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Psychological Need Thwarting in the Sport Context: Assessing the Darker Side of Athletic Experience

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Research in self-determination theory (Ryan & Deci, 2002) has shown that satisfaction of autonomy, competence, and relatedness needs in sport contexts is associated with enhanced engagement, performance, and well-being. This article outlines the initial development of a multidimensional measure designed to assess psychological need thwarting, an under-studied area of conceptual and practical importance. Study 1 generated a pool of items designed to tap the negative experiential state that occurs when athletes perceive their needs for autonomy, competence, and relatedness to be actively undermined. Study 2 tested the factorial structure of the questionnaire using confirmatory factor analysis. The supported model comprised 3 factors, which represented the hypothesized interrelated dimensions of need thwarting. The model was refined and cross-validated using an independent sample in Study 3. Overall, the psychological need thwarting scale (PNTS) demonstrated good content, factorial, and predictive validity, as well as internal consistency and invariance across gender, sport type, competitive level, and competitive experience. The conceptualization of psychological need thwarting is discussed, and suggestions are made regarding the use of the PNTS in research pertaining to the darker side of sport participation.

Keywords: self-determination theory, autonomy, competence, relatedness, scale development

There is a large body of evidence to suggest that athletes derive many psychological and physiological benefits from their sport participation (Fraser-Thomas, Côté, & Deaken, 2005; Reinboth, Duda, & Ntoumanis, 2004). However, negative experiences in the sport environment are not uncommon (Scanlan, Stein, & Ravizza, 1991; Theberge, 2008). The extreme mental and physical demands often placed

upon athletes can have a detrimental effect upon athlete engagement, performance, and well-being, contributing to negative outcomes such as overtraining and burnout (Gould, 1993), disordered eating (Sundgot-Borgen & Torstveit, 2004), damaged self-esteem, and affective disorders such as anxiety and depression (Fraser-Thomas & Côté, 2009; Krane, Greenleaf, & Snow, 1997). Therefore, it is important to understand how social-contextual factors shape both the positive and negative experiences of athletes in sporting environments (Smoll & Smith, 2002). Based upon the framework of self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2002), the aim of the current paper is to facilitate research into the darker side of sport participation by presenting a scale that assesses athletes' perceptions of psychological need thwarting.

Self-Determination Theory and Basic Psychological Needs

One integral component of SDT is the concept of psychological needs. Basic psychological needs theory (BPNT; Deci & Ryan, 2000), one of five mini-theories within SDT, proposes that people function and develop most effectively as a consequence of social environmental supports for their basic psychological needs. According to BPNT, humans have three innate and developmentally persistent psychological needs, namely those for autonomy, competence, and relatedness. *Autonomy* refers to the degree to which individuals feel volitional and responsible for their own behavior and, therefore, represents a need for an inner endorsement of one's actions (Ryan, 1995). The need for *competence* concerns the degree to which individuals feel effective in their ongoing interactions with the social environment and experience opportunities in which to express their capabilities (Ryan & Deci, 2002). Finally, the need for *relatedness* is defined as the extent to which individuals feel a secure sense of belongingness and connectedness to others in their social environment (Baumeister & Leary, 1995; Ryan, 1995). Satisfaction of these psychological needs is assumed to directly enhance psychological and physical well-being in various life domains (Baard, Deci, & Ryan, 2004; Reeve & Jang, 2006; Ryan, Patrick, Deci, & Williams, 2008). Research conducted in the sport context has also confirmed the utility of examining optimal well-being from a need-fulfillment perspective (Adie, Duda, & Ntoumanis, 2008; Gagné, Ryan, & Bargmann, 2003; Reinboth et al., 2004).

However, "SDT has historically dealt not only with growth and well-being, but equally with the undermining, alienating, and pathogenic effects of need thwarting . . . " (Ryan & Deci, 2000, p. 319). Deci and Ryan (2000) proposed that the deprivation of any need will lead to alternative, and often defensive or self-protective, psychological accommodations which can have severe costs for health and well-being (e.g., low vitality and high levels of emotional and physical exhaustion; Adie et al., 2008). Such psychological accommodations include the development of controlling regulatory styles, compensatory motives or need substitutes, and rigid behavior patterns that may, over time, lead to further thwarting of need satisfaction (Ryan, Deci, Grolnick, & La Guardia, 2006). Controlling regulatory styles represent nonoptimal (i.e., non-self-determined) forms of motivation, such as external regulation (e.g., behaviors motivated by coercive demands and reward contingencies) and introjected regulation (e.g., behaviors motivated by one's sense of guilt, obligation or perceived threats to one's ego). Compensatory motives are

need substitutes that do not really satisfy the thwarted basic need but provide some collateral satisfaction (Deci, 1980). For example, if the need for relatedness is thwarted during childhood, one may compensate by attempting to gain approval or a sense of worth by pursuing image-oriented outcomes, such as accumulating money or material possessions (e.g., Kasser, Ryan, Zax, & Sameroff, 1995). The third intertwined component of the response to need thwarting, the development of rigid behavior patterns, helps protect individuals from the inner hurt that results from psychological need thwarting but also tends to prevent individuals from dealing with their inner experiences (Deci & Ryan, 2000). For example, eating disorders represent one instance of rigid behavior that results from the thwarting of autonomy and competence needs (Bruch, 1973; Pelletier, Dion, & Lévesque, 2004; Strauss & Ryan, 1987).

In summary, need thwarting is hypothesized to lead to patterns of regulations, goals, behaviors, and affect that do not represent the optimal development and well-being that would be expected when the psychological needs are satisfied (Deci & Ryan, 2000; Ryan et al., 2006). Such adaptations, regardless of whether individuals claim to value them, will have significant negative consequences for health and well-being (e.g., low levels of vitality and high levels of emotional and physical exhaustion). Therefore, BPNT and, more specifically, its conceptualization of psychological need thwarting, should provide a conceptual framework through which to examine the mechanism which links dimensions of the social environment to negative indices of athlete well-being. However, little research has focused on the direct consequences of psychological need thwarting (Vallerand, Pelletier, & Koestner, 2008), primarily due to the way in which this construct has been operationalized and subsequently measured.

Psychological Need Thwarting

Research conducted to date has examined negative relations between need satisfaction and various maladaptive outcomes and has thus provided indirect evidence to support the hypothesized detrimental effects of need thwarting on health and well-being (e.g., Adie et al., 2008; Jang, Reeve, Ryan, & Kim, 2009). For example, significant negative correlations have indicated that low levels of need satisfaction relate to higher levels of ill-being (e.g., burnout, Hodge, Lonsdale, & Ng, 2008; self-reported physical symptoms, Reinboth et al., 2004). In this approach, however, low need satisfaction scores are inadvertently considered evidence of both a lack of need satisfaction and psychological need thwarting, without distinguishing between the two constructs. In this paper we question whether low need satisfaction scores can be conceptually equated with need thwarting. Specifically, we propose that low scores on measures of psychological need satisfaction do not adequately tap the intensity of need frustration that Deci and Ryan (2000) describe as states of need thwarting. For instance, a low score on a need satisfaction scale may not necessarily indicate that an athlete feels as if his or her needs are being thwarted during their interactions with the sport environment; it may merely suggest that the athlete feels dissatisfied with the extent to which his or her needs are currently being met. As such, a female athlete could feel incompetent in her sport purely because she does not have the necessary skills to perform well (despite the best efforts of her coach); however, another female athlete might feel incompetent because her coach

is severely demeaning and critical of her. The first situation is a case of low need satisfaction (or need dissatisfaction) whereas the latter is a case of need thwarting. Similarly, a male athlete could feel lonely in his sport because he cannot meaningfully associate with his teammates or because he is actively rejected by them. We argue that need thwarting is evident only in the latter case in which loneliness results from active exclusion by others.

According to the Oxford English Dictionary, "to be dissatisfied" means to feel that something is not as good as it should be (i.e., it is a feeling). Contrastingly, "to thwart" means to stop something from happening (i.e., it is a prevention). Therefore, similarly to need satisfaction, need thwarting is an experience, a "feeling state." For instance, one feels oppressed, inadequate, or rejected when one's psychological needs are thwarted. However, conceptualizations and assessment tools must also reflect this focus on the perceived undermining effect of significant others. Thus, need thwarting does not simply reflect the perception that need satisfaction is low, but moreover the perception that need satisfactions are being obstructed or actively frustrated within a given context.

An additional problem with using existing measures of need satisfaction to tap need thwarting is one of item relevance. The three psychological needs are currently measured in terms of positive psychological experiences only. For example, the need for relatedness is assessed in terms of positive aspects of social relationships (e.g., feelings of support, acceptance, and understanding) and does not capture negative aspects of social relationships in a broader sense (e.g., feelings such as rejection, jealousy, or conflict), which are likely to occur when the need for relatedness is actively thwarted. As such, one would expect perceived support for relatedness to better predict positive affect as opposed to negative affect (McDonough & Crocker, 2007; Ryan & Deci, 2001). Similar findings have also been reported in the youth sport context. For example, Gagné et al. (2003) found that although daily need satisfaction during practice led to increased positive affect, it was unrelated to the extent to which gymnasts experienced feelings of negative affect. In addition, Quested and Duda (2010) found that satisfaction of the three psychological needs was unrelated to emotional and physical exhaustion in a sample of young dancers. Thus, it is not surprising that current research has suggested that the psychological needs are often more pertinent in understanding the presence of well-being, as opposed to the absence of ill-being (e.g., Adie et al., 2008; McDonough & Crocker, 2007; Sheldon & Bettencourt, 2002). Such findings highlight the potential disadvantages of measuring need thwarting indirectly via low levels of need satisfaction.

It is thus of theoretical and empirical interest to explore how a more direct assessment of need thwarting can contribute to the prediction of psychological well-being / ill-being. Of additional interest is the possibility that alongside perceived need satisfaction, athletes can also experience the active thwarting of needs within the same environment. That is, need satisfaction and need thwarting can sometimes co-occur. Within observations of coaching and physical training environments, we often see mixed patterns of positive and negative events (Smoll & Smith, 2002) that may, over time, have the potential to facilitate feelings of both need satisfaction and need thwarting in athletes. In line with BPNT, we thus suggest that a measure that taps the experience of having one's needs actively countered may yield better predictions concerning negative outcomes associated with sport participation,

compared with existing measures of psychological need satisfaction, an issue that no doubt could be extended to other domains.

Present Research

To date there has been no systematic attempt to develop and validate a measure of psychological need thwarting. To address this gap in the literature, we outline the development of a SDT-based multidimensional questionnaire designed to tap the negative experiential state that occurs when athletes' perceive their psychological needs to be actively undermined in the sport environment. A series of three studies were carried out in a youth sport context to develop and provide initial evidence for the validity and reliability of the psychological need thwarting scale (PNTS). Study 1 sought to generate and provide evidence for the content validity of a pool of items designed to tap psychological need thwarting. Study 2 tested the factorial structure of the questionnaire and examined whether the resultant PNTS scores were invariant across gender, sport type, competitive level, and competitive experience. Finally, Study 3 cross-validated the PNTS model with an independent sample and provided preliminary evidence for the predictive validity of the measure. Youth sport settings were an apt place to explore these issues as previous research has indicated that younger athletes can be highly susceptible to the demands and excessive pressures often placed on them by coaches and significant others in the sport environment (Fraser-Thomas & Côté, 2009; Gould, 2007; Krane et al., 1997; Ommundsen & Vaglum, 1991). Further, SDT-based research has also indicated that when young athletes experience low levels of need satisfaction they are prone to experience negative outcomes such as burnout (Perreault, Gaudreau, Lapointe & Lacroix, 2007), physical illness (Reinboth et al., 2004), and negative affect (Quested & Duda, 2010).

Study 1

Study 1 used qualitative and quantitative feedback from coaches, athletes, and academic experts to develop and provide evidence for the content validity of a pool of items designed to tap psychological need thwarting in the sport context (an important component of construct validity; see Messick, 1995).

Method

Participants

The sample ($N = 23$) comprised 6 British coaches and 17 British athletes. The coaches were drawn from three sports: athletics ($n = 1$), swimming ($n = 3$), and squash ($n = 2$). The athletes were 7 males and 10 females aged between 12 and 17 years old ($M = 14.41$; $SD = 1.42$). These athletes represented three sports, athletics ($n = 5$), swimming ($n = 7$), and dancing ($n = 5$), and were competing at regional ($n = 6$) or national ($n = 11$) level at the time of the study. Their competitive experience ranged from 3 to 10 years ($M = 6.75$; $SD = 2.11$). A panel of nine academic experts in SDT-based research was also consulted to review the content validity of the developed items from a theoretical perspective.

Procedure

Ethical approval was obtained from the principal investigator's university ethics committee for each of the three studies, which were conducted in accordance with APA guidelines, reported in this article. Study 1 consisted of six coach interviews and three athlete focus groups (one focus group was conducted within each sport). The coaches and athletes were recruited via sports clubs administrators. The purpose and nature of the study was explained and coach and athlete consent were provided before participation. In addition, coach and parental consent were also obtained before athletes participated in the focus groups. Based upon the operational definitions of the three basic psychological needs, a review of the relevant SDT literature, and the personal experiences of the principal investigator (an experienced athlete who competed at national level as a junior), an initial pool of sport-relevant need thwarting items was developed. Guidelines for item wording were closely followed to maximize the clarity, specificity, and shortness of the items (e.g., DeVellis, 1991). The aim was to develop a number of potential items that could be discussed with coaches and athletes during the interviews and focus groups.

Each coach interview lasted approximately 60 min. A semistructured interview schedule was used to facilitate general discussion relating to the sport environment and its potential impact upon young athletes' feelings of autonomy, competence, and relatedness. The purpose of these interviews was to identify need thwarting situations which occurred in the sport environment. The athlete focus groups were all approximately 90 min in length. Athletes were provided with lay definitions of the three psychological needs[1] and asked, by considering their own sporting experiences, to discuss situations in their sport in which their feelings of autonomy, competence, and relatedness were actively thwarted or undermined by others. All interviews and focus groups were recorded and the data were transcribed verbatim. Subsequently, a content analysis was carried out based on the definition of need thwarting to explore athletes' experiences of psychological need thwarting (i.e., the way in which athletes' perceived their needs to be thwarted and how this made them feel).

In addition, the athlete focus groups were used to collect quantitative data concerning the pool of 21 items developed before the interviews and focus groups. The items were presented to the athletes and, using a dichotomous scale (*applicable* vs. *inapplicable*), they were instructed to assess the relevance of each item to the sport context. Items deemed inapplicable by 75% or more of the athletes involved in the focus group were eliminated. For the applicable items, athletes were also asked to rate their clarity using a 7-point scale (1 = *not at all clear;* 7 = *extremely clear*). The athletes' anonymous responses were then discussed at a group level and athletes were encouraged to suggest additional items or alternative wordings for items perceived to be problematic (i.e., items rated below 5 on clarity).

Subsequently, an online questionnaire was set up and nine academic experts worldwide were recruited, via an invitational e-mail, to review the pool of items derived from the interviews and focus groups. The experts were provided with a definition of need thwarting ("the negative experiential state which occurs when athletes perceive their psychological needs for autonomy, competence, and relatedness to be actively undermined via interactions with significant others") and, using a 5-point scale (1 = *poor match;* 5 = *excellent match*), were asked to indicate the

extent to which they perceived the items to tap the active thwarting of each of the psychological needs. The ratings provided by the experts were used to calculate the Content Validity Index (CVI; Lynn, 1986) for each item and inform final decisions about whether to retain, eliminate, or revise the items. The experts were also asked to make suggestions for improving these items and to propose alternative items.

Results and Discussion

The coaches and athletes interviewed in this study believed that the sport context was a domain that could empower young people and facilitate feelings of autonomy, competence, and relatedness. However, they also recognized that the sport context could be a highly pressurized environment in which an athlete's psychological needs could easily be thwarted in the pursuit of performance-related goals. For example, athletes suggested that the sport environment could, at times, leave them feeling controlled (e.g., dictatorial coaches), over-challenged and incompetent (e.g., imposed goals/expectations), and even rejected (e.g., conflict/jealousy between athletes). Based upon the ratings and comments provided by the coaches and athletes, two items were deleted and four items were rewritten to improve their clarity and broaden their applicability across sports. The resultant pool of 19 items was then examined by the expert researchers. A table containing the CVI for each item is available from the first author upon request. The CVI was calculated by dividing the number of experts who gave a rating of 3, 4, or 5 (i.e., rated the item as a good match, a very good match, or an excellent match to the need construct) by 9, the number of experts on the panel. Lynn (1986) suggested that when expert panels consisted of six or more reviewers, CVIs in the vicinity of .80 were acceptable (see also Polit, Beck, & Owen, 2007). One item displayed a CVI of .56 (5/9) and was thus deleted. All of the remaining items exhibited CVIs ranging from .78 (7/9) to 1.00 (9/9) and were retained. However, based upon the expert reviewers' qualitative feedback, very minor modifications were made to the wording of six items to further emphasize the active thwarting of the psychological needs by significant others in the sport environment. The final pool of 18 items was deemed to be clear and applicable to the sport environment by athletes, coaches, and SDT researchers.

Study 2

The next step in the measurement development process was to administer a questionnaire containing the 18 items to a large sample to test the factorial structure of the items generated in Study 1 via confirmatory factor analysis (CFA). The use of CFA is advocated when there is a strong theoretical base for the hypothesized model (Williams, 1995), as in the current research. In line with SDT, a three-factor model was hypothesized. Study 2 also examined two additional components of construct validity (i.e., generalizability and discriminant validity; see Messick, 1995). Generalizability was assessed by examining whether the resultant PNTS scores were invariant across gender, sport type, competitive level, and competitive experience. Subsequently, the relations between athletes' perceptions of psychological need thwarting and need satisfaction were explored via correlations and exploratory factor analysis (EFA) to test for discriminant validity. Relatively small

negative correlations were expected between corresponding need satisfaction and need thwarting subscales; the latter were also hypothesized to form independent factors in individual EFA analyses.

Method

Participants

The sample ($N = 354$) comprised 197 males and 144 females aged between 12 and 17 years old ($M = 14.72$; $SD = 1.61$); 13 athletes did not report their gender. The athletes represented individual ($n = 208$) and teams sports ($n = 146$) such as athletics, squash, swimming, rowing, rugby, football, netball, and basketball. They were competing at club ($n = 87$), county ($n = 61$), regional ($n = 35$), national ($n = 121$), or international ($n = 36$) level at the time of the study. The remaining athletes ($n = 14$) did not report their competition level. Competitive experience ranged from 1 to 13 years ($M = 5.23$; $SD = 2.91$).

Measures

Psychological Need Thwarting.   At the beginning of the questionnaire, written instructions requested that athletes consider their general experiences in the sport context and indicate how much they agreed or disagreed with each statement. The stem used in the questionnaire was "In my sport. . . ." To ensure that the response scale of the new measure corresponded with the response scale of existing measures used to assess need satisfaction in sport (McAuley, Duncan, & Tammen, 1989; Richer & Vallerand, 1998; Standage, Duda, & Ntoumanis, 2003), the 18 items (5 autonomy, 7 competence, 6 relatedness) created in Study 1 were assigned a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Psychological Need Satisfaction.   Three previously validated questionnaires were used to assess the degree to which athletes experienced satisfaction of the three psychological needs. To assess satisfaction of the need for autonomy, five items collated by Standage et al., (2003) were used. An example item is "I have some choice in what I want to do in my sport." Satisfaction of the need for competence was assessed using five items from the competence subscale of the Intrinsic Motivation Inventory (IMI; McAuley et al., 1989). An example item is "I think I am pretty good at my sport." Finally, satisfaction of the need for relatedness was assessed using the 5-item acceptance subscale of the Need for Relatedness Scale (NRS-10; Richer & Vallerand, 1998). A sample item is "when participating in my sport I feel supported." Responses for all three measures were provided on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The subscales have demonstrated satisfactory levels of internal reliability in previous research conducted in the sport domain (e.g., Reinboth et al., 2004; Standage et al., 2003; Standage, Duda, & Ntoumanis, 2005).

Procedure

Athletes were recruited via club coaches and sports events organizers. The purpose and nature of the study was explained and athlete, coach, and parental consent

were obtained. The primary researcher personally supervised the questionnaire completion for 63.3% of the athletes involved in the current study. For athletes who could only be reached by mail (due to practical constraints such as distance), the researcher sent enveloped questionnaire packs, including written instructions and consent forms, to a contact at the club (36.7% of athletes were reached this way). Athletes were then allowed to take the questionnaire pack away with them and return it to the contact person (in a sealed envelope) who mailed the completed consent forms and questionnaires back to the researcher.

Data Analysis

The 18 items from Study 1 were analyzed via CFA using EQS 6.1 (Bentler & Wu, 2002). No cross-loadings of items were allowed, all latent factors were intercorrelated, and one item from each factor was fixed to 1.0 for purposes of identification and latent variable scaling. Standardized factor loadings, standardized residuals, and modification indices were analyzed to screen for model misspecification. In line with previous work (e.g., Gaudreau & Blondin, 2002; Sebire, Standage, & Vansteenkiste, 2008), items with standardized factor loadings below .40 or a large standardized residual (>|2.00|) were removed. Furthermore, items were deleted if a large modification index suggested that the item could load on a nonintended factor or that its residual could correlate with the residuals of other items. Descriptive statistics and internal reliability estimates were also calculated. Raykov's composite reliability coefficient (Raykov's rho [ρ]; Raykov, 1997) was employed to assess the internal reliability of each scale. The resultant PNTS scores were then analyzed to test for invariance across gender, sport type, competitive level, and competitive experience. Finally, to explore how need thwarting is related to need satisfaction, the correlations between athletes' perceptions of psychological need thwarting and need satisfaction were obtained and the PNTS and need satisfaction items were analyzed via EFA.

Results and Discussion

Distribution of the Need Thwarting Items

The univariate skewness and kurtosis values for items comprising the final solution in Study 2 are presented in Table 1. An examination of Mardia's normalized coefficient of multivariate kurtosis indicated that the data departed from multivariate normality (e.g., for the final three-factor model the coefficient was 28.99). Subsequently, and in line with the recommendations of Chou, Bentler, and Satorra (1991), all CFAs were conducted using the robust maximum likelihood (ML) estimation procedure. A robust χ^2 statistic called the *Satorra–Bentler scaled statistic* (S-B χ^2; Satorra & Bentler, 1994), and robust parameter standard errors (Bentler & Dijkstra, 1985) are produced using this method to correct for non-normality in large samples (200–500 cases; West, Finch, & Curran, 1995).

The adequacy of the model to the data were evaluated using multiple fit indices, such as the robust chi-square statistic, the robust comparative fit index (CFI; Bentler, 1990), the robust Bentler–Bonett non-normed fit index (NNFI; Bentler & Bonett, 1980), the standardized root mean residual (SRMR; Hu & Bentler, 1998),

Table 1 Item Means, Standard Deviations, Factor Loadings, Residuals, and Skewness and Kurtosis Values Following Confirmatory Factor Analysis of a Three-Factor Model in Study 2

Subscale and Item	M	SD	Loading	Residual	Skewness	Kurtosis
In my sport . . .						
Autonomy						
I feel prevented from making choices with regard to the way I train	3.14	1.66	.57	.83	.55	−.46
I feel pushed to behave in certain ways	3.07	1.79	.57	.82	.55	−.69
I feel obliged to follow training decisions made for me	3.70	1.85	.59	.81	.18	−1.00
I feel under pressure to agree with the training regimen I am provided	2.76	1.56	.61	.80	.57	−.52
Competence						
There are occasions where I feel incompetent because others impose unrealistic expectations upon me	2.27	1.43	.71	.71	1.09	.38
There are times when I am told things that make me feel incompetent	2.23	1.38	.77	.64	1.12	.78
There are situations where I am made to feel inadequate	2.21	1.43	.81	.59	1.17	.79
I feel inadequate because I am not given opportunities to fulfill my potential	2.11	1.42	.49	.87	1.26	.66
Relatedness						
I feel I am rejected by those around me	1.64	1.27	.63	.78	2.58	6.58
I feel others can be dismissive of me	2.11	1.37	.75	.66	1.41	1.67
I feel other people dislike me	1.99	1.42	.67	.75	1.67	2.32
I feel some of the athletes around me are envious when I achieve success	2.96	1.87	.50	.87	.61	−.84

Factor Correlations and Internal Consistency	1	2	3
1 Autonomy	.67		
2 Competence	.59	.79	
3 Relatedness	.52	.85	.71

Note. All factor loadings and factor correlations are statistically significant ($p < .05$). Raykov's composite reliability coefficients are presented on the diagonal of the factor correlation matrix. All items were scored on a 7-point scale; athletes employed the entire response range for all items.

and the robust root mean square error of approximation (RMSEA; Steiger, 1990). Although values indicative of acceptable model fit remain controversial (Markland, 2007; Marsh, Hau, & Wen, 2004), it is typically accepted that CFI and NNFI values exceeding .90 and .95 are indicative of acceptable and excellent fit, respectively (Hu & Bentler, 1999). Values less than .08 for the RMSEA suggest an excellent fit, whereas values exceeding .10 are undesirable (Browne & Cudeck, 1993). Finally, values approximating .08 for the SRMR are typically considered satisfactory (Hu & Bentler, 1999).

CFA Analysis

Results of the initial CFA indicated room for improvement: S-B $\chi^2(132) = 386.64$, $p < .001$, RCFI = .84, RNNFI = .82, SRMR = .07, RRMSEA = .07 (90% CI = 0.07–0.08). Large modification indices suggested that the residuals of a number of items correlated with those of other items. Three of these items (two competence items and one relatedness item) were also associated with standardized residuals > |2.00|. Further, the modification indices indicated that one of the aforementioned competence items and one autonomy item cross-loaded onto a nonintended factor. Excluding these four items improved the fit of the model to the data: S-B $\chi^2(74)$ = 161.09, $p < .001$, RCFI = .91, RNNFI = .90, SRMR = .06, RRMSEA = .06 (90% CI = 0.05–0.07). However, further examination of the modification indices and standardized residuals identified two additional items (one competence item and one relatedness item) as problematic. These items were thus removed and the model was tested again. The final model demonstrated an excellent fit to the data: S-B $\chi^2(51) = 87.92$, $p < .001$, RCFI = .96, RNNFI = .95, SRMR = .05, RRMSEA = .05 (90% CI = 0.03–0.06), and included three 4-item factors, representing the thwarting of the autonomy, competence, and relatedness needs. All deleted items are available from the first author upon request. Table 1 displays item means, standard deviations, standardized factor loadings, and residuals for this solution, as well as internal consistency estimates and factor correlations. Raykov's composite reliability coefficient was just below .70 for the autonomy subscale ($\rho = .67$). In addition, the factor correlation between the competence and relatedness subscales was large (.85), although it should be clarified that this correlation is not attenuated for measurement error.[2] Thus, in an effort to improve the internal reliability of the autonomy subscale and decrease the size of the large interfactor correlation, three items were rephrased before Study 3 (see final CFA solution in Study 3).

Invariance Testing

A sequential model testing approach was employed via multisample CFA to examine whether the PNTS displayed invariance across gender, sport type (team or individual), competitive level (club, county, and regional or above) and competitive experience (low or high based on a median split). In relation to gender, a baseline model was established and then two increasingly constrained models were specified to examine the equality of measurement (i.e., factor loadings) and structural parameters (i.e., factor variances and factor covariances) across male and female samples (see Byrne, 2006). The procedure was then repeated to test for invariance across athletes involved in team and individual sports and athletes of high and low competitive levels and competitive experience. The relative goodness of fit between

Table 2 Fit Indices for Alternative Factor Models in Study 2 and Study 3

Model	S-B χ²	df	RCFI	RNNFI	SRMR	RRMSEA (90% CI)
Study 2						
F1 = Autonomy/Competence F2 = Relatedness	161.31**	53	.88	.85	.07	.08 (0.06–0.09)
F1 = Autonomy/Relatedness F2 = Competence	165.65**	53	.87	.84	.07	.08 (0.07–0.09)
F1 = Competence/Relatedness F2 = Autonomy	110.25**	53	.94	.92	.05	.06 (0.04–0.07)
F1 = Autonomy/Competence/Relatedness	185.39**	54	.85	.82	.07	.08 (0.07–0.10)
Study 3						
F1 = Autonomy/Competence F2 = Relatedness	165.49**	53	.91	.88	.07	.09 (0.07–0.10)
F1 = Autonomy/Relatedness F2 = Competence	217.61**	53	.86	.83	.08	.10 (0.09–0.12)
F1 = Competence/Relatedness F2 = Autonomy	149.51**	53	.92	.90	.07	.08 (0.06–0.09)
F1 = Autonomy/Competence/Relatedness	224.96**	54	.96	.83	.08	.11 (0.09–0.12)

Note. S-B χ² = Satorra–Bentler scaled chi-square statistic, RCFI = robust comparative fit index, RNNFI = robust non-normed fit index, SRMR = standardized root mean residual, RRMSEA = robust root mean square error of approximation, 90% CI = 90% confidence interval for the RRMSEA point estimate. **$p < 0.01$.

increasingly constrained models was analyzed via the S-B χ^2 difference test (Satorra & Bentler, 2001) using the "sbdiff" software (Crawford, 2007; Crawford & Henry, 2003). However, because the χ^2 statistic is influenced by sample size, the recommendations of Cheung and Rensvold (2002) were also adopted and a change in CFI of $\leq$ .01 was considered indicative of model invariance.

Table 3 displays the goodness-of-fit indices for all multigroup models tested during the invariance analysis. Although changes in the S-B χ^2 statistic were significant when the factor loadings were constrained across gender and across sport type, the change in the CFI values was less than or equal to .01 in both analyses, supporting the equality of the factor loadings across the separate gender and sport type groups. Nonsignificant changes in the S-B χ^2 statistic and differences in the CFI values of less than .01, suggested that the factor variances and covariances were also equal across gender and sport type. Nonsignificant changes in the S-B χ^2 statistic and differences in the CFI values of less than .01 between increasingly constrained models revealed that the three-factor model was also invariant across competitive level and competitive experience.[3] These findings provide substantial support for the factorial invariance of the PNTS measurement model.

Correlation and EFA Analyses

The three need satisfaction subscales exhibited satisfactory levels of internal reliability in the current study (autonomy ρ = .79; competence ρ = .85; relatedness ρ = .75). As hypothesized, small negative Pearson's correlations were observed between the corresponding need thwarting and need satisfaction subscales (autonomy r = –.27, competence r = –.21, relatedness r = –.26), indicating that, empirically, need thwarting and need satisfaction may not be antipodal (see Table 4 for descriptive statistics and the complete correlation matrix). Further, the results of three separate EFA analyses showed that, within each need, need thwarting and need satisfaction represented distinct factors. Principal axis factor analyses were carried out with a direct oblimin rotation and factor extraction was based on the criterion of an eigenvalue value greater than 1.0. Two factors were extracted in each EFA analysis. With the exception of one need satisfaction item, all items had primary loadings above .40. Over all three needs, the need thwarting items had primary factor loadings ranging from .48 to .82 (mean loading = .63) and secondary loadings ranging from .01 to .17 (mean loading = .05). Similarly, the need satisfaction items had primary loadings ranging from .31 to .92 (mean loading = .65) and secondary loadings ranging from .00 to .09 (mean loading = .04). In concert, these findings support the discriminant validity of the need thwarting scale and indicate that need thwarting and need satisfaction should be viewed as independent constructs. Therefore, it would appear that athletes can perceive need thwarting as potentially co-occurring and perhaps interacting with need satisfaction.

Study 3

The purpose of Study 3 was to use an independent sample to cross-validate the three-factor model supported in Study 2 and further refine the scale if necessary. Study 3 also aimed to provide preliminary evidence for the predictive validity of the PNTS (i.e., criterion relevance; see Messick, 1995). It was hypothesized that

Table 3 Fit Indices for Invariance Analysis in Study 2

Model	S-B χ²	df	RCFI	RNNFI	SRMR	RRMSEA (90% CI)	ΔS-B χ²	Δdf	ΔRCFI
Gender									
1. Unconstrained	151.30**	102	.946	.930	.059	.054 (0.03–0.07)			
2. Constrained factor loadings	171.70**	111	.934	.921	.084	.057 (0.04–0.07)	20.40*	9	.012
3. Constrained factor variances/covariances	180.21**	117	.931	.922	.096	.057 (0.04–0.07)	8.46	6	.003
Sport Type									
1. Unconstrained	154.16**	102	.944	.928	.059	.054 (0.04–0.07)			
2. Constrained factor loadings	172.10**	111	.935	.923	.074	.056 (0.04–0.07)	17.85*	9	.009
3. Constrained factor variances/covariances	180.12**	117	.933	.924	.094	.056 (0.04–0.07)	8.08	6	.002
Competitive Level									
1. Unconstrained	130.51**	102	.967	.957	.056	.041 (0.01–0.06)			
2. Constrained factor loadings	141.07**	111	.965	.958	.068	.040 (0.01–0.06)	10.57	9	.002
3. Constrained factor variances/covariances	144.13**	117	.968	.964	.071	.037 (0.01–0.06)	2.90	6	.003
Competitive Experience									
1. Unconstrained	140.79**	102	.952	.937	.058	.049 (0.03–0.07)			
2. Constrained factor loadings	155.75**	111	.944	.934	.076	.050 (0.03–0.07)	14.96	9	.008
3. Constrained factor variances/covariances	164.56**	117	.941	.933	.081	.050 (0.03–0.07)	8.81	6	.003

Note. S-B χ² = Satorra–Bentler scaled chi-square statistic, RCFI = robust comparative fit index, RNNFI = robust non-normed fit index, SRMR = standardized root mean residual, RRMSEA = robust root mean square error of approximation 90% CI = 90% confidence interval for the RRMSEA point estimate. ΔS-B χ² = Satorra–Bentler scaled chi-square difference, Δdf = difference in degrees of freedom, ΔRCFI = change in RCFI, when the fit of the more constrained model is compared with that of the previous less constrained model (Cheung & Rensvold, 2002). *p < 0.05, **p < 0.01.

Table 4 Descriptive Statistics and Correlations Among the Need Thwarting and Need Satisfaction Subscales in Study 2

Variable	M	SD	Skewness	Kurtosis	1	2	3	4	5
1 Need thwarting—Autonomy	3.17	1.22	.18	-.39					
2 Need thwarting—Competence	2.24	1.19	1.08	.62	.40**				
3 Need thwarting—Relatedness	2.18	1.09	1.24	1.45	.38**	.65**			
4 Need satisfaction—Autonomy	5.62	0.90	-.88	1.47	-.27**	-.20**	-.13**		
5 Need satisfaction—Competence	5.69	0.92	-1.28	2.43	-.09*	-.21**	-.01	.45**	
6 Need satisfaction—Relatedness	5.84	0.78	-1.31	4.80	-.21**	-.24**	-.26**	.62**	.48**

*$p < 0.05$, **$p < 0.01$.

need thwarting would predict additional variance, over and above that accounted for by need satisfaction, of well-being / ill-being outcome variables. Further, in the same set of analyses, the scores derived from the PNTS were expected to more strongly predict an index of ill-being (emotional and physical exhaustion) when compared with the scores obtained from established measures of need satisfaction. The opposite relationships were hypothesized in relation to an index of well-being (subjective vitality). In addition, Study 3 also examined the interactive effects of perceived need thwarting and need satisfaction on the outcome variables as these independent dimensions could potentially co-occur in the same sport context. Hierarchical regression analyses were employed to test these hypotheses at the individual need level. Subsequently, structural equation modeling (SEM) was used to test a model incorporating all three psychological needs.

Method

Participants

The sample ($N = 289$) comprised 79 males and 210 females aged between 12 and 17 years old ($M = 14.54$; $SD = 1.70$). The athletes were involved in both individual ($n = 158$) and team sports ($n = 131$), similar to the sports sampled in the previous study. The athletes were competing at club ($n = 41$), county ($n = 132$), regional ($n = 41$), national ($n = 57$), or international ($n = 18$) level at the time of the study. Competitive experience ranged from 1 to 11 years ($M = 4.57$; $SD = 2.14$).

Measures

Psychological Needs.   Psychological need thwarting was measured using the PNTS, as designed in Study 2. Similarly, psychological need satisfaction was measured using the same scales outlined in the previous study. Each of the need satisfaction subscales demonstrated satisfactory internal reliability in the current study (autonomy $\rho = .84$; competence $\rho = .88$; relatedness $\rho = .84$).

Well-Being / Ill-Being Outcomes.   A five-item version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) was employed to measure athletes' feelings of positive energy. Subjective vitality has been referred to as a primary component of psychological well-being (Ryan & Deci, 2001). An example item is, "I feel alive and full of vitality." Responses were provided on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale demonstrated good internal reliability in the current study ($\rho = .91$) and in previous research conducted in the sport domain (e.g., Gagné et al., 2003; Reinboth et al., 2004). The five-item emotional and physical exhaustion subscale of the Athlete Burnout Questionnaire (Raedeke & Smith, 2001) was employed as an indicator of ill-being. An example item is, "I am exhausted by the mental and physical demands of my sport." Responses were provided on a 5-point scale ranging from 1 (*almost never*) to 5 (*almost always*). In line with previous research conducted in the sport domain (e.g., Lemyre, Roberts, & Stray-Gundersen, 2007; Raedeke & Smith, 2001), the subscale exhibited satisfactory levels of internal reliability in the current study ($\rho = .88$).

Procedure

The way in which the participants were recruited and the data collection procedure remained the same as those outlined in the previous study. Athletes completed the questionnaire supervised (71.9%) or were reached by mail (28.1%).

Results and Discussion

The 12-item three-factor solution from Study 2 was analyzed via CFA using EQS 6.1 (Bentler & Wu, 2002). Examination of Mardia's normalized coefficient (33.74) indicated that the data departed from multivariate normality. Subsequently, the robust maximum likelihood (ML) estimation procedure was used. The model displayed a good fit to the data, S-B $\chi^2(51) = 107.78$, $p < .001$, RCFI = .95, RNNFI = .94, SRMR = .06, and RRMSEA = .06 (90% CI = 0.05–0.08), and all three subscales demonstrated good internal consistency with composite reliability coefficients ranging from .77 to .82. However, the correlation between the competence and relatedness subscales remained high (.83). Further, the correlation between the competence and autonomy subscales had increased from that observed in Study 2 (.79).[2] Table 5 displays item means, standard deviations, standardized factor loadings, and residuals for the final solution, as well as internal consistency estimates and factor correlations.

Predictive Validity

Table 6 displays the descriptive statistics and correlations among the variables used in the regression and SEM analyses. A total of six hierarchical regression analyses were performed to examine the incremental effect of the need thwarting subscales and the potentially interactive effects of need thwarting and need satisfaction on exhaustion and vitality. Specifically, for each of the three needs, two hierarchical regressions were carried out using exhaustion and then vitality as the dependent variable. The need satisfaction and need thwarting subscales were standardized, as recommended by Aiken and West (1991), before being entered into the equation. Need satisfaction was entered in the first step, need thwarting was entered in the second step, and the interaction term for corresponding need satisfaction and need thwarting subscales was added in the third step.

As shown in Table 7 and indicated by the ΔR^2 values, need thwarting made a significant contribution to the prediction of exhaustion and vitality over and above the significant contribution of need satisfaction in all cases. Notably, across all three psychological needs, need thwarting was a stronger predictor of exhaustion and need satisfaction was a stronger predictor of vitality. Further, three of six interaction terms were significant. First, with regard to exhaustion, there were significant interactions involving the corresponding autonomy and competence subscales. For autonomy, at high levels of need thwarting, increased need satisfaction levels were associated with lower levels of exhaustion ($b = -.22$; $p < .05$), while at low levels of need thwarting, need satisfaction did not predict exhaustion ($b = -.06$; $p > .05$). With regard to competence, at high levels of need thwarting, need satisfaction did not predict exhaustion ($b = -.05$; $p > .05$), while at low levels of need thwarting, increased need satisfaction scores were associated with lower exhaustion scores ($b = -.26$; $p < .05$). Across both needs, exhaustion was most prevalent when athletes experienced high levels of need

Table 5 Item Means, Standard Deviations, Factor Loadings, Residuals, and Skewness and Kurtosis Values Following Confirmatory Factor Analysis of a Three-Factor Model in Study 3

Subscale and Item	M	SD	Loading	Residual	Skewness	Kurtosis
In my sport . . .						
Autonomy						
I feel prevented from making choices with regard to the way I train	3.15	1.65	.61	.80	.57	–.39
I feel pushed to behave in certain ways	3.31	1.90	.69	.72	.36	–1.03
I feel *forced* to follow training decisions made for me	3.01	1.67	.82	.58	.53	–.70
I feel under pressure to agree with the training regimen I am provided	2.75	1.59	.75	.66	.64	–.50
Competence						
Situations occur in which I am made to feel incapable	2.39	1.43	.77	.64	.96	.05
There are times when I am told things that make me feel incompetent	2.29	1.50	.75	.66	1.21	.80
There are situations where I am made to feel inadequate	2.70	1.70	.71	.70	.84	–.28
I feel inadequate because I am not given opportunities to fulfill my potential	2.12	1.41	.70	.71	1.25	.81
Relatedness						
I feel I am rejected by those around me	1.78	1.26	.68	.73	1.97	3.77
I feel others can be dismissive of me	2.29	1.46	.86	.51	1.05	.25
I feel other people dislike me	2.17	1.52	.68	.73	1.47	1.54
I feel *other people* are envious when I achieve success	2.56	1.78	.53	.85	.97	–.18

Factor Correlations and Internal Consistency	1	2	3
1 Autonomy	.80		
2 Competence	.79	.82	
3 Relatedness	.55	.83	.77

Note. All factor loadings and factor correlations are statistically significant ($p < .05$). Raykov's composite reliability coefficients are presented on the diagonal of the factor correlation matrix. Words in italics represent modified items from Study 2. All items were scored on a 7-point scale; athletes employed the entire response range for all items.

Table 6   Descriptive Statistics and Correlations Among Variables in Study 3

Variable	Range	*M*	*SD*	1	2	3
1 Need satisfaction	1–7	5.52	0.86			
2 Need thwarting	1–7	2.54	1.06	–.39**		
3 Subjective vitality	1–7	5.22	1.25	.47**	–.35**	
4 Emotional and physical exhaustion	1–5	2.13	0.93	–.31**	.46**	–.47**

**$p < 0.01$.

thwarting and low levels of need satisfaction. In relation to vitality, a significant interaction effect was observed between the corresponding competence subscales. At both low ($b = .56$; $p < .05$) and high ($b = .30$; $p < .05$) levels of need thwarting, increased levels of need satisfaction was associated with higher levels of vitality. As expected, vitality was greatest when need thwarting was low and need satisfaction was high. All interaction plots are available from the first author upon request.

Subsequently, all three psychological needs were included in the hypothesized SEM, which was examined using a two-step approach (Anderson & Gerbing, 1988). A second-order factorial structure, in which the three first-order latent factors were represented by one higher order latent factor, was hypothesized for both the need thwarting and need satisfaction measurement models to create a more parsimonious SEM (see Figure 1). As such, one first-order factor loading was fixed to 1.0 on the second-order factor for purposes of identification and latent variable scaling. A hierarchical need thwarting model could not be tested before Study 3 because such a model can only be used if the scale is used alongside other variables in a SEM. This is because from a statistical perspective, it is not possible to discriminate between a hierarchical model and a first-order model with three factors as the degrees of freedom in both models are identical. The use of the two models in future research is discussed later in the General Discussion.

Although the initial measurement model demonstrated a reasonable fit to the data, S-B $\chi^2(601) = 1015.90$, $p < .001$, RCFI = .91, RNNFI = .90, SRMR = .06, RRMSEA = .05 (90% CI = 0.04–0.05), an examination of the modification indices, standardized residuals, and standardized factor loadings, suggested the elimination of five items (three need satisfaction items, one vitality item, and one exhaustion item).[4] None of the PNTS items were identified as problematic. The five items were removed one at a time and the model fit was reevaluated. This procedure is considered a justifiable process in measurement evaluation as it preserves the general structure of the hypothesized factor model, but only with the best available indicators (Hofmann, 1995). The final measurement model demonstrated a good fit to the data, S-B $\chi^2(436) = 661.32$, $p < .001$, RCFI = .94, RNNFI = .93, SRMR = .06, RRMSEA = .04 (90% CI = 0.04–0.05), and the removal of these items did not compromise the internal reliability of the scales (all scales exhibited composite reliability coefficients of .87 and above). After the measurement model was evaluated and modified, the fit of the structural model was tested and the concurrent relationships between the latent variables were examined. The hypothesized model

Table 7 Individual Need Satisfaction and Need Thwarting Subscales Predicting Vitality and Exhaustion in Study 3

|	1. Autonomy: Vitality		2. Autonomy: Exhaustion		3. Competence: Vitality		4. Competence: Exhaustion		5. Relatedness: Vitality		6. Relatedness: Exhaustion	
	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.18**		.12**		.15**		.06**		.16**		.05**	
Need satisfaction		.42**		-.34**		.39**		-.25**		.40**		-.22**
Step 2	.03**		.16**		.03**		.10**		.02**		.05**	
Need satisfaction		.36**		-.17**		.33**		-.15*		.35**		-.14*
Need thwarting		-.17**		.43**		-.19**		.33**		-.16**		.25**
Step 3	.00		.01*		.02*		.02**		.00		.01	
Need satisfaction		.37**		-.15**		.35**		-.17**		.35**		-.15**
Need thwarting		-.17**		.43**		-.21**		.35**		-.16**		.26**
Interaction		-.04		-.10*		-.14*		.15**		.01		.09

*$p < 0.05$, **$p < 0.01$.
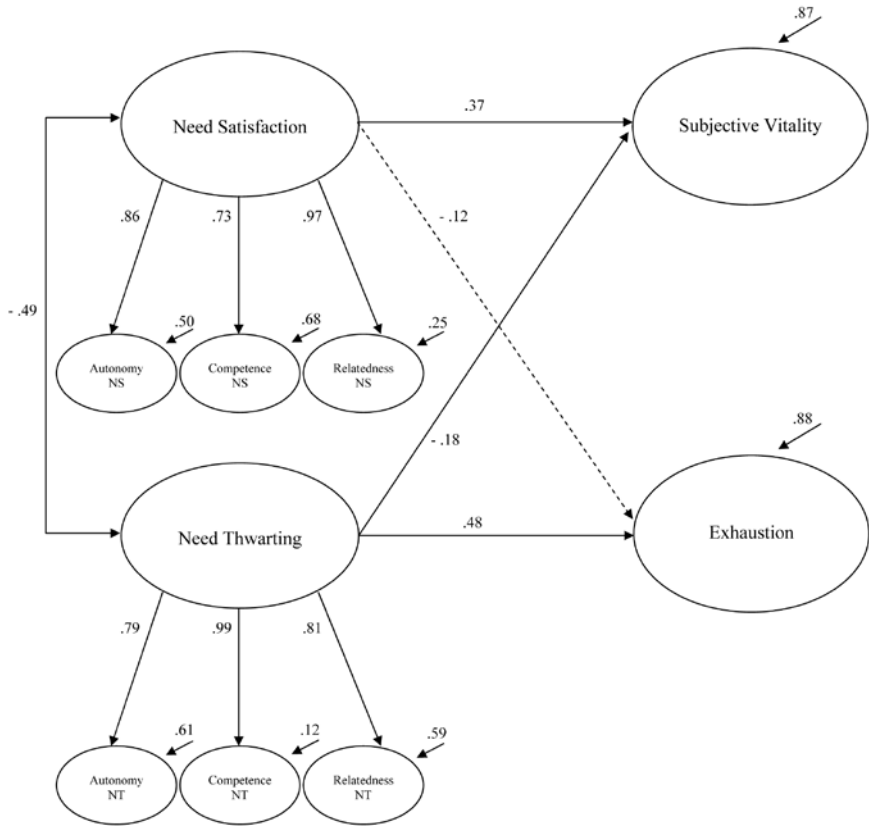
Figure 1 — Revised second-order factor model of need satisfaction, need thwarting, subjective vitality, and emotional and physical exhaustion. All paths are significant, with the exception of the need satisfaction–exhaustion path. Item indicators are not presented for presentation simplicity purposes.

demonstrated a good fit to the data, S-B χ^2(451) = 712.48, $p < .001$, RCFI = .93, RNNFI = .93, SRMR = .07, RRMSEA = .05 (90% CI = 0.04–0.05). However, the path from need satisfaction to exhaustion was not significant. As expected and illustrated in Figure 1, vitality was better predicted by need satisfaction than need thwarting. Exhaustion was predicted by need thwarting only. These findings support the predictive validity of the PNTS and highlight the limitations associated with using measures of need satisfaction to investigate ill-being.

General Discussion

Based upon the framework of BPNT, the purpose of the present research was to further develop the concept of need thwarting and to psychometrically evaluate a measure designed to assess psychological need thwarting in the sport context. A

systematic series of studies provided initial support for the reliability and validity of the scores derived from the new measure. Collectively, the findings from this research suggest that the PNTS could be used to supplement and extend research investigating psychological needs in the sport context. Although much discussed within theoretical overviews (e.g., Deci & Ryan, 2000; Ryan et al., 2006; Vallerand et al., 2008), currently psychological need thwarting remains a relatively under-studied component of SDT. Sport offers an important application of this construct because it is a domain characterized by both support and encouragement and pressure and critique. It is thus a domain where both need support and need thwarts could be salient. Nonetheless, need thwarting measures could also be developed in other life contexts, given the lack of such measures in the extant SDT literature.

The results of Studies 2 and 3 revealed that the factor structure of the PNTS reflected the three-factor model proposed by SDT. Analyses also supported the internal consistency of the autonomy, competence, and relatedness subscales. As a further examination of the factor structure, three alternative two-factor CFA models were tested in Studies 2 and 3. Comparisons with the competing models provided additional support for the hypothesized three-factor model. Further, a one-factor model exhibited a very poor fit to the data in both CFA studies. These analyses suggest that the need thwarting subscales represent correlated, but distinct constructs. This pattern is consistent with prior research on need satisfaction, in which high correlations are frequently observed between the three needs (Deci & Ryan, 2000; Ryan, Bernstein, & Brown, 2010). One potential reason for this could be that all three psychological needs are often impacted by common antecedents. For example, in the same way that autonomy-supportive behaviors involve valuing and demonstrating confidence in the other person (and thus not only contribute to feelings of autonomy need satisfaction but also relatedness and competence; Deci & Ryan, 2000), excessively controlling behaviors can thwart all three needs as they not only undermine feelings of autonomy but also often devalue and convey a lack of trust in the athlete and/or his or her ability (Batholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010).

Additional analyses were conducted in Study 2 to examine the extent to which the scores derived from the PNTS were invariant across gender, sport type, competitive level, and competitive experience. Establishing invariance is important to ensure that future group-based comparisons are meaningful (Hoyle & Smith, 1994). The results supported the factorial invariance of the PNTS by suggesting that the factor loadings, factor variances, and factor covariances are equivalent across gender, sport type and competitive level and experience. The decision was made to carry out the invariance testing in Study 2, where the gender split was relatively equal, because model fit indices can be misleading when subsamples differ markedly in size (Vandenberg & Lance, 2000), as was the case in Study 3. Future research is needed to confirm the invariance of the scale across age and should also test the temporal stability (time invariance) of the PNTS.

A second-order need thwarting model, in which the three first-order factors were represented by one higher order factor, was also used in Study 3. Such a model would be particularly useful for researchers who are interested in obtaining an overall measure of need thwarting (e.g., when such a measure is used in complex SEM) and is justifiable from a theoretical perspective as previous research has suggested that the three psychological needs tend to function in unison in

natural settings (e.g., Baard et al., 2004; Gagné et al., 2003). On the other hand, if researchers are interested in examining whether the thwarting of specific needs predict specific outcomes, we would recommend the use of the three-factor model to examine the impact of each need separately. For instance, future research utilizing the three-factor model could explore whether it is necessary for all three needs to be thwarted in order for ill-being to occur, or whether the thwarting of one need is more strongly linked to particular negative outcomes.

As expected, small negative correlations were observed between athletes' perceptions of psychological need thwarting and psychological need satisfaction. These small correlations and the results of the EFA analyses in Study 2 support the discriminant validity of the need thwarting scale and suggest that perceived need satisfaction and perceived need thwarting are independent constructs. As such, low scores on measures of need satisfaction do not represent need thwarting and, therefore, the traditional bipolar approach (i.e., need satisfaction / need dissatisfaction) cannot adequately investigate the hypothesized detrimental effects of need thwarting on health and well-being. Such a conclusion is in line with previous research in which low levels of need satisfaction have not reliably predicted athlete ill-being (e.g., Gagné et al., 2003; Quested & Duda, 2010).

In Study 3 we presented evidence to support the incremental predictive validity of the three need thwarting subscales over and above need satisfaction, as well as a SEM that included all three needs. These analyses demonstrated the value of considering need thwarting—in every case need thwarting accounted for additional variance above and beyond that due to need satisfaction scores. As expected, the assessment of need thwarting added especially to the prediction of negative outcomes. Further, in the SEM analysis, exhaustion was predicted by need thwarting only. In line with BPNT, we suggest that this is because the thwarting of psychological needs can lead to defensive psychological accommodations (e.g., the development of controlling regulatory styles, compensatory motives or need substitutes, and rigid behavior patterns) that have severe costs for health and well-being (Deci & Ryan, 2000; Ryan et al., 2006). In concert, these findings indicate that the manifestation of ill-being in sport may be more related to the presence of psychological need thwarting than to the absence of psychological need satisfaction. The finding that need satisfaction and need thwarting differently predict positive and negative mental health outcomes provides further impetus to disentangling these constructs in future SDT-based research.

Given their potential independence, it is plausible that need thwarting and need satisfaction can be perceived to co-occur within the same sport context. Accordingly we tested for interactions between corresponding need thwarting and need satisfaction subscales. Three of six interactions were significant, albeit with relatively small effect sizes relative to the main effects. One indicated that higher autonomy need satisfaction can help buffer the effects of need thwarting in fostering exhaustion. A second interaction suggested that high competence need thwarting can diminish the salutary impact of satisfaction on exhaustion. A third interaction suggested that vitality is most catalyzed when competence need satisfaction is high and need thwarting low. Thus, these interactions generally indicated that buffering effects can occur between need satisfaction and thwarting constructs, and are suggestive of the need for further study of these opposing, yet sometimes co-occurring, dynamics within sport settings.

In Study 3 we modeled the overall relations between both the need satisfaction and thwarting constructs and positive and negative outcomes. Results indicated that when ill-being and other maladaptive outcomes are the focus of investigation, need thwarting can predict a larger amount of variance relative to measures of need satisfaction. The current research findings thus highlight the importance of future work investigating the distinct consequences of psychological need thwarting. For example, research should continue to investigate the role that the thwarting of one or more psychological needs play in predicting other burnout symptoms and various maladaptive outcomes associated with competitive sport, such as low or contingent self-esteem, anxiety and depression, disordered eating, and self-handicapping. Future research could also examine the direct effects of psychological need thwarting on the development of defensive psychological accommodations assumed to have severe costs for mental health and well-being (e.g., controlling regulatory styles, need substitutes, extrinsic goals and rigid behavior patterns such as disordered eating and obsessive compulsive behaviors; Deci & Ryan, 2000). A greater understanding of psychological need thwarting in sport could aid the development of appropriate interventions that aim to reduce the prevalence of athlete ill-being.

In summary, the purpose of the current research was to evaluate the construct validity and reliability of scores derived from the PNTS, a self-report measure designed to assess athletes' perceptions of psychological need thwarting based upon the framework of SDT. Overall, the findings have provided substantial support for the new questionnaire measure and have emphasized the importance of measuring need thwarting, an understudied aspect of SDT with important ramifications for psychological well-being. We hope that the PNTS will facilitate research into the darker side of sports participation.

Notes

1. The need satisfaction definitions used in the athlete focus groups were as follows: *autonomy*, "the need to feel in charge of your own behavior and that you are offered choices / have a say in the decisions made regarding your sport participation"; *competence,* "the need to feel really good/skilled at your sport"; and *relatedness*, "the need to feel close to and accepted by those around you in your sport."

2. Owing to the large factor correlations, the tenability of three alternative two-factor models was tested in Study 2 and Study 3. In each model, two of the subscales were combined to form one factor and then paired with the remaining subscale. In both studies, the hypothesized three-factor model demonstrated a superior fit to the data in comparison with each of the competing two-factor models. A one-factor model also exhibited a very poor fit in both data sets. Table 2 provides the fit indices for all alternative models tested in Studies 2 and 3. These additional analyses support the discriminant validity of the three factors.

3. Nonsignificant changes in the S-B χ^2 statistic and differences in the CFI values of less than .01 between increasingly constrained models revealed that the model was also invariant across the two data collection methods. This suggests that athletes responded to the PNTS items in a similar fashion independent of whether they completed the questionnaire supervised or unsupervised.

4. From the need satisfaction scale, the following three items were removed: one autonomy item, "I can decide which activities I want to practice in my sport"; one competence item, "After training at my sport for a while I feel pretty competent"; and one relatedness item, "When participating in my sport I feel safe." The item "I nearly always feel alert and awake" was removed

from the vitality scale. Finally, one item was removed from the exhaustion subscale: "I feel so tired from my training that I have trouble finding energy to do other things").

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