2015

Development and initial validation of the Chinese version of psychological needs thwarting scale in physical education

Jingdong Liu  
*Hong Kong Baptist University, jdliu@hkbu.edu.hk*

Pak Kwong Chung  
*Hong Kong Baptist University, pkchung@hkbu.edu.hk*

This document is the authors' final version of the published article.  
Link to published article: [http://dx.doi.org/10.1123/jtpe.2014-0053](http://dx.doi.org/10.1123/jtpe.2014-0053)

**APA Citation**  
Development and Initial Validation of the Chinese Version of Psychological Needs Thwarting Scale in Physical Education
Abstract

The current study presents the development process and initial validation of a measure designed for assessing psychological needs thwarting (frustration) in a secondary school physical education context (Psychological Needs Thwarting Scale in Physical Education, PNTSPE). Secondary school students (grades 7-9) from Hong Kong (N = 1258) were invited to participate in three studies. In Study 1, item generation and initial content validity of the PNTSPE were achieved. In Study 2, the factorial structure of the measure was tested using exploratory and confirmatory factor analysis. Internal consistency reliabilities of the subscales were also examined. In Study 3, the reliability and validity of the scores derived from the PNTSPE were further examined in an independent sample. Overall, the findings from the three studies provided initial psychometric evidence for the PNTSPE and suggested that the PNTSPE could be used as a valid and reliable measure to assess Hong Kong secondary school students’ psychological needs thwarting in physical education.

Keywords: needs thwarting, needs satisfaction, physical education, validity, reliability
Development and Initial Validation of the Chinese Version of Psychological Needs Thwarting Scale in Physical Education

School physical education has been suggested one of the potential venues to promote a physically-active lifestyle in children and adolescent (Kahn et al., 2002). Therefore, it is important to better understand how the social contextual factors in physical education classes (e.g., teachers’ teaching styles) shape and influence students’ experiences (both positive and negative). Self-determination theory (SDT; Deci & Ryan, 2002) has been widely used to investigate the relationship between social contextual factors and people’s experiences. In SDT, social contextual factors are thought to be fundamental to the progression or attenuation of self-motivated actions and health. This is achieved via the satisfaction or thwarting (frustration) of the three basic psychological needs: autonomy, competence, and relatedness (Ryan, 1995). Autonomy refers to the need for self-governance and self-endorsement of behaviors (Ryan & Deci, 2002). Competence refers to feeling effective in one’s ongoing interaction with the social environment and experiencing opportunities to express one’s capacities (Deci, 1975; White, 1959). Relatedness refers to feeling connected to others, to caring for and being cared for by those others, and to having a sense of belongingness both with other individuals and with one’s community (Ryan, 1995). Satisfaction of psychological needs within social contexts (need supportive contexts; e.g., autonomy supportive teaching or coaching) results in positive experiences (e.g., promoting integration and adaptation, or having a direct impact on well-being). In contrast, thwarting of psychological needs within social contexts (need thwarting contexts; e.g., controlling teaching or coaching) leads to negative experiences (e.g., provoking maladaptation and psychological ill-being; Deci & Ryan, 2002).

Previous studies from the physical education context have provided support for the assumption that social factors that foster the satisfaction of the basic psychological needs will result in positive and adaptive outcomes. For instance, it was found that physical education teachers’ autonomy support positively predicted students’ satisfaction of autonomy,
competence, and relatedness (see Standage, Gillison, & Treasure, 2007), students’ autonomous motivation toward physical education (e.g., Standage, Duda, & Ntoumanis, 2003, 2006; Standage, Gillison, Ntoumanis, & Treasure, 2012), as well as students’ subjective vitality and effort in physical education class (e.g., Taylor & Lonsdale, 2010; Vlachopoulos, Katartzi, & Kontou, 2011). However, very limited work within the physical education setting has examined the assumption that social contextual factors that lead to thwarting of basic psychological needs may result in individuals’ maladaptation or ill-being.

According to Deci and Ryan (2002), SDT not only looks at the brighter side of human existence (i.e., psychological needs satisfaction), but also provides accounts of the darker side of human experiences (i.e. psychological needs thwarting). Recently, Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) explained the reason why the darker side of human experiences had been widely discussed in theoretical overviews (e.g., Deci & Ryan, 2000; Ryan, Deci, Grolnick, & La Guardia, 2006) but seldom studied (Vallerand, Pelletier, & Koestner, 2008). They argued that it was mainly because previous researchers failed to clearly operationalize and accurately assess the construct of psychological needs thwarting. Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) distinguished psychological needs thwarting from psychological needs satisfaction by suggesting that low scores on psychological needs satisfaction may not indicate that needs are thwarted, but may suggest that an individual is unsatisfied with the degree to which needs are being met. Bartholomew and colleagues further conceptualized the psychological needs thwarting as the perception that the three basic psychological needs are being obstructed or actively frustrated within a given context (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). For example, if an individual gives a low score (i.e., 1 or 2), on a 7-point Likert scale (1=strongly disagree; 7= strongly agree), to a psychological needs satisfaction item (e.g., I am free to do physical activities the way I like in my physical education classes), it doesn’t necessarily imply that the individual will give a high score (i.e., 5 or 7 ) to a psychological needs thwarting item (e.g., I feel pushed to do physical activities in certain ways in my physical
education classes). A high score on a psychological needs satisfaction item means that the need is satisfied, while a low score on a psychological needs satisfaction item means the need is unsatisfied instead of being thwarted, such as being pushed or coerced. Therefore, psychological needs thwarting should be concerned with an active process and not simply the lack of psychological needs satisfaction (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011).

Based on this conceptualization, Bartholomew and colleagues developed the first psychological needs thwarting instrument, the Psychological Need Thwarting Scale (PNTS; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011) and further conducted a series of studies to investigate athletes’ experiences in a sport context (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011). It was found that athletes’ psychological needs thwarting was better predicted by athletes’ perceptions of coaches’ controlling whereas athletes’ psychological needs satisfaction was better predicted by athletes’ perceptions of coaches’ autonomy support. Athletes’ perceptions of psychological needs thwarting more consistently predicted maladaptive outcomes (disordered eating, burnout, depression, negative affect, and physical symptoms) whereas psychological needs satisfaction predicted positive outcomes associated with sport participation (vitality and positive affect). These findings not only provided support for SDT’s assumptions but also provided a practical and vivid illustration of the influences of social factors on human negative experiences through psychological needs thwarting. In another study, Bartholomew, Ntoumanis, Cuevas and Lonsdale (2014) investigated the relationships among the perceptions of job pressure, psychological needs thwarting, and psychological ill-being among physical education teachers. They found that psychological needs thwarting mediated the relationship between physical education teachers’ perceptions of job pressure and ill-beings, which further provided support for psychological needs thwarting as a promising underlying mechanism for explaining negative health-related outcomes.

School physical education is compulsory for most of elementary and secondary school
students in many countries or regions (e.g., Curriculum Development Council, 2002; Ha, Abbott, Macdonald, & Pang, 2009; Ntoumanis, Pensgaard, Martin, & Pipe, 2004; Tessier, Sarrazin, & Ntoumanis, 2010; Wallhead, Garn, Vidoni, & Youngberg, 2013). For example, in Hong Kong, physical education is a subject that aims to educate students through physical activity. Its goal is to develop students’ physical competence, knowledge of movement and safety, ability to use these to perform in wide range of activities associated with the development of an active and healthy lifestyle (Curriculum Development Council, 2002). All students in grades 1-9 from government aided schools in Hong Kong are required to attend physical education classes, which constitute at least 5% (5%–8%) of their total lesson time (i.e., 70–80 min per week) (Curriculum Development Council, 2002).

Although the compulsory school curriculum does not inevitably result in controlling environmental atmosphere in classes, many studies have suggested that the controlling agency often is manifested in the curriculum, teacher behavior, school regulations and rules, as well as the assessment system (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Eccles & Midgley, 1989; Sun & Chen, 2010). Some researchers assumed that an over-arching characteristic of school is to control, either overtly or covertly. Therefore, school administrators and teachers are controlling agents and students are controlled because all these agents demand students to behave in certain ways to be successful in school (Sun & Chen, 2010). Some educational psychologists provided explanations for the prevalence of teachers’ controlling teaching style in the classroom (e.g., Reeve, 2009) and suggested that there were several forces that influence teachers’ formation of controlling styles during instruction. For example, some influences come from outside agents, such as school policies, administrators, parents, societal expectations, or cultural norms; some influences may arise out of the classroom dynamics, such as interactions between teacher and students (what students say, do, and do not do during instruction); some other influences may be because of the characteristics of the teacher himself or herself, such as personality and beliefs (Deci, Speigel, Ryan, Koestner, & Kauffman, 1982; Deci, Schwartz, Sheinman, & Ryan, 1981; Ryan
Regardles of the reasons that lead to the teachers’ adoption of controlling styles in their classes or during instruction, previous research has widely reported that controlling teaching is significantly related to negative emotions (e.g., anger, anxiety, boredom, stress), maladaptive forms of motivations (e.g., amotivation, controlled motivation), restricted engagement, and poor academic achievement (Assor & Kaplan, 2001; Assor et al., 2005; Deci, Ryan, & Williams, 1996; Soenens, Sierens, Vansteenkiste, Dochy, & Goossens, 2012; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005). Therefore, it is important to further examine how teachers’ controlling teaching affects students’ learning outcomes, especially the negative ones.

Bartholomew et al. (2014) suggested that direct assessments of psychological needs thwarting should be used when negative experiences (e.g., ill-being and other maladaptive outcomes) are the interests of the study. Given the controlling nature of institutionalized schooling (Sun & Chen, 2010), to develop a more desirable and reasonable physical education environment for students, it is important for researchers and practitioners to better understand how physical education teachers’ teaching behaviors affect their students experiences, especially the negative ones. Although plenty of studies in physical education have investigated students’ psychological needs satisfaction and adaptive outcomes, limited research has looked at students’ psychological needs thwarting and negative experiences. This is primarily due to the lack of relevant valid and reliable measures. To the best of our knowledge, the only available psychometrically sound psychological needs thwarting measure is the PNTS (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011), which consists of 12 items and measures three subscales, namely, autonomy thwarting (4 items), competence thwarting (4 items) and relatedness thwarting (4 items), using a 7-point Likert scale in the scoring. It has been demonstrated that the specific measure produces valid and reliable scores in a series of studies.
Thøgersen-Ntoumani, 2011). The PNTS has been recently modified to measure the
psychological needs thwarting in other fields, such as exercise (Gunnell, Crocker, Wilson,
Mack, & Zumbo, 2013) and general life (Bateman, 2011). Although the modified scales have
been reported to produce reliable scores, the factor structure has been found problematic in
some studies with very high interfactor correlations (e.g., ranging from .85 to .96; Gunnell et
al., 2013). These findings imply that the modified or revised scales from sport settings may
not function well in other fields, such as exercise or physical education contexts. It is
imperative to develop psychometrically sound domain-specific measures so that the studies
related to individuals’ negative experiences in specific fields could be further investigated.

The purpose of the current study was to develop a domain-specific measure, the
Psychological Needs Thwarting Scale in Physical Education (PNTSPE), to assess secondary
school students’ psychological needs thwarting (autonomy thwarting, competence thwarting,
and relatedness thwarting) in a physical education context. To achieve the purpose of this
study, three sequential studies were conducted. A total of 1258 students (grades 7-9) from
nine government aided secondary schools in Hong Kong were invited to take part in the three
studies. In Study 1, the pool of PNTSPE items was generated, and the content validity was
assessed. In Study 2, selected psychometric properties of the initial PNTSPE established in
Study 1 were examined. In Study 3, the findings in Study 2 were cross-validated using an
independent sample.

Study 1

Methods

Participants. The sample comprised of 49 secondary school students (23 for the first
four focus groups with 5-6 students in each one; 26 for the second four focus groups with 6-7
students in each one) and 7 PE teachers (for face-to-face interviews). The students were 29
females and 20 males aged between 12 and 16 years old ($M = 13.52; SD = 1.2$), from three
classes of two schools, with one class from each grade level (grades 7 to 9). The teachers
were 3 females and 4 males, from six different schools, aged from 26 to 47 years old ($M =
34.86; $SD = 6.89$), with teaching experience ranging from 1 to 15 years ($M = 5; SD = 4.69$).

Three academic experts who have published SDT-based research were also consulted to review the content validity of the items from a theoretical perspective.

**Procedures.** Ethical approval was obtained from a local university’s human and animal research ethics committee. To generate the pool of PNTSPE items, some items from the established instrument (PNTS; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011) were used as reference. Eleven items (3 autonomy items, 4 competence items, and 4 relatedness items) from the PNTS were identified and modified to physical education contexts to form the candidate items of the initial items pool of the PNTSPE. All modified items were translated into Chinese using the translation and back-translation strategy. Two bilingual translators with doctoral degrees (in physical education and psychology, respectively) translated the items independently from English into Chinese. Consensus was obtained through discussion to form a preliminary Chinese version, which was then independently translated back to English by two other translators. Comparison of the back translated English version with the original English version revealed that the meaning of the items was identical.

Twenty-three of the 49 students were invited to complete a set of questions (example questions: please describe your experience of competence in your physical education classes; please think about some conditions that make you feel NOT competent and effective during physical education), and then take part in a set of focus groups to explore their experiences of psychological needs thwarting in physical education classes (the outline of the questions is available from the first author upon request). The focus groups were audiotaped and then transcribed verbatim. The qualitative data collected from the open-ended questions and the focus groups were qualitatively analyzed using content analysis. Sixteen draft items were generated. When combining the draft items from qualitative analysis and those modified from the existing instrument, it was found that there was some overlap between the two sets of items. Eight items (2 autonomy items, 3 relatedness items, and 3 competence items) that were
modified from the PNST were also frequently mentioned by students (see Appendix). After
removing the overlapped items, an initial pool of items (19 items representing three subscales:
8 autonomy items, 6 competence items, and 5 relatedness items) for the PNTSPE was
established.

The 19 items were presented to other 26 students and seven physical education teachers
to ask them to indicate whether the items were applicable or inapplicable using a
dichotomous scale before the focus groups. Items which were perceived as inapplicable by
75% or more of the students and the PE teachers were deleted (see Bartholomew et al., 2011).
For items perceived as applicable, students were further asked to rate their clarity using a
7-point Likert scale (1 = not at all clear; 7 = extremely clear). Items rated lower than 5 were
classified as problematic. In the focus groups, the 26 students were encouraged to suggest
additional items or alternative wordings for items that were rated as problematic. The data
collected from the second set of focus groups were qualitatively analyzed to complement and
refine the generated items. No new additional items were generated.

Three judges with expertise in SDT were invited to review the pool of items developed
based on the existing instrument and focus groups. They were provided with a definition of
the psychological needs thwarting and were asked to indicate the extent to which the items
were assigned to each of the factors, using a 4-point Likert scale (1 = not relevant; 2 =
somewhat relevant; 3 = quite relevant; 4 = highly relevant). The rating scales were used to
compute the content validity index (CVI; Lynn, 1986) of each item; this was subsequently
used as a reference for deciding whether to retain, delete or revise the item. The three judges
were also asked to provide suggestions for additional items if appropriate.

Results of Study 1

Nineteen PNTSPE items (see Appendix) were initially developed based on the existing
instrument and the results of the focus groups with the students. Two items (items 8 and 12)
classified as inapplicable to physical education context were removed. The remaining 17
items were then reviewed by the three judges. The CVI was computed by dividing the
number of judges who gave a rating of 3 or 4 (quite relevant or highly relevant to the needs thwarting construct) by 3, the number of judges. According to Polit, Beck, and Owen (2007), when there are three judges, CVIs equal to 1.00 are considered to be excellent, whereas CVIs equal to .67 are considered to be fair. Two items (items 2 and 13) displayed CVIs of .67 without modification suggestions from the judges and were deleted. Two items (items 10 and 17) displayed CVIs of .67 with modification suggestions and were revised and then retained. Upon completion of this development process, a pool of 15 items for PNTSPE (7 autonomy items, 3 competence items, 5 relatedness items) was established.

Study 2

Method

Participants. A group (N = 646) of secondary school students (grades 7 to 9), aged from 10 to 16 years (M = 13.67, SD = 1.06) were invited to participate in this study (348 Males and 298 Females). Students were from 22 classes of five secondary schools located in the New Territories (2), Kowloon (2), and Hong Kong Island (1). All students were Chinese and could read and speak Chinese.

Procedures. Ethical approval was obtained from a local university’s human and animal research ethic committee. Secondary school principals were contacted and were provided information about the study to obtain the permission to access their students. With this approval, informed written consent was obtained from the teachers who were asked to act in loco parentis and from the students who participated in the study. The students were informed that the survey was voluntary and that they had the right to withdraw at any time from the study. To prevent social desirability effects, the students were told that the study aimed to investigate their true feelings and general experiences in physical education classes, and there were no right or wrong answers. The students were asked to complete the questionnaires in a quiet classroom under the supervision of two well-trained research assistants, without the presence of their teachers. The students were also told that it was an anonymous survey, and that all of the information they provided would be absolutely confidential; it was further
explained that their physical education teachers would not be able to access their responses. Measures. Participants were required to answer the 15-item PNTSPE (7 autonomy items, 3 competence items, 5 relatedness items). At the beginning of the questionnaire, written instructions requested that the students consider their general experiences in physical education classes, and indicate how much they agree or disagree with each statement on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The scores of subscales were calculated by averaging the scores of all items of each subscale. The global psychological needs thwarting score was calculated by averaging the scores of all subscales. Data analysis. Due to the fact that the students in this study were nested within 22 classes, intraclass correlations (ICCs) for the 15 PNTSPE items were calculated to estimate the “class-level” effects (Kline, 2011). The ICCs of 13 items were found less than .10 (ranged from .021 to .094) while the ICCs of 2 items were higher than .10 (item 4 = .125 and item 15 = .134). Therefore, we treated the data as a whole and didn’t take the between-class variances into consideration in the subsequent analyses. The use of Exploratory Factor Analysis (EFA) is advocated during the early stages of scale development to avoid misspecification of the number of factors, and to maximize the convergent and discriminant validity of the items constituting each factor (Hurley et al., 1997). However, when there is a strong theoretical base for the hypothesized model, the use of Confirmatory Factor Analysis (CFA) could be advocated (Hurley et al., 1997). In this study, although we have strong theoretical support for our hypothesized model, we employed EFA in the early stage for the purpose of maximizing the convergent and discriminant validity of the items. Thus, EFA was conducted on the PNTSPE items using SPSS 18.0. The principal axis factor analyses were carried out with a direct oblimin rotation since it is hypothesized that the three basic psychological needs would be interrelated. Factor extraction was based on an eigenvalue of > 1.0 and a confirmatory inspection of the scree plot. In terms of interpreting the extracted factors, factor-loadings of .40 and above were considered satisfactory (Hinkin, 1995). In this study, all items with primary factor-loadings of < .40, and
all items with high cross-loadings (i.e., secondary loadings > .30), were deleted.

CFAs were further conducted to examine the factorial validity and internal consistency reliability of the preliminary PNTSPE using AMOS 18.0. The adequacy of the model fit to the data were evaluated using multiple fit indices, such as the chi-square statistic, the comparative fit index (CFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA; including its 90% confidence interval) (Hu & Bentler, 1999). The thresholds of >.90, close to (or less than) .08, and up to .08 for the CFI, SRMR, and RMSEA indices, respectively, indicate an acceptable fit. The CFI value exceeding .95, and SRMR and RMSEA close to (or less than) .08 and .06 are indicative of good fit (Hu & Bentler, 1999).

Cronbach’s apha coefficients, composite reliability values (CR) and average variance extracted (AVE) were calculated to evaluate the internal consistency reliability of the PNTSPE. Furthermore, discriminant validity and gender and grade level invariance of the PNTSPE measurement model were examined.

Results of Study 2

Exploratory factor analysis. The initial EFA resulted in a solution containing three factors, accounting for 60.14% of the variance in the items. Employing the aforementioned criteria to examine the pattern matrix, three items (items 1, 10 and 17) that displayed low primary factor loading or cross-loadings were removed. An additional EFA was performed, and the solution comprised of three factors, accounting for 64.32% of the variance of the 12 remaining items (see Table 1). All factor-loadings exceeded the recommended .40 level. Analysis of item content suggested that the extracted items could be represented by the hypothesized three basic psychological needs. Factor 1, autonomy, consisted of five items; Factor 2, relatedness, was represented by four items; Factor 3, competence, comprised of three items.

Confirmatory factor analysis. CFA was conducted to confirm the factor structure of the PNTSPE identified in the EFA analysis. Examination of Mardia’s coefficient (61.72, p
14

< .001) indicated that the data violated the assumption of multivariate normality.

Subsequently, in following the recommendations of Byrne (2010), all CFAs were conducted using maximum-likelihood estimation coupled with bootstrapping procedures. According to the recommendations of Preacher and Hayes (2008), this study used 5,000 bootstrap samples, with replacement based on the original sample.

Results of the initial CFA indicated room for improvement: $\chi^2 (51) = 374.28, p < .001$; CFI = .934; SRMR = .048; RMSEA = .10 (90% CI: .09 – .11). We inspected the modification indices and standardized residual matrix, and found that one item (item 3) cross-loaded onto unintended factors and the residuals of three items (items 3, 4, and 15) associated with multiple standardized residuals exceeding ± 2.00. Excluding these three items much improved the fit of the model to the data: $\chi^2 (24) = 123.23, p < .001$; CFI = .959; SRMR = .04; RMSEA = .08 (90% CI: .07 – .09). Further examination of the modification indices and standardized residuals of this solution revealed no further factorially complex items. The PNTSPE comprised of three 3-item subscales, representing students’ perceived thwarting of the need for autonomy, competence and relatedness. The correlations between the three subscales were $r_{relatedness-competence} = .768$, $r_{autonomy-competence} = .692$, and $r_{relatedness-autonomy} = .615$. The fully-standardized item-loadings ranged from .720 to .894, with an average loading of .805. All three subscales demonstrated good internal consistency reliabilities, with CR values ranging from .796 to .904, alpha coefficients ranging from .797 to .903 and AVE values ranging from .566 to .757. Table 2 displays item means, standard deviations, standardized factor-loadings, standardized error, and squared multiple correlations for this solution, CR values, Cronbach’s alpha coefficients, as well as AVE of the PNTSPE subscales.

**Discriminant validity.** The hypothesized three-factor structure of PNTSPE was compared with three different two-factor models in which two needs were taken together and contrasted with the remaining need, and a one-factor model in which all three needs were combined together (see Table 3). Results revealed that the hypothesized three-factor model
fitted the data best compared with any other model. This finding suggests that the three needs of PNTSPE represent distinct constructs, which provided support for the discriminant validity of the newly-developed PNTSPE.

**Invariance testing across gender and grade level.** A sequential model testing approach was employed via multiple-group CFA to examine whether the PNTSPE measurement model displayed invariance across gender and grade levels. A baseline model (M0: unconstrained model) was established first, and then two increasingly-constrained models were specified to examine the equality of measurement (M1: Factor-loadings were constrained to be equal) and structural parameters (M2: Factor-loadings, factor variances and covariances were constrained to be equal) across gender as well as grade levels. The invariance of error variances and covariances was not investigated in this study because it is widely considered to be excessively stringent and, therefore, is rarely implemented (Byrne, 2010). Both chi-square differences test ($\Delta \chi^2$; Marsh, 1987) and change in the value of the CFI ($\Delta$CFI; Cheung & Rensvold, 2002) were used in this study to evaluate the model fit. Due to the fact that the likelihood ratio (chi-square difference test) is sensitive to nonnormality and is influenced by sample size, the conclusion of invariance analysis in this study was reached based on the change in the CFI test when there was inconsistency between the two tests (see Chen, Sousa, & West, 2005). A decrease in CFI smaller than .01 from one model to the next was taken as indicative of invariance (Cheung & Rensvold, 2002).

Table 4 displays the goodness-of-fit indices for the gender and grade level invariance analysis of the PNTSPE measurement model. For the gender invariance analysis, although the chi-square difference test between M1 and M0 was significant, $\Delta \chi^2 (\Delta df = 6) = 20.6, p < .01$, there was no substantial change in the CFI value ($\Delta$CFI = .005). Therefore, we concluded that the factor loadings of PNTSPE measurement model were invariant across gender. Furthermore, the chi-square difference test between M2 and M1 was significant, $\Delta \chi^2 (\Delta df = 6) = 22.42, p < .01$, but there was no substantial change in the CFI value ($\Delta$CFI = .006). This finding suggested that the factor variances and covariances were also invariant.
across gender. For the grade level invariance analysis, the chi-square difference test between M1 and M0 was not significant, $\Delta \chi^2(\Delta df = 12) = 6.08, p < .01$, and no substantial change in the CFI value ($\Delta CFI = .001$) was found either. Therefore, we concluded that the factor loadings of PNTSPE measurement model were invariant across grade levels. The chi-square difference test between M2 and M1 was non-significant, $\Delta \chi^2(\Delta df = 12) = 15.38, p < .01$, and there was no substantial change in the CFI value. This finding suggested that the factor variances and covariances were also invariant across grade levels.

In summary, based on the results of EFAs and CFAs, a three-factor PNTSPE measurement model was identified. Six items were removed due to low primary factor loadings or high cross-loadings. Internal consistency reliability, discriminant validity and measurement invariance of the 9-item PNTSPE across gender and grade levels were examined. The 9-item PNTSPE demonstrated good validity and acceptable reliability. The measurement model of the PNTSPE was also found invariant across gender and grade levels.

**Study 3**

**Method**

**Participants and procedures.** Five hundred and sixty-three secondary school students (grades 7 to 9), aged from 11 to 16 years ($M = 13.63, SD = 1.02$) were invited to participate in this study (264 Males and 299 Females). Students were from 18 classes of four secondary schools located in the New Territories (2) and Kowloon (2). All students were Chinese and could read and speak Chinese. Ethical approval was obtained from a local university’s human and animal research ethic committee, and the procedure was the same with that in Study 2.

**Measures.** The 9-item PNTSPE (3 autonomy items, 3 competence items, 3 relatedness items) was used to measure students’ psychological needs thwarting. The participants were asked to respond to the 9-item PNTSPE on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

A six-item version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) was employed to measure students’ feelings of positive energy. Responses were provided on a
7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). A previous study has provided support for the application of the scale among secondary school students in Hong Kong (i.e., Taylor & Lonsdale, 2010). The scale demonstrated acceptable factorial validity ($\chi^2(9) = 43.24, p < .001$, CFI = .98, SRMR = .04, RMSEA = .08 [90% CI: .06 – .10]) and internal consistency reliability (CR = .87) in the current study.

A five-item Negative Affect Subscale from the International Positive and Negative Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007) was used to measure students’ negative affect in this study. Responses were provided on a 5-point Likert scale ranging from 1 (never) to 5 (always). Previous studies have provided support for the validity and reliability of the scale among Chinese populations (e.g., Chung & Liu, 2012; Thompson, 2007). The scale demonstrated an acceptable factorial validity ($\chi^2(5) = 45.24, p < .001$, CFI = .94, SRMR = .08, RMSEA = .10 [90% CI: .09 – .12]) and internal consistency reliability (CR = .85) in the current study.

**Data analysis.** Intra-class correlations (ICCs) for the 9 PNTSPE items were calculated to estimate the “class-level” effect. The ICCs were found less than .10, ranging from .01 to .03. Therefore, the class-level effect was not taken into consideration in the subsequent analyses. CFA was conducted to cross-validate the findings of study 2. The multi-fit indices used in Study 2 were also used in this study for evaluating the model fit of the measurement models to the data. Internal consistency reliability and discriminant validity of PNTSPE were also examined. Nomological validity was evaluated by examining the correlations of psychological needs thwarting with the theoretical correlated structures (subjective vitality and negative affect). Finally, the cross sample measurement invariance of the PNTSPE was examined using multiple-group CFA.

**Results of Study 3**

**Factorial validity and internal consistency reliability.** The 9-item three-factor structure of PNTSPE from Study 2 was examined via CFA using AMOS 18.0. Examination of Mardia’s coefficient (59.16, $p < .001$) indicated that the data violated the assumption of...
multivariate normality. Subsequently, all CFAs were conducted using maximum-likelihood estimation coupled with bootstrapping procedures (i.e. 5000 bootstrap samples). The model displayed a good fit to the data, $\chi^2 (24) = 111.37, p<.001$, CFI = .961, SRMR = .04, RMSEA = .08 (90% CI: .07 – .09). The correlations between the three subscales were $r_{relatedness-competence} = .716$, $r_{autonomy-competence} = .762$, and $r_{relatedness-autonomy} = .646$, respectively. All three subscales demonstrated good internal consistency reliabilities, with CR values ranging from .789 to .820, alpha coefficients ranging from .787 to .812 and AVE values ranging from .555 to .605. These findings provided support for the factorial validity and internal consistency reliability of the PNTSPE. Table 2 displays standardized factor-loadings, item means, standard deviation, standard error, squared multiple correlation, CR values, Cronbach’s alphas, and AVE of the PNTSPE subscales.

**Discriminant validity.** The hypothesized three-factor structure of PNTSPE was compared with the corresponding three different two-factor models in which two needs were taken together and contrasted with the remaining need and an one-factor model in which all three needs were combined together (see Table 3). Results revealed that the hypothesized three-factor PNTSPE measurement model fitted the data best compared with other corresponding models. These findings suggest that the three needs of PNTSEP represent distinct constructs and provide support for the discriminant validity of the PNTSPE.

**Nomological validity.** According to SDT, the thwarting of psychological needs will result in negative experiences (e.g., psychological ill-being; Deci & Ryan, 2002). A previous study within a sport setting has revealed that both specific and global psychological needs thwarting were positively correlated (moderate-to-high) with negative affect (Bartholomew, Ntoumanis, Ryan, Bosch et al., 2011). Moreover, it was also found that the psychological needs thwarting was negatively correlated (low-to-moderate) with subjective vitality. Therefore, the nomological validity was evaluated by examining the relationships between the psychological needs thwarting (both specific and global) and negative affect and subjective vitality. Table 5 displays the descriptive statistics and correlations among the
variables. As hypothesized, moderate positive correlation between the psychological needs thwarting and negative affect, and low-to-moderate negative correlation between the psychological needs thwarting and subjective vitality were found in this study. These findings provided support for the nomological validity of the PNTSPE.

**Invariance testing across samples.** The same model testing approach used in Study 2 was conducted to examine whether the PNTSPE measurement model displayed invariance across samples (Study 2 and Study 3). Table 4 displays the goodness of fit indices for the multiple-group model. The chi-square difference test between M1 and M0 was not significant and no substantial change in the CFI value (ΔCFI = .001) was found. Therefore, we concluded that the factor loadings of PNTSPE measurement model were invariant across two samples. Furthermore, although the chi-square difference test between M2 and M1 was significant, Δχ² (Δdf = 6) = 25.28, p < .01, there was no substantial change in the CFI value (ΔCFI = .004). This finding suggested that the factor variances and covariances were also invariant across gender. In general, these findings provide substantial support for the factorial invariance of the PNTSPE measurement model across samples.

**Test-retest reliability.** Eighty-three secondary school students (47 male and 36 female) aged from 11 to 18 years (M = 13.6, SD = 1.5) completed the 9-item PNTSPE on two occasions separated by one month. Test-retest reliabilities for each subscale were calculated using intra-class correlation coefficient (ICCₐ,k), with a 95% CI obtained from a two-way random model (McGraw & Wong, 1996). The ICCs for each subscale were as follows: autonomy thwarting, r = .80 (95% CI: .69 – .87); competence thwarting, r = .76 (95% CI: .63 – .84); relatedness thwarting, r = .85 (95% CI: .76 – .90). These findings provided support for the test-retest stability of the newly developed PNTSPE.

In summary, the Study 3 replicated the findings of Study 2 and provided support for the factorial validity, internal consistency reliability and discriminant validity of the 9-item PNTSPE with an independent sample. Invariance analysis suggested that the measurement model of the PNTSPE was invariant across sample. Further, results of the study also
suggested that the nomological validity and test-retest reliability of the scores derived from
the 9-item PNTSPE were satisfactory.

**General Discussion**

The tenets of SDT have been widely examined in various domains, including physical
education (e.g., Aelterman, Vansteenkiste, Van Keer, Van den Berghe, De Meyer, & Haerens,
2012; Cox & William, 2008; Rutten, Boen, & Seghers, 2012; Shen, Sun, & Rukavina, 2010;
Standage et al., 2012; Taylor & Lonsdale, 2010). However, previous related studies mainly
focused on the psychological needs satisfaction, which is related to the brighter side of
human experience. The psychological needs thwarting, which is thought to be related to the
darker side of human experience, has not been given enough attention. The main reason may
have been the lack of a valid and reliable measure that could be used for tapping students’
psychological needs thwarting. Therefore, the purpose of the current study was to develop
and validate a questionnaire measure for assessing the psychological needs thwarting of
secondary school students in a physical education context.

The findings of three sequential studies provided initial psychometric evidence for the
newly developed PNTSPE, which consists of 9 items and measures three correlated but
distinctive factors (autonomy, competence and relatedness). Collectively, the PNTSPE
demonstrated acceptable internal consistency reliability and test-retest reliability, and
displayed good content, factorial, discriminant, as well as nomological validities among
secondary school students in Hong Kong. The measurement model of the PNTSPE was also
found invariant across gender, grade levels and samples. These findings suggested that the
PNTSPE could be used in future studies to directly assess secondary school students’
psychological needs thwarting in a physical education context.

There are several advantages of the newly developed PNTSPE. First, the development of
the PNTSPE makes it possible for researchers and practitioners in future studies to directly
assess secondary school students’ psychological needs thwarting in a physical education
context. A previous study within a sport setting revealed a small negative correlation between
psychological needs thwarting and psychological needs satisfaction, which suggested that psychological needs thwarting and psychological needs satisfaction were independent constructs (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). Investigation on the relationship between the constructs in physical education contexts will contribute to further understanding of the basic psychological needs within the SDT framework. Second, it allows researchers and practitioners to further investigate students’ psychological needs thwarting in relation to teachers’ teaching behaviors in physical education classes. This kind of investigations will provide researchers and practitioners useful information to better understand the prevalence of students’ negative experiences (i.e., amotivation, stress) in physical education classes. Finally, the PNTSPE could be used in future studies as an indicator of physical education teachers’ need thwarting behaviors, which may be further used as alternative strategies to evaluate physical education teachers’ teaching. Although our findings of a series of studies provided promising evidence for the psychometric properties of the scores derived from the PNTSPE, questionnaire validation is an on-going process, and thus, further development and validation of the measure is needed. With this in mind, future research may involve further investigation of the SDT based psychological needs thwarting assessment in a physical education context. For example, a cross-sectional validation was used to examine the nomological validity of the PNTSPE in the current study, and therefore, other methods such as longitudinal, cross-lagged or experimental designs are suggested to be used to further examine the nomological validity of the PNTSPE. Furthermore, only relationships between psychological needs thwarting and their consequent variables (subjective vitality and negative affect) were examined. Other relationships between psychological needs thwarting and both their antecedences (e.g., need thwarting behaviors) and consequences (e.g., amotivation, dropout of PE, and anxiety in PE class) should be further examined. Moreover, the PNTSPE measurement model was found invariant across students in grades 7 to 9; future studies should examine whether the measurement model is invariant across other higher or lower grades, such as senior secondary
school student or elementary school students. In addition, the participants in this study were Chinese secondary school students in Hong Kong. Future studies are encouraged to examine the psychometric properties of the measure among or across Chinese secondary school students in other Chinese societies, such as Mainland China, Taiwan and Macau. Finally, the PNTSPE was developed in the Chinese language (traditional Chinese), and therefore, future studies are expected to validate the measure in other languages, such as simplified Chinese and English. Psychological needs thwarting is a very interesting issue that warrants future cross-cultural investigations.

In general, the current study provided initial psychometric evidence for the newly developed PNTSPE. The results from our three studies demonstrated that the reliability and validity of the scores derived from the PNTSPE were acceptable and satisfactory, which suggests that the measure could be used in future investigations among secondary school students in Hong Kong.
References


measurement invariance. *Structural Equation Modeling*, 9, 233–255.


Table 1

*Factor Loadings from EFA Analyses of PNTSPE (N =646)*

<table>
<thead>
<tr>
<th>PNTSPE Item</th>
<th>EFA 1</th>
<th>EFA 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor 1</td>
<td>Factor 2</td>
</tr>
<tr>
<td>Autonomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 5</td>
<td>.898</td>
<td>.013</td>
</tr>
<tr>
<td>Item 6</td>
<td>.852</td>
<td>.120</td>
</tr>
<tr>
<td>Item 7</td>
<td>.849</td>
<td>.036</td>
</tr>
<tr>
<td>Item 4</td>
<td>.772</td>
<td>.131</td>
</tr>
<tr>
<td>Item 3</td>
<td>.686</td>
<td>.039</td>
</tr>
<tr>
<td>Item 10</td>
<td>.539</td>
<td>.330</td>
</tr>
<tr>
<td>Item 1</td>
<td>.345</td>
<td>.109</td>
</tr>
<tr>
<td>Relatedness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 15</td>
<td>.133</td>
<td>.661</td>
</tr>
<tr>
<td>Item 18</td>
<td>.138</td>
<td>.748</td>
</tr>
<tr>
<td>Item 19</td>
<td>.019</td>
<td>.797</td>
</tr>
<tr>
<td>Item 16</td>
<td>.013</td>
<td>.744</td>
</tr>
<tr>
<td>Item 17</td>
<td>.103</td>
<td>.326</td>
</tr>
<tr>
<td>Competence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 9</td>
<td>.021</td>
<td>.255</td>
</tr>
<tr>
<td>Item 14</td>
<td>.285</td>
<td>.062</td>
</tr>
<tr>
<td>Item 11</td>
<td>.259</td>
<td>.098</td>
</tr>
</tbody>
</table>

*Note.* PNTSPE = psychological needs thwarting scale in physical education; EFA = exploratory factor analysis
Table 2

*CFA Factor Loadings (FL), Item Means (M), Standard Deviation (SD), Standard Error (SE), Squared Multiple Correlation (SMC), Composite Reliabilities (CR), Cronbach’ alpha (a) and Average Variance Extracted (AVE) of PNTSPE*

<table>
<thead>
<tr>
<th>PNTSPE items</th>
<th>CFA of Study 2 (N = 646)</th>
<th>CFA of Study 3 (N = 563)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Autonomy</td>
<td>.904</td>
<td>903</td>
</tr>
<tr>
<td>Item 5</td>
<td>3.01</td>
<td>1.77</td>
</tr>
<tr>
<td>Item 6</td>
<td>3.31</td>
<td>1.74</td>
</tr>
<tr>
<td>Item 7</td>
<td>2.94</td>
<td>1.85</td>
</tr>
<tr>
<td>Competence</td>
<td>.796</td>
<td>.797</td>
</tr>
<tr>
<td>Item 9</td>
<td>3.05</td>
<td>1.57</td>
</tr>
<tr>
<td>Item 11</td>
<td>3.10</td>
<td>1.66</td>
</tr>
<tr>
<td>Item 14</td>
<td>3.27</td>
<td>1.66</td>
</tr>
<tr>
<td>Relatedness</td>
<td>.835</td>
<td>.834</td>
</tr>
<tr>
<td>Item 16</td>
<td>2.52</td>
<td>1.49</td>
</tr>
<tr>
<td>Item 18</td>
<td>2.55</td>
<td>1.62</td>
</tr>
<tr>
<td>Item 19</td>
<td>2.23</td>
<td>1.54</td>
</tr>
</tbody>
</table>

*Note. PNTSPE = psychological needs thwarting scale in physical education; CFA = confirmatory factor analysis*
Table 3

Fit Indices for the Various Measurement Models of PNTSPE in Study 2 and Study 3

<table>
<thead>
<tr>
<th>Model</th>
<th>χ²</th>
<th>df</th>
<th>p</th>
<th>CFI</th>
<th>RMSEA (90%CI)</th>
<th>SRMR</th>
<th>ΔCFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 2 (N = 646)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1=Autonomy F2= Competence F3=Relatedness</td>
<td>123.23</td>
<td>24</td>
<td>.000</td>
<td>.959</td>
<td>.08 (.07-.09)</td>
<td>.040</td>
<td></td>
</tr>
<tr>
<td>F1=Autonomy F2= Competence/Relatedness</td>
<td>497.62</td>
<td>26</td>
<td>.000</td>
<td>.859</td>
<td>.17 (.16-.18)</td>
<td>.095</td>
<td>.100</td>
</tr>
<tr>
<td>F1=Relatedness F2=Autonomy/Competence</td>
<td>313.16</td>
<td>26</td>
<td>.000</td>
<td>.914</td>
<td>.13 (.12-.14)</td>
<td>.060</td>
<td>.045</td>
</tr>
<tr>
<td>F1=Competence F2=Autonomy/Relatedness</td>
<td>665.27</td>
<td>26</td>
<td>.000</td>
<td>.809</td>
<td>.20 (.18-.21)</td>
<td>.105</td>
<td>.150</td>
</tr>
<tr>
<td>F1= Autonomy/Relatedness/Competence</td>
<td>826.11</td>
<td>27</td>
<td>.000</td>
<td>.761</td>
<td>.21 (.20-.23)</td>
<td>.099</td>
<td>.198</td>
</tr>
<tr>
<td>Study 3 (N = 563)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1=Autonomy F2= Competence F3=Relatedness</td>
<td>111.37</td>
<td>24</td>
<td>.000</td>
<td>.961</td>
<td>.08 (.07-.09)</td>
<td>.037</td>
<td></td>
</tr>
<tr>
<td>F1=Autonomy F2= Competence/Relatedness</td>
<td>258.18</td>
<td>26</td>
<td>.000</td>
<td>.895</td>
<td>.13 (.11-.14)</td>
<td>.061</td>
<td>.066</td>
</tr>
<tr>
<td>F1=Relatedness F2=Autonomy/Competence</td>
<td>237.85</td>
<td>26</td>
<td>.000</td>
<td>.905</td>
<td>.12 (.10-.13)</td>
<td>.052</td>
<td>.055</td>
</tr>
<tr>
<td>F1=Competence F2=Autonomy/Relatedness</td>
<td>323.00</td>
<td>26</td>
<td>.000</td>
<td>.866</td>
<td>.14 (.13-.16)</td>
<td>.067</td>
<td>.095</td>
</tr>
<tr>
<td>F1= Autonomy/Relatedness/Competence</td>
<td>400.32</td>
<td>27</td>
<td>.000</td>
<td>.832</td>
<td>.16 (.14-.17)</td>
<td>.074</td>
<td>.129</td>
</tr>
</tbody>
</table>

**Note.** PNTSPE = psychological needs thwarting scale in physical education; F = factor
Table 4

*Fit Indices for the Invariance Testing of PNTSPE Measurement Model across Gender, Grade Levels and Samples*

<table>
<thead>
<tr>
<th></th>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>Model Comparison</th>
<th>$\Delta \chi^2$</th>
<th>$\Delta df$</th>
<th>CFI</th>
<th>RMSEA (90%CI)</th>
<th>SRMR</th>
<th>ΔCFI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender Invariance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(NM = 348; NF = 298)</td>
<td>M0</td>
<td>177.57</td>
<td>48</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>.962</td>
<td>.06 (.05–.07)</td>
<td>.032</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M1</td>
<td>198.17</td>
<td>54</td>
<td>M1 vs M0</td>
<td>20.6**</td>
<td>6</td>
<td>.957</td>
<td>.06 (.05–.07)</td>
<td>.038</td>
<td>.005</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>220.59</td>
<td>60</td>
<td>M2 vs M1</td>
<td>22.42**</td>
<td>6</td>
<td>.951</td>
<td>.06 (.05–.07)</td>
<td>.047</td>
<td>.006</td>
</tr>
<tr>
<td><strong>Grade Level Invariance</strong></td>
<td>M0</td>
<td>328.96</td>
<td>72</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>.910</td>
<td>.077 (.07–.08)</td>
<td>.056</td>
<td></td>
</tr>
<tr>
<td>(NG7 = 226; NG8 = 190; NG9 = 230)</td>
<td>M1</td>
<td>335.04</td>
<td>84</td>
<td>M1 vs M0</td>
<td>6.08</td>
<td>12</td>
<td>.911</td>
<td>.071 (.06–.08)</td>
<td>.057</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>350.42</td>
<td>96</td>
<td>M2 vs M1</td>
<td>15.38</td>
<td>12</td>
<td>.911</td>
<td>.067 (.06–.07)</td>
<td>.058</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Sample Invariance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(NS2 = 646; NS3 = 563)</td>
<td>M0</td>
<td>272.93</td>
<td>48</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>.960</td>
<td>.062 (.05–.07)</td>
<td>.040</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M1</td>
<td>284.46</td>
<td>54</td>
<td>M1 vs M0</td>
<td>11.53</td>
<td>6</td>
<td>.959</td>
<td>.059 (.05–.07)</td>
<td>.042</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>309.74</td>
<td>60</td>
<td>M2 vs M1</td>
<td>25.28**</td>
<td>6</td>
<td>.955</td>
<td>.059 (.05–.07)</td>
<td>.043</td>
<td>.004</td>
</tr>
</tbody>
</table>

*Note.*  **p < .01. M = male; F = female; G7 = grade 7; G8 = grade 8; G9 = grade 9; S2 = study 2; S3 = study 3; PNTSPE = psychological needs thwarting scale in physical education.*
Table 5

*Descriptive Statistics and Correlations among Specific and Global Psychological Needs Thwarting, Subjective Vitality and Negative Affect*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Global Psychological Needs Thwarting</td>
<td>1-7</td>
<td>3.26</td>
<td>1.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Autonomy Thwarting</td>
<td>1-7</td>
<td>3.41</td>
<td>1.44</td>
<td>.85**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Competence Thwarting</td>
<td>1-7</td>
<td>3.55</td>
<td>1.41</td>
<td>.86**</td>
<td>.62**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Relatedness Thwarting</td>
<td>1-7</td>
<td>2.82</td>
<td>1.37</td>
<td>.82**</td>
<td>.53**</td>
<td>.56**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Subjective Vitality</td>
<td>1-7</td>
<td>4.27</td>
<td>1.43</td>
<td>-.32**</td>
<td>-.30**</td>
<td>-.35**</td>
<td>-.16**</td>
<td></td>
</tr>
<tr>
<td>6. Negative Affect</td>
<td>1-5</td>
<td>2.20</td>
<td>.95</td>
<td>.51**</td>
<td>.41**</td>
<td>.46**</td>
<td>.43**</td>
<td>-.33**</td>
</tr>
</tbody>
</table>

*Note.* **p < .01.
Appendix

The Chinese PNTSPE Items and the Corresponding English Translations

<table>
<thead>
<tr>
<th>Item</th>
<th>Chinese</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>我感覚有壓力。</td>
<td>I feel pressured.</td>
</tr>
<tr>
<td>2</td>
<td>我常常不得不做别人讓我做的事。</td>
<td>I frequently have to do what others tell me.</td>
</tr>
<tr>
<td>3</td>
<td>我覺得我沒有機會選擇如何做事。</td>
<td>There is not much opportunity for me to decide for myself how to behave.</td>
</tr>
<tr>
<td>4</td>
<td>我覺得我沒有機會選擇做什麼活動。</td>
<td>I feel prevented from making choices with regard to the activities.</td>
</tr>
<tr>
<td>*5</td>
<td>我經常覺得被迫以指定的方式做事。</td>
<td>I feel pushed to behave in certain ways.</td>
</tr>
<tr>
<td>*6</td>
<td>我經常覺得我要依照別人的要求做事。</td>
<td>I often feel like I have to follow others’ commands.</td>
</tr>
<tr>
<td>*7</td>
<td>我經常覺得被迫做我不想做的事。</td>
<td>I often feel that I am being forced to do things I don’t want to do.</td>
</tr>
<tr>
<td>10</td>
<td>我經常覺得沒有機會展示自己。</td>
<td>I often feel that I do not get much of a chance to express myself.</td>
</tr>
<tr>
<td>8</td>
<td>我經常覺得能力不足。</td>
<td>I often feel incompetent.</td>
</tr>
<tr>
<td>*9</td>
<td>我經常覺得自己力不從心。</td>
<td>I often feel I am inadequate.</td>
</tr>
<tr>
<td>*11</td>
<td>經常會有讓我感到能力不足的情況。</td>
<td>There are situations where I am made to feel inadequate.</td>
</tr>
<tr>
<td>12</td>
<td>我沒有機會發揮我的潛能。</td>
<td>I don’t have opportunities to fulfill my potential.</td>
</tr>
<tr>
<td>13</td>
<td>我無法真正感受我在體育方面的能力。</td>
<td>I can’t really feel competent in sport.</td>
</tr>
<tr>
<td>*14</td>
<td>我懷疑自己是否能夠做出適當表現。</td>
<td>I often doubt whether I am able to execute the tasks properly.</td>
</tr>
<tr>
<td>15</td>
<td>我被周圍的人所排斥。</td>
<td>I feel rejected by those around me.</td>
</tr>
<tr>
<td>*16</td>
<td>我被其他人所輕視。</td>
<td>I feel others are dismissive of me.</td>
</tr>
<tr>
<td>17</td>
<td>我被其他人嫉妒我。</td>
<td>I feel others are jealous of me.</td>
</tr>
<tr>
<td>*18</td>
<td>我被有人不甚喜歡我。</td>
<td>I feel some people do not like me.</td>
</tr>
<tr>
<td>*19</td>
<td>我覺得孤獨。</td>
<td>I feel alone.</td>
</tr>
</tbody>
</table>

Note. The 9 final PNTSPE items are marked with “**”. The items modified from the PNTS are marked with “×”. The overlapped items that both modified from PNTS and identified in qualitative analysis are marked with “#”. The PNTSPE has been developed in traditional Chinese. The English translations of the items have been presented to convey the items meaning. The English version of the PNTSPE has not been validated with English-speaking populations.