 2006). The lack of baseline data will otherwise undermine further attempts to promote physical activity since no frame of reference will be available for intervention programs. The baseline data will assist intervention programs by directing the development of effective strategies, because tailored stage-matched interventions can use different programs for individuals at different stages of motivational readiness (Suminski & Petosa, 2002). Data concerning the stage distribution in China can also make cross-cultural comparisons possible so that intervention strategies can be shared on a global level. Furthermore, compared to traditional self-reported measures of physical activity, the Physical Activity Stages of Change Questionnaire has its unique advantages by focusing on habitual physical activity behaviors (i.e., lasting longer than six months), which provides a more comprehensive physical activity assessment than other measures that usually focus on a one-week period to estimate an individual's physical activity behavior. Its brevity will also make the use of the questionnaire feasible in large-scale surveys (i.e., mega-trials).

In summary, by validating the questionnaire, a gap has been filled and a valid tool has been provided to be used with confidence both in research and in practice. This will foster further application of the transtheoretical model (Prochaska & Di Clemente, 1983) in China and pave the way for the development of effective intervention programs in the future.

5.1.2 Knowledge of the physical activity guidelines. With the realization that no physical activity guidelines have been published in China, Article 2, which is based on the

transtheoretical model (Prochaska & DiClemente, 1983), mainly aimed to explore the potential effect of physical activity guidelines on the promotion of physical activity among Chinese college students. The results from the cross-sectional study indicate a low prevalence of awareness of the international (i.e., WHO) physical activity guidelines among college students in China (i.e., 4%); the knowledge of physical activity guidelines was significantly associated with higher physical activity stage membership and participants with the knowledge of physical activity guidelines were significantly more physically active than those without the knowledge. The results from the intervention study illustrated that significant shifts in physical activity stages of change happened as a result of the intervention. Although no significant change in physical activity level was observed, the knowledge of the guidelines significantly influenced behavioral intentions, which is the most proximal predictor of physical activity behavior (Rhodes & Plotnikoff, 2006). Future studies that combine knowledge with other related factors (e.g., skills, environment) and implementation of stage-matched intervention programs may be the right direction.

Physical activity guidelines summarize established evidence on the minimum level of physical activity needed to accrue health benefits. They were developed with the underlying hypothesis that the publication of the guidelines will influence people's knowledge, which subsequently influences their physical activity behavior (Bauman et al., 2005). Theories from health and social psychology may explain the link between knowledge and behavior change. According to the precaution adoption process model (Weinstein, 1988), individuals should be aware of their present behavior, for example by self-monitoring, in order to be able to initiate behavior change. That is, individuals are not likely to alter their behavior if they do not know that their present behavior is not optimal. From this perspective, the physical activity guidelines may provide a criterion for self-monitoring by enabling individuals to realize that their current level of physical activity does not conform to the recommended level. Similarly, according to the health belief model (Rosenstock, 1974), perceived vulnerability and severity,

which to some extent also depend on knowledge, are important antecedents of behavior.

Rosenstock (1974) proposed that for a desired behavior change to happen, at least a minimum level of awareness is essential because people's perceptions of vulnerability are derived from the self-monitoring process. The guidelines for physical activity may provide a reference point for people in this process, which enables behavioral monitoring to take place. Social cognitive theory also regards knowledge and attitude as important cognitive factors (personal factors) that are significantly related to behavior change (MacDowell, Bonnell, & Davies, 2006). From a social learning theory perspective, Parcel and Baranowski (1981) also argue that an individual needs to have some knowledge of a desired behavior in order to elicit a behavior change.

Although knowledge of physical activity guidelines can theoretically be supported as an important factor related to an individual's positive engagement in physical activity, the determinants of physical activity are highly complex (see socio-ecological model; Sallis et al., 2006), so that mere knowledge may therefore not significantly predict actual participation. As a matter of fact, a confusing picture emerged from previous studies investigating the relationship between knowledge of physical activity guidelines and physical activity levels (e.g., Cameron et al., 2007; Plotnikoff et al., 2011; Morrow et al., 2004; Loughlan & Mutrie, 1997; Plotnikoff et al., 2007). The question that then arises is whether the publication of physical activity guidelines is an effective way to promote physical activity in a society. Interestingly, all the studies that are mentioned above have adopted a dichotomous "all-or-nothing" approach towards the assessment of physical activity. Such an arbitrary paradigm ignores the different phases and shifts experienced by individuals in the process of adoption and maintenance of physical activity. Physical activity behavior is a dynamic process in which one goes through a range of different phases that stand for various levels of motivational readiness for physical activity. Article 2 has therefore employed the transtheoretical model (Prochaska & Di Clemente, 1983), which considers behavior change as

a multi-determined dynamic process and describes the different phases that individuals go through during behavior change as the theoretical framework. The model provides a useful lens to examine the issues of adoption and maintenance of physical activity, and integrates an individual's present behavior with his/her intention to maintain or change the pattern of behavior. A cross-sectional and an experimental study were then conducted accordingly to examine the relationship between knowledge of physical activity guidelines and physical activity level.

In the cross-sectional study, it was found that students who were aware of the international physical activity guidelines were at later stages of physical activity behavior change and more physically active than those who were not aware of the guidelines. Although individuals with or without knowledge significantly differed in their stages of physical activity behavior change, no causal relation could be verified from this cross-sectional study design. That is, it is possible that those who became aware of the guidelines are motivated to initiate behavior change. At the same time, it is also possible that those who were more motivationally ready (i.e., have intentions) were more likely to pay attention to or remember the physical activity recommendations. A second study with an experimental research design was therefore warranted to confirm the causality. The results from the experimental study demonstrated, although no significant change in the actual level of physical activity took place after the intervention, that a significant proportion of the participants in the experimental group progressed in their physical activity stages of change following the educational intervention, progressing from a lower to a higher motivational readiness for change. However, the degree of progress in the stages of behavior change as a result of the intervention was dependent on the individuals' baseline stage, with those in lower stages, especially pre-contemplation and contemplation, showing greater improvement than those in higher stages. This is in line with Prochaska and DiClemente (1986) who proposed that cognitive processes might especially play a significant role in earlier stages of physical

activity behavior change, but not for individuals in higher stages. As a cognitive process, increased knowledge of physical activity guidelines may therefore only be effective for those in earlier stages. Similarly, according to the precaution adoption process model (Weinstein, 1988), an individual will proceed to contemplation stage when he/she is aware that he/she is not engaging in enough physical activity. The awareness of personal risk behavior is especially important in this process. In short, the findings of significant advancement in behavioral stages suggest that increasing knowledge of physical activity guidelines can shift individuals from lower stages to higher stages. However, for people to rise up to the highest stages of action or maintenance, more related factors, such as skills, self-efficacy, social support, etc. may need to be present in order to carry out physical activity behavior regularly.

The non-significant change in the level of physical activity after the intervention could be explained in a similar way, in that individuals at different behavioral stages use different strategies to adapt and maintain physical activity (Marcus & Forsyth, 2003). For example, individuals at the “lower” stages, i.e., pre-contemplation, contemplation and preparation, generally use more cognitive and fewer behavioral processes than people in the “higher” stages, i.e., action and maintenance (Marcus & Simkin, 1993). As a cognitive process, knowledge is perhaps not used by those in action and maintenance stages, but is frequently used by those in pre-contemplation, contemplation and preparation stages. Individuals in “higher” or “lower” stages of change vary in their experiences, skills and abilities (Marcus & Forsyth, 2003). This means that materials designed for those in lower stages may be considered as unattractive, irrelevant or unclear by those in higher stages and, at the same time, that materials designed for those in higher stages may be perceived as too demanding for those in lower stages of change. The present studies’ so-called “one-size-fits-all” intervention design of providing knowledge to all the participants alike may therefore not be sufficient for them to produce a significant shift in physical activity level. Health behavior change research supports that delivering individualized materials and stage-targeted

interventions based on unique or individual characteristics are more effective in increasing participants' physical activity than the delivery of general non-targeted interventions (Marshall & Biddle, 2001). These "one size fits all" approaches do not adequately address the unique aspects of each person and how these factors affect individuals' decisions to make changes to their health. Hence, identifying an individual's stage of change and then using the stage-matched behavior change techniques that combine different aspects related to physical activity might be the right direction.

The stage of change paradigm may help to resolve the seemingly inconsistent findings in the previous literature by showing that making people aware of physical activity guidelines primarily affects the intention for physical activity. Consequently, increasing awareness of physical activity guidelines may be considered an effective cognitive strategy to promote physical activity behavior, even if effects on the actual level of physical activity are not yet visible. On the other hand, the finding that increasing awareness of physical activity guidelines primarily affects intentions for physical activity also implies limitations of such educational interventions. Developing intentions is a prerequisite for new behavior; however, it alone is not sufficient for long-term maintenance of that behavior (Marcus & Forsyth, 2003). Physical activity is multi-componential in nature, which is related to informational, behavioral, social, environmental and policy aspects. Publication of the physical activity guideline may therefore not be enough on its own and should be used in combination with a broader framework of social, community and environmental components in order to usher in successful behavior change.

Nevertheless, in spite of the lack of significant change in physical activity levels, the intervention study still has important implications. While the ultimate aim of intervention is to increase physical activity levels, and since stage advancement can only serve as an intermediate step during this process through which the change in behavior occurs, previous studies using the stages of change model in smoking cessation have shown that helping

people advance just one stage further can double the probability of actual behavior in the future (DiClemente et al., 1991). Studies also found that advanced stage membership is significantly related to many other positive factors, including higher self-efficacy, better disease management, fewer health-related costs and good health habits, etc. (Spencer et al., 2006). Knowledge of the guidelines may therefore serve as an important pre-cursor to behavior change, meaning that when individuals are one stage further in the stages of physical activity behavior change, they may be one step closer to an actual behavior.

To conclude, the second article presents the first findings in regard to knowledge of physical activity guidelines and physical activity behavior from a stage of change paradigm among the Chinese population. Overall, the results from both the cross-sectional and the experimental study clearly suggest that the knowledge of physical activity guidelines is significantly associated with higher stage membership and may lead to actual physical activity behavior change through fostering intentions to participate in physical activity. Although not sufficient to bring about an actual increase in physical activity level, publication and propagation of China's guidelines may be an effective and relatively inexpensive method for assisting thousands of Chinese students to progress through the stages of physical activity.

5.1.3 Autonomy-supportive PE. With the realization that every student can be reached through the PE platform in China, Article 3, based on the trans-contextual model (Hagger et al., 2003), mainly aimed to explore the potential role of PE in promoting students' physically active lifestyles outside of the classroom. Consistent with the propositions of the model, the results from the cross-sectional study demonstrated that students' perceived autonomy support in PE predicted higher autonomous motivation in PE, which in turn predicted higher autonomous motivation towards leisure-time physical activity. The intervention study results indicate that improving teachers' autonomy-supportive teaching

increased students' autonomous motivation during PE classes, subsequently leading to higher autonomous motivation to be physically active during leisure times.

Among the many efforts that have tried to connect PE and students' leisure-time physical activity (e.g., Green, 2014; MacNamara et al., 2011), the trans-contextual model (Hagger et al., 2003) has successfully emerged as one of the most comprehensive theoretical frameworks to explain the underlying mechanisms through which the gap between PE and leisure-time physical activity could be filled. Since motivation is one of the most important individual factors associated with physical activity (Bauman et al., 2012), the trans-contextual motivational sequence provides a useful entry point for the development of successful PE intervention programs that aim at increasing students' leisure-time physical activity engagement. The first step in the proposed motivational sequence begins with the significant influence of perceived autonomy support on the autonomous motivation in PE. This within-context role of autonomy support from PE teachers emphasizes the important role that PE teachers play in the encouragement of students' autonomous forms of motivation in PE. This connection has been established in many studies in the PE setting (e.g., Standage, Duda, & Ntoumanis, 2006; Standage, Gillison, Ntoumanis, & Treasure, 2012). In the next step in the motivational sequence, autonomous motivation in PE predicts autonomous motivation towards leisure-time physical activity. According to the trans-contextual model, the perceived locus of causality in one context will have a significant effect on the perceived locus of causality in another similar setting, in which behaviors share similar characteristics (Hagger et al., 2003). Particularly for a context like PE, which is closely related to leisure-time physical activity in terms of the involved types of behaviors and skills, a strong transfer of motivation can be expected. The final step is the indirect effect of perceived autonomy support on autonomous motivation towards leisure-time physical activity via autonomous motivation in PE. Because one of the functions of perceived locus of causality is translating social factors into contextual motivation, it was proposed that the perceived locus of causality in PE will

fully mediate the effect of perceived autonomy support on the autonomous motivation towards leisure-time physical activity (Hagger & Chatzisarantis, 2016).

In a nutshell, the model underlines the pivotal role of autonomous motivation in the decision-making process that leads a student to look for similar activities in leisure-time contexts in the future (Hagger et al., 2003). However, some researchers have doubted the cross-cultural generalizability of this motivational transfer, arguing that while highlighting the key role of nurturing autonomous motivation in PE, one should not simply assume or take for granted that autonomy will be perceived in the same way regardless of the culture. There has been fierce debate in the literature about whether or not nurturing autonomous motivation generates cross-culturally universal benefits (Pomerantz & Wang, 2009). Self-determination theory scholars vigorously claim that autonomy is a universal basic psychological need, satisfaction of which is essential regardless of the culture (e.g., Ryan & Deci, 2000; Chirkov & Ryan, 2001; Chirkov, 2009; Nagasaku & Arai, 2005; Lonsdale et al., 2009; Vansteenkiste et al., 2005). Cross-cultural theorists however underscore the cultural-specificity of motivation and the context in which it should be interpreted (Xiang, Li & Shen, 2001). As a psycho-social concept, motivation is subjective in nature and holds different norms in different cultures. Caution is therefore warranted when implementing standardization in an intercultural context. Researchers argue in particular that autonomy may be less important in Eastern collectivist cultures because the needs of a group are seen as superior compared to the needs of the individual (e.g., Iyengar & Lepper, 1999; Markus & Kitayama, 2003). Given this communal outlook, the need for a sense of relatedness to the collective is of principal concern in Eastern cultures (Heine, Lehman, Markus, & Kitayama, 1999). Thus, they argue that in collectivistic countries like China, where the values of obedience and respect to seniors are more highly valued in comparison to individual freedoms (Chao & Tseng, 2002), students may not necessarily benefit from or feel comfortable when exposed to autonomy support from their PE teachers.

In spite of evidence supporting the generalizability of the trans-contextual model across cultures (e.g., Hagger et al., 2005), only few instances of research have been conducted to examine the proposition of this model among the Mainland Chinese population up to now and it is not clear whether or not the same implications of the model can be drawn in regard to the Chinese PE setting. To test the generalizability of the trans-contextual motivational transfer in a collectivistic culture of Chinese PE, a cross-sectional study was first implemented, which confirmed the propositions of the model. Since a major limitation of the cross-sectional research design is its inability to provide information on causal relationships, an experimental study was then conducted to overcome this limitation and to more directly address the propositions of the model. The experimental study expands the findings of the cross-sectional study in a more strictly controlled setting via the creation an autonomy-supportive motivational climate by training teachers' skills to support their students' experience of autonomy. The results demonstrate that improving teachers' autonomy-supportive skills increases the students' autonomous motivation during PE classes, which results in higher autonomous motivation of the students to be physically active during leisure times.

These findings seem to be quite robust, because the same pattern of results emerged for both studies despite substantial changes in research design. The findings are strongly in favor of the self-determination theory's perspective that autonomous motivation in PE yields positive outcomes in terms of improved motivation for leisure-time physical activity. Yet, one may still question the reconciliation of the contradicting results in the previous literature in terms of the role of autonomous motivation in collectivistic and individualistic societies (e.g., Iyengar & Lepper, 1999; Hagger et al., 2005). One possible explanation is that the discrepancies relating to the role of autonomy may be a result of differing definitions. Many cross-cultural scholars view autonomy as similar to independence from others (e.g., Markus & Kitayama, 2003). Therefore, it is natural that they find the support for autonomy as

dysfunctional in collectivistic cultures in which interdependence is valued and functional in comparison with individualistic cultures where independence is esteemed. On the contrary, self-determination scholars define autonomy as the tendency to be self-governed and to experience a sense of volition in behavior (e.g., Chirkov & Ryan, 2001). From this perspective, autonomy may not be incompatible with or exclude conformity, i.e., a person can autonomously depend on others or, in the same manner, autonomously decline to depend on others. This may explain the findings of self-determination scholars of the adaptive role of autonomy even in collectivistic societies.

In short, the findings from both cross-sectional and experimental studies fully confirmed the propositions of the trans-contextual model in the collectivistic Chinese PE context with perceived autonomy support promoting Chinese students' autonomous motivation towards leisure-time physical activity. These findings imply the important role autonomy-supportive PE teaching could play in China to support students in adopting a physically active lifestyle beyond the limits of PE. The teachers' delivery of autonomy-supportive instructions demonstrates one of the key avenues through which PE may promote the self-determined motivation of students. Regrettably, however, controlling teaching styles were previously observed to be the main instruction method in Chinese classrooms, with the education system mainly assessment-driven and characterized by high restraint (Zhou, Ma & Deci, 2009; Chen & Liu, 2008). The present findings of the important role of cultivating students' autonomous motivation in PE therefore highlights the potential role Chinese PE platforms could play in promoting physical activity in a scalable way in China. Chinese PE curricula should change from being merely a forum for teaching students sports skills to becoming a platform where quality motivation and lifetime participation of physical activity are emphasized.

5.2 Practical implications

This dissertation research proposes a number of practical implications. Firstly, the successful validation of the Chinese version of the Physical Activity Stages of Change Questionnaire in Article 1 effectively fills a gap in the literature and provides a valid tool to be used confidently in China. This may pave the way for more empirical research and practical applications based on the transtheoretical model in the future.

Secondly, the findings of Article 2 demonstrate that the knowledge of physical activity guidelines is significantly associated with higher stage membership and may lead to physical activity behavior change through fostering behavioral intentions. Although this was not sufficient to bring about a significant shift in the actual physical activity level, increasing the knowledge of physical activity guidelines may be an effective method for assisting thousands of Chinese students to progress through the stages of physical activity as postulated in the transtheoretical model. Particularly for people in lower behavioral stages, the increased awareness of the guidelines may lead to a higher motivational readiness to change. This highlights the practical necessity for an official publication of China's national guidelines. The guidelines may be propagated through mass media campaigns or printed materials through avenues such as hospitals, leisure centers, and health promotion events, etc. The potential benefits of this approach include the stimulation of self-initiated change, relative low cost and the capacity to reach large numbers of people without the influence of time barriers.

Thirdly, the findings from Article 3 also have important implications for both theory and practice. From the theoretical point of view, validation of the trans-contextual motivational sequence in Mainland China is attained. As Biddle (1997) pointed out, sports and exercise psychology literature has been strongly biased towards the study of samples from Western cultures. Cross-cultural validation of theories is important, because interventions should be tailored to specific populations in order to provide sample-specific guidelines for the design and implementation of successful intervention programs (Keating et al., 2005).

From a practical point of view, the results demonstrate that PE may represent a powerful platform for promoting active lifestyles among college students in China, especially when teachers are likely to provide students with the experience of autonomy. Furthermore, despite a predisposition toward a controlling teaching style in China (Zhou, Ma, & Deci, 2009), the present findings indicate that Chinese PE teachers can be successfully trained in autonomy-supportive skills and that this training pays off in terms of increasing students' autonomous motivation towards leisure-time physical activity. The development and inclusion of autonomy-supportive training programs should therefore be given priority in Chinese PE teachers' professional development and curriculum modification. PE should change from a narrow medical rationale that focuses on the promotion of fitness, disease prevention and teaching of sports skills to a more comprehensive approach emphasizing quality motivation and lifetime participation. One major measure of the ultimate success of PE should depend on the ability of PE teachers to improve participation of students in life-long physical activity. If we can change students' motivational experiences during PE, we may be one step closer to achieving active lifestyles for today's Chinese youth.

In summary, the ideal way for effective promotion of physical activity in China may be to reach large numbers of individuals with fewer expenses. Publication of physical activity guidelines and promotion of autonomy-supportive PE teaching are effective ways that have the potential to reach a large audience to promote physically active lifestyles in China.

5.3 Limitations

Some general limitations may warrant attention. Firstly, generalizability of the findings from both studies may be limited by their convenience and non-representative sampling methods. College students are relatively well-educated compared to the general public. At the same time, university life is a phase in life where lifestyle behaviors are predominantly under students' own control, and without family or work responsibilities.

University campuses also have various readily accessible facilities that can provide students with opportunities to conveniently participate in physical activity. Therefore, all else being equal, university students may be more ready and able than the general public to translate the health message of physical activity guidelines and autonomous motivation into actual physical activity behavior. Secondly, in terms of the design of the experimental studies, there were only two measuring time points in both of the intervention studies and there was no subsequent follow-up, which may be insufficient for an understanding of the trajectory of change and also be inadequate to test the potential long-term effects of the interventions. Future research should therefore include more measuring time points in addition to the pretest and posttest to arrive at a more comprehensive picture. Thirdly, when it comes to the measurement of physical activity, only self-reported physical activity was taken into account in Article 2. As a result, there may have been a likelihood of over-estimation of physical activity (Sallis & Saelens, 2000). More objective measurements such as pedometers and accelerometers may be vital for future research. Article 3, however, did not include a measurement of actual physical activity behavior. Although participants reported being more motivated towards leisure-time physical activity after the intervention, it cannot be ensured that they were or were not actually more active than before the intervention. Researchers should therefore include measurements of physical activity to address the motivation-behavior gap. Fourthly, although persuasive evidence exists that the Chinese population holds collectivistic cultural values (Oyserman et al., 2002) and that these values are relatively stable over time, acculturation and globalization may influence the cultural orientation of all countries. Since the actual cultural orientation was not measured in Article 3, it cannot be completely ascertained whether the current Chinese sample wholly endorsed the collectivistic cultural values that have tended to distinguish the Chinese population. Future investigation may need to measure participants' individualistic/collectivistic orientation to examine the cultural values adopted by the participants.

5.4 Conclusion

Given the large population base and high levels of physical inactivity in China, successful promotion of physical activity requires the development of effective intervention strategies that can be delivered to a large number of people at a low cost. The present dissertation mainly addressed the promotion of physical activity in a scalable way from a theory-driven perspective. In the first article, the Physical Activity Stages of Change Questionnaire was successfully validated. In the second article, the potential role of publication and dissemination of China's physical activity guidelines on the stages of physical activity behavior change and the level of physical activity were examined. In the third article, the potential effect of autonomous PE teaching on fostering students' autonomous motivation towards leisure-time physical activity was examined. Combining the results from the studies on physical activity guidelines and PE, the dissertation integrated the transtheoretical model (Prochaska & Di Clemente, 1983), which proposes promotion strategies to motivate people to change, and the trans-contextual model (Hagger et al., 2003), which addresses a transfer of motivation from educational to out-of-educational contexts. The findings clearly demonstrate that the publication of physical activity guidelines and the creation of an autonomy-supportive PE environment are two potential areas that can effectively contribute to the promotion of physically active lifestyles to tackle the growing problem of physical inactivity among Chinese college students on a large scale.

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7 Appendix

7.1 Reprint permission Cogent Psychology

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Tue 15/01, 11:57
Abula, Kahaerjiang

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Best wishes,
Louise Butler

Subject: permission for reprint

Sent by: ga32yux@mytum.de

Sent on: 15/01/2019

Dear Sir/Madam,

I am a doctoral student from Germany. I am writing this email to ask for permission to use my published article in the journal Cogent Psychology ("Validation of the Chinese version of the Physical Activity Stages of Change Questionnaire", doi:10.1080/23311908.2016.1228509) with the usual acknowledgments (author, title, publisher, journal name) as a reprint for my Doctoral Thesis/Dissertation. My university requires me to have a consent from the Publisher. If possible, could you please kindly consider this request as soon as possible?

Thank you very much in advance!

Warm regards,

Kahar

7.2 Reprint permission Journal of Sport and Health Science

Reprint permission



JSHS Editorial Office <jshs@sus.edu.cn>
 Fri 11/01, 09:03
 Abula, Kahaerjiang ✉

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Dear Kahar,
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If you need a formal letter, I would appreciate your help in providing a draft.

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Wei Gao (Science Editor)
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 Shanghai University of Sport, 650 Qingyuanhuan Road, Shanghai 200438, China
 E-mail: jshs@sus.edu.cn;
 Website: www.jshs.org.cn

...

Abula, Kahaerjiang

Wed 09/01, 11:32
jshs@sus.edu.cn; carolzhanghui@sus.edu.cn ✉

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Dear Sir/Madam,

with this email I would like to ask for permission to use my published article (JSHS_340 JSHS-2016-0421, "Does knowledge of physical activity recommendations increase physical activity among Chinese college students? Empirical investigations based on the transtheoretical model") with the usual acknowledgments (author, title, publisher, journal name) as a reprint for my Doctoral Thesis/Dissertation. My university requires me to have a consent from the Publisher.

Looking forward to hearing from you.
 Best wishes,
 Kahar

7.3 Reprint permission Health Promotion International



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Yesterday, 10:56

Abula, Kahaerjiang

Reply all

Dear Kahar,

RE. Kahar Abula et al. Autonomy support in physical education promotes autonomous motivation towards leisure-time physical activity: evidence from a sample of Chinese college students. *Health Promotion International* (2018) Doi: 10.1093/heapro/day102

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Abula, Kahaerjiang

Tue 15/01, 15:48

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Looking forward to hearing from you.
Best wishes,
Kahar

7.4 List of publications

Abula, K., Beckmann, J., He, Z. K., Cheong, C. W., Lu, F. Q., Gröpel, P. (2018).

Autonomous motivation in physical education promotes autonomous motivation towards leisure-time physical activity: Evidence from a sample of Chinese college students. *Health Promotion International*. doi:10.1093/heapro/day102

Abula, K., Gröpel, P., Chen, K., & Beckmann, J. (2018). Does knowledge of physical activity recommendations increase physical activity among Chinese college students?

Empirical investigations based on the transtheoretical model. *Journal of Sport and Health Science*, 7(1), 77-82. doi:10.1016/j.jshs.2016.10.010

Abula, K., Beckmann, J., Chen, K., & Gröpel, P. (2016). Validation of the Chinese version of the physical activity stages of change questionnaire. *Cogent Psychology*, 3(1), 1228509. doi:10.1080/23311908.2016.1228509

Abula, K., & He, Z. K. (2013). The association between exercise motivation, exercise adherence and mental health. *Review in Psychology Research*, 2(4), 61-68. (in Chinese)

Abula, K., & Zou, X. (2014). Validation of the peer pressure inventory among Chinese university students. *Psychological Technique and Application*, 5, 23-27. (in Chinese)