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The Basic Psychological Needs in Exercise Scale: Translation and Evidence for Cross-Cultural Validity

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Abstract

The present study reports on the psychometric evaluation and cross-cultural validity of the Basic Psychological Needs in Exercise Scale (BPNES; Vlachopoulos & Michailidou, 2006) translated from Greek into English. The data obtained from 346 British exercise participants supported the hypothesized 3-factor structure, showed satisfactory internal reliability coefficients, and offered evidence for the factor concurrent, discriminant, and nomological validity of the translated scale. Cross-cultural validity analyses across British and Greek participants supported configural invariance and partial metric, partial strong, and partial strict factorial invariance of the BPNES responses. The findings provide promising evidence for the validity and reliability of the translated BPNES and support the use of the scale in single-culture and cross-culture exercise-related motivational research within the self-determination theory framework.

Key words: Self-determination theory, psychological need satisfaction, cross-cultural equivalence, multi-group confirmatory factor analysis, physical activity

The numerous physical (Bouchard, Shephard, & Stephens, 1994) and psychological health benefits (Biddle, Fox, & Boutcher, 2000) associated with regular exercise participation, in combination with the documented low rates of exercise involvement in the U.S. and other developed countries (e.g., see Pleis & Lethbridge-Cejku, 2006), have spurred research efforts to better understand how to maximize exercise participation and adherence. To this end, research has used theories of motivation and behavior change to understand individuals' decisions to exercise or withdraw from exercise programs. One of these theories, which has lately attracted considerable interest in the exercise domain, is the Self-Determination Theory (SDT; Ryan & Deci, 2002). This theory posits the existence of three universal, innate, and nonhierarchical psychological needs, the

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fulfillment of which leads to optimal behavior and psychological well-being. According to Ryan and Deci (2002), the need for *autonomy* reflects feeling a sense of volition and self-endorsement in one's behavior. The need for *competence* refers to the need to interact effectively with one's environment and to experience opportunities for expressing or developing one's capacities. The need for *relatedness* refers to situations where individuals feel that they are authentically associated with significant others and experience a sense of belonging.

In line with the SDT, the satisfaction of these needs results in higher levels of behavioral self-determination; that is, behavior emanating from the individuals' true self. Further, psychological needs operate as mediators of the effects of socio-contextual factors (e.g., fitness instructors' autonomy-supportive behaviors) on levels of behavioral self-determination (Vallerand, 2001). Greater self-determination is reflected by high levels of intrinsic motivation (e.g., finding exercise enjoyable), identified regulation (e.g., considering exercise outcomes to be personally important), and lower levels of amotivation (e.g., absence of motivation to exercise/continue exercising), external regulation (e.g., exercising owing to external pressures or to obtain rewards), and introjected regulation (e.g., exercising to avoid internal pressure and negative feelings and to support conditional self-worth). Greater self-determination in turn leads to more positive cognitive (e.g., concentration), affective (e.g., exercise enjoyment), and behavioral (e.g., frequent exercise participation) motivational outcomes (Vallerand, 2001).

Considerable evidence has supported the propositions of SDT concerning the positive effects of need fulfillment on psychological well-being and behavior (Sheldon & Filak, 2008; Vansteenkiste, et al., 2007). In the exercise domain, research has demonstrated the positive relationship of psychological need fulfillment within life satisfaction among overweight and obese exercise participants (Edmunds, Ntoumanis, & Duda, 2007). Further, research has demonstrated positive relationships between the three psychological needs and exercise behavior using cross-sectional (Edmunds, Ntoumanis, & Duda, 2006) and prospective designs (Vlachopoulos & Neikou, 2007). In the exercise domain, researchers have often measured psychological need satisfaction by adapting a wide variety of scales developed for other domains. Efforts to study the effects of psychological need fulfillment using scales specifically developed and validated in the exercise domain led to the development of instruments such as the Basic Psychological Needs in Exercise Scale (BPNES; Vlachopoulos & Michailidou, 2006) and the Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson, et al., 2006). The PNSE is an 18-item scale with six items per need factor. Wilson and colleagues demonstrated for the PNSE adequate factor structure through confirmatory factor analysis, strong internal consistency, and convergent validity with proxy measures. The BPNES was developed for Greek-speaking exercise participants, whereas the PNSE was constructed for English-speaking exercisers.

Duda and Allison (1990) have argued that investigations in sport and exercise psychology that do not incorporate cross-cultural analyses run contrary to the very essence of scientific inquiry. Lack of cross-cultural research may result in theoretical frameworks that are likely to be misleading in their presumed generalizability as culture and ethnicity

may be important explanatory variables in psychological theories of cognitions, affect, and behavior in the sport/exercise domain (Duda & Allison, 1990). Given that the majority of the SDT exercise-related research has been conducted with English-speaking populations, the availability of the BPNES provides an opportunity to explore the cross-cultural equivalence of the constructs of the psychological needs posited by SDT in the exercise domain. Cross-cultural comparisons in psychological research aiming to test the equivalence of research instruments across cultural groups are imperative prerequisites for testing the cross-cultural applicability of theories and models (Sue, 1999). Thus, the primary purpose of this study was to examine the extent of the equivalence of the psychometric properties of the BPNES scores across the original and a translated (into English) version of the scale.

Before embarking on such cross-cultural comparisons, it was important to evaluate in detail the psychometric properties of the translated BPNES. Therefore, the aims of the study were to examine the scale's factorial validity by investigating whether the BPNES responses would fit a 3-correlated factor (i.e., autonomy, competence, and relatedness) model tested via Confirmatory Factor Analysis (CFA). CFA may be applied to test the validity of the factorial structure of an assessment measure or, put differently, to determine the extent to which items constructed to measure a particular factor actually do so (Byrne, 2006).

The study also aimed to examine the discriminant validity of the scale (i.e. the degree to which measures of different variables of the scale are unique from each other) by looking at whether the 95% confidence intervals around factor correlation coefficients included or did not include the value of 1 (Bagozzi, 1981). The latter case would offer evidence for discriminant validity.

It also aimed to investigate the scale's internal reliability by examining whether, for each BPNES subscale, an alpha value (Cronbach, 1951) greater than .70, a composite reliability value greater than .60 (Bagozzi & Yi, 1988), and an average variance extracted (AVE) value greater than .50 (Fornell & Larcker, 1981) would emerge.

The study also examined the concurrent validity of the translated BPNES by looking at whether the Pearson's correlations between the homonymous subscales of the translated BPNES and the PNSE (e.g., BPNES-competence / PNSE-competence) are greater than the correlations involving heteronymous subscales of the instruments (e.g., BPNES-competence / PNSE – relatedness).

The study also aimed to investigate the nomological validity (i.e., the extent to which predictions derived from a theoretical framework describing this construct are in fact confirmed; (Cronbach & Meehl, 1955; Li, 1999) of the translated BPNES by looking at whether the psychological need constructs would mediate the relationship between perceived autonomy support and relative self-determination for exercise (relative autonomy index; Markland & Ingledew, 2007). In addition, positive correlations between the BPNES subscales and the variables of perceived autonomy support (PAS); behavioral regulations for exercise and relative autonomy index (RAI); subjective vitality; and frequency of mild, moderate, strenuous, and total exercise behavior would provide further support for the nomological validity of the translated BPNES.

Finally, it examined the cross-cultural validity of the scale by investigating whether measurement invariance of the BPNES responses would be achieved across the Greek-speaking and English-speaking samples of exercise participants through multi-group CFA.

Method

Participants

Two samples of exercise participants—comprising a sample of 346 English-speaking participants from Great Britain and a sample of 504 Greek-speaking participants from Greece—were included in the study. The British sample comprised of 270 women (78%) and 76 men (22%) between the ages of 18 and 69 years (M = 29.40, SD = 10.91). The Greek sample (n = 504) represents the validation sample employed by Vlachopoulos and Michailidou (2006) with 246 male (48.8%) and 258 female (51.2%) exercise participants between the ages of 18 and 65 years (M = 28.92, SD = 8.45).

Measures

Psychological need satisfaction. The BPNES (Vlachopoulos & Michailidou, 2006; see Appendix) was used to assess the extent to which the psychological needs of the participants from the two samples were fulfilled in organized exercise settings. The scale comprises 12 items divided into three subscales, with four items per subscale, to assess autonomy (e.g., "The way I exercise is in agreement with my choices and interests"), competence (e.g., "I feel I perform successfully the activities of my exercise programme"), and relatedness (e.g., "My relationships with the people I exercise with are close"). Responses were provided on a 5-point Likert scale ranging from 1 (*I don't agree at all*) to 5 (*I completely agree*). Evidence for the validity and reliability of the scale has been presented with Greek-speaking exercise participants (Vlachopoulos, 2007, 2008; Vlachopoulos & Michailidou, 2006; Vlachopoulos & Neikou, 2007). Psychological need satisfaction among English-speaking exercise participants was additionally assessed via the PNSE (Wilson et al., 2006), which is comprised of 18 items (six items per need subscale). Sample items include, "I feel free to exercise in my own way" (autonomy), "I feel capable of completing exercises that are challenging to me" (competence), and "I feel attached to my exercise companions because they accept me for who I am" (relatedness). Responses were provided to each item via a 6-point scale ranging from 1 (*false*) to 6 (*true*). Wilson and colleagues (2006) have offered evidence for the validity and reliability of the PNSE. This scale was employed for the concurrent validity assessment of the translated BPNES scale.

Perceived autonomy support. Perceptions of autonomy support (PAS) provided by the exercise class leader were assessed via a short (6-item) version of the Health Care Climate Questionnaire (HCCQ; Williams, et al., 1996). This version was adapted to exercise settings by Edmunds and colleagues (2006) and includes items such as "I feel that my exercise class leader provides me choices and options." Responses were provided on

a 7-point Likert scale ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*). The short version of the scale was used to reduce the burden on respondents, owing to the large number of questionnaires administered. Edmunds and colleagues (2007) have reported Cronbach's alpha coefficients above .90 for this short version.

Behavioral regulations in exercise. Levels of self-determination for exercise were assessed using the Behavioural Regulation in Exercise Questionnaire–2 (BREQ–2; Markland & Tobin, 2004). The BREQ–2 assesses amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation. Following the stem "why do you exercise?" respondents indicated their agreement with each of the 19 items of the questionnaire using a response scale ranging from 0 (*not true for me*) to 4 (*very true for me*). Markland and Tobin (2004) have offered evidence for the validity and reliability of the BREQ–2. A relative autonomy index (RAI) was calculated to reflect levels of self-determination. Each subscale was differentially weighted, and the weighted scores were summed to create the RAI. The weights applied to each regulation were as follow: amotivation –3; external regulation –2; introjected regulation –1; identified regulation +2; intrinsic regulation +3 (Markland & Ingledew, 2007). Higher RAI positive scores reflect more self-determined motivation whereas negative scores indicate less self-determined motivation. The highest possible score using this formula with the BREQ–2 is 20, whereas the lowest possible score is –24 (Markland & Ingledew, 2007).

Subjective vitality. Subjective vitality was assessed through the individual differences version of the Subjective Vitality Scale (Ryan & Frederick, 1997). This scale reflects eudaemonic well-being; for example, feeling alive and alert and having energy available to the self (e.g., "I feel alive and vital" and "I have energy and spirit"). The scale is unidimensional and consists of seven items. Item 2 was eliminated in the present study to improve the scale's effectiveness (Bostic, Rubio, & Hood, 2000). Responses were provided on a 7-point Likert scale ranging from 1 (*not at all true*) to 7 (*very true*). Evidence for the validity and reliability of the scale has been proved by Ryan and Frederick (1997) and Bostic and colleagues (2000).

Leisure time exercise behavior. Self-reported exercise behavior was assessed via the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shepard, 1985). This questionnaire assesses frequency of mild, moderate, and strenuous exercise behavior in which individuals engaged for an average of at least 15 min per week. An overall exercise behavior score can be calculated by using the following formula: (Mild x 3) + (Moderate x 5) + (Strenuous x 9). Evidence for the validity of the scale has been shown through correlations of the GLTEQ scores with objective indicators of exercise and physical fitness (e.g., exercise monitor and maximal aerobic capacity test scores; Jacobs, Ainsworth, Hartman, & Leon, 1993).

Procedures

Data were collected from nine health and fitness centers in central and south England. The data collection lasted for about two months. The questionnaire was distributed to the participants before their exercise class and took approximately 15 min to complete.

Data were collected all days of the week during morning and evening classes. The questionnaires were completed under the supervision of trained research assistants. Participants were treated in accordance with the American Psychological Association (APA) ethical guidelines. The study had the approval of the ethics committee of the University of Birmingham. All participants signed informed consent forms and were reassured that their responses would be confidential and anonymous.

Scale Translation

Initially the BPNES was translated into English using the back-translation technique (Vallerand, 1989) which requires the contribution of four bilingual translators. Translators A and B—two bilingual university faculty members with doctorate degrees in sport science and with research experience in exercise-based self-determination theory research—independently translated the BPNES from Greek into English. Following discussions, they reached consensus on a preliminary English version. This version was then independently translated from English back to Greek by translators C and D—two bilingual faculty staff with a Master's degree in English-language teaching and a doctorate in sports science, respectively). Comparison of the version that was re-translated into Greek by translators C and D, with the original Greek BPNES, revealed that the meaning of the items was identical. Consequently, the preliminary English version agreed upon by translators A and B was retained. Subsequently, four native English speakers studying for a doctorate in sports science commented on the translated scale and slight modifications were made in the wording and syntax to enhance item clarity and comprehension.

Data Analysis

Initially, CFA was performed to test the first hypotheses of the factor structure and discriminant validity of the translated BPNES. The factor variances were fixed to unity, the factor covariances were free to be estimated, and item error covariances were fixed to zero. The goodness of fit indexes used were the chi-square value (χ^2), the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA) accompanied by a 90% confidence interval (90% CI), and the Akaike's Information Criterion (AIC). Given the sensitivity of the χ^2 to sample size (Byrne, 2006), model fit assessment was based mainly on the remaining fit indexes. CFI values close to .95 indicate an excellent fit to the data (Hu & Bentler, 1999), whereas values .90 or greater indicate a reasonable fit. A RMSEA value less than .05 indicates a good model fit (Hu & Bentler, 1999), while values from .08 to .10 represent an adequate fit (Browne & Cudeck, 1993; Byrne, 2000). According to Byrne (1998), the AIC can be used to compare competing models—even those which are non-nested (i.e., models with the same number of variables but with one being a more constrained version of the other)—and penalizes model complexity (i.e., overparameterization). Smaller AIC values indicate a better model fit. The internal reliability of the subscales was estimated through Cronbach's alpha, average variance extracted (AVE)—that is, the variance accounted for by the construct indicators relative

to measurement error (Fornell & Larcker, 1981)—and composite reliability indexes that reflect the proportion of shared variance to error variance in a construct (Li, Harmer, & Acock, 1996).

Pearson's correlations were computed between the translated BPNES composite scores and psychological needs scores from the PNSE to assess concurrent validity. Further, to test for nomological validity, we examined the mediating role of the BPNES psychological need scores—in the relationship between autonomy support and the RAI—using the procedures outlined by Baron and Kenny (1986). In addition, Pearson's correlations were computed between the psychological needs and the variables of autonomy support, amotivation, external regulation, introjected regulation, identified regulation, intrinsic motivation, RAI, subjective vitality, and indexes of mild, moderate, strenuous, and total exercise behavior to further examine nomological validity.

Multi-group confirmatory factor analysis (MGCFA) is considered the most powerful approach to testing cross-national measurement invariance (Steenkamp & Baumgartner, 1998). According to Little (1997), there are two categories of measurement invariance tests. Category 1 includes invariance tests of the psychometric properties of the measurement scales. Category 2 includes invariance tests of factor variances, covariances, and means. Category 1 invariance is a prerequisite for interpreting Category 2 differences which usually have substantive research interest (Cheung & Rensvold, 2002). The present analyses focused on the examination of the cross-cultural equivalence of the BPNES Category 1 psychometric properties.

In line with Gregorich (2006), we examined the following types of measurement invariance: configural (no equality constraints; Model 1), metric (equal factor loadings; Model 2), strong (equal factor loadings and item intercepts concurrently; Model 3), and strict (equal factor loadings, item intercepts, and item residuals concurrently; Model 4). Model 1 specified a multi-sample model based on the 3-correlated factor CFA BPNES model without any equality constraint imposed on any of the model parameters. It was hypothesized that the same number of common factors would be present in each group and each factor would be related to the same set of items. In Model 2, the item-factor relationships (i.e., loadings) were constrained to be equal across groups. Support for this model would imply that the common factors have the same meaning across groups. In Model 3, item intercept equality constraints were added to the multi-sample model, and the item loading constraints were also retained. This strong factorial invariance model examined whether cross-group mean comparisons were defensible. In Model 4, item residual equality constraints were also added to the multi-sample model while retaining the item loading and the item intercept constraints. This strict factorial invariance test examined whether cross-group comparisons of observed item or composite score variances were meaningful (Gregorich, 2006). Given that, for the determination of invariance in multi-sample testing, the $\Delta\chi^2$ value has been considered unsatisfactory, evaluations of multi-sample nested models were based on the degree of adequate model fit exhibited by the more constrained model, and the ΔCFI value between the two nested models; values not exceeding .01 indicating invariance (Cheung & Rensvold, 2002).

Results

Factorial Validity, Discriminant Validity, and Estimates of Reliability

Given the multivariate non-normality of the data (normalized estimate of Mardia's coefficient of multivariate kurtosis = 20.53; Byrne, 2006), we employed the ML robust method using EQSWIN 6.1 (Bentler, 2003). This method provides the non-normality corrected Satorra-Bentler Scaled χ^2 (S-B χ^2), CFI, and RMSEA with 90% CI (also called robust estimates). The CFA results supported a marginal fit for the 3-correlated factor model of the English BPNES, χ^2 = 248.34, *df* = 51, $p < .001$, CFI = .898, RMSEA = .107 (90% CI = .094 – .121); corrected for non-normality indexes, S-B scaled χ^2 = 190.34, *df* = 51, $p < .001$, Robust CFI = .912, Robust RMSEA = .090 (90% CI = .077 – .104). The fully standardized item loadings ranged from .556 to .870. Given the unsatisfactory model fit, we inspected the standardized residual matrix and the multivariate results of the Lagrange Multiplier test. This evaluation revealed that removing the Relatedness 1 item from the CFA model would considerably improve model fit. This was because this item cross-loaded on the Competence factor. The revised 11-item BPNES model displayed a good model fit, χ^2 = 151.35, *df* = 41, $p < .001$, CFI = .936, RMSEA = .090 (90% CI = .074 – .105); corrected for non-normality indexes, S-B scaled χ^2 (346) = 114.55, *df* = 41, $p < .001$, Robust CFI = .948, Robust RMSEA = .073 (90% CI = .057 – .089)[1]. The fully standardized factor loadings ranged from .559 to .908. The goodness of fit indexes presented by Vlachopoulos and Michailidou (2006) for the Greek BPNES were (multivariate normality was found in that study), χ^2 = 122.28, $p < .001$, *df* = 51, CFI = .979, RMSEA = .053 (90% CI = .041 – .065).

Table 1 presents a description of the psychometric properties of the translated BPNES items based on the revised 3-correlated factor CFA model. All factor loadings were moderate to large (median = .749). CFA discriminant validity analyses provided support for the distinctiveness of the translated BPNES factors. Specifically, the factor correlation between autonomy and competence was r = .86 (95% CI = .80 – .92), between autonomy and relatedness was r = .69 (95% CI = .61 – .77), and between competence and relatedness was r = .52 (95% CI = .44 – .60). No confidence interval included 1, indicating that the instrument assesses related but distinct constructs. It should be noted that factor correlations are usually larger than Pearson's correlations.

The reliability indexes supported adequate internal reliability for all three subscales. The alpha coefficients for autonomy, competence, and relatedness were .75, .80, and .86, respectively. Composite reliability values were .76 for autonomy, .81 for competence, and .86 for relatedness, all greater than the .60 criterion (Bagozzi & Yi, 1988). AVE values were .54 for autonomy, .58 for competence, and .69 for relatedness, all greater than the .50 criterion (Fornell & Larcker, 1981).

Table 1. Confirmatory Factor Analysis: Completely Standardized Parameter Estimates for the Translated Basic Psychological Needs in Exercise Scale (BPNES) Items

BPNES items	M	SD	Skewness	Kurtosis	Item loading	Item uniqueness	SMC
Autonomy 1	4.18	0.77	–0.94	1.35	.622	.783	38%
Autonomy 2	3.93	0.90	–0.61	–0.13	.751	.661	56%
Autonomy 3	3.49	1.06	–0.36	–0.53	.730	.683	53%
Autonomy 4	3.90	0.91	–0.74	0.28	.559	.829	31%
Competence 1	3.29	0.91	–0.20	–0.21	.615	.788	37%
Competence 2	3.73	0.85	–0.43	0.04	.749	.663	56%
Competence 3	3.52	0.97	–0.32	–0.08	.759	.651	57%
Competence 4	3.69	0.84	–0.55	0.33	.763	.647	58%
Relatedness 2	4.01	0.91	–0.80	0.24	.830	.558	68%
Relatedness 3	3.57	1.01	–0.32	–0.49	.908	.419	82%
Relatedness 4	3.28	1.22	–0.25	–0.83	.747	.665	55%

Note. All factor loadings and item uniquenesses are significant ($p < .05$); SMC = Squared multiple correlation. N = 346.

Concurrent Validity

To a great extent, Pearson's correlations supported the concurrent validity hypotheses. Specifically, the competence-BPNES subscale displayed a greater correlation with the competence-PNSE subscale than with the other two PNSE subscales (see Table 2). This was also the case with the relatedness-BPNES subscale. The Autonomy-BPNES subscale displayed a higher correlation ($r = .47$) with the autonomy-PNSE subscale than with the relatedness-PNSE but, unexpectedly, a little lower correlation than with the competence-PNSE.

Nomological Validity

Using hierarchical regression analyses, and following the recommendations of Baron and Kenny (1986) concerning mediation analysis, the RAI scores were regressed onto the PAS scores. After controlling for age and gender in Step 1, PAS was found to significantly predict RAI ($\beta = .33$, $p < .05$). In the second hierarchical regression analysis, the three psychological need subscale scores were regressed onto PAS. After controlling for age and gender in Step 1, all three needs were found to significantly relate to PAS (autonomy, $\beta = .37$, $p < .05$; competence, $\beta = .36$, $p < .05$; relatedness, $\beta = .31$, $p < .05$). Then, in a third hierarchical regression analysis, after controlling for age and gender in Step 1, PAS was entered in Step 2 together with the three need satisfaction scores to predict the RAI scores. The beta coefficient concerning the relationship between PAS and

Table 2. Descriptive Statistics, Cronbach's Alpha, and Pearson's Correlations Between the Study Variables

Variables		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M		4.86	3.88	3.56	3.62	4.61	4.23	3.98	0.27	0.54	2.16	3.28	3.18	12.17	4.69	11.14	16.48	31.85	59.29
SD		1.32	0.69	0.71	0.93	1.04	0.99	1.31	0.57	0.75	1.04	0.66	0.78	5.04	1.23	9.70	12.31	18.37	88.99
Cronbach's alpha		.93	.75	.80	.86	.92	.94	.95	.80	.84	.75	.75	.87	__	.91	__	__	__	__
1	Autonomy support	__																	
2	BPNES Autonomy	.38*	__																
3	BPNES Competence-	.36*	.68*	__															
4	BPNES Relatedness	.33*	.54*	.39*	__														
5	PNSE Autonomy	.27*	.47*	.34*	.21*	__													
6	PNSE Competence	.33*	.52*	.61*	.37*	.44*	__												
7	PNSE Relatedness	.34*	.45*	.35*	.72*	.25*	.36*	__											
8	Amotivation	–.15*	–.19*	–.13*	–.05	–.19*	–.12*	–.13*	__										
9	External regulation	–.20*	–.31*	–.18*	–.00	–.18*	–.21*	.02	.37*	__									
10	Introjected regulation	–.03	.00	.08	.09	.00	.10	.09	.01	.25*	__								
11	Identified regulation	.20*	.31*	.39*	.21*	.15*	.40*	.21*	–.36*	-.14*	.38*	__							
12	Intrinsic motivation	.29*	.47*	.46*	.42*	.23*	.42*	.40*	–.36*	-.33*	.11*	.61*	__						
13	RAI	.33*	.48*	.41*	25*	.28*	.40*	.25*	–.71*	-.65*	–.10	.64*	.82*	__					
14	Subjective vitality	.39*	.47*	.50*	.40*	.32*	.50*	.38*	–12*	-.18*	.07	.37*	.48*	.42*	__				
15	Mild exercise	.02	–.06	.02	.01	.04	.02	.10	–.02	.11*	–.02	–.02	–.00	–.02	.06	__			
16	Moderate exercise	–.01	–.04	.02	.04	.00	–.01	.08	.00	.12*	.10	.05	.02	–.03	.00	.39*	__		
17	Strenuous exercise	.12*	.15*	.36*	.23*	.10*	.29*	.24*	-.09	.04	.21*	.41*	.24*	.19*	.26*	.16*	.24*	__	
18	Total exercise	.07	.06	.25*	.18*	.08	.18*	.23*	-.06	.10	.17*	.26*	.16*	.10	.19*	.60*	.71*	.78*	__

Note. BPNES responses: 1 – 5; PNSE responses: 1 – 6; BREQ-2 responses: 0 – 4; subjective vitality and autonomy support responses: 1 – 7. Cronbach's alpha is not reported for single items.
$N = 346$. * $p < .05$.

RAI was substantively reduced to β= .16 (p < .05) from β=.33, demonstrating the partial mediatory role of psychological need satisfaction in the relationship between perceived autonomy support and relative autonomy for exercise. These findings supported the nomological validity of the translated BPNES scores. In addition, positive correlations, consistent with theoretical predictions, were obtained between the translated BPNES subscales and the composite scores of autonomy support, exercise behavioral regulations and the RAI, subjective vitality, and indexes of mild, moderate, strenuous, and total exercise behavior. These correlations provide further support to the nomological validity of the translated BPNES (see Table 2).

Cross-Cultural Validity

All four MGCFA models displayed a good fit to the data (see Table 3). Model comparisons were primarily based on the ΔCFI value (Cheung & Rensvold, 2002) and to a lesser extent on the Satorra and Bentler's (2001) corrected S-B χ^2 difference tests (see Table 3). Model 2 had a significantly worse fit than Model 1 (ΔCFI= .014). The Lagrange Multiplier test (LM test) revealed that in Model 2 the multi-group equality constraints for loadings of items Relatedness 2, Autonomy 1, and Autonomy 4 were not tenable. In fact, releasing the equality constraint for Relatedness 2 had the greatest impact on improving model fit compared to the release of the other two equality constraints. Therefore, Model 2 was re-estimated (called Model 2a) after releasing the Relatedness 2 cross-group equality constraint. The improvement in model fit was such that Model 2a did not differ (ΔCFI= .006) from the configural Model 1.

In Model 3, the partial strong factorial invariance model was estimated, without cross-group equality constraints for item loading and item intercept of Relatedness 2. Although Model 3 did not differ from Model 2a (ΔCFI = .002; see Table 3), the results showed significant item-intercept equality constraints associated with Autonomy 1 and Autonomy 3, Competence 1, Competence 2, and Competence 3, and Relatedness 4 items. In other words, the equality cross-group constraints were not tenable with these items. Model 4 was the partial strict factorial invariance model with no residual constraint for the Relatedness 2 item. This model differed from Model 3 (ΔCFI = .032; see Table 3). The cross-group equality constraints of residual variance were not tenable for Autonomy 4, Competence 3, and Relatedness 3 and Relatedness 4 items. Inspection of the LM test showed that releasing the constraint associated with the Relatedness 4 residual variance would improve most model fit. Re-estimating Model 4 after releasing that constraint led to an improved model fit (Model 4a; see Table 3); however, this was still worse from the fit of Model 3 (ΔCFI = .021). Inspection of the LM test within Model 4a revealed that the next equality constraint that should be released was that associated with the residual variance of Autonomy 4. Re-estimation of Model 4a after releasing that constraint led to further model improvement (Model 4b; see Table 3). The fit of Model 4b was not different from the fit of Model 3 (ΔCFI = .010). In summary, cross-group equality constraints did not hold for the item loading of Relatedness 2, the item intercept of Relatedness 2, and the residual variances of Relatedness 2, Relatedness 4, and Autonomy 4.

Table 3. Goodness-of-Fit Indexes for the Cross-Cultural Measurement Invariance Models

BPNES Multi-group CFA models	$\chi 2$	Satorra-Bentler Scaled $\chi 2$	*df*	Satorra-Bentler $\chi 2$ diff.	*df* diff.	Robust CFI	ΔCFI	Robust RMSEA	Robust RMSEA 90% CI	Robust AIC
Model 1: Configural invariance	264.28	204.08	82	___	___	.963	___	.042	.035 – .049	40.08
Model 2: Full metric invariance	331.54	261.00	90	66.13*	8	.949	.014a	.048	.041 – .054	81.00
Model 2a: Partial metric invariance (omitting Relatedness # 2)	297.95	232.65	89	30.24*	7	.957	.006	.044	.037 – .051	54.65
Model 3: Partial strong factorial invariance (omitting Relatedness # 2)	416.42	342.05	99	181.02*	10	.955	.002	.054	.048 – .060	144.05
Model 4: Partial strict factorial invariance (omitting Relatedness # 2)	613.31	464.29	109	83.92*	10	.923	.032a	.062	.056 – .068	246.29
Model 4a: Partial strict factorial invariance (omitting Relatedness # 2 and 4)	543.19	424.17	108	64.17*	9	.934	.021a	.059	.053 – .065	208.17
Model 4b: Partial strict factorial invariance (omitting Relatedness # 2 and 4 and Autonomy # 4)	485.96	385.17	107	38.43*	8	.945	.010	.056	.050 – .062	171.17

Note: CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; AIC = Akaike's Information Criterion.
Models 2 and 2a are compared to Model 1; Model 3 is compared to Model 2a; Models 4, 4a and 4b are compared to Model 3.
*significantly different at $p < .05$; [a] indicates model difference based on the ΔCFI value (Cheung & Rensvold, 2002).
The Satorra-Bentler scaled χ^2 difference tests of significance have been corrected using Satorra and Bentler's (2001) correction factor.

Discussion

The present study examined the extent of cross-cultural equivalence of the BPNES, an exercise-specific instrument designed to assess the three psychological needs of autonomy, competence, and relatedness which are central in self-determination theory and research. The impetus for this research was Duda and Allison's (1990) and Sue's (1999) arguments about the importance of testing the cross-cultural applicability of psychological theories and models. While we agree with these arguments, we believe that such comparisons should be carried out using measurement instruments that demonstrate cross-cultural equivalence in terms of their psychometric properties. In this study the BPNES was first translated from the Greek to the English language and the reliability and validity of the instrument scores were extensively examined. Following this, the cross-cultural equivalence of the original and translated BPNES scale scores was then investigated.

The findings from CFA testing supported the adequacy of an English version consisting of 11 items (as opposed to 12 items included in the Greek version). The Relatedness 1 item (i.e., "I feel comfortable with the people I exercise with") was removed due to a large cross-loading on the competence factor that substantively reduced CFA model

fit. Given that a strong cross-loading means that the desired simple structure of a scale cannot be attained (Kline, 1994), it was hence appropriate to remove this item. A possible reason why this item cross-loaded on the competence factor in the British sample is that feeling comfortable exercising with others may depend on demonstrating exercise competence. This possibility has to be tested in future research. The results of the slightly modified model offered good support for a 3-factor structure (i.e., autonomy, competence, and relatedness) and showed that the respondents perceived the psychological need subscale items as indicators of related but distinct constructs. There was a quite high correlation (r = .86) between the autonomy and competence factors. Wilson and colleagues (2006) have also reported a high autonomy/competence latent correlation, which, however, was relatively lower (r = .71) than that reported in this study. Strong correlations have also been reported in other contexts, such as the academic domain (e.g., r = .74 in Evelein, Korthagen, & Brekelmans, 2008). Such large correlations might be, to some degree, unavoidable due to the empirical links between the two constructs—that is, individuals often feel competent when they also experience autonomy. In other words, autonomy may facilitate mastery experiences (hence increasing competence) because individuals feel able to choose tasks that provide optimal challenge.

Adequate internal reliability was evident from the satisfactory Cronbach's alphas, composite reliability estimates, and AVE values. Further, the concurrent validity of the translated BPNES was supported through correlations with another instrument of exercise-specific psychological needs (PNSE). In addition, evidence for the nomological validity of the translated BPNES emerged by demonstrating the partially mediating role of psychological needs in the relationship between perceived autonomy support and relative self-determination, as well as through the positive correlations between the three psychological needs with perceived autonomy support by the exercise instructor, behavioral regulations, subjective vitality, and frequency of mild, moderate, strenuous, and total exercise behavior. In sum, the evidence in the present article shows promising results for the reliability and validity of the translated BPNES, suggesting that this instrument could be used in exercise-related motivational research among English-speaking adult exercise participants. However, given that instrument validation is an ongoing process and validity evidence should be collected from a number of sources and samples (Messick, 1995), the present evidence should be considered as only initial. Future research should further examine the scale's psychometric properties in various exercise settings, populations (e.g., obese individuals and older individuals), and cultural contexts.

Cross-Cultural Validity

The examination of the extent of the cross-cultural equivalence of the BPNES is important given that substantive group comparisons require that psychological constructs have the same meaning across groups (Gregorich, 2006). Based on the present findings, the tenability of the configural invariance hypothesis was supported. This demonstrates that the cultural groups associated the same items with the same construct, or put differently, conceptualized a construct in the same way (Cheung & Rensvold, 2002). Reasons for

failure of configural invariance may include the differential influence of the cultural context on participants' perceptions (Tayeb, 1994), or the possibility that the participants may attach different meanings to the construct (Millsap & Everson, 1991; Riordan & Vanderberg, 1994), or translation errors (Cheung & Rensvold, 2002). In particular, translation errors may distort the meaning of certain items which are supposed to operate as indirect indicators of the construct. When the item meaning is distorted, that item may not be conceived by the members of that population as an indicator of the construct; this may have implications for the meaning of the construct for that population. The present support of the configural invariance hypothesis led to the conclusions that (a) the different cultural context of the participants did not influence their perceptions of the construct, (b) the participants from the different cultures did not attach different meanings to the construct, and (c) translation errors did not influence the meaning of the items. The support for the configural invariance hypothesis in the present study leads to the conclusion that the meaning of the translated BPNES items has not been influenced by translation errors.

The support found for the metric invariance hypothesis for 10 out of the 11 translated BPNES items (with the exception of Relatedness 2 item) indicates partial metric invariance (Byrne, Shavelson, & Muthen, 1989). This provides evidence that the three common factors have, to a large extent, the same meaning across groups (Gregorich, 2006). Metric invariance represents the minimum prerequisite for meaningful cross-group comparisons of any type (Bollen, 1989) and enables valid group comparisons of latent factor variances and covariances (i.e., controlling for measurement error), as well as comparisons of structural relationships (i.e., regression parameters) between latent variables (Gregorich, 2006).

Strong factorial invariance (i.e., concurrently imposed equality constraints for item loadings and item intercepts) is a prerequisite for latent mean and observed mean comparisons (Gregorich, 2006). According to Gregorich (2006), research instruments that do not demonstrate at least partial strong factorial invariance (i.e., equivalence of item intercepts) may be counterproductive in comparative research. Lack of strong factorial invariance means that variables unrelated to the common factors—such as cultural norms—result in higher or lower item responses in one group compared to the other (Gregorich, 2006). Given strong factorial invariance, cross-group differences in observed means are assumed to be unbiased estimates of group differences in the corresponding latent factor means (Gregorich, 2006). Hence, if strong factorial invariance is found, quantitative group comparisons of observed and latent factor means are warranted. The translated BPNES does satisfy the criteria of strong factorial invariance for all three need subscales for most items (i.e., partial strong invariance).

Strict factorial invariance—concurrently equivalent item loadings, item intercepts, and item residuals—is necessary for the comparison of observed variance and covariance estimates across groups because such comparisons should entirely reflect differences in common factor variation and should not be contaminated by differences in residual variation. Therefore, residual invariance is necessary for meaningful group comparisons of item or composite score variance estimates (Gregorich, 2006). This would be the case, for example, when one would want to compare the magnitude of the variance of

an item or the variance of an observed subscale composite score across cultural groups. Lack of strict factorial invariance may be due to differences in vocabulary, idioms, grammar, and syntax (Malpass, 1977). The present data supported partial strict factorial invariance. Therefore, cross-cultural comparisons of observed subscale variances may be meaningful for autonomy and competence but not for relatedness, given that only the Relatedness 3 item met the necessary criteria. This is not considered a substantial problem: Cross-cultural comparisons of observed variances are not very informative since they do not take into account measurement error.

The present study contributes to the extant literature by providing a measure that may facilitate systematic research attempts to study the cross-national equivalence of psychological needs, and associated antecedents and outcomes posited by SDT, in regard to exercise behavior. As Duda and Allison (1990) have argued, such cross-cultural investigations are important for sound theory and knowledge base development given that they take into account the cultural/ethnic context in which exercise behavior and related psychological processes take place.

A limitation of the present study is the unequal number of males and females comprising the sample of the British exercise participants. Future psychometric evaluation of the translated BPNES should include a balanced number of male and female exercisers and test the cross-gender measurement invariance. Recent research has provided initial evidence for cross-gender measurement invariance of the BPNES responses among Greek-speaking exercise participants (Vlachopoulos, 2008).

In brief, the translated BPNES may lend itself to valid quantitative cross-cultural comparisons of latent factor variances, covariances, and/or regression coefficients (metric invariance); latent factor means and/or observed means (strong invariance); and observed variance and covariance estimates (strict invariance) across Greek-speaking and English-speaking exercise participants. Given that the BPNES is a relatively short and is easy to administer, it could be useful in studies examining predictors of need satisfaction among exercise participants. When employing longitudinal designs, future research should evaluate the degree of temporal stability of the translated BPNES scores over short and longer time periods, as well as predictors of possible change. Clearly, the existence of the translated BPNES opens new avenues for potentially fruitful single-culture and cross-culture, and cross-sectional and longitudinal research examining the equivalence of the dynamic psychological processes posited by SDT in the exercise domain. Further, the BPNES may appear useful in evaluations of the effectiveness of experimentally-induced exercise-instructing styles aiming to satisfy the exercise participants' psychological needs and promote self-determined exercise behavior and psychological well-being.

References

Bagozzi, R. P. (1981). An examination of the validity of two models of attitude. *Multivariate Behavioral Research, 16,* 323-359.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16,* 74-94.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bentler, P.M. (2003). *EQS 6.1 for Windows* [Computer software]. Encino, CA: Multivariate Software.

Biddle, S. J. H., Fox, K. R., & Boutcher, S. H. (2000). *Physical activity and psychological well-being.* London: Routledge.

Bollen, K. A. (1989). *Structural equations with latent variables.* New York: Wiley.

Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the Subjective Vitality Scale using structural equation modeling. *Social Indicators Research, 52,* 313-324.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & S. J. Long (Eds.), *Testing structural equation models* (pp. 445-455). Newbury Park, CA: Sage.

Bouchard, C., Shephard, R. J., & Stephens, T. (Eds.) (1994). *Physical activity, fitness, and health: The consensus statement.* Champaign, IL: Human Kinetics.

Byrne, B. M. (1998). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming.* Mahwah, NJ: Lawrence Erlbaum Associates.

Byrne, B. M. (2000). *Structural equation modeling with AMOS: Basic concepts, applications, and programming.* Mahwah, NJ: Lawrence Erlbaum Associates.

Byrne, B. M. (2006). *Structural equation modeling with EQS: Basic concepts, applications, and programming* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Byrne, B. M., Shavelson, R. J., & Muthen, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin, 105,* 456-466.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9,* 233-255.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16,* 297- 334.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin, 52,* 281-302.

Duda, J. L., & Allison, M. T. (1990). Cross-cultural analysis in exercise and sport psychology: A void in the field. *Journal of Sport and Exercise Psychology, 12,* 114-131.

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2006). A test of self-determination theory in the exercise domain. *Journal of Applied Social Psychology, 36,* 2240-2265.

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2007). Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: A self-determination theory perspective. *Psychology of Sport and Exercise, 8,* 722-740.

Evelein, F., Korthagen, F., & Brekelmans, M. (2008). Fulfillment of the basic psychological needs of student teachers during their first teaching experiences. *Teaching and Teacher Education, 24,* 1137-1148.

Fornell, C., & Larcker, D. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, *18,* 39-50.

Godin, G., & Shepard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Science, 10,* 141-146.

Gregorich, S. E. (2006). Do self-report instruments allow meaningful comparisons across diverse population groups? Testing measurement invariance using the confirmatory factor analysis framework. *Medical Care, 44,* S78-S94.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1-55.

Jacobs, D. R., Ainsworth, B. E., Hartman, T. J., & Leon, A. S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine and Science in Sports and Exercise, 25,* 81-91.

Kline, P. (1994). *An easy guide to factor analysis.* London: Routledge.

Li, F. (1999). The Exercise Motivation Scale: Its multifaceted structure and construct validity. *Journal of Applied Sport Psychology, 11,* 97-115.

Li, F., Harmer, P., & Acock, A. (1996). The task and ego orientation in sport questionnaire: Construct equivalence and mean differences across gender. *Research Quarterly for Exercise and Sport, 68,* 228-238.

Little, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data: Practical and theoretical issues. *Multivariate Behavioral Research, 32,* 53–76.

Malpass, R. S. (1977). Theory and method in cross-cultural psychology. *American Psychologist, 32,* 1069-1079.

Markland, D., & Ingledew, D. K. (2007). The relationships between body mass and body image and relative autonomy for exercise among adolescent males and females. *Psychology of Sport and Exercise, 8,* 836-853.

Markland, D., & Tobin, V. (2004). A modification of the Behavioral Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology, 26,* 191–196.

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist, 50,* 741–749.

Millsap, R. E., & Everson, H. (1991). Confirmatory measurement model comparisons using latent means. *Multivariate Behavioral Research, 26,* 479-497.

Pleis, J.R., & Lethbridge-Cejku, M. (2006). Summary health statistics for U.S. adults: National health interview survey, 2005. National Center for Health Statistics. *Vital Health Statistics, 10,* (232).

Riordan, C. M., & Vanderberg, R. J. (1994). A central question in cross-cultural research: Do employees of different cultures interpret work-related measures in an equivalent manner? *Journal of Management, 20,* 643-671.

Ryan, R. M., & Deci, E. L. (2002). An overview of Self-determination Theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3-33). Rochester, NY: The University of Rochester Press.

Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality, 65,* 529-565.

Satorra, A., & Bentler, P. M. (2001) A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika, 66,* 507-514.

Sheldon, K. M., & Filak, V. (2008). Manipulating autonomy, competence, and relatedness support in a game-learning context: New evidence that all three needs matter. *British Journal of Social Psychology, 47,* 267-283.

Steenkamp, J. E. M., & Baumgartner, H. (1998). Assessing measurement invariance in cross-national consumer research. *Journal of Consumer Research, 25,* 78-90.

Sue, S. (1999). Science, ethnicity, and bias: Where have we gone wrong? *American Psychologist, 54,* 1070-1077.

Tayeb, M. (1994). Organizations and national culture: Methodology considered. Organization Studies, 15, 429-446.

Vallerand, R. J. (1989). Vers une mèthodologie de validation trans-culturelle de questionnaires psychologiques: Implications pour la recherche en langue française [Toward a methodology of cross-cultural validation of psychological questionnaires: Implications for research in French]. *Psychologie Canadienne, 30,* 662-680.

Vallerand, R. J. (2001). A hierarchical model of intrinsic and extrinsic motivation in sport and exercise. In G. C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 263-319). Champaign, IL: Human Kinetics.

Vansteenkiste, M., Neyrinck, B., Niemiec, C. P., Soenens, B., De Witte, H., & Van den Broeck, A. (2007). On the relations among work value orientations, psychological need satisfaction and job outcomes: A self-determination theory approach. *Journal of Occupational and Organizational Psychology, 80,* 251-277.

Vlachopoulos, S. P. (2007). Psychometric evaluation of the Basic Psychological Needs in Exercise Scale in community exercise programs: A cross-validation approach. *Hellenic Journal of Psychology, 4,* 52-74.

Vlachopoulos, S. P. (2008). The Basic Psychological Needs in Exercise Scale: Measurement invariance over gender. *Structural Equation Modeling, 15,* 114-135.

Vlachopoulos, S. P., & Michailidou, S. (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The Basic Psychological Needs in Exercise Scale. *Measurement in Physical Education and Exercise Science, 10,* 179-201.

Vlachopoulos, S. P., & Neikou, E. (2007). A prospective study of the relationships of autonomy, competence, and relatedness with exercise attendance, adherence, and dropout. *Journal of Sports Medicine and Physical Fitness, 47,* 475-482.

Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology, 70,* 115-126.

Wilson, P. M., Rogers, W. T., Rodgers, W. M., & Wild, T. C. (2006). The Psychological Need Satisfaction in Exercise Scale. *Journal of Sport and Exercise Psychology, 28,* 231-251.

Notes

[1]CFA of the 12-item translated BPNES using a polychoric correlation matrix (assuming that the 5-point rating scale is ordinal and not interval) revealed similar goodness of fit indexes, S-B scaled χ^2 = 195.21, *df* = 51, $p < .001$, Robust CFI = .947, Robust RMSEA = .092 (90% CI = .078 – .105). In addition, inspection of the largest standardized residuals and the LM test results indicated a considerable cross-loading of the Relatedness 1 item on the competence factor. After the removal of this item, the CFA demonstrated similar improved fit indexes, S-B scaled χ^2 = 122.53, *df* = 41, $p < .001$, Robust CFI = .966, Robust RMSEA = .077 (90% CI = .061 – .092).

Appendix

The Basic Psychological Needs in Exercise Scale (BPNES)

Instructions. The following sentences refer to your overall experiences in exercise as opposed to any particular situation. Using the 1-5 scale below, please indicate the extent to which you agree with these statements by circling one number for each statement.

	I don't agree at all	I agree a little bit	I somewhat agree	I agree a lot	I completely agree
1. I feel I have made a lot of progress in relation to the goal I want to achieve.	1	2	3	4	5
2. The way I exercise is in agreement with my choices and interests.	1	2	3	4	5
3. I feel I perform successfully the activities of my exercise program.	1	2	3	4	5
4. My relationships with the people I exercise with are very friendly.	1	2	3	4	5
5. I feel that the way I exercise is the way I want to.	1	2	3	4	5
6. I feel exercise is an activity which I do very well.	1	2	3	4	5
7. I feel I have excellent communication with the people I exercise with.	1	2	3	4	5
8. I feel that the way I exercise is a true expression of who I am.	1	2	3	4	5
9. I am able to meet the requirements of my exercise program.	1	2	3	4	5
10. My relationships with the people I exercise with are close.	1	2	3	4	5
11. I feel that I have the opportunity to make choices with regard to the way I exercise	1	2	3	4	5

Note. The initial Relatedness 1 item, "I feel comfortable with the people I exercise with," was removed from the translated BPNES version.

Key. Autonomy: items 2, 5, 8, 11; Competence: items 1, 3, 6, 9; Relatedness: items 4, 7, 10.