MEASUREMENT IN PHYSICAL EDUCATION AND EXERCISE SCIENCE, *10*(3), 179–201
Copyright © 2006, Lawrence Erlbaum Associates, Inc.

Development and Initial Validation of a Measure of Autonomy, Competence, and Relatedness in Exercise: The Basic Psychological Needs in Exercise Scale

Symeon P. Vlachopoulos and Sotiria Michailidou
Department of Physical Education and Sport Science at Serres
Aristotle University of Thessaloniki, Greece

The development process and initial validation of the Basic Psychological Needs in Exercise Scale (BPNES) are presented in this study. The BPNES is a domain-specific self-report instrument designed to assess perceptions of the extent to which the innate needs for autonomy, competence, and relatedness (Deci & Ryan, 2000) are satisfied in exercise. Two separate samples of 508 and 504 participants were employed from private fitness centers for scale calibration and validation purposes, respectively. The results demonstrated an adequate factor structure, internal consistency, generalizability of the factor dimensionality across the calibration and the validation samples, discriminant validity and predictive validity; acceptable stability of the BPNES scores over 4 weeks also was found. In addition, the scale scores were found to be largely unaffected by socially desirable responding and specifically the tendency for impression management.

Key words: self-determination, intrinsic motivation, physical activity

Understanding why individuals participate in and adhere to exercise has attracted considerable attention in exercise science research (Biddle, 1995; Dishman, 1994; Doganis & Theodorakis, 1995; McAuley, Pena, & Jerome, 2001; Vallerand, 2001). Ryan, Frederick, Lepes, Rubio, and Sheldon (1997) have successfully employed Self-determination Theory (SDT; Deci & Ryan, 1985, 2000) in this respect. In the

Correspondence should be sent to Symeon Vlachopoulos, Aristotle University of Thessaloniki, Department of Physical Education and Sport Science at Serres, TEFAA Serres, Laboratory of Social Research on Physical Activity, Agios Ioannis, Serres 62 110, Greece. E-mail: vlachop@phed-sr.auth.gr

context of SDT, social-contextual supports of the basic psychological needs for autonomy, competence, and relatedness are considered essential to motivation and psychological growth in any domain (Ryan, 1995).

The need for autonomy reflects the desire of individuals to be the origin or source of their own behavior (Deci & Ryan, 1985) and is experienced when individuals perceive their behavior as self-endorsed (Ryan & La Guardia, 2000). The need for competence refers to one's propensity to interact effectively with one's environment and to experience opportunities to exercise and express one's capacities (Ryan & La Guardia, 2000). Producing desired outcomes and preventing undesired events, however, cannot satisfy the needs for autonomy and relatedness (Deci & Ryan, 2000). The need for relatedness refers to feeling connected with significant others, cared for, or that one belongs in a given social milieu. According to Ryan and La Guardia (2000), relatedness reflects "the desire to have others to respond with sensitivity and care to one's experience and who convey that one is significant and loved" (p. 150). Factors in the social environment that fulfill the needs for autonomy, competence, and relatedness will facilitate intrinsic motivation and the internalization of extrinsic motivation, whereas neglecting or thwarting of these needs will adversely affect self-determined motivation (Vallerand, 1997, 2001). These nonhierarchical, innate, and universal needs differ from one's conscious or unconscious wants or goals and refer to the nutriments or the conditions that are essential to psychological growth. Psychological health requires that all three needs are satisfied (Deci & Ryan, 2000).

Ryan (1995) has recognized that differences in the degree to which the three needs are supported between domains may lead to differences in integration within the individual. According to Vallerand's (1997) hierarchical conceptualization of motivation, the innate needs and motivations are represented at three levels of generality: the global (personality) level, the contextual (life domain) level, and the situational level. Top-down and bottom-up influences are forwarded among these levels whereby individuals' motivation at higher levels in the hierarchy affects motivation in lower levels whereas the reverse is also true. Owing to the emphasis placed on domain-specific research by Ryan (1995) and Vallerand (1997), domain-specific scales are necessary to explain and predict behavior accurately in various domains. The extent to which the three needs are satisfied in various domains has been examined in a number of studies using context-specific scales such as the Basic Need Satisfaction at Work Scale (Deci et al., 2001) and the Basic Need Satisfaction in Relationships Scale (La Guardia, Ryan, Couchman, & Deci, 2000).

A number of researchers who have employed a diary methodology have demonstrated that fulfillment of the basic psychological needs corresponded with greater well-being (Gagne, Ryan, & Bargmann, 2003; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Ryan, & Reiss, 1996). Researchers using a goal methodology have concluded that satisfaction of the three needs during an activity predicted enhanced well-being (Sheldon & Elliot, 1999), whereas researchers using cross-sectional designs have demonstrated the positive motivational influences of the fulfillment of the basic needs in various contexts such as education (Vallerand, Fortier, & Guay, 1997), sport (Reinboth, Duda, & Ntoumanis, 2004), exercise (Markland, 1999), and work (Deci et al., 2001), as well as in relation to well-being (Sheldon & Bettencourt, 2002), and prosocial behavior (Gagne, 2003). Overall, need fulfillment systematically leads to enhanced motivation and psychological well-being within various life domains.

According to Ryan (1995) and in line with predictions in Vallerand's (1997, 2001) Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM), need support will promote psychological well-being, satisfaction, and the experience of a number of exercise-related positive motivational consequences. We hypothesized that in exercise, such consequences would be higher levels of exercise enjoyment and interest in the activity, higher concentration on the task during exercise, a more positive attitude toward exercise, stronger intention for continued exercise involvement, a greater sense of felt control over sustaining exercise involvement, and higher frequency of weekly exercise participation. According to Vallerand (2001), the effects of the innate needs on the motivational consequences are theoretically channeled through the participants' motivations for exercising. The more the participants' basic needs are satisfied, the more one's levels of self-determined motivation may increase, leading to enhanced psychological functioning (Deci, 1980).

Flow state (Jackson, 1996) is an enjoyable state relevant in the context of exercise participation. As concentration is a flow component (Jackson, 1996), individuals who enjoy and are absorbed in the process of exercise are expected to be highly concentrated on the task at hand. As far as attitude and intention are concerned, and in line with the three-component view of the attitude construct (Ajzen & Fishbein, 1980), the experience of enhanced psychological functioning may contribute to the affective component of the participants' attitude toward exercise which in turn may strengthen participants' attitudes. In turn, a positive attitude may contribute to stronger intentions for sustaining exercise involvement (Ajzen & Fishbein, 1980); hence, attitude and intention were expected to be positively predicted by the need constructs. In addition, a positive link was expected between need satisfaction and internal locus of control but not external locus of control. Higher levels of self-determination correspond with a greater sense of ownership of the enactment of exercise behavior, and, consequently, a greater sense of an internal but not an external locus of control. Finally, the higher levels of enjoyment and satisfaction that may accrue from support of the basic needs may correspond with a higher weekly frequency of exercise participation.

With respect to the relative importance of each of the three needs in predicting the motivational outcomes, the need for competence was expected to correlate more strongly with the positive motivational consequences compared to the needs for autonomy and relatedness. Such a finding was expected due to the nature of the domain under study where the physical and athletic element dominates. Clearly, a perception of progress with respect to the end result and feelings of effectance in exercise were expected to more powerfully predict the positive motivational outcomes under study. Furthermore, because intrinsically motivated behaviors are based on people's needs to feel competent and self-determined (Deci, 1975) and because interest is said to be the basis of intrinsically motivated behavior (Izard, 1977), enjoyment and interest was expected to correlate more strongly with autonomy compared with the remaining outcomes. With regard to relatedness, Deci and Ryan (2000) discussed the less central role of this need in the maintenance of intrinsically motivated behavior for some situations. They suggested that supports of relatedness may not be necessary as proximal factors in the maintenance of intrinsic motivation in situations where individuals may engage in isolation. Therefore, because many individuals engage in exercise in isolation, the motivational outcomes were expected to more strongly correlate with autonomy and competence rather than relatedness.

Despite the importance of a domain-specific instrument to assess the extent to which the three innate psychological needs are satisfied in exercise, the lack thereof may impede progress in better understanding the role of the three needs in the initiation and maintenance of exercise behavior. Therefore, this study was designed to investigate the development and initial validation of an exercise-specific self-report scale to assess perceptions of autonomy, competence, and relatedness among exercise participants. Such an endeavor would contribute an instrument useful in testing the theoretical tenets of SDT with respect to the role of the need constructs in motivational processes underpinning exercise involvement.

PURPOSE AND HYPOTHESES

This study included the following scale construction steps: (a) the item development and the examination of the content validity of the scale; (b) the item selection for inclusion into the final version of the scale; (c) the examination of the factor structure, internal consistency, generalizability validity, and discriminant validity; (d) the examination of the predictive validity of the scale and the degree to which the BPNES item scores are susceptible to socially desirable responding; (e) the extent to which the psychometric properties of the scale in the calibration sample would be replicable in a validation sample; and (f) the test–retest reliability of the instrument's scores over a 4-week period.

The hypotheses forwarded were that (a) the selected items would confirm the hypothesized three-factor structure; (b) the instrument subscales would emerge internally consistent; (c) the factor structure of the scale would be invariant across the calibration and the validation samples including specifically the factor loadings, factor variances, factor covariances, and item uniquenesses; (d) the instrument's factors would emerge as related but distinct constructs; (e) the subscales' mean scores would be predictive of key exercise-related motivational outcomes and would be related in theoretically expected ways with such outcomes; (f) the items and subscale mean scores would not attract socially desirable responses; and (g) the need subscale mean scores would remain relatively stable over a 4-week time period (i.e., mean stability; Schutz, 1998). As far as the relationships with the motivational outcomes were concerned, all of the outcomes were hypothesized to be more strongly correlated with autonomy and competence rather than relatedness whereas the external locus of control would be unrelated to all of the need variables because it does not reflect any degree of responsibility on the part of the participants for regulating their exercise behavior. Finally, enjoyment and interest would be more strongly correlated with both autonomy and competence compared to the remaining outcomes.

METHOD

Participants

Both samples comprised Greek-speaking exercise participants, men and women, ages 18 to 64 years who voluntarily participated in organized exercise programs in private fitness centers. Participants were paying to use the fitness centers. This population was targeted because approximately 50% of such participants are at risk of dropping out of organized exercise programs within 6 months from program initiation (Dishman, 1994). Item selection and initial validity examination of the items took place in the calibration sample (CS) whereas a validation sample (VS) was used to examine the extent to which the psychometric properties would be replicated in a separate sample representing the same population. Data from the VS were collected 5 months after data had been collected from the CS. Individuals were not randomly assigned to the samples. The samples were different in terms of individuals who comprised the samples, fitness centers used, and the time period in which data collection took place.

Calibration Sample

There were 508 Greek-speaking exercise participants attending structured exercise programs in five large private fitness centers in Thessaloniki, a city in the northern part of Greece. The gender breakdown was 254 men and 254 women. All participants had attended at least six exercise sessions by the time they provided their responses. The participants' age ranged from 18 to 55 years (M = 30.06 years, SD = 8.13 years). Their exercise experience ranged from a few months to 38 years (M = 8.18 years, SD = 7.30 years). The weekly frequency of their exercise participation ranged from one to seven times per week (M = 3.82, SD = 1.16). Their average exercise class duration was approximately 1½ hr (M = 84.55 min, SD = 29.69 min). For activity type, 102 participants (20.1%) reported that they were mainly involved in group-type activities such as aerobics, body pump, tae-bo, and cycling, whereas 313 participants (61.6%) were mainly involved in conventional weight-training activities such as free style weight lifting. Finally, 93 participants (18.3%) reported exercise activity involving a combination of the aforementioned activities.

Validation Sample

There were 504 participants attending structured exercise programs in five large private fitness centers, different from the centers used for the CS, in Thessaloniki, Greece. There were 246 men (48.8%) and 258 women (51.2%). All of the participants had attended at least six exercise sessions by the time they provided their responses. Participants' age ranged from 18 to 65 years (M = 28.92 years, SD = 8.45 years). The participants' exercise experience ranged from a few months to 45 years (M = 6.88 years, SD = 6.91 years). The weekly frequency of exercise attendance ranged from one to seven times (M = 3.74, SD = 1.07) and the average exercise class duration ranged from 40 to 240 min (M = 85.08, SD = 30.08). For activities, 109 participants (21.6%) reported that they were mainly involved in group-type activities such as aerobics, body pump, tae-bo, and cycling, whereas 280 participants (55.6%) were mainly involved in conventional weight-training activities such as free style weight lifting. Finally, 108 participants (21.4%) reported exercise activity involving a combination of the aforementioned activities.

Retest Sample

The retest sample comprised 75 exercise participants. Data were collected from one of the fitness centers used for the VS data collection. There were 46 men (61.3%) and 29 women (38.7%). The participants' age ranged from 18 to 55 years (M = 28.43, SD = 8.36). The participants' exercise experience ranged from a few months to 45 years (M = 8.64, SD = 8.66), and their weekly attendance in the fitness center ranged from one to six times (M = 4.02, SD = 1.03). The duration of their exercise classes ranged from 45 to 190 min (M = 93.46, SD = 33.77). For activities, 10 participants (13.3%) reported to be involved in group-type activities, 44 (58.7%) in conventional weight-training activities, whereas 21 individuals (28%) reported to be involved in a combination of the aforementioned activities.

Measurement Tools

Seven external variables were assessed. The variables of concentration, attitude, and internal–external locus of control were considered to be cognitive variables.

Exercise enjoyment was considered to be an affective variable. Intention for exercise involvement and frequency of participation were considered to be behavioral variables.

Concentration. To assess the participants' concentration levels, four items were used from the Concentration subscale of the Trait Flow Scale (TFS; Jackson, Kimiecik, Ford, & Marsh, 1998). Construct validity evidence has been reported for the TFS through correlations with theoretically related variables (Jackson et al., 1998). Item wording was modified to become appropriate for use in exercise by substituting the term *sport* with the term *exercise.* The scale items adopted the following stem: "During my participation in this exercise program … ." Sample items were: "My attention is totally focused on what I am doing," and "I find it easy to keep my attention where I should be … ." In line with the TFS response scale, participants provided their responses on a 5-point Likert-type scale ranging from 1 (*never*) to 5 (*always*). The Cronbach's (1951) alpha coefficient was .84 for the CS and .84 for the VS.

Intrinsic Motivation Inventory. To determine the degree to which participants enjoyed their exercise classes, the Enjoyment-Intrinsic Interest subscale was employed from the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) that has been adapted and used successfully with a Hellenic population in school-based physical education classes (Goudas, Dermitzaki, & Bagiatis, 2000). Goudas et al. provided evidence for the structural validity of the IMI in a Hellenic sample. Scale items were modified for use in exercise. The respondents indicated the extent of their agreement with the subscales' items on a 5-point Likert-type scale ranging from 1 (*do not agree at all*) to 5 (*very strongly agree*). Sample items included the following: "In general, I find my involvement in exercise very interesting," and "In general, I have a lot of fun when I exercise." The alpha value was .78 for the CS and .83 for the VS.

Attitude. Attitude toward exercise participation was assessed by the following question: "I think that participating in exercise five times per week is … ." In line with recommendations by Ajzen and Fishbein (1980), participants responded to four bipolar adjectives on a 7-point semantic differential scale (i.e., 1 ["extremely boring"] to 7 ["extremely interesting"]). The adjectives used were "harmful–beneficial," "pleasant–unpleasant," "boring–interesting," and "important–unimportant." The frequency of exercise participation included in these items falls within the guidelines forwarded by the American College of Sports Medicine (ACSM; 1990) for physiological and psychological changes to occur and be maintained through regular exercise participation. Adequate reliability evidence for these items has been provided in a Greek exercise context by Theodorakis (1994). The alpha value for both the CS and the VS was .80.

Intention. To assess strength of intention for continued exercise involvement, three items were used: “I intend/I will try/I am determined to continue participating in this exercise program five times per week for the remainder of this year.” In line with Ajzen and Fishbein (1980), participants responded on a semantic differential scale ranging from 1 (*extremely unlikely*) to 7 (*extremely likely*). Satisfactory reliability has been demonstrated for the intention items in a Greek exercise context (Theodorakis, 1994). Once more the frequency of exercise participation included in the intention items was based on ACSM (1990) guidelines for the appropriate frequency of exercise behavior that should be undertaken for healthy adults to obtain and maintain a number of physiological and psychological benefits. The alpha values for both samples were .95.

Athletic Behavior Locus of Control Scale. To assess the degree to which the participants felt they had control over sustaining their exercise involvement, their internal–external locus of control levels were assessed. To this end, the Athletic Behavior Locus of Control Scale (Θεοδωράκης, 1993) was employed. This scale has been modified for a Greek population based on the Exercise Locus of Control Scale (McCready & Long, 1985). The subscales used in this study were the “Internal Locus of Control” subscale and the “External Locus of Control–Instructor” subscale. Participants indicated their agreement with six “internal locus” and three “external locus” items responding on a 5-point answer scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Items adopted the following stem: “Sustaining my involvement in exercise five times per week for the remainder of this year in the present fitness center depends … .” Sample items for the “internal locus” subscale were as follows: “totally on me,” “on my own actions,” and “on my patience.” For the “external locus” subscale, sample items were “totally on the fitness instructor” and “totally on the fitness instructor’s exercise program.” The alpha values for the internal locus of control were .94 for the CS and .91 for the VS. For external locus of control the alpha values were .87 and .88, respectively, for each one of the samples. Evidence of structural and predictive validity of the scale has been provided by Θεοδωράκης (1993).

Frequency of exercise participation. The weekly frequency of exercise participation served as a behavioral indicator of the participants’ persistence in exercise. Weekly frequency was estimated over the last 2 months from the time of the initiation of data collection.

Social Desirability Scale. To assess the extent to which the scale’s items may be susceptible to social desirability, Reynolds’s (1982) Social Desirability Scale was administered with the aforementioned scales. This is a 13-item shortened version of Crowne and Marlowe’s (1960) Social Desirability Scale that originally comprised 33 items. The items describe culturally approved behaviors that have a low incidence of occurrence. Reynolds (1982) provided satisfactory evidence of factorial validity, reliability, and concurrent validity of the scale.

Item Development and Content Validity

Initially the operational definitions of the constructs of interest were examined. Owing to a lack of existing instruments to assess basic need satisfaction in exercise, the SDT Basic Psychological Needs Scales were consulted (Deci & Ryan, 2001). Thirteen items were written to reflect Autonomy, 10 items to reflect Competence, and 8 items to reflect Relatedness specific to the exercise domain. One of the two researchers had extensive experience as an exercise participant and exercise instructor in private fitness centers. The items were examined by a panel of three judges with SDT expertise. Two of the judges were sport scientists with a doctoral specialization in exercise psychology in the area of SDT, whereas the third judge was a practitioner with a specialization in exercise psychology in the area of SDT. The judges were selected due to their knowledge regarding the concepts of the basic psychological needs in SDT. The judges were provided with the operational definitions of the constructs of interest and were asked to indicate (a) which psychological need they thought each item tapped, (b) the degree of relevance of each item to the construct intended to tap, and (c) the clarity of item wording. One item was deleted from each of the Autonomy and Competence subscales and two new items were added to the Relatedness subscale. The new item list included 12 Autonomy items, 9 Competence items, and 10 Relatedness items. After the new items were examined, they were distributed in questionnaire form to 20 exercise participants from one private fitness center to actively engage the participants in the process of content validation. The participants were provided with written instructions and were asked to comment in writing on the form, on the clarity and personal relevance of the items in the context of exercise, and to highlight any problems with item comprehension. The item response format was a 5-point Likert-type scale anchored by 1 (t*otally disagree*), 2 (*agree a little bit*), 3 (*moderately agree*), 4 (*strongly agree*), and 5 (*very strongly agree*).

Procedures

Due to a lack of a comprehensive list of the Greek exercising population, nonprobability sampling procedures were used with convenience sampling. Participants were included in each sample to achieve a ratio of participants to parameters to be estimated in the three-factor CFA model greater than 15 to 1. The same procedures were followed during data collection for both samples. Initially, the fitness center managers were informed about the purpose of the study and permission for approaching the participants was secured. The participants were systematically intercepted by research assistants (every second person) around reception areas during various times of day (morning, afternoons, and evenings). Data were collected during both weekdays and weekends. Before administration of the questionnaires, the participants signed an informed consent form for participation in the study while they were informed that no harm or danger of any kind was involved and that their participation would be anonymous. The questionnaires were completed before initiation of the exercise class. Questionnaire completion took approximately 12 min.

Data Analyses

To select the final BPNES items, the model generating approach (Jöreskog, 1993) was employed through CFA procedures using the EQS software (Bentler, 1995). The first phase of the analyses involved estimating three "one-factor" CFA models, one for each BPNES factor. The aim was to identify those items that strongly defined their intended factor and drop those items that were weakly associated with the factor. The second phase involved the estimation of "two-factor" CFA models with correlated factors representing all the possible pairs of the BPNES factors (see Table 1). The purpose was to identify those items whose presence in the models maximized the overall goodness-of-fit indexes, and drop the remaining items. The items to be dropped were identified by inspection of the goodness-of-fit indexes and the largest standardized residuals provided by EQS. The third phase of the analyses involved the estimation of one "three-factor" CFA model including the final 12 items to be included in the scale.

In line with Hoyle and Panter (1995), the fit indexes used for model assessment were the chi-square statistic (χ^2), the Comparative Fit Index (CFI), and the

TABLE 1
Fit Indexes for One-Factor and Two-Factor CFA Models in Phases 1 and 2

Scale or Item	χ^2	*df*	*p* (χ^2)	*NNFI*	*CFI*	*SRMR*	*RMSEA*
Phase 1							
Autonomy (four items)	5.842	2	.181	.987	.996	.014	.062
Competence (five items)	32.050	5	.001	.952	.976	.027	.103
Relatedness (seven items)	86.869	14	.000	.961	.974	.025	.101
Phase 2							
Autonomy/competence (eight items)	79.298	19	.001	.959	.972	.035	.079
Autonomy/relatedness (nine items)	82.688	26	.001	.975	.982	.038	.066
Competence/relatedness (nine items)	137.922	26	.001	.950	.964	.035	.092

Note. *N* = 508. CFA = Confirmatory Factor Analysis; NNFI = Non-Normed Fit Index; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Residual: RMSEA = Root Mean Squared Error of Approximation.

Non-Normed Fit Index (NNFI). CFI values range between 0 and 1 and are unaffected by sample size (Byrne, 1994). NNFI and CFI values greater than .90 indicate a good fit of the model to the data (Hu & Bentler, 1995), whereas values greater than .95 indicate an excellent fit (Hu & Bentler, 1999). In addition, the Standardized Root Mean Residual (SRMR), the Root Mean Squared Error of Approximation (RMSEA), and the 90% RMSEA confidence interval (CI) were examined. Values close to .08 for the SRMR and .06 for the RMSEA are indicative of an adequate model fit (Hu & Bentler, 1999). The 90% RMSEA CI was examined to assess the stability of the RMSEA across samples. Also, the Akaike's Information Criterion (AIC) was used for comparing competing CFA models because it takes into account both the goodness of fit of the model and the number of parameters that have to be estimated to achieve that degree of fit in a balanced way (Bentler, 1995).

RESULTS

The results section includes three major sections entitled confirmatory factor analysis, predictive validity, and test–retest reliability. The first section includes subsections on descriptive statistics, discriminant validity, and factorial invariance.

Confirmatory Factor Analysis

Statistical description of BPNES items. The univariate skewness values of the BPNES items ranged from –1.02 to –.34 for the CS and from –.78 to –.11 for the VS. The univariate kurtosis values ranged from –.41 to 1.09 for the CS and from –.31 to .75 for the VS. The Mardia's coefficient (Mardia, 1970) of multivariate kurtosis was 83.97 for the CS and 47.16 for the VS indicating multivariate normality in both samples. For this CFA model, multivariate normality was indicated by Mardia's values lower than 168 based on the formula $p\ (p+2)$ where p equals the number of observed variables (see Bollen, 1989). The results of the final three-factor CFA model (see Table 2 for scale items) showed an adequate fit of the model to the data for both the CS ($\chi^2 = 166.43$, $p < .001$, $df = 51$, NNFI = .96, CFI = .96, SRMR = .04, RMSEA = .06, 90% CI = .05–.07) and the VS ($\chi^2 = 122.28$, $p < .001$, $df = 51$, NNFI = .97, CFI = .97, SRMR = .03, RMSEA = .05, 90% CI = .04–.06). In the CS, the factor loadings ranged from .59 to .91. The latent factor correlations were .79 (Autonomy-Competence), .50 (Autonomy-Relatedness), and .41 (Competence-Relatedness). In the VS, the factor loadings ranged from .60 to .89. The correlations between the need latent factors were .76 (Autonomy-Competence), .48 (Autonomy-Relatedness), and .55 (Competence-Relatedness). Stan-

TABLE 2
Three–Factor CFA Parameter Estimates for the BPNES Items on the Validation Sample

BPNES Items	*Skewness*	*Kurtosis*	*Item Loadings*	*Item Uniqueness*	*SMCs*
Autonomy 1: The exercise program I follow is highly compatible with my choices and interests.	–.595	.264	.699	.715	.488
Autonomy 2: I feel very strongly that the way I exercise fits perfectly the way I prefer to exercise.	–.781	.756	.765	.644	.585
Autonomy 3: I feel that the way I exercise is definitely an expression of myself.	–.419	.184	.750	.661	.563
Autonomy 4: I feel very strongly that I have the opportunity to make choices with respect to the way I exercise.	–.575	.390	.847	.531	.718
Competence 1: I feel I have been making a huge progress with respect to the end result I pursue.	–.331	–.013	.599	.801	.359
Competence 2: I feel that I execute very effectively the exercises of my training program.	–.419	.057	.713	.701	.508
Competence 3: I feel that exercise is an activity in which I do very well.	–.403	.431	.790	.614	.624
Competence 4: I feel that I can manage with the requirements of the training program I am involved.	–.111	.068	.750	.662	.562
Relatedness 1: I feel extremely comfortable when with the other exercise participants.	–.365	–.250	.901	.435	.811
Relatedness 2: I feel that I associate with the other exercise participants in a very friendly way.	–.362	–.313	.895	.446	.801
Relatedness 3: I feel there are open channels of communication with the other exercise participants.	–.451	–.148	.770	.638	.593
Relatedness 4: I feel very much at ease with the other exercise participants.	–.357	–.180	.869	.495	.754

Note. N = 504. CFA = Confirmatory Factor Analysis; BPNES = Basic Psychological Needs in Exercise Scale; SMC = Squared Multiple Correlation. All factor loadings and item uniquenesses are statistically significant ($p < .05$).

dardized factor loadings, squared multiple correlations, and item uniqueness estimates based on the VS together with the item wording are presented in Table 2.[1]

Discriminant validity. To examine the empirical separability of the BPNES factors, a series of CFA models that involved all the possible combinations of the BPNES factors were compared to the three-factor model. Overall, the results showed that the three-factor model was significantly better compared to the other models in both samples indicating that the three factors were empirically separable (Table 3).

BPNES factorial invariance. To assess the generalizability validity of the scale's scores (Messick, 1995), the instrument's factorial invariance was examined across the CS and the VS. According to Marsh (1993), the invariance of all factor loadings is the minimal condition for factorial invariance. Byrne (1994) argued for the usefulness of "partial invariance" of factor loadings that is a less demanding test. According to Bentler (1995), the invariance of measurement errors is the least important hypothesis to test. In line with Marsh (1993), a totally noninvariant multisample model (Model 1) was computed first to serve as a baseline model on which the following models would be compared. In Model 2, factor loadings were constrained to be equal whereas further equality constraints were added to the factor covariances in Model 3. In Model 4, the factor variances were also constrained to be equal whereas in Model 5, equality constraints were added on item uniquenesses. The goodness-of-fit indexes and results of the chi-square difference tests are presented in Table 4. All the multisample models were in general supported by the data. The Lagrange Multiplier test showed that out of the 12 items, the factor loadings of the third Autonomy and the fourth Competence items emerged as noninvariant, whereas the covariance between the Competence and Relatedness factors was also noninvariant across samples. All factor variances were invariant whereas three item uniquenesses were found to be noninvariant. The chi-square difference tests showed that the more constrained models were significantly worse in terms of fit compared to the less constrained models, except for the difference between Models 3 and 4; however, despite the significance of the model differences, the magnitude of the fit indexes showed that even when all parameters were constrained (Model 5), the model still had an excellent fit to the data (NNFI and CFI > .95; Hu & Bentler, 1999).

Overall, for the CS, BPNES item mean scores ranged from 3.75 to 4.03 for Autonomy, from 3.53 to 4.00 for Competence, and from 3.49 to 3.84 for Relatedness.

---

[1]The BPNES items presented in Table 2 have not been systematically translated from Greek using the back-translation procedure and have not been psychometrically tested for their reliability and validity aspects. They are presented for the purpose of conveying to interested non-Greek-speaking readers the meaning of the items.

TABLE 3
Fit Indexes of the Three-Factor and Alternate BPNES CFA Models in Discriminant Validity Analyses

BPNES CFA Models	χ^2	*df*	*NNFI*	*CFI*	*SRMR*	*RMSEA*	*90% CI*	*AIC*
Calibration sample								
One-factor model: Model 1	1,450.153	54	.539	.623	.133	.226	.216–.236	1,342.152
Two-factor models								
Autonomy-competence: Model 2	314.115	53	.912	.930	.054	.099	.088–.109	208.114
Autonomy-relatedness: Model 3	987.932	53	.686	.748	.168	.187	.176–.197	881.931
Competence-relatedness: Model 4	930.363	53	.705	.763	.176	.181	.170–.191	824.363
Three-factor model: Model 5	166.434	51	.960	.969	.046	.067	.056–.078	64.434
Validation sample								
One-factor model: Model 1	1,172.474	54	.601	.673	.136	.203	.193–.213	1064.474
Two-factor models								
Autonomy-competence: Model 2	284.349	53	.916	.932	.053	.093	.083–.104	178.349
Autonomy-relatedness: Model 3	859.572	53	.707	.746	.147	.174	.164–.184	753.572
Competence-relatedness: Model 4	660.813	53	.779	.823	.135	.151	.141–.161	554.812
Three-factor model: Model 5	122.288	51	.973	.979	.036	.053	.041–.065	20.288

Note. In the two-factor models, each pair of factors indicates those items allowed to load onto the same factor. The remaining items loaded onto their respective factor. BPNES = Basic Psychological Needs in Exercise Scale; CFA = Confirmatory Factor Analysis; NNFI = Non-Normed Fit Index; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Residual; RMSEA = Root Mean Squared Error of Approximation; CI = Confidence Interval; AIC = Akaike's Informaton Criterion.

TABLE 4
Results of BPNES Multisample Analyses Across the Calibration and Validation Samples

Multisample Models	χ^2	*df*	χ^2 *difference*	*df difference*	*NNFI*	*CFI*	*SRMR*	*RMSEA*	*90% CI*
Model 1: Totally noninvariant	288.723	102	—	—	.966	.974	.041	.041	.037–.048
Model 2: Invariant factor loadings	316.765	114	28.04*	12	.967	.972	.067	.042	.036–.047
Model 3: Invariant factor loadings and factor covariances	332.977	117	16.21*	3	.966	.970	.064	.043	.037–.048
Model 4: Invariant factor loadings, factor covariances and factor variances	332.976	117	0.00	0	.966	.970	.064	.043	.037–.048
Model 5: Invariant factor loadings, factor covariances, factor variances, and item uniquenesses	360.449	126	27.47*	9	.966	.967	.062	.043	.038–.048

Note. BPNES = Basic Psychological Needs in Exercise Scale; NNFI = Non-Normed Fit Index; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Residual; RMSEA = Root Mean Squared Error of Approximation; CI = Confidence Interval.

* $p < .05$.

The Cronbach's (1951) alpha values were .84 for Autonomy, .81 for Competence, and .92 for Relatedness. Factor loadings ranged from .60 to .86 for Autonomy, from .59 to .78 for Competence, and from .80 to .91 for Relatedness. Item correlations with the Social Desirability Scale ranged from .00 to .18, whereas the correlation with the mean Autonomy score was .13, with the mean Competence score it was .14, and with the mean Relatedness score it was .17. All the correlation values were significant ($p < .05$, $N = 508$) except for the first Competence item. The values obtained from the VS on the aforementioned statistical indexes were very close to those reported for the CS.

Predictive Validity

A series of latent variable structural equation models (SEM) were tested to determine the predictive efficacy of each one of the latent need constructs with respect to the outcome variables. These latent outcome variables were concentration, enjoyment and interest, attitude toward exercise, intention for continued exercise involvement, internal locus of control, external locus of control, and weekly frequency of exercise participation. Frequency was treated as an observed variable in a nonstandard SEM model (see Bentler, 1995). Besides the amount of variance predicted in each outcome variable by the three needs, the extent of invariance of the structural path coefficients across the samples was also examined through multisample analyses.

The completely standardized beta coefficients (structural paths) reported are based on the CS. For concentration, the coefficients were –.11 (*ns*) for Autonomy, .56 ($p < .05$) for Competence, and .06 (*ns*) for Relatedness (26% variance explained; NNFI = .97, CFI = .97, RMSEA = .04). For enjoyment and interest, the coefficients were .25 ($p < .05$) for Autonomy, .51 ($p < .05$) for Competence, and .05 (*ns*) for Relatedness (58% variance explained; NNFI = .96, CFI = .96, RMSEA = .05). For attitude, the coefficients were .07 (*ns*) for Autonomy, .40 ($p < .05$) for Competence, and .04 (*ns*) for Relatedness (23% variance explained; NNFI = .94, CFI = .95, RMSEA = .06). For intention, the coefficients were .03 (*ns*) for Autonomy, .30 ($p < .05$) for Competence, and .04 (*ns*) for Relatedness (12% variance explained; NNFI = .96, CFI = .97, RMSEA = .06). For internal locus of control, the coefficients were .01 (*ns*) for Autonomy, .24 ($p < .05$) for Competence, and .04 (*ns*) for Relatedness (7% variance explained; NNFI = .95, CFI = .96, RMSEA = .06). For external locus of control, the coefficients were .00 (*ns*) for Autonomy, –.03 (*ns*) for Competence, and .06 (*ns*) for Relatedness (0% variance explained; NNFI = .96, CFI = .97, RMSEA = .05). For frequency of exercise participation, the coefficients were .14 (*ns*) for Autonomy, .21 ($p < .05$) for Competence, and –.03 (*ns*) for Relatedness (10% variance explained; NNFI = .95, CFI = .96, RMSEA = .06). A series of multisample analyses with equality constraints on the structural path coefficients demonstrated invariance for all the path coefficients across the two samples except for the coefficient of the link of Autonomy with enjoyment and interest. The completely standardized value of the coefficient for the VS was .52 ($p < .05$). The invariance of the path coefficients demonstrated the robustness of the predictive validity findings.

Test–Retest Reliability

To assess the test–retest reliability of the BPNES subscale scores, 75 exercise participants of the VS were re-assessed over a 4-week period. Similar intervals have been used in examining the temporal stability of scores from domain-specific scales assessing variables in the SDT framework in exercise and sport (1-week interval, Li, 1999; 5-week interval, Pelletier et al., 1995). To examine the stability of the scales, the intraclass correlation coefficient (ICC; Vincent, 1995) was used. ICC values between .70 and .80 indicate acceptable levels of stability, between .80 and .89 moderate levels of stability, and .90 or higher high stability (Vincent, 1995). For Autonomy, the mean score changed from 3.94 (*SD* = 0.66) to 3.97 (*SD* = 0.67) with an ICC value of .97. For Competence, the mean changed from 3.80 (*SD* = 0.57) to 3.81 (*SD* = 0.59) with an ICC value of .97. For Relatedness, the mean changed from 3.70 (*SD* = 0.73) to 3.74 (*SD* = 0.75) with an ICC value of .97. The results revealed high levels of test–retest reliability for all three BPNES subscales.

DISCUSSION

The development and initial validation of the BPNES, a domain-specific self-report instrument designed to assess perceptions of the extent to which the innate psychological needs for Autonomy, Competence, and Relatedness are satisfied in exercise (Deci & Ryan, 1985, 2000), have been reported here. The results of this study largely supported a number of psychometric qualities of the scale including its factorial composition, internal consistency, test–retest reliability over a 4-week period, the reproducibility of the factor structure across two separate samples representing the same population, discriminant validity, predictive validity with respect to a number of motivational outcomes, and low correlations between the need scores and social desirability scores.

BPNES Factor Composition and Reliability

The results of the CFA supported the three-factor structure of the BPNES. The results revealed that the 12 BPNES items had an acceptable factor structure with strong factor loadings to define their respective factors. Factor correlations were of a moderate size except for the correlation between Autonomy and Competence that was quite strong; however, despite the sizeable correlation between these factors, comparisons of competing CFA models in the context of discriminant validity analyses demonstrated that they represented correlated but distinct constructs.

In the context of discriminant validity analyses, the model in which the Autonomy and Competence items were specified to load onto the same factor resulted into acceptable goodness-of-fit indexes, yet much worse than the fit indexes of the three-factor model. Accepting the two-factor model as correctly specified would imply that the combined Autonomy-Competence factor would be employed for predicting various motivational outcomes; however, the predictive validity results revealed that it was only enjoyment/interest that was independently predicted by both Autonomy and Competence scores whereas all the remaining outcomes except the external locus of control were predicted significantly and considerably only by the Competence factor. These findings in conjunction with the considerably better fit indexes of the three-factor model led us to accept the initially hypothesized three-factor model as the best representation of the latent structure of the BPNES responses.

The extent to which the factor structure that emerged from the CS would be replicable in the VS was examined through tests of factorial invariance. Despite that the factor structure was confirmed in both the CS and the VS independently through CFA, the tests of factorial invariance demonstrated the equivalence of all the factor loadings across the samples except for the third Autonomy and the fourth Competence items; however, in both samples, these particular factor loadings were greater than .750. These results supported the robustness of the BPNES factor composition. In line with calls for assessment of scale dimensionality in populations different from the one on which the scale was developed (Messick, 1995), the BPNES factor structure should be examined in other exercising populations such as older individuals, and contexts such as community fitness centers and rehabilitation clinics where developing a better understanding of exercise adherence is an important research goal. Evidence of factorial invariance across populations would further enhance the generalizability validity of the scale.

With respect to the sizeable correlation between the Autonomy and Competence factors that reflected 62% common variance in the CS and 57% common variance in the VS, researchers should be aware of the potential problem that this high correlation may cause in predictive analyses. That is, the great overlap between the constructs may mask important relationships with other variables due to collinearity effects. Hence, researchers should attempt to determine the unique relationships between these need constructs and the criterion variables.

The results of this study supported the adequate internal consistency of the BPNES subscales indicating a tight item structure within subscales. Furthermore, the results of the test–retest reliability analyses demonstrated a high level of stability of the subscale mean scores over a 4-week period, indicating that the participants' scores on the instrument are relatively stable over time. These findings are consistent with the assessment of the need constructs at the contextual level (Vallerand, 1997, 2001); however, because changes in the perceptions of need satisfaction at the context level may require interventions that may last longer than 4 weeks, the stability of the scale scores needs to be examined over longer time intervals in future studies.

Construct Validity of the BPNES

The predictive validity of the BPNES was supported through the examination of the relationships between the need constructs and the motivational outcomes of concentration during exercise, enjoyment/interest, attitude toward exercise, intention for continued exercise involvement, internal and external loci of control, and weekly frequency of exercise participation. The latent variable structural equation modeling analyses supported the predictive validity of the BPNES subscales by confirming the hypotheses.

With respect to the relative contribution of Autonomy and Competence in the prediction of the motivational outcomes, the results demonstrated that it was the need for Competence that appeared considerably stronger compared to Autonomy in predicting all of the motivational outcomes except enjoyment/interest and external locus of control. Enjoyment/interest was predicted by both needs whereas external locus of control was not predicted by any of them. That is, except these two outcomes, the need for Competence appeared as the stronger and only significant predictor of concentration, attitude, intention, internal locus of control, and frequency of exercise participation. These findings speak to the importance of the need for Competence in predicting factors that may be responsible for the maintenance of exercise behavior in a context where the physical and athletic element dominates. That is, perceptions of progress with respect to the end result and feelings of effectance with respect to the activity are central to the maximization of motivational outcomes that may be responsible for the maintenance of exercise behavior.

As far as the contribution of Autonomy is concerned, it was only enjoyment/interest that was predicted by this subscale. According to Deci (1975), intrinsically motivated behaviors are based on people's needs to feel competent and self-determined. Because interest is the prototype of intrinsically motivated behavior (Izard, 1977), the fact that only enjoyment/interest was predicted by scores of the Autonomy subscale supported the predictive validity of the Autonomy subscale scores. Finally, the fact that neither of the subscale scores predicted external locus of control confirmed theoretical expectations with respect to the relationship between the constructs.

As far as the magnitude of the contribution of the need for Relatedness in the prediction of the outcomes is concerned, the results demonstrated that Relatedness did not contribute to the prediction of any of the outcomes. These findings are consistent with Deci and Ryan's (2000) position; they argued for the possibility that the need for Relatedness in some occasions may be less central for intrinsically motivated behavior than Autonomy and Competence, and especially in situations in which people engage in isolation. That is, Relatedness may not be necessary as a proximal factor in maintaining intrinsic motivation. Such a phenomenon may be frequently observed in the exercise domain where many individuals exercise in isolation.

The predictive validity of the BPNES was also supported by the considerable amounts of variance explained in most of the outcome variables such as concentration, enjoyment/interest, attitude, intention, and frequency of exercise behavior but not internal and external locus of control (less than 10% variance explained). At last, the robustness of the predictive validity findings was supported by the large extent of invariance of the structural path coefficients across the CS and the VS. In sum, strong evidence has emerged for the predictive validity of the BPNES scores. Given that the specific names given to scales are based on a priori expectations rather than empirical evidence, future research studies should be designed to aid in clarifying the specific meanings of scores from the three BPNES factors as well as to examine the predictive validity of the instrument with a wider range of behavioral motivational outcomes relevant to exercise involvement such as levels of exercise adherence or dropout in various populations and contexts.

Given the possibility that the BPNES items might be susceptible to the social desirability response bias, the results revealed that they were largely unaffected by this type of bias. According to Paulhus (1991), the Crowne–Marlowe Social Desirability Scale (Crowne & Marlowe, 1960) that was presently used assesses the impression management aspect of social desirability; hence, the BPNES scores have been shown to be largely unaffected from this particular response bias.

In general, the psychometric properties of the BPNES have received initial support. Because the BPNES is a new instrument, more research should be conducted to further examine the construct validity of the scale. Furthermore, and in line with the HMIEM (Vallerand, 1997, 2001), future research attempts may focus on examining social-psychological factors that may enhance or impede the satisfaction of the three innate psychological needs in exercise. Understanding the impact of such factors on the extent to which these needs are satisfied will promote knowledge concerning practical ways to achieve exercise participants' innate need support. Fulfillment of these needs may, in turn, enhance exercise participants' intrinsic motivation and self-determined forms of extrinsic motivation. These, in turn, may result in a number of positive motivational consequences such as long-term exercise involvement.

ACKNOWLEDGMENTS

Thanks are extended to Maria Hassandra, Vassilios Papacharisis, and Frederiki Moustaka, for their contribution to the item examination procedures, as well as to three anonymous reviewers and Barbara E. Jensen (co-editor), for their contribution during the review process in developing the quality of this article.

Readers interested in the Greek version of the BPNES may contact the lead author.

REFERENCES

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice Hall.

American College of Sports Medicine. (1990). American College of Sports Medicine position stand: The recommended quantity and quality of exercise for developing and maintaining cardio-respiratory and muscular fitness in healthy adults. *Medicine and Science in Sports and Exercise, 22,* 265–274.

Bentler, P. M. (1995). *EQS structural equations program manual.* Los Angeles: BMDP Statistical Software.

Biddle, S. J. H. (1995). Exercise motivation across the life span. In S. J. H. Biddle (Ed.), *European perspectives on exercise and sport psychology* (pp. 3–25). Champaign, IL: Human Kinetics.

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

Byrne, B. M. (1994). One application of structural equation modeling from two perspectives: Exploring the EQS and LISREL strategies. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 138–157). Thousand Oaks, CA: Sage.

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

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24,* 349–354.

Deci, E. L. (1975). *Intrinsic motivation.* New York: Plenum.

Deci, E. L. (1980). *The psychology of self-determination.* Lexington, MA: Heath.

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

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.

Deci, E. L., & Ryan, R. M. (2001). *Questionnaires: Basic Psychological Needs Scales.* Retrieved September 11, 2001, from http://www.psych.rochester.edu/SDT/measures/needs.html

Deci, E. L., Ryan, R. M., Gagne, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former Eastern Block country: A cross-cultural study of self-determination. *Personality and Social Psychology Bulletin, 27,* 930–942.

Dishman, R. K. (1994). *Advances in exercise adherence.* Champaign, IL: Human Kinetics.

Doganis, G., & Theodorakis, Y. (1995). The influence of attitude on exercise participation. In S. J. H. Biddle (Ed.), *European perspectives on exercise and sport psychology* (pp. 26–49). Champaign, IL: Human Kinetics.

Gagne, M. (2003). The role of autonomy support and autonomy orientation in prosocial behavior engagement. *Motivation and Emotion, 27,* 199–223.

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.

Goudas, M., Dermitzaki, I., & Bagiatis, K. (2000). Predictors of students’ intrinsic motivation in school physical education. *European Journal of Psychology of Education, 15,* 271–280.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 158–176). Thousand Oaks, CA: Sage.

Hu, L., & Bentler, P. M. (1995). Evaluating model fit. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 76–99). Thousand Oaks, CA: Sage.

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.

Izard, C. (1977). *Human emotions.* New York: Plenum.

Jackson, S. A. (1996). Toward a conceptual understanding of the flow experience in elite athletes. *Research Quarterly for Exercise and Sport, 67,* 76–90.

Jackson, S. A., Kimiecik, J. C., Ford, S. K., & Marsh, H. W. (1998). Psychological correlates of flow in sport. *Journal of Sport and Exercise Psychology, 20,* 358–378.

Jöreskog, K. G. (1993). Testing structural equation models. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 294–316). Newbury Park, CA: Sage.

La Guardia, J. G., Ryan, R. M., Couchman, C. E., & Deci, E. L. (2000). Within-person variation in security of attachment: A self-determination theory perspective on attachment, need fulfillment, and well-being. *Journal of Personality and Social Psychology, 79,* 367–384.

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

Mardia, K. V. (1970). Measures of multivariate skewness and kurtosis with applications. *Biometrica, 57,* 519–530.

Markland, D. (1999). Self-determination moderates the effects of perceived competence on intrinsic motivation in an exercise setting. *Journal of Sport and Exercise Psychology, 21,* 351–361.

Marsh, H. W. (1993). The multidimensional structure of physical fitness: Invariance over gender and age. *Research Quarterly for Exercise and Sport, 64,* 256–273.

McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 60,* 48–58.

McAuley, E., Pena, M. M., & Jerome, G. J. (2001). Self-efficacy as a determinant and an outcome of exercise. In G. C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 235–261). Champaign, IL: Human Kinetics.

McCready, M. L., & Long, B. C. (1985). Locus of control, attitudes toward physical activity, and exercise adherence. *Journal of Sport Psychology, 7,* 346–359.

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.

Paulhus, D. L. (1991). Measurement and control of response bias. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.), *Measures of personality and social psychological attitudes: Vol. 1: Measures of social psychological attitudes* (pp. 17–59). San Diego, CA: Academic.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., Tuson, K. M., Briere, N. M., & Blais, M. R. (1995). Toward a new measure of intrinsic motivation, extrinsic motivation, and amotivation in sports: The Sport Motivation Scale (SMS). *Journal of Sport and Exercise Psychology, 17,* 35–62.

Reinboth, M., Duda, J. L., & Ntoumanis, N. (2004). Dimensions of coaching behavior, need satisfaction, and the psychological and physical welfare of young athletes. *Motivation and Emotion, 28,* 297–313.

Reiss, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin, 26,* 419–435.

Reynolds, M. W. (1982). Development of reliable and valid short forms of the Marlowe–Crowne social desirability scale. *Journal of Clinical Psychology, 38,* 119–125.

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality, 63,* 397–427.

Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology, 28,* 335–354.

Ryan, R. M., & La Guardia, J. G. (2000). What is being optimized? Self-determination theory and basic psychological needs. In S. H. Qualls & N. Abeles (Eds.), *Psychology and the aging revolution: How we adapt to longer life* (pp. 145–172). Washington, DC: American Psychological Association.

Schutz, R. W. (1998). Assessing the stability of psychological traits and measures. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 393–408). Morgantown, WV: Fitness Information Technology.

Sheldon. K. M., & Bettencourt, B. A. (2002). Psychological need-satisfaction and subjective well-being within social groups. *British Journal of Social Psychology, 41,* 25–38.

Sheldon, K. M., & Elliot, A. J. (1999). Goal striving, need satisfaction, and longitudinal well-being: The Self-Concordance Model. *Journal of Personality and Social Psychology, 76,* 482–497.

Sheldon, K. M., Ryan, R. M., & Reiss, H. T. (1996). What makes for a good day? Competence and autonomy in the day and in the person. *Personality and Social Psychology Bulletin, 22,* 1270–1279.

Theodorakis, Y. (1994). Planned behavior, attitude strength, role identity, and the prediction of exercise behavior. *The Sport Psychologist, 8,* 149–165.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 271–360). San Diego, CA: Academic.

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.

Vallerand, R. J., Fortier, M. S., & Guay, F. (1997). Self-determination and persistence in a real life-setting: Toward a motivational model of high school dropout. *Journal of Personality and Social Psychology, 72,* 1161–1176.

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

Θεοδωράκης Γ. (1993). "Ποιος ευθύνεται; Οι άλλοι, όχι εμείς": Εστία ελέγχου αθλητικής συμπεριφοράς. ["Whose responsibility? Theirs, not ours": Athletic behavior locus of control]. Άθληση & Κοινωνία, *7,* 17–34.