The Spanish Journal of Psychology
2012, Vol. 15, No. 1, 399-409
http://dx.doi.org/10.5209/rev_SJOP.2012.v15.n1.37346

Copyright 2012 by The Spanish Journal of Psychology
ISSN 1138-7416

Validation of the Basic Psychological Needs in Exercise Scale in a Portuguese Sample

João Miguel Raimundo Peres Moutão[1], Luis Filipe Cid Serra[1], José Augusto Marinho Alves[1], José Carlos Leitão[2], and Symeon P. Vlachopoulos[3]

[1]Escuela Superior de Deporte de Rio Maior (Portugal)
[2]Universidade de Trás-os-Montes e Alto Douro (Portugal)
[3]Aristotle University of Thessaloniki (Greece)

In line with self-determination theory (SDT: Deci & Ryan, 1985, 2002) the satisfaction of the basic psychological needs for autonomy, competence, and relatedness has been identified as an important predictor of behavior and optimal functioning in various contexts including exercise. The lack of a valid and reliable instrument to assess the extent to which these needs are fulfilled among Portuguese exercise participants limits the evaluation of causal links proposed by SDT in the Portuguese exercise context. The aim of the present study was to translate into Portuguese and validate the Basic Psychological Needs in Exercise Scale (BPNES: Vlachopoulos & Michailidou, 2006). Using data from 522 exercise participants the findings provided evidence of strong internal consistency of the translated BPNES subscales while confirmatory factor analysis supported a good fit of the correlated 3-factor model to the data. The present findings support the use of the translated into Portuguese BPNES to assess the extent of basic psychological need fulfilment among Portuguese exercise participants.
Keywords: self-determination theory, autonomy, competence, relatedness, physical activity.

De acuerdo con la teoría de la autodeterminación (TAD: Deci & Ryan, 1985, 2002) la satisfacción de las necesidades psicológicas básicas de autonomía, competencia y relación ha sido identificada como un importante instrumento para predecir un óptimo comportamiento y funcionamiento en diversos contextos, incluyendo el del ejercicio. La falta de un instrumento válido y fiable para evaluar la percepción que tienen los practicantes de ejercicio portugueses de que estas necesidades se satisfacen limita la evaluación de las relaciones causales propuestas por la TAD en esta población. El objeto del presente estudio ha sido traducir al portugués y validar la Basic Psychological Needs in Exercise Scale (BPNES: Vlachopoulos & Michailidou, 2006). Los resultados obtenidos a través de 522 practicantes de ejercicio ponen de manifiesto una fuerte consistencia interna de las subescalas de la versión traducida de la BPNES, mientras que el análisis factorial confirmatorio soportó el ajuste del modelo original de 3 factores correlacionados. Estos resultados dan soporte inicial al uso de la versión traducida al portugués de la BPNES para la evaluación de la satisfacción de las necesidades psicológicas básicas en practicantes de ejercicio portugueses.
Palabras clave: teoría de la autodeterminación, autonomía, competencia, relación, actividad física.

Correspondence concerning this article should be addressed to João Moutão. Escola Superior de Desporto de Rio Maior, Av. Dr. Mário Soares, Pavilhão Multiusos 2040-413 Rio Maior (Portugal). E-mail: jmoutao@esdrm.ipsantarem.pt

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

Despite the scientific evidence on the benefits of physical activity (ACSM 2009; WHO, 2004) in preventing disease (e.g. heart disease, hypertension, obesity, osteoporosis) and promoting optimal mental health (e.g. improved well-being, vitality, and life satisfaction), the most recent survey by Eurobarometer 334 (2010), shows that the indices of physical activity participation are still below desired levels. On average, about 60% of Europeans do not participate in physical activity at all or participate occasionally, suggesting that the previously mentioned benefits are not strong enough reasons for the desired behavior change.

If we consider intrinsic motivation a key aspect in promoting physical activity the determinants of intrinsic motivation become of utmost importance. According to SDT (Deci & Ryan, 1985, 2002) there are a set of basic psychological needs (BPN) – for autonomy, competence and relatedness - which have to be met by the social context to promote psychological growth (i.e. intrinsic motivation), integrity (i.e. internalization and assimilation of cultural practices), and well-being (i.e. fulfilment and mental health).

The need for autonomy is the desire to be the source of one's own behavior, reflecting a prior "acceptance" and "involvement" in a chosen behavior, which is different from the concept of "independence" or "total freedom" (deCharms, 1968; Deci & Ryan, 2000). The need for competence reflects a desire to interact effectively with the environment and is satisfied when challenging tasks and activities are successfully completed (Deci & Ryan, 2000; White, 1959). The need for relatedness reflects the aspiration of affiliation to a particular social context and reflects the need to develop feelings of belonging (Baumeister & Leary, 1995; Deci & Ryan, 2000). These non-hierarchical needs are seen as innate and universal, that is, they are not "learnt" and are relevant to human behavior regardless of gender, ethnicity or cultural background, even considering that the means for meeting them may differ (Chirkov, Ryan, Kim, & Kaplan, 2003).

The assumption that the more the BPN are satisfied, the stronger the exercise participants' intrinsic motivation was recently demonstrated through a meta-analysis of 33 studies (Wilson, Mack, Gunnell, Oster, & Gregson, 2008). Additionally, other studies, both cross-sectional (Edmunds, Ntoumanis, & Duda, 2006) and prospective (Vlachopoulos & Neikou, 2007) have shown that fulfilment of BPN produces a direct positive effect on exercise behavior, regardless of the effect on intrinsic motivation.

Satisfaction of BPN and subsequent intrinsic motivation can be seen not only as a means of promoting exercise motivation and adherence, but also as a variable to be considered in the promotion of mental health. Several studies have demonstrated the positive effect of BPN satisfaction on well-being (Edmunds et al., 2007; Gagne, Ryan, & Bargmann, 2003), global self-esteem (Hein & Hagger, 2007; Wilson & Rodgers, 2002) and subjective vitality (Vlachopoulos & Karavani, 2009).

According to Wilson et al. (2008) the measurement of the BPN in exercise was initially characterized by the inadequate use of questionnaires with modification of their original purpose or scales that were not developed specifically for the exercise context, such as the Basic Psychological Need Satisfaction Scale (BPNS: Kasser, Davey, & Ryan, 1992). Considering this necessity, two independent research groups developed instruments specifically designed for the purpose of evaluating the BPN in the exercise context, namely the Psychological Need Satisfaction in Exercise Scale (PNSE: Wilson, Rogers, Rodgers, & Wild, 2006) and the Basic Psychological Needs in Exercise Scale (BPNES: Vlachopoulos & Michailidou, 2006). Both questionnaires have demonstrated their potential in assessing the basic psychological needs in the context of exercise.

Regardless of the positive results in weight loss programs developed in Portugal adopting the SDT as an intervention model (Silva et al., 2010), the reality is that the lack of an appropriate instrument for assessing this construct in Portuguese exercise participants limits the potential for the assessment of the causal sequence proposed by SDT. The existence of such an instrument could bridge this gap and establish itself as an important tool not only for research but also in the applied field, helping fitness instructors to assess the quality of their intervention with the aim of promoting greater adherence to exercise and well-being.

The fact that the BPNES have been originally developed in a Mediterranean country leads us to believe that this questionnaire is the best option for the study of the BPN in Portuguese exercisers. Moreover, since BPNES is a shorter questionnaire (i.e. 12 items) compared to PNSE (consisting of 18 items), this may be an additional advantage, given that the exercisers pay a monthly fee to use fitness center facilities and do not want to spend too much of their time to complete questionnaires, especially in studies where a number of questionnaires are distributed simultaneously

In the development and initial validation study, the BPNES 3-factor model revealed optimal goodness-of-fit indexes (χ^2 = 122.28, *df* = 51, *p* = .000; SRMR = .036; NNFI = .973; CFI = .979; RMSEA = .053; RMSEA 90% CI = .041 - .065), high subscale internal consistency (Autonomy = .84; Competence = .81; Relatedness = .92) and strong standardized items loadings ranging between .60 and .89. The results also revealed high levels of temporal stability in test-retest for all the subscales over a period of 4 weeks. Subsequently, the BPNES was validated in a sample of community fitness exercisers (Vlachopoulos, 2007) also revealing satisfactory results in relation to construct validity (χ^2 = 209.87, *df* = 51, *p* = .000; NNFI = .971; CFI = .977; RMSEA = .061, RMSEA 90% CI = .052 - .069), subscale internal consistency (Autonomy = .84, Competence = .86, Relatedness = .92),

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

and standardized item loading ranging between .59 and .90. The BPNES validity and reliability were also supported, separately, for males (χ^2 = 145.82, *df* = 51, *p* = .000; SRMR = .032; NNFI = .978; CFI = .983; RMSEA = .051, RMSEA 90% CI = .041 - .061) and females (χ^2 = 161.74, *df* = 51, *p* = .000; SRMR = .034; NNFI = .984; CFI = .987; RMSEA = .044, RMSEA 90% CI = .036 - .051) exercisers, and shown to be invariant as a function of gender (Vlachopoulos, 2008). With regard to cross-cultural BPNES translation and validity analyses, the Spanish version of the scale showed satisfactory goodness of fit, both in fitness exercisers (CFI = .95; IFI = .95; SRMR = .05; RMSEA = .08) (Sánchez & Núñez, 2007) and physical education students (χ^2/df = 3.29, NNFI = .92, CFI = .94, SRMR = .07, RMSEA = .07) (Moreno, González-Cutre, Chillón, & Parra, 2008). The results obtained among fitness exercisers based on the translated into English BPNES version (Vlachopoulos, Ntoumanis, & Smith, 2010) were also satisfactory (χ^2 = 114.55, *df* = 41, Robust CFI = .948, Robust RMSEA = .073, RMSEA 90% CI = .057 - .089).

Taking into account the state of current research, the purpose of this study is to translate the original version of the BPNES into Portuguese and examine whether (a) the responses would be best represented by the original correlated 3-factor model, (b) the internal reliability of the translated subscales would be greater than .70, and (c) all of the subscale mean scores would remain relatively stable over a 2-week time period.

Method

Sample

The sample comprised 522 exercise participants attending structured exercise programs, both female (*n* = 313; 60%) and male (*n* = 209; 40%), aged between 16 and 70 years (M_{age} = 32.82 years; *SD* = 12.08), involved in cardio-fitness type activities using ergometers (*n* = 116; 22.2%), weight training activities (*n* = 157; 30.1%) and group exercise classes (*n* = 249; 47.7%). The frequency of weekly exercise participation ranged from 1 to 6 days (*M* = 3.3, *SD* = 1.2), with a total duration that ranged from 1 to 15 hours per week (*M* = 4.1, *SD* = 2.7). With respect to length of exercise participation, 171 participants (32.8%) attended the fitness center less than 6 months, 99 participants (19%) between 6 and 18 months, and the remaining 251 participants (48.2%) attended for more than 18 months continuously.

Data were collected from 16 private fitness centres from different geographical areas (i.e. urban / rural) and type of facilities in the area of Lisbon and west-central coast of Portugal. After having secured approval for the study from the fitness centers, via contacting the managers, the data were collected by trained research assistants, based on a previously defined protocol at different times of the day (morning, afternoon, and evening) and different weekdays. The participants were approached before initiating their exercise session. After informed consent was provided, the participants provided their responses to the entire set of questionnaires. Questionnaire completion lasted for about 12 minutes.

Measurement Tools

Basic psychological needs. The Basic Psychological Needs in Exercise Scale (BPNES: Vlachopoulos & Michailidou, 2006) was used to assess participants' need satisfaction in exercise. This questionnaire is a self-report instrument developed specifically for the context of physical exercise to evaluate participants' perceptions of their psychological need fulfilment in exercise (Vlachopoulos & Michailidou, 2006). The BPNES comprises 12 items as indicators of the three factors of autonomy (items 3, 6, 9, 12), competence (items 1, 4, 7, 10) and relatedness (items 2, 5, 8, 11). Responses are provided on a 5-point Likert-type scale ranging from 1 ("*Strongly Disagree*") to "5" ("*Strongly Agree*"). Several studies have supported the reliability and validity of BPNES responses among Greek exercise participants (Vlachopoulos, 2007, 2008; Vlachopoulos & Michailidou, 2006; Vlachopoulos & Neikou, 2007), English exercise participants (Vlachopoulos, Ntoumanis, & Smith, 2010) and Spanish exercise participants (Sánchez & Núñez, 2007).

Translation Procedures

To ensure the quality of translation of the BPNES items, we adopted the back-translation methodology proposed by Vallerand (1989) and adopted in the context of physical activity (Banville, Desrosiers, & Genet-Volet, 2000). The BPNES items were initially translated independently into Portuguese by four bilingual translators (phase 1). Consequently, a different committee of four bilingual academics specialized in exercise psychology compared the item content of the translated version with the original proceeding to further item modifications (phase 2). Then, a new committee was formed comprising four members holding MSc and PhD degrees with specialization in sport psychology, who reached a consensus on the final form of the translated scale confirming the meaning equivalence between the original and the translated version of the BPNES (stage 3). The preceding version was distributed to a sample of 50 university students who participated in exercise and who reported no problems with the meaning and clarity of the items (stage 4). At last, two Portuguese language professors reviewed the final version and agreed upon the proper language application (stage 5).

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

Confirmatory Factor Analysis

Initially item descriptive statistics were calculated to examine the normality of the data (Table 2). Item skewness values ranged from -0.32 to -1.28 while item kurtosis values ranged from -0.03 to 1.31. The normalized estimate of Mardia's multivariate kurtosis was 40.34 indicating multivariate non-normality in the data (Byrne, 2006). The Mahalanobis distance statistic D^2 was calculated to detect the presence of multivariate outliers. This method weighs the observation distances at the mean by the matrix of covariances and compares it with the chi-square distribution (Hair, Black, Babin, & Anderson, 2009). Based on these statistics, no multivariate outliers were found.

To assess the overall model fit of the correlated 3-factor BPNES model to the data, confirmatory factor analysis (CFA) was employed using the EQSWIN 6.1 software (Bentler, 2003). Each item was specified to load only onto the factor intended to define, latent factors were allowed to correlate, and item uniquenesses were specified to be uncorrelated. Further, the maximum likelihood (ML) method of estimation was used and the χ^2 value as an index of overall model fit. However, the sensitivity of the χ^2 value to sample size and variable distribution makes this criterion too demanding for model contrasting, particularly in social science studies where sources of variability are numerous (Byrne, 2006). Thus, the evaluation of overall model fit took into consideration alternative goodness-of-fit indices (Hair et al., 2009; Kahn, 2006; Worthington & Whittaker, 2006). These were the Comparative Fit Index (CFI) (Bentler, 1990), the Non-normed Fit Index (NNFI), the Standardized Root Mean Residual (SRMS) and the Root Mean Square Error of Approximation (RMSEA: Steiger & Lind, 1980) accompanied by its' 90% confidence interval (90% CI). The cut-off values given for each of these indicators as proposed by Hu and Bentler (1999) were $\leq .08$ for SRMR, $\geq .95$ for CFI and NNFI and $\leq .06$ for RMSEA. Since the theory underlying the ML estimation method assumes that the data have a multivariate normal distribution (Kahn, 2006; Kline, 2005), it will be necessary to consider Mardia's coefficient (see Mardia, 1970). If the normalized Mardia's value is greater than 5.0 (Byrne, 2006) the robust method proposed by Satorra and Bentler (2001) will be used that corrects the above indices for non-normality, thereby providing the Satorra-Bentler scaled χ^2 value (S-B χ^2) as well as robust estimates for NNFI, CFI, RMSEA and its 90% CI. No robust estimate is provided for SRMR and for this reason the relevant information is not reported. The dimensionality of the translated BPNES responses was examined via the comparison of competing BPNES CFA Models. Considering that the Satorra-Bentler χ^2 statistic (S-B χ^2) is used rather than the standard χ^2 statistic, and that the difference between S-B χ^2 for nested models is typically not distributed as χ^2 (Satorra, 2000), the recently developed scaled-difference χ^2 test statistic (Satorra & Bentler, 2001) is used to compare S-B χ^2 based on nested models.

Results

BPNES Translation

In regard to the BPNES item translation, satisfactory equivalence was identified between the original and the translated versions. The phases of the translation process improve the item meaning equivalence of the original version with the translated version, reinforcing the importance of compliance with this methodology in studies of this nature (see Appendix A).

Descriptive Statistics

Measures of central tendency and dispersion for the BPNESp items are presented in Table 1. The mean values obtained are above the midpoint in the 1-5 response scale. The present data are in line with the meta-analysis conducted by Wilson et al. (2008) showing that in all studies reviewed, regardless of the instrument used, BPN satisfaction reflected moderate to high values. Given this trend, the present data display a univariate non-normal distribution, as can be seen from the fact that some values of skewness and kurtosis fall outside the ranges $\geq -.5$ and $\geq .5$ as suggested by Bulmer (1965).

Confirmatory Factor Analysis and Internal Consistency

The goodness-of-fit indices obtained for the translated BPNES correlated 3-factor model indicated an acceptable overall model fit [S-B scaled $\chi^2 = 144.14$, $p = .001$, $\chi^2/df = 2.82$, robust NNFI = .938, robust CFI = .952, robust RMSEA = .059 with RMSEA 90% CI (.048 - .071)]. The standardized factor loadings for autonomy, competence, and relatedness ranged from .58 to .83, all significant at $p < .05$, and greater than .45 as suggested by Hair et al. (2009), supporting the assumption of convergent validity of the items within their respective factors. The squared multiple correlations representing the proportion of item variance explained by their respective factors were all above .25, ranging from .34 to .69 (Figure 1). With respect to the internal consistency, the Cronbach's alpha values, and their 95% confidence intervals computed using ScoreRel CI (Barnette, 2005), were all above .70 (Nunnally, 1978) for all the subscales [(Autonomy = .75 (.71-.78); Competence = .75 (.71-.78); Relatedness = .83 (.80-.85)].

The correlations between the three latent factors were all significant and non-negligible. However the correlation between the factor of autonomy and competence was comparatively high ($r = .80$).

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

Table 1
Descriptive Statistics, Parameter Estimates, Subscale Internal Consistency and Items/Subscale Correlation for the BPNES Items Correlated 3-Factor CFA

BPNESp	Scale items	*M*	*SD*	Item skewness	Item kurtosis	Item loading	Item uniqueness	Square Multiple Correlation	Alpha if item deleted	Item Subscale Correlation
Autonomy (α = .75)		4.22	.56							
	Item 3	4.35	.72	–1.28	2.65	.62	.79	.38	.69	.75
	Item 6	4.28	.68	–0.82	1.27	.72	.70	.51	.66	.78
	Item 9	4.12	.72	–0.61	0.81	.69	.73	.47	.70	.74
	Item 12	4.11	.82	–0.98	1.31	.60	.80	.35	.72	.75
Competence (α = .75)		4.10	.52							
	Item 1	4.01	.70	–0.72	1.08	.58	.82	.34	.73	.71
	Item 4	4.17	.63	–0.34	0.22	.75	.66	.56	.65	.79
	Item 7	3.99	.75	–0.38	–0.03	.64	.77	.41	.71	.75
	Item 10	4.20	.66	–0.61	0.82	.67	.74	.45	.66	.78
Relatedness (α = .83)		4.23	.58							
	Item 2	4.45	.56	–0.32	–0.91	.63	.78	.39	.83	.71
	Item 5	4.27	.72	–0.71	0.29	.83	.56	.69	.74	.87
	Item 8	4.19	.74	–0.63	0.18	.81	.58	.66	.76	.85
	Item 11	4.00	.82	–0.55	–0.09	.72	.69	.52	.80	.83

Note. All item loadings and item/subscale correlations are statistically significant ($p < .05$).

Comparison of Competing BPNES CFA Models

The dimensionality of the translated BPNES responses was examined via the comparison of a single-factor model, various two-factor models, and a hierarchical CFA model of the scale responses. The assumption underlying the single-factor model was that the participants' responses are best explained by a single factor. The assumption underlying the correlated 2-factor models was that scale responses could be best represented by two factors where the items of each pair of factors were specified to load onto the same factor while the remaining items loaded onto their respective factor. In regard to the hierarchical model we tested the assumption that participants' responses can best be represented by a higher-order factor explaining the covariation between the three first-order factors. Based on the goodness-of-fit indices the conclusion emerged that it was the correlated 3-factor model and the hierarchical model that fit the data better compared to the remaining models. These data provided additional support to the construct validity of the correlated 3-factor translated BPNES model (Table 2).

The data corroborate findings from studies that have tested the hierarchical structure of scales assessing the three psychological needs in exercise such as the BPNES (Vlachopoulos, 2007) and other BPN questionnaires (cf. Hagger, Chatzisarantis, & Harris, 2006; Wilson, Mack, Blanchard, & Gray, 2009). The standardized parameter estimates for the hierarchical model, all statistically significant at $p < .05$, are presented in Figure 2. The second order factor loadings for the hierarchical BPNES model were .94 for autonomy (disturbance = .415; 83% variance explained by the higher order factor), .85 for competence (disturbance =.472; 78% variance explained by the second order factor) and .66 for relatedness (disturbance = .753; 43% variance explained by the second order factor).

Test–Retest Reliability

To assess the temporal stability of the BPNESp subscale scores, 60 exercise participants were re-assessed over a 2-week period and the intra-class correlation coefficient (ICC; Vincent, 1995) was used. According to Vincent (1995) ICC values above .90 are considered high levels of stability. Comparing the test-retest results, the Autonomy mean score changed from 3.75 (*SD* = .43) to 3.78 (*SD* = .50) with an ICC value of .96. For Competence, the mean changed from 3.70 (*SD* = .39) to 3.81 (*SD* = .48) with an ICC value of .91. For Relatedness, the mean changed from 3.91 (*SD* = .48) to 3.95 (*SD* = .50) with an ICC value of .93. These results revealed high levels of test–retest reliability and are consistent with those obtained in the original BNPES development study where the ICC values were .97 for all BPNES subscales (Vlachopoulos & Michailidou, 2006).

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

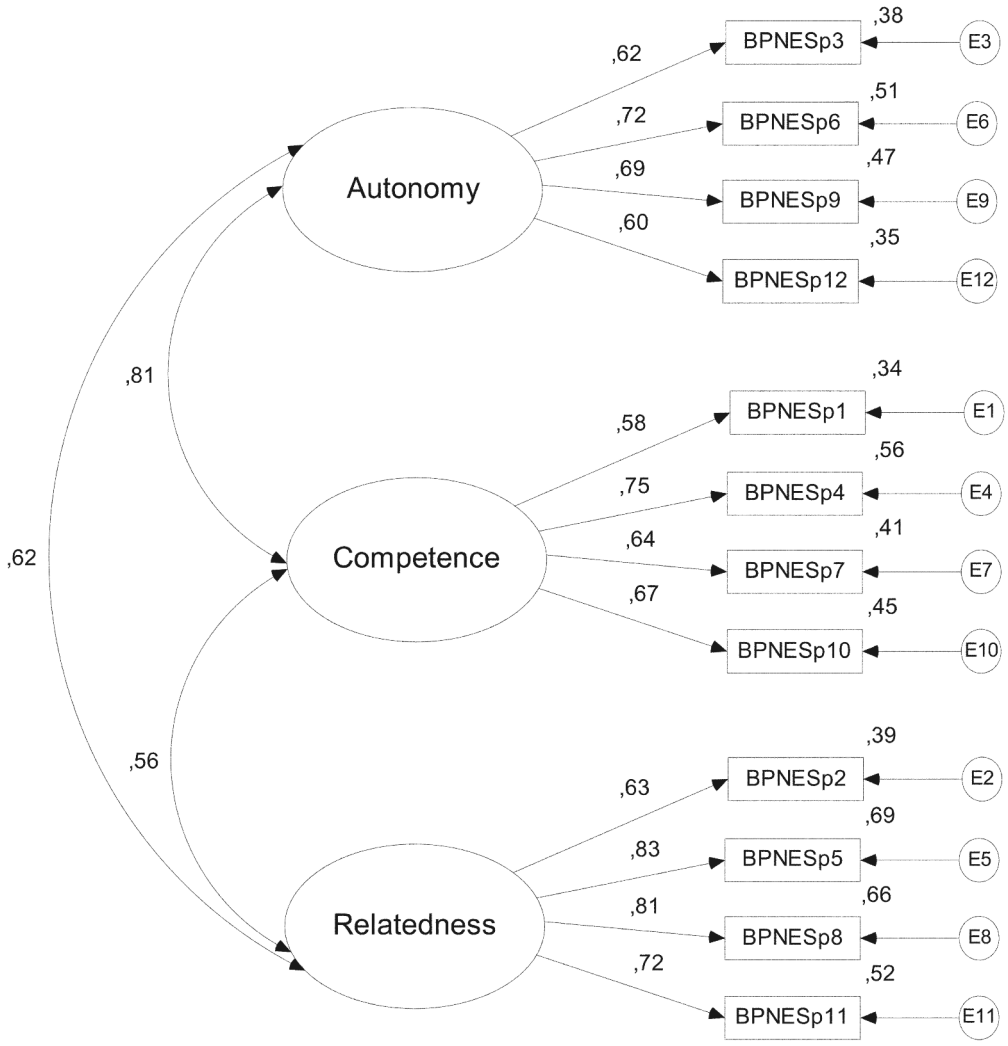


Figure 1. Standardized solution of the correlated 3-factor translated BPNES CFA model.
Note. BPNESp 1 to 12 represent the scale item numbers; E = error term (item uniqueness) for each item; The values at the right and above the rectangles represent the proportion of item variance accounted for by its' related factor (i.e. Squared Multiple Correlation). All item loadings and latent factor correlations are completely standardized.

Table 2
Goodness-of-fit Indexes for the Correlated 3-Factor and Alternative CFA BPNESp Models

BPNESp alternative models	χ^2	Satorra-Bentler scaled χ^2	*df*	Δ Satorra-Bentler χ^2	Δ *df*	Robust NNFI	Robust CFI	Robust RMSEA	Robust RMSEA 90% CI	Robust AIC
Model 1: Correlated 3-Factor model	201.72	144.14	51	__	__	.938	.952	.059	.048-.071	42.14
Model 2: Correlated 2-Factor models										
Model 2a: Autonomy/competence	256.14	182.14	53	34.45*	2	.918	.934	.068	.058-.079	76.14
Model 2b: Competence/relatedness	509.89	371.10	53	425.45*	2	.797	.837	.107	.097-.118	265.10
Model 2c: Autonomy/relatedness	475.17	342.87	53	263.25*	2	.815	.852	.102	.092-.113	236.90
Model 3: 1-Factor model	596.30	425.25	54	272.28*	3	.768	.810	.115	.110-.113	317.25
Model 4: Hierarchical model	201.72	144.14	51	0	0	.938	.952	.059	.047-.070	42.13

Note: CFI = Comparative Fit Index; NNFI = Non-normed Fit Index; RMSEA = Root Mean Squared Error of Approximation; CI = Confidence Interval; AIC = Akaike's Information Criterion.
Chi-square comparisons are performed between the 3-factor model and each one of the alternative 1 and 2-factor models.
*significantly different at $p < .05$.
The Satorra-Bentler scaled χ^2 difference tests of significance have been corrected using Satorra and Bentler's (2001) correction factor.

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

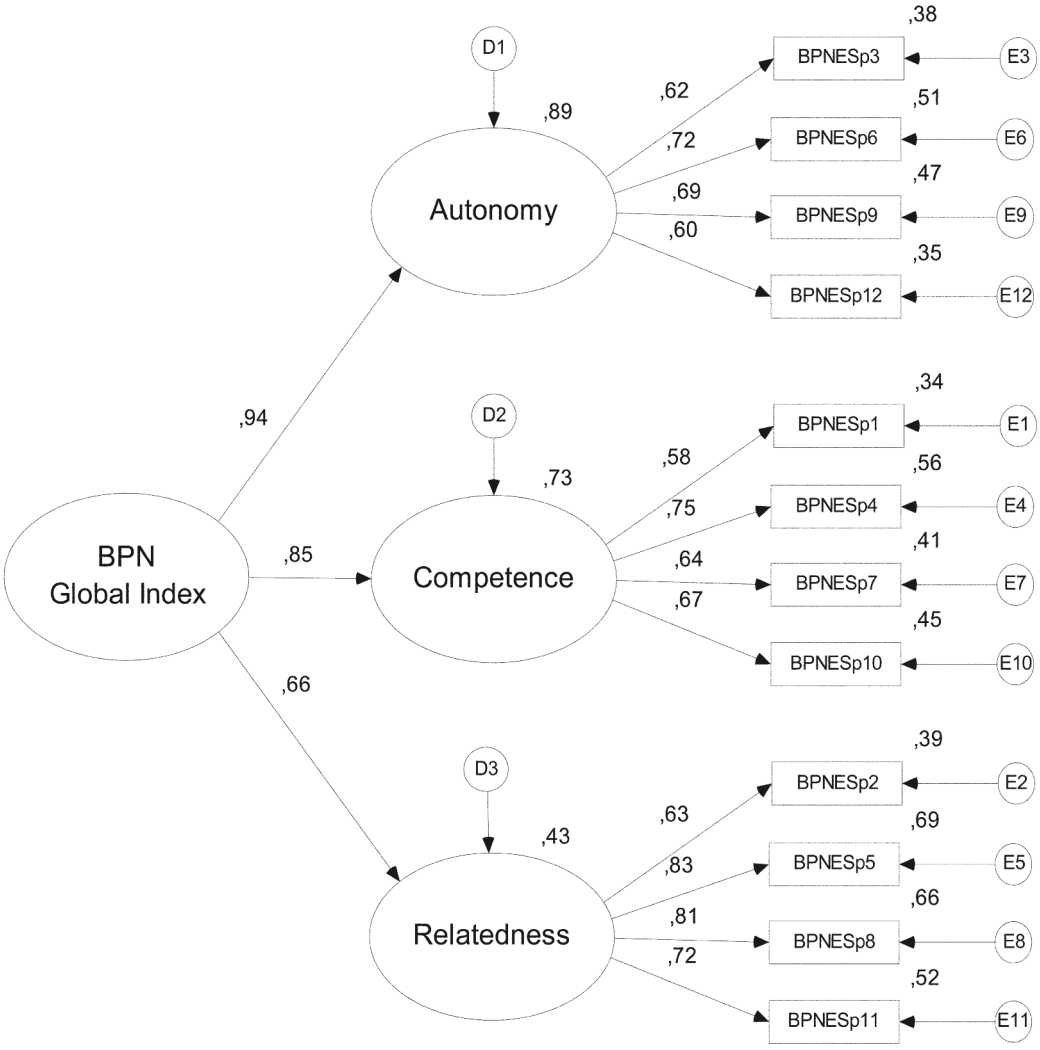


Figure 2. Standardized solution for the BPNESp hierarchical model.
Note. BPNES 1-12 = Question item numbers; BPN = Basic Psychological Needs; E = error term (item uniqueness) for each item; D = Disturbance or Error terms for each factor; The values at the right and above the rectangles represent the proportion of item variance accounted for by its related factor (i.e. Squared Multiple Correlation); All item loadings are completely standardized.

Discussion

The aim of the present study was the translation of the BPNES questionnaire into Portuguese and its' preliminary validation with Portuguese exercise participants. Given that satisfaction of the needs for autonomy, competence, and relatedness may lead to the internalization of exercise behavior and the enhancement of mental health and subjective vitality (Ryan & Deci, 2002), the impetus of the present study was the need for an instrument to assess in a valid and reliable way the extent to which the needs for autonomy, competence, and relatedness are fulfilled in exercise settings. Given the lack of such an instrument to assess the satisfaction of the three psychological needs among Portuguese exercise participants, the translation and validation of an already existing exercise-specific, short, valid and reliable scale among this population was deemed important.

The factor structure of the translated BPNES responses was studied via confirmatory factor analysis. The results supported the hypothesized correlated 3-factor structure of the translated BPNES responses in agreement with previous studies that demonstrated the good fit of the BPNES factor structure with Greek exercise participants (Vlachopoulos, 2007, 2008; Vlachopoulos & Michailidou, 2006; Vlachopoulos & Neikou, 2007), English exercise participants (Vlachopoulos et al., 2010) and Spanish exercise participants (Sánchez & Núñez, 2007). The present findings supported strong item loadings accompanied by high internal consistency coefficients for each need subscale separately in line with those obtained by Vlachopoulos and Michailidou (2006) who reported alpha values equal to or greater than

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

.81 with Greek exercise participants; to those obtained by Sánchez and Núñez (2007) with alpha values equal to or greater than .74 among Spanish exercise participants; and to those obtained by Vlachopoulos et al. (2010) exhibiting alpha values equal to or greater than .75 with British exercise participants. The present results provide evidence of a tight item structure and satisfactory levels of internal consistency demonstrating that the translated BPNES items function as strong indicators of the factor intended to define while each subscale includes a satisfactory amount of true variance of the construct developed to measure.

The comparison of competing CFA models via calculating the difference between S-B χ^2 values, led to the conclusion that the correlated 3-factor model was a significant improvement over the alternative 2-factor models supporting the distinctiveness between the three need latent factors. The findings also reveal that the correlated 3-factor model was significantly better than the single-factor model confirming that the twelve BPNES items are not perceived as indicators of the same construct, and therefore, should not be used in computing a single need satisfaction score. Such an action would necessitate a good fit for the single-factor model, something that clearly is not the case. Despite the equally good fit of the hierarchical model in comparison to the correlated 3-factor model, it has been suggested that the use of the higher-order need construct is not theoretically justified given that SDT presents three distinct need constructs rather than one general need construct (Vlachopoulos, 2007). SDT theorists posit that each one of the psychological needs plays a distinct and necessary part in optimal development so than none can be neglected without significant negative consequences (Deci & Ryan, 2000). That is, studying each need construct individually may provide information on the role of each need construct separately in motivated behavior and well-being, something that cannot be attained when the higher-order need factor is used.

In terms of factor correlations the present findings speak to non-negligible latent factor correlations between the need constructs. Correlations of such a magnitude have consistently emerged in the exercise psychology literature not only in studies using the BPNES but also in studies using the PNSE. The correlations between the three latent factors were all significant and non-negligible. However the correlation between the factor of autonomy and competence was high (r = .80). Such high correlations between the autonomy and competence factors have consistently emerged not only across different populations but also across instruments assessing the three psychological needs in exercise. For instance, in relation to the English version of the BPNES, Vlachopoulos et al. (2010) reported a latent factor correlation of .86 between the subscales of autonomy and competence. Similarly, Wilson et al. (2006) reported a high correlation (r = .71) between the same two subscales measured by the PNSE. In a similar fashion, Evelein, Korthagen, and Brekelmans (2008) reported a correspondent correlation coefficient of .74 in an educational context. Hence, the question arises as to whether the phenomenon of high correlations between the three needs and especially between autonomy and competence is attributed to the instruments used to measure such an association or to the fact that the constructs are indeed highly correlated and this is the case independent of the method and the population used to measure need satisfaction. Possibly, alternative methods of assessing need satisfaction need to be developed in order to further assess the validity of the findings emerging from the use of self-report questionnaires to assess need satisfaction.

These present results support the use of BPNESp for the assessment of the extent to which basic psychological needs are fulfilled among Portuguese exercise participants. Notwithstanding, and realizing that the validation of an instrument is a continuous–process requiring evidence collected from a number of sources and samples to determine the psychometric merit of an instrument (Messick, 1995), we would like to emphasize that we consider the present validation study as a preliminary effort to determine the construct validity of BPNESp scores. We therefore consider it appropriate to continue investigation on the psychometric properties of the scale scores with a view to further examine various aspects of the scale's construct validity. Future studies should replicate the present analysis with other populations such as older individuals and individuals with a chronic disease given the centrality and importance for these populations of long-term and regular exercise participation. Further, and given the need for experimental designs to test the effectiveness of interventions aiming to support participants' psychological needs with the goal of achieving internalization of exercise behavior and enhancement of subjective vitality, future studies should test the equivalence in meaning of the BPNESp items to rule out the likely differential performance of the BPNES items across gender as a source of score variability when both males and females are included in a study or compared. Also, given the requirement of repeated assessments of need fulfilment in experimental designs, the stability of the BPNESp scores should be assessed over shorter and longer time intervals. Given the promising psychometric properties of the BPNES scores in a Portuguese sample, the translated scale seems to offer opportunities for valid tests of the SDT tenets in a Portuguese exercising population.

References

ACSM (2009). *Resource manual for guidelines for exercise testing and prescription* (7th Ed.). Baltimore, MD: Lippincott Williams &Wilkins.

Banville, D., Desrosiers, P., & Genet-Volet, Y. (2000). Translating questionnaires and inventories using a cross-cultural translation technique. *Journal of Teaching in Physical Education, 19*, 374–387.

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

Barnette, J. J. (2005). ScoreRel CI. An Excel program for computing confidence intervals for commonly used score reliability coefficients. *American Journal of Evaluation, 65*, 980–983. http://dx.doi.org/10.1177/0013164405278577

Baumeister, R., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117,* 497–529. http://dx.doi.org/10.1037//0033-2909.117.3.497

Bentler, P. M. (1990). Comparative fit indices in structural models. *Psychological Bulletin, 107*, 238–246. http://dx.doi.org/10.1037//0033-2909.107.2.238

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

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

Bulmer, M. G. (1965). *Principles of statistics*. Cambridge, MA: MIT Press.

Chirkov, V., Ryan, R. M., Kim, Y., & Kaplan, U. (2003). Differentiating autonomy from individualism and independence: A self-determination perspective on internalization of cultural orientations, gender and well being. *Journal of Personality and Social Psychology, 84*, 97–110. http://dx.doi.org/10.1037//0022-3514.84.1.97

deCharms, R. (1968). *Personal causation*. New York, NY: Academic Press.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227–268. http://dx.doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.

Edmunds, J., Ntoumanis, N., & Duda, J. (2006). A Test of Self-determination Theory in the exercise domain. *Journal of Applied Social Psychology, 36*, 2240–2265. http://dx.doi.org/10.1111/j.0021-9029.2006.00102.x

Edmunds, J., Ntoumanis, N., & Duda, J. (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. http://dx.doi.org/10.1016/j.psychsport.2006.07.006

European Comission (2010). *Eurobarometer-334: Sport and physical activity.* Brussels, Belgium: Author. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_334_en.pdf

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. http://dx.doi.org/10.1016/j.tate.2007.09.001

Gagne, M., Ryan, R. M., & Bargmann, K. (2003). Autonomy support and need satisfaction in the motivation and well-being of gymnasts. *Journal of Applied Sport Psychology, 15*, 372–390. http://dx.doi.org/10.1080/714044203

Hagger, M. S., Chatzisarantis, N., & Harris, J. (2006). From psychological need satisfaction to intentional behavior: Testing a motivational sequence in two behavioral contexts. *Personality and Social Psychology Bulletin, 32*, 131–138. http://dx.doi.org/10.1177/0146167205279905

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th Ed.). New Jersey, NJ: Prentice Hall.

Hein, V., & Hagger, M. S. (2007). Global self-esteem, goal achievement orientations, and self-determined behavioral regulations in a physical education setting *Journal of Sports Sciences, 25*, 149–159. http://dx.doi.org/10.1080/02640410600598315

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1–55. http://dx.doi.org/10.1080/10705519909540118

Kahn, J. H. (2006). Factor analysis in counseling psychology research, training, and practice: Principles, advances, and applications. *The Counseling Psychologist, 34*, 684–718. http://dx.doi.org/10.1177/0011000006286347

Kline, R. (2005). *Principles and practice of structural equation modelling.* New York, NY: The Guilford Press.

Kasser, T., Davey, J., & Ryan, R. M. (1992). Motivation, dependability, and employee-supervisor discrepancies in psychiatric vocational rehabilitation settings. *Rehabilitation Psychology, 37*, 175–187. http://dx.doi.org/10.1037/h0079104

Mardia, K. (1970). Measures of multivariate skewness and kurtosis with applications. *Biometrika, 57*, 519–530. http://dx.doi.org/10.2307/2334770

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. http://dx.doi.org/10.1037//0003-066X.50.9.741

Moreno, J. A., González-Cutre, D., Chillón, M., & Parra, N. (2008). Adaptación a la educación física de la escala de las necesidades psicológicas básicas en el ejercicio [Basic psychological needs, intrinsic motivation, and autotelic experience propensity in physical exercise]. *Revista Mexicana de Psicología, 25*, 295–303

Nunnally, J. C. (1978). *Psychometric theory*. New York, NY: McGraw-Hill Inc.

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.

Sánchez, J., & Núñez, J. L. (2007). Análisis preliminar de las propiedades psicométricas de la versión española de la Escala de Necesidades Psicológicas Básicas en el ejercicio físico. [Preliminar analysis of the psychometric properties of the Spanish versión of the Basic Psychological Needs Scale in physical exercise]. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte, 2*, 83–92.

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

Satorra, A. (2000). Scaled and adjusted restricted tests in multi-sample analysis of moment structures. In D. D. H. Heijmans, D. S. G. Pollock, & A. Satorra (Eds.), *Innovations in multivariate statistical analysis* (pp. 233-247). Dordrecht, The Netherlands: Kluwer Academic.

Satorra, A., & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika, 66*, 507–514. http://dx.doi.org/10.1007/BF02296192

Silva, M. N., Vieira, P. N., Coutinho, S. R., Minderico, C. S., Matos, M. G., Sardinha, L. B., & P. J. Teixeira (2010). Using self-determination theory to promote physical activity and weight control: A randomized controlled trial in women. *Journal of Behavioral Medicine, 33*, 110–122. http://dx.doi.org/10.1007/s10865-009-9239-y

Steiger, J. H., & Lind, J. M. (1980, June). *Statistically based tests for the number of common factors.* Paper presented at the meeting of the Psychometric Society, Iowa City, IA.

Vallerand, R. J. (1989). Vers une méthodologie de validation transculturelle de questionnaires psychologiques: Implications pour la recherche en langue française [Towards a methodology for cross-cultural validation of psychological questionnaires: implications for research in French]. *Psychologie Canadienne, 30*, 662–680. http://dx.doi.org/10.1037/h0079856

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: A Multidisciplinary Journal, 15*, 114–135. http://dx.doi.org/10.1080/10705510701758398

Vlachopoulos, S. P., & Karavani, E. (2009). Psychological needs and subjective vitality in exercise: A cross-gender situational test of the needs universality hypothesis. *Hellenic Journal of Psychology, 6*, 207–222.

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. http://dx.doi.org/10.1207/s15327841mpee1003_4

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.

Vlachopoulos, S. P., Ntoumanis, N., & Smith, A. L. (2010). The Basic Psychological Needs in Exercise Scale: Translation and evidence for cross-cultural validity. *International Journal of Sport and Exercise Psychology, 8*, 394–412. http://dx.doi.org/10.1080/1612197X.2010.9671960

Vincent, J. W. (1995). *Statistics in kinesiology.* Champaign, IL: Human Kinetics.

White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66*, 297–333. http://dx.doi.org/10.1037/h0040934

World Health Organization (2004). *Global strategy on diet, physical activity and health*. Geneva, Switzerland: Author.

Wilson, P. M., Mack, D. E., Blanchard, C. M., & Gray, C. E. (2009). The role of perceived psychological need satisfaction in exercise-related affect. *Hellenic Journal of Psychology, 6*, 138–206.

Wilson, P. M., Mack, D. E., Gunnell, K., Oster, K., & Gregson, J. P. (2008). Analyzing the measurement of psychological need satisfaction in exercise contexts: Evidence, issues, and future directions. In M. P. Simmons & L. A. Foster (Eds.), *Sport and exercise psychology research advances* (pp. 361-391). Hauppauge, NY: Nova Science.

Wilson, P. M., & Rodgers, W. (2002). The relationship between exercise motives and physical self-esteem in female exercise participants: An application of self-determination theory. *Journal of Applied Biobehavioral Research, 7*, 30–43. http://dx.doi.org/10.1111/j.1751-9861.2002.tb00074.x

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.

Worthington, R. L., & Whittaker, T. A. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist, 34*, 806–838. http://dx.doi.org/10.1177/0011000006288127

Received October 13, 2010
Revision received January 16, 2011
Accepted April 10, 2011

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press

APPENDIX A

Comparison between original and translated BPNESp: Basic Psychological Needs in Exercise Scale (Portuguese version)

English version Instructions: The following sentences refer to your overall experiences in exercise in general 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.

Portuguese version Instructions: Seguidamente apresentamos um conjunto de afirmações referentes às suas experiências em relação ao exercício físico em geral, não considerando qualquer situação em particular. De acordo com a escala de 1-5, responda assinalando o número que melhor reflecte o seu grau de concordância com cada uma destas frases.

item 1	I feel I have made a lot of progress in relation to the goal I want to achieve. Sinto que tenho feito grandes progressos em relação ao(s) objectivo(s) que pretendo atingir.
item 2	I feel comfortable with the people I exercise with Sinto-me confortável com as pessoas com quem faço exercício
item 3	The way I exercise is in agreement with my choices and interests. Sinto que faço exercício de acordo com os meus interesses.
item 4	I feel I perform successfully the activities of my exercise programme. Sinto que realizo com sucesso as actividades do meu programa de exercício.
item 5	My relationships with the people I exercise with are very friendly. Sinto que tenho uma relação muito amigável com as pessoas com quem faço exercício.
item 6	I feel that the way I exercise is the way I want to. Sinto que faço exercício de acordo com aquilo que pretendo fazer.
item 7	I feel exercise is an activity which I do very well. Sinto que o exercício é uma actividade que faço muito bem.
item 8	I feel I have excellent communication with the people I exercise with. Sinto que tenho uma excelente comunicação com as pessoas com quem faço exercício.
item 9	I feel that the way I exercise is a true expression of who I am. Sinto que a forma como faço exercício expressa verdadeiramente aquilo que sou.
item 10	I am able to meet the requirements of my exercise program. Sinto que sou capaz de cumprir com as exigências do meu programa de exercício.
item 11	My relationships with the people I exercise with are close. Sinto que tenho uma relação próxima com as pessoas com quem faço exercício.
item 12	I feel that I have the opportunity to make choices with regard to the way I exercise Sinto que tenho a oportunidade de fazer escolhas em relação aos exercícios.

https://doi.org/10.5209/rev_SJOP.2012.v15.n1.37346 Published online by Cambridge University Press