

Development and Initial Validation of the Chinese Version of Psychological Needs Thwarting Scale in Physical Education

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2 Scale in Physical Education

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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

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56 Scale in Physical Education

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

78 Previous studies from the physical education context have provided support for the
79 assumption that social factors that foster the satisfaction of the basic psychological needs will
80 result in positive and adaptive outcomes. For instance, it was found that physical education
81 teachers' autonomy support positively predicted students' satisfaction of autonomy,

82 competence, and relatedness (see Standage, Gillison, & Treasure, 2007), students'
83 autonomous motivation toward physical education (e.g., Standage, Duda, & Ntoumanis, 2003,
84 2006; Standage, Gillison, Ntoumanis, & Treasure, 2012), as well as students' subjective
85 vitality and effort in physical education class (e.g., Taylor & Lonsdale, 2010; Vlachopoulos,
86 Katartzi, & Kontou, 2011). However, very limited work within the physical education setting
87 has examined the assumption that social contextual factors that lead to thwarting of basic
88 psychological needs may result in individuals' maladaptation or ill-being.

89 According to Deci and Ryan (2002), SDT not only looks at the brighter side of human
90 existence (i.e., psychological needs satisfaction), but also provides accounts of the darker side
91 of human experiences (i.e. psychological needs thwarting). Recently, Bartholomew,
92 Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) explained the reason why the darker side
93 of human experiences had been widely discussed in theoretical overviews (e.g., Deci & Ryan,
94 2000; Ryan, Deci, Grolnick, & La Guardia, 2006) but seldom studied (Vallerand, Pelletier, &
95 Koestner, 2008). They argued that it was mainly because previous researchers failed to
96 clearly operationalize and accurately assess the construct of psychological needs thwarting.
97 Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) distinguished
98 psychological needs thwarting from psychological needs satisfaction by suggesting that low
99 scores on psychological needs satisfaction may not indicate that needs are thwarted, but may
100 suggest that an individual is unsatisfied with the degree to which needs are being met.
101 Bartholomew and colleagues further conceptualized the psychological needs thwarting as the
102 perception that the three basic psychological needs are being obstructed or actively frustrated
103 within a given context (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). For
104 example, if an individual gives a low score (i.e., 1 or 2), on a 7-point Likert scale (1=strongly
105 disagree; 7= strongly agree), to a psychological needs satisfaction item (e.g., I am free to do
106 physical activities the way I like in my physical education classes), it doesn't necessarily
107 imply that the individual will give a high score (i.e., 5 or 7) to a psychological needs
108 thwarting item (e.g., I feel pushed to do physical activities in certain ways in my physical

109 education classes). A high score on a psychological needs satisfaction item means that the
110 need is satisfied, while a low score on a psychological needs satisfaction item means the need
111 is unsatisfied instead of being thwarted, such as being pushed or coerced. Therefore,
112 psychological needs thwarting should be concerned with an active process and not simply the
113 lack of psychological needs satisfaction (Bartholomew, Ntoumanis, Ryan, &
114 Thøgersen-Ntoumani, 2011).

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

135 School physical education is compulsory for most of elementary and secondary school

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

146 Although the compulsory school curriculum does not inevitably result in controlling
147 environmental atmosphere in classes, many studies have suggested that the controlling
148 agency often is manifested in the curriculum, teacher behavior, school regulations and rules,
149 as well as the assessment system (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Eccles &
150 Midgley, 1989; Sun & Chen, 2010). Some researchers assumed that an over-arching
151 characteristic of school is to control, either overtly or covertly. Therefore, school
152 administrators and teachers are controlling agents and students are controlled because all
153 these agents demand students to behave in certain ways to be successful in school (Sun &
154 Chen, 2010). Some educational psychologists provided explanations for the prevalence of
155 teachers' controlling teaching style in the classroom (e.g., Reeve, 2009) and suggested that
156 there were several forces that influence teachers' formation of controlling styles during
157 instruction. For example, some influences come from outside agents, such as school policies,
158 administrators, parents, societal expectations, or cultural norms; some influences may arise
159 out of the classroom dynamics, such as interactions between teacher and students (what
160 students say, do, and do not do during instruction); some other influences may be because of
161 the characteristics of the teacher himself or herself, such as personality and beliefs (Deci,
162 Speigel, Ryan, Koestner, & Kauffman, 1982; Deci, Schwartz, Sheinman, & Ryan, 1981; Ryan

163 & Deci, 2000; Reeve, 2009). Physical education, as a subject in the school curriculum, shares
164 the similar characteristics with other subjects (Sun & Chen, 2010).

165 Regardless of the reasons that lead to the teachers' adoption of controlling styles in their
166 classes or during instruction, previous research has widely reported that controlling teaching
167 is significantly related to negative emotions (e.g., anger, anxiety, boredom, stress),
168 maladaptive forms of motivations (e.g., amotivation, controlled motivation), restricted
169 engagement, and poor academic achievement (Assor & Kaplan, 2001; Assor et al., 2005;
170 Deci, Ryan, & Williams, 1996; Soenens, Sierens, Vansteenkiste, Dochy, & Goossens, 2012;
171 Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005). Therefore, it is important to further
172 examine how teachers' controlling teaching affects students' learning outcomes, especially
173 the negative ones.

174 Bartholomew et al. (2014) suggested that direct assessments of psychological needs
175 thwarting should be used when negative experiences (e.g., ill-being and other maladaptive
176 outcomes) are the interests of the study. Given the controlling nature of institutionalized
177 schooling (Sun & Chen, 2010), to develop a more desirable and reasonable physical
178 education environment for students, it is important for researchers and practitioners to better
179 understand how physical education teachers' teaching behaviors affect their students
180 experiences, especially the negative ones. Although plenty of studies in physical education
181 have investigated students' psychological needs satisfaction and adaptive outcomes, limited
182 research has looked at students' psychological needs thwarting and negative experiences.
183 This is primarily due to the lack of relevant valid and reliable measures. To the best of our
184 knowledge, the only available psychometrically sound psychological needs thwarting
185 measure is the PNTS (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011),
186 which consists of 12 items and measures three subscales, namely, autonomy thwarting (4
187 items), competence thwarting (4 items) and relatedness thwarting (4 items), using a 7-point
188 Likert scale in the scoring. It has been demonstrated that the specific measure produces valid
189 and reliable scores in a series of studies (Bartholomew, Ntoumanis, Ryan, &

190 Thøgersen-Ntoumani, 2011). The PNTS has been recently modified to measure the
191 psychological needs thwarting in other fields, such as exercise (Gunnell, Crocker, Wilson,
192 Mack, & Zumbo, 2013) and general life (Bateman, 2011). Although the modified scales have
193 been reported to produce reliable scores, the factor structure has been found problematic in
194 some studies with very high interfactor correlations (e.g., ranging from .85 to .96; Gunnell et
195 al., 2013). These findings imply that the modified or revised scales from sport settings may
196 not function well in other fields, such as exercise or physical education contexts. It is
197 imperative to develop psychometrically sound domain-specific measures so that the studies
198 related to individuals' negative experiences in specific fields could be further investigated.

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

209 Study 1

210 Methods

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

217 34.86; $SD = 6.89$), with teaching experience ranging from 1 to 15 years ($M = 5$; $SD = 4.69$).
218 Three academic experts who have published SDT-based researches were also consulted to
219 review the content validity of the items from a theoretical perspective.

220 **Procedures.** Ethical approval was obtained from a local university's human and animal
221 research ethics committee. To generate the pool of PNTSPE items, some items from the
222 established instrument (PNTS; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani,
223 2011) were used as reference. Eleven items (3 autonomy items, 4 competence items, and 4
224 relatedness items) from the PNTS were identified and modified to physical education
225 contexts to form the candidate items of the initial items pool of the PNTSPE. All modified
226 items were translated into Chinese using the translation and back-translation strategy. Two
227 bilingual translators with doctoral degrees (in physical education and psychology,
228 respectively) translated the items independently from English into Chinese. Consensus was
229 obtained through discussion to form a preliminary Chinese version, which was then
230 independently translated back to English by two other translators. Comparison of the back
231 translated English version with the original English version revealed that the meaning of the
232 items was identical.

233 Twenty-three of the 49 students were invited to complete a set of questions (example
234 questions: please describe your experience of competence in your physical education classes;
235 please think about some conditions that make you feel NOT competent and effective during
236 physical education), and then take part in a set of focus groups to explore their experiences of
237 psychological needs thwarting in physical education classes (the outline of the questions is
238 available from the first author upon request). The focus groups were audiotaped and then
239 transcribed verbatim. The qualitative data collected from the open-ended questions and the
240 focus groups were qualitatively analyzed using content analysis. Sixteen draft items were
241 generated. When combining the draft items from qualitative analysis and those modified from
242 the existing instrument, it was found that there was some overlap between the two sets of
243 items. Eight items (2 autonomy items, 3 relatedness items, and 3 competence items) that were

244 modified from the PNST were also frequently mentioned by students (see Appendix). After
245 removing the overlapped items, an initial pool of items (19 items representing three subscales:
246 8 autonomy items, 6 competence items, and 5 relatedness items) for the PNTSPE was
247 established.

248 The 19 items were presented to other 26 students and seven physical education teachers
249 to ask them to indicate whether the items were *applicable* or *inapplicable* using a
250 dichotomous scale before the focus groups. Items which were perceived as inapplicable by
251 75% or more of the students and the PE teachers were deleted (see Bartholomew et al., 2011).
252 For items perceived as applicable, students were further asked to rate their clarity using a
253 7-point Likert scale (1 = not at all clear; 7 = extremely clear). Items rated lower than 5 were
254 classified as problematic. In the focus groups, the 26 students were encouraged to suggest
255 additional items or alternative wordings for items that were rated as problematic. The data
256 collected from the second set of focus groups were qualitatively analyzed to complement and
257 refine the generated items. No new additional items were generated.

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

266 **Results of Study 1**

267 Nineteen PNTSPE items (see Appendix) were initially developed based on the existing
268 instrument and the results of the focus groups with the students. Two items (items 8 and 12)
269 classified as inapplicable to physical education context were removed. The remaining 17
270 items were then reviewed by the three judges. The CVI was computed by dividing the

271 number of judges who gave a rating of 3 or 4 (quite relevant or highly relevant to the needs
272 thwarting construct) by 3, the number of judges. According to Polit, Beck, and Owen (2007),
273 when there are three judges, CVIs equal to 1.00 are considered to be excellent, whereas CVIs
274 equal to .67 are considered to be fair. Two items (items 2 and 13) displayed CVIs of .67
275 without modification suggestions from the judges and were deleted. Two items (items 10 and
276 17) displayed CVIs of .67 with modification suggestions and were revised and then retained.
277 Upon completion of this development process, a pool of 15 items for PNTSPE (7 autonomy
278 items, 3 competence items, 5 relatedness items) was established.

279 **Study 2**

280 **Method**

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

286 **Procedures.** Ethical approval was obtained from a local university's human and animal
287 research ethic committee. Secondary school principals were contacted and were provided
288 information about the study to obtain the permission to access their students. With this
289 approval, informed written consent was obtained from the teachers who were asked to act in
290 *loco parentis* and from the students who participated in the study. The students were informed
291 that the survey was voluntary and that they had the right to withdraw at any time from the
292 study. To prevent social desirability effects, the students were told that the study aimed to
293 investigate their true feelings and general experiences in physical education classes, and there
294 were no right or wrong answers. The students were asked to complete the questionnaires in a
295 quiet classroom under the supervision of two well-trained research assistants, without the
296 presence of their teachers. The students were also told that it was an anonymous survey, and
297 that all of the information they provided would be absolutely confidential; it was further

298 explained that their physical education teachers would not be able to access their responses.

299 **Measures.** Participants were required to answer the 15-item PNTSPE (7 autonomy
300 items, 3 competence items, 5 relatedness items). At the beginning of the questionnaire,
301 written instructions requested that the students consider their general experiences in physical
302 education classes, and indicate how much they agree or disagree with each statement on a
303 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The scores of
304 subscales were calculated by averaging the scores of all items of each subscale. The global
305 psychological needs thwarting score was calculated by averaging the scores of all subscales.

306 **Data analysis.** Due to the fact that the students in this study were nested within 22
307 classes, intraclass correlations (ICCs) for the 15 PNTSPE items were calculated to estimate
308 the “class-level” effects (Kline, 2011). The ICCs of 13 items were found less than .10 (ranged
309 from .021 to .094) while the ICCs of 2 items were higher than .10 (item 4 = .125 and item 15
310 = .134). Therefore, we treated the data as a whole and didn’t take the between-class variances
311 into consideration in the subsequent analyses.

312 The use of Exploratory Factor Analysis (EFA) is advocated during the early stages of
313 scale development to avoid misspecification of the number of factors, and to maximize the
314 convergent and discriminant validity of the items constituting each factor (Hurley et al.,
315 1997). However, when there is a strong theoretical base for the hypothesized model, the use
316 of Confirmatory Factor Analysis (CFA) could be advocated (Hurley et al., 1997). In this
317 study, although we have strong theoretical support for our hypothesized model, we employed
318 EFA in the early stage for the purpose of maximizing the convergent and discriminant
319 validity of the items. Thus, EFA was conducted on the PNTSPE items using SPSS 18.0. The
320 principal axis factor analyses were carried out with a direct oblimin rotation since it is
321 hypothesized that the three basic psychological needs would be interrelated. Factor extraction
322 was based on an eigenvalue of > 1.0 and a confirmatory inspection of the scree plot. In terms
323 of interpreting the extracted factors, factor-loadings of .40 and above were considered
324 satisfactory (Hinkin, 1995). In this study, all items with primary factor-loadings of $< .40$, and

325 all items with high cross-loadings (i.e., secondary loadings > .30), were deleted.

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

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

339 **Results of Study 2**

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

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

352 < .001) indicated that the data violated the assumption of multivariate normality.
353 Subsequently, in following the recommendations of Byrne (2010), all CFAs were conducted
354 using maximum-likelihood estimation coupled with bootstrapping procedures. According to
355 the recommendations of Preacher and Hayes (2008), this study used 5,000 bootstrap samples,
356 with replacement based on the original sample.

357 Results of the initial CFA indicated room for improvement: $\chi^2(51) = 374.28, p < .001$;
358 CFI = .934; SRMR = .048; RMSEA = .10 (90% CI: .09 – .11). We inspected the modification
359 indices and standardized residual matrix, and found that one item (item 3) cross-loaded onto
360 unintended factors and the residuals of three items (items 3, 4, and 15) associated with
361 multiple standardized residuals exceeding ± 2.00 . Excluding these three items much
362 improved the fit of the model to the data: $\chi^2(24) = 123.23, p < .001$; CFI = .959; SRMR = .04;
363 RMSEA = .08 (90% CI: .07 – .09). Further examination of the modification indices and
364 standardized residuals of this solution revealed no further factorially complex items. The
365 PNTSPE comprised of three 3-item subscales, representing students' perceived thwarting of
366 the need for autonomy, competence and relatedness. The correlations between the three
367 subscales were $r_{relatedness-competence} = .768$, $r_{autonomy-competence} = .692$, and $r_{relatedness-autonomy}$
368 $= .615$. The fully-standardized item-loadings ranged from .720 to .894, with an average
369 loading of .805. All three subscales demonstrated good internal consistency reliabilities, with
370 CR values ranging from .796 to .904, alpha coefficients ranging from .797 to .903 and AVE
371 values ranging from .566 to .757. Table 2 displays item means, standard deviations,
372 standardized factor-loadings, standardized error, and squared multiple correlations for this
373 solution, CR values, Cronbach's alpha coefficients, as well as AVE of the PNTSPE
374 subscales.

375 **Discriminant validity.** The hypothesized three-factor structure of PNTSPE was
376 compared with three different two-factor models in which two needs were taken together and
377 contrasted with the remaining need, and a one-factor model in which all three needs were
378 combined together (see Table 3). Results revealed that the hypothesized three-factor model

379 fitted the data best compared with any other model. This finding suggests that the three needs
380 of PNTSPE represent distinct constructs, which provided support for the discriminant validity
381 of the newly-developed PNTSPE.

382 **Invariance testing across gender and grade level.** A sequential model testing
383 approach was employed via multiple-group CFA to examine whether the PNTSPE
384 measurement model displayed invariance across gender and grade levels. A baseline model
385 (M0: unconstrained model) was established first, and then two increasingly-constrained
386 models were specified to examine the equality of measurement (M1: Factor-loadings were
387 constrained to be equal) and structural parameters (M2: Factor-loadings, factor variances and
388 covariances were constrained to be equal) across gender as well as grade levels. The
389 invariance of error variances and covariances was not investigated in this study because it is
390 widely considered to be excessively stringent and, therefore, is rarely implemented (Byrne,
391 2010). Both chi-square differences test ($\Delta\chi^2$; Marsh, 1987) and change in the value of the CFI
392 (Δ CFI; Cheung & Rensvold, 2002) were used in this study to evaluate the model fit. Due to
393 the fact that the likelihood ratio (chi-square difference test) is sensitive to nonnormality and is
394 influenced by sample size, the conclusion of invariance analysis in this study was reached
395 based on the change in the CFI test when there was inconsistency between the two tests (see
396 Chen, Sousa, & West, 2005). A decrease in CFI smaller than .01 from one model to the next
397 was taken as indicative of invariance (Cheung & Rensvold, 2002).

398 Table 4 displays the goodness-of-fit indices for the gender and grade level invariance
399 analysis of the PNTSPE measurement model. For the gender invariance analysis, although
400 the chi-square difference test between M1 and M0 was significant, $\Delta\chi^2$ ($\Delta df = 6$) = 20.6, p
401 < .01, there was no substantial change in the CFI value (Δ CFI = .005). Therefore, we
402 concluded that the factor loadings of PNTSPE measurement model were invariant across
403 gender. Furthermore, the chi-square difference test between M2 and M1 was significant, $\Delta\chi^2$
404 ($\Delta df = 6$) = 22.42, p < .01, but there was no substantial change in the CFI value (Δ CFI
405 = .006). This finding suggested that the factor variances and covariances were also invariant

406 across gender. For the grade level invariance analysis, the chi-square difference test between
407 M1 and M0 was not significant, $\Delta\chi^2 (\Delta df = 12) = 6.08, p < .01$, and no substantial change in
408 the CFI value ($\Delta CFI = .001$) was found either. Therefore, we concluded that the factor
409 loadings of PNTSPE measurement model were invariant across grade levels. The chi-square
410 difference test between M2 and M1 was non-significant, $\Delta\chi^2 (\Delta df = 12) = 15.38, p < .01$, and
411 there was no substantial change in the CFI value. This finding suggested that the factor
412 variances and covariances were also invariant across grade levels.

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

419 **Study 3**

420 **Method**

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

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

431 A six-item version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) was
432 employed to measure students' feelings of positive energy. Responses were provided on a

433 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). A previous study
434 has provided support for the application of the scale among secondary school students in
435 Hong Kong (i.e. Taylor & Lonsdale, 2010). The scale demonstrated acceptable factorial
436 validity ($\chi^2_{(9)} = 43.24, p < .001, CFI = .98, SRMR = .04, RMSEA = .08$ [90% CI: .06 – .10])
437 and internal consistency reliability (CR = .87) in the current study.

438 A five-item Negative Affect Subscale from the International Positive and Negative
439 Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007) was used to measure students'
440 negative affect in this study. Responses were provided on a 5-point Likert scale ranging from
441 1 (*never*) to 5 (*always*). Previous studies have provided support for the validity and reliability
442 of the scale among Chinese populations (e.g., Chung & Liu, 2012; Thompson, 2007). The
443 scale demonstrated an acceptable factorial validity ($\chi^2_{(5)} = 45.24, p < .001, CFI = .94, SRMR$
444 $= .08, RMSEA = .10$ [90% CI: .09 – .12]) and internal consistency reliability (CR = .85) in the
445 current study.

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

456 **Results of Study 3**

457 **Factorial validity and internal consistency reliability.** The 9-item three-factor
458 structure of PNTSPE from Study 2 was examined via CFA using AMOS 18.0. Examination
459 of Mardia's coefficient (59.16, $p < .001$) indicated that the data violated the assumption of

460 multivariate normality. Subsequently, all CFAs were conducted using maximum-likelihood
 461 estimation coupled with bootstrapping procedures (i.e. 5000 bootstrap samples). The model
 462 displayed a good fit to the data, $\chi^2(24) = 111.37$, $p < .001$, CFI = .961, SRMR = .04, RMSEA
 463 = .08 (90% CI: .07–.09). The correlations between the three subscales were $r_{relatedness-competence}$
 464 = .716, $r_{autonomy-competence} = .762$, and $r_{relatedness-autonomy} = .646$, respectively. All three
 465 subscales demonstrated good internal consistency reliabilities, with CR values ranging
 466 from .789 to .820, alpha coefficients ranging from .787 to .812 and AVE values ranging
 467 from .555 to .605. These findings provided support for the factorial validity and internal
 468 consistency reliability of the PNTSPE. Table 2 displays standardized factor-loadings, item
 469 means, standard deviation, standard error, squared multiple correlation, CR values,
 470 Cronbach's alphas, and AVE of the PNTSPE subscales.

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

478 **Nomological validity.** According to SDT, the thwarting of psychological needs will
 479 result in negative experiences (e.g., psychological ill-being; Deci & Ryan, 2002). A previous
 480 study within a sport setting has revealed that both specific and global psychological needs
 481 thwarting were positively correlated (moderate-to-high) with negative affect (Bartholomew,
 482 Ntoumanis, Ryan, Bosch et al., 2011). Moreover, it was also found that the psychological
 483 needs thwarting was negatively correlated (low-to-moderate) with subjective vitality.
 484 Therefore, the nomological validity was evaluated by examining the relationships between
 485 the psychological needs thwarting (both specific and global) and negative affect and
 486 subjective vitality. Table 5 displays the descriptive statistics and correlations among the

487 variables. As hypothesized, moderate positive correlation between the psychological needs
488 thwarting and negative affect, and low-to-moderate negative correlation between the
489 psychological needs thwarting and subjective vitality were found in this study. These findings
490 provided support for the nomological validity of the PNTSPE.

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

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

510 In summary, the Study 3 replicated the findings of Study 2 and provided support for the
511 factorial validity, internal consistency reliability and discriminant validity of the 9-item
512 PNTSPE with an independent sample. Invariance analysis suggested that the measurement
513 model of the PNTSPE was invariant across sample. Further, results of the study also

514 suggested that the nomological validity and test-retest reliability of the scores derived from
515 the 9-item PNTSPE were satisfactory.

516 **General Discussion**

517 The tenets of SDT have been widely examined in various domains, including physical
518 education (e.g., Aelterman, Vansteenkiste, Van Keer, Van den Berghe, De Meyer, & Haerens,
519 2012; Cox & William, 2008; Rutten, Boen, & Seghers, 2012; Shen, Sun, & Rukavina, 2010;
520 Standage et al., 2012; Taylor & Lonsdale, 2010). However, previous related studies mainly
521 focused on the psychological needs satisfaction, which is related to the brighter side of
522 human experience. The psychological needs thwarting, which is thought to be related to the
523 darker side of human experience, has not been given enough attention. The main reason may
524 have been the lack of a valid and reliable measure that could be used for tapping students'
525 psychological needs thwarting. Therefore, the purpose of the current study was to develop
526 and validate a questionnaire measure for assessing the psychological needs thwarting of
527 secondary school students in a physical education context.

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

537 There are several advantages of the newly developed PNTSPE. First, the development of
538 the PNTSPE makes it possible for researchers and practitioners in future studies to directly
539 assess secondary school students' psychological needs thwarting in a physical education
540 context. A previous study within a sport setting revealed a small negative correlation between

541 psychological needs thwarting and psychological needs satisfaction, which suggested that
542 psychological needs thwarting and psychological needs satisfaction were independent
543 constructs (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). Investigation on
544 the relationship between the constructs in physical education contexts will contribute to
545 further understanding of the basic psychological needs within the SDT framework. Second, it
546 allows researchers and practitioners to further investigate students' psychological needs
547 thwarting in relation to teachers' teaching behaviors in physical education classes. This kind
548 of investigations will provide researchers and practitioners useful information to better
549 understand the prevalence of students' negative experiences (i.e., amotivation, stress) in
550 physical education classes. Finally, the PNTSPE could be used in future studies as an
551 indicator of physical education teachers' need thwarting behaviors, which may be further
552 used as alternative strategies to evaluate physical education teachers' teaching.

553 Although our findings of a series of studies provided promising evidence for the
554 psychometric properties of the scores derived from the PNTSPE, questionnaire validation is
555 an on-going process, and thus, further development and validation of the measure is needed.
556 With this in mind, future research may involve further investigation of the SDT based
557 psychological needs thwarting assessment in a physical education context. For example, a
558 cross-sectional validation was used to examine the nomological validity of the PNTSPE in
559 the current study, and therefore, other methods such as longitudinal, cross-lagged or
560 experimental designs are suggested to be used to further examine the nomological validity of
561 the PNTSPE. Furthermore, only relationships between psychological needs thwarting and
562 their consequent variables (subjective vitality and negative affect) were examined. Other
563 relationships between psychological needs thwarting and both their antecedences (e.g., need
564 thwarting behaviors) and consequences (e.g., amotivation, dropout of PE, and anxiety in PE
565 class) should be further examined. Moreover, the PNTSPE measurement model was found
566 invariant across students in grades 7 to 9; future studies should examine whether the
567 measurement model is invariant across other higher or lower grades, such as senior secondary

568 school student or elementary school students. In addition, the participants in this study were
569 Chinese secondary school students in Hong Kong. Future studies are encouraged to examine
570 the psychometric properties of the measure among or across Chinese secondary school
571 students in other Chinese societies, such as Mainland China, Taiwan and Macau. Finally, the
572 PNTSPE was developed in the Chinese language (traditional Chinese), and therefore, future
573 studies are expected to validate the measure in other languages, such as simplified Chinese
574 and English. Psychological needs thwarting is a very interesting issue that warrants future
575 cross-cultural investigations.

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

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Table 1

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

PNTSPE Item	EFA 1			EFA2		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Autonomy						
Item 5	.898	.013	.017	.900	.013	.037
Item 6	.852	.120	.096	.852	.117	.112
Item 7	.849	.036	.034	.853	.076	.064
Item 4	.772	.131	.066	.728	.135	.021
Item 3	.686	.039	.154	.655	.077	.139
Item 10	.539	.330	.068	-	-	-
Item 1	.345	.109	.333	-	-	-
Relatedness						
Item 15	.133	.661	.235	.099	.609	.240
Item 18	.138	.748	.107	.170	.752	.126
Item 19	.019	.797	.037	.038	.786	.019
Item 16	.013	.744	.095	.017	.732	.136
Item 17	.103	.326	.105	-	-	-
Competence						
Item 9	.021	.255	.752	.016	.204	.702
Item 14	.285	.062	.447	.293	.049	.503
Item 11	.259	.098	.426	.297	.080	.475

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 (α) and Average Variance Extracted (AVE) of PNTSPE

PNTSPE items	CFA of Study 2 (N = 646)								CFA of Study 3 (N = 563)							
	M	SD	FL	SE	SMC	CR	α	AVE	M	SD	FL	SE	SMC	CR	α	AVE
Autonomy						.904	.903	.757						.820	.812	.605
Item 5	3.01	1.77	.894	.017	.799				3.39	1.69	.850	.021	.723			
Item 6	3.31	1.74	.833	.020	.694				3.65	1.63	.676	.038	.458			
Item 7	2.94	1.85	.883	.016	.780				3.19	1.73	.796	.030	.634			
Competence						.796	.797	.566						.794	.796	.563
Item 9	3.05	1.57	.720	.032	.519				3.46	1.66	.731	.034	.534			
Item 11	3.10	1.66	.766	.034	.586				3.51	1.60	.817	.027	.668			
Item 14	3.27	1.66	.771	.027	.594				3.69	1.67	.698	.040	.487			
Relatedness						.835	.834	.627						.789	.787	.555
Item 16	2.52	1.49	.774	.033	.599				2.90	1.57	.764	.032	.584			
Item 18	2.55	1.62	.798	.031	.637				2.85	1.61	.757	.037	.574			
Item 19	2.23	1.54	.805	.030	.647				2.74	1.71	.713	.040	.508			

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

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

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

	Model	χ^2	<i>df</i>	Model Comparison	$\Delta \chi^2$	Δdf	CFI	RMSEA (90%CI)	SRMR	ΔCFI
Gender Invariance ($N_M = 348$; $N_F = 298$)	M0	177.57	48	–	–	–	.962	.06(.05–.07)	.032	
	M1	198.17	54	M1 vs M0	20.6**	6	.957	.06 (.05–.07)	.038	.005
	M2	220.59	60	M2 vs M1	22.42**	6	.951	.06 (.05–.07)	.047	.006
Grade Level Invariance ($N_{G7} = 226$; $N_{G8} = 190$; $N_{G9} = 230$)	M0	328.96	72		–	–	.910	.077 (.07–.08)	.056	
	M1	335.04	84	M1 vs M0	6.08	12	.911	.071 (.06–.08)	.057	.001
	M2	350.42	96	M2 vs M1	15.38	12	.911	.067 (.06–.07)	.058	.000
Sample Invariance ($N_{S2} = 646$; $N_{S3} = 563$)	M0	272.93	48		–	–	.960	.062 (.05–.07)	.040	
	M1	284.46	54	M1 vs M0	11.53	6	.959	.059 (.05–.07)	.042	.001
	M2	309.74	60	M2 vs M1	25.28**	6	.955	.059 (.05–.07)	.043	.004

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

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

Note. ** $p < .01$.

Appendix

The Chinese PNTSPE Items and the Corresponding English Translations

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

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.