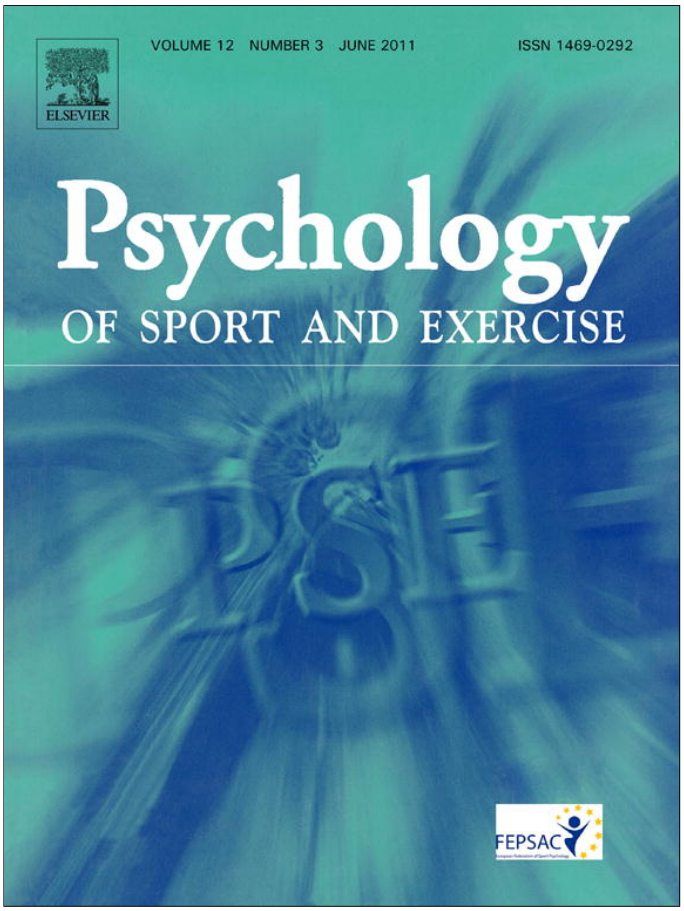

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The Basic Needs Satisfaction in Sport Scale (BNSSS): Instrument development and initial validity evidence

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ABSTRACT

Objectives: Employing a self-determination theory framework, the purpose of this project was to develop a measure of basic needs satisfaction in sport (autonomy, competence, and relatedness).
Method: Two studies were conducted to examine various aspects of reliability and validity. Hong Kong athletes ($n = 273$; mean age = 20.75 yrs) participated in Study 1. Reliability and factorial validity was examined using alpha coefficients and confirmatory factor analysis (CFA), respectively. New Zealand athletes ($n = 371$; mean age = 18.97 yrs) participated in Study 2. Factorial validity was revisited; nomological validity was assessed using correlations between theoretically related constructs (motivation, flow, athlete burnout).
Results: In Study 1, good fit to the hypothesized three-factor model was found (CFI = .98, RMSEA = .06). Alpha coefficients ranged from .80 to .87. In Study 2, construct coverage of BNSSS was reviewed, Experts suggested that the autonomy subscale did not adequately cover the internal perceived locus of causality (IPLOC) and volition aspects of autonomy; thus we added six new items intended to tap these constructs. Model fit of the hypothesized five-factor model was examined using CFA (CFI = .97, RMSEA = .06). Alpha coefficients were: Competence = .77, Autonomy-Choice = .82, Autonomy-IPLOC = .76, Autonomy-Volition = .61, Relatedness = .77. Significant correlations ($p < .05$) with scores representing theoretically related constructs were in the hypothesized direction.
Conclusion: Initial supportive evidence of reliability and construct validity of BNSSS scores was found. However, scale development is an ongoing process and future research is needed to further examine the validity of the BNSSS scores.

Self-determination theory (SDT; Ryan & Deci, 2002, 2007) has been used widely to explain and predict human motivation in a variety of life contexts, including competitive sport (e.g., Hodge, Lonsdale, & Ng, 2008; Hollembeak & Amorose, 2005; Perreault, Gaudreau, & Lapointe, 2007; Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002). Despite this popularity, no sport-specific instrument has been developed to measure some of the theory's most central constructs – the satisfaction of basic needs for competence, autonomy, and relatedness. In order to improve our understanding of the antecedents and consequences of basic needs satisfaction in the sport context, a domain-specific measure is needed. Therefore, the purpose of the studies reported here was to develop a needs satisfaction scale for use in the sport domain and to provide initial reliability and validity evidence of scores derived from this instrument.

Deci and Ryan (2000) considered competence, autonomy, and relatedness to be "innate psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (p. 229) for all individuals regardless of age, gender, or culture (Ryan & Deci, 2002). Within SDT, competence refers to "feeling effective in one's ongoing interactions with the social environment and experiencing opportunities to exercise and express one's capacities" (Ryan & Deci, 2002, p. 7). Autonomy refers to "being the perceived origin or source of one's own behavior" (Ryan & Deci, 2002, p. 8). Finally, relatedness refers to "feeling connected to others, to caring for and being cared for by those others, to having a sense of belongingness both with other individuals and with one's community" (Ryan & Deci, 2002, p. 7). In the sport context perceptions of relatedness may result from interactions from a variety of individuals, including teammates, training

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partners, coaches, parents, and others involved in athlete's sport participation.

Previous studies have shown that the satisfaction of these three basic needs predicts intrinsic motivation, well-being, and other positive outcomes in various life domains such as work (e.g., Baard, Deci, & Ryan, 2004), education (e.g., Ferrer-Caja & Weiss, 2000), sport rehabilitation (e.g., Podlog & Eklund, 2007), and exercise (e.g., Wilson & Rodgers, 2004). In the sport domain, numerous studies have been conducted to investigate the links between basic needs satisfaction and indicators of adaptive functioning, including intrinsic motivation (Hollembeak & Amorose, 2005), well-being (Gagné, Ryan, & Bargmann, 2003; Reinboth & Duda, 2006), persistence (Sarrazin et al., 2002) and flow experiences (Kowal & Fortier, 2000). Basic needs satisfaction in sport has also been negatively associated with maladaptive outcomes, including athlete burnout in elite rugby players (Hodge et al., 2008) and adolescent athletes (Perreault et al., 2007).

Measuring basic needs satisfaction in sport

In spite of the growing evidence regarding the importance of basic needs satisfaction in competitive sport, little emphasis has been paid to creating a measure of basic needs satisfaction specifically for use in the sport context. In previous sport studies, researchers have measured perceived basic needs satisfaction using scales that were adapted from other domains such as work (e.g., Gagné et al., 2003) and education (e.g., Kowal & Fortier, 2000). These adaptations may be problematic because the domains in which the scales were developed may be dissimilar to the sport context and basic needs satisfaction might be characterized differently. Reliability of scores derived from adapted scales may seem questionable in some studies (e.g., Kowal & Fortier, 2000). Furthermore, the current literature is also lacking evidence of these adapted scales having construct validity in the sport domain – such information is crucial when deciding whether or not to use a scale. In fact, issues such as insufficient model fit were found in some of the studies where adapted scales were used (e.g., Reinboth, Duda, & Ntoumanis, 2004). By creating a new scale, our objective was to provide a measure that could produce reliable and valid indicators of need satisfaction, specifically in the sport domain.

Even if researchers have some level of confidence in the reliability and validity of the scores derived from an adapted scale, when different scales are used across different studies the findings from these investigations cannot be easily compared (McDonough & Crocker, 2007). For example, Perreault et al. (2007) found a significant negative relation between relatedness and burnout scores, while Hodge et al. (2008) did not find differences in relatedness scores between high and low burnout groups. However, these studies employed different needs satisfaction measures. As a result, it was impossible to ascertain whether their somewhat inconsistent findings regarding the importance of relatedness were due to differences in the populations studied or the measurement instruments employed. If research was conducted using the same basic needs satisfaction measurement instrument then findings across different studies could be compared more easily.

The lack of a sport-specific needs satisfaction scale constitutes a pressing need for those interested in using SDT to understand and enhance athletes' sport experiences. Therefore, the aim of the studies reported in this paper was to develop the Basic Needs Satisfaction in Sport Scale (BNSSS), to measure perceived basic needs satisfaction in competitive sport contexts. Three studies were conducted to develop the BNSSS items and to provide initial evidence of reliability and construct validity. In Study 1, a pool of items for the scale was generated and their content relevance was reviewed by a panel of experts. Internal consistency and factorial validity of the scores derived from the scale was also examined. In Study 2, construct coverage of the retained items was reviewed, and further factorial validity evidence was provided. Initial nomological validity evidence was also provided by examining correlations between the scores of the BNSSS and hypothesized outcomes. Finally, the test–retest reliability of the scale scores was examined in Study 3.

Study 1

Based on the definitions of the basic needs for competence, autonomy, and relatedness proposed by Ryan and Deci (2002) and informal interviews with six athletes, 32 items (10 for competence, 10 for autonomy, and 12 for relatedness) were created in English and designed to reflect athletes' cognitions and affect associated with their sport participation (see Table A in supplementary document). The content relevance of these items was assessed using procedures recommended by Dunn, Bouffard, and Rogers (1999). Ten experts who had published SDT-related articles agreed to review the items. Utilizing an online survey tool with a 5-point Likert scale (1 = "Poor match"; 2 = "Fair match"; 3 = "Good match"; 4 = "Very good match"; 5 = "Excellent match"), reviewers indicated the degree to which each of the 32 items aligned with the definitions of competence, autonomy, and relatedness (see definitions in introduction). Reviewers could also provide typed feedback on item wording or other concerns.

Following Dunn et al.'s (1999) suggestions, a preliminary evaluation of the judges' ratings was conducted to screen out discrepant reviewers. During this process, the majority of responses (53%) from one reviewer were found to be at least two points lower than the mean ratings of those from other reviewers for items that were otherwise retained. This reviewer was therefore considered discrepant, and his/her responses were not included in the remaining analyses.

Aiken's (1985) item content-validity coefficient (V) was used to determine whether an item was relevant to a construct. V can range from 0 to 1, with a value of 1 denoting that all reviewers gave the highest possible rating (i.e., 5 or "Excellent match") and a value of 0 showing that all reviewers gave the lowest possible rating (i.e., 1 or "Poor match"). When there are nine reviewers, V values are significant at $p < .05$ for $V \geq .72$ Aiken (1985). Results revealed that 15 items (five for competence; five for autonomy; five for relatedness) met this $V \geq .72$ criterion (see Table A in supplementary document); these items were retained.

To determine whether the retained items were only relevant to a single construct, Cohen's (1977) effect size indices for dependent means were computed. This index showed the magnitude of the difference between the mean ratings associated with two different constructs on the same item. In line with Dunn et al.'s procedures, it was decided *a priori* that a large effect size ($\geq$.80) would need to be observed before an item could be deemed to be relevant only to a single construct. As shown in Table B (supplementary document), the computed effect size indices for all 15 retained items exceeded the .80 criterion. Taken together with the previously described content-validity coefficients (V), the effect size results suggested that all 15 retained items were relevant to the intended construct, and not to constructs that they were not intended to measure. As a result, all 15 items were included in the initial version of the BNSSS.

Method

Participants and procedures

Athletes ($n = 273$, mean age = 20.75 yrs, $SD = 1.64$ yrs) representing two universities in Hong Kong participated in this study.

Participants included 140 females and 131 males (2 did not specify their gender) from 18 different team (e.g., handball, $n = 39$) and individual sports (e.g., badminton, $n = 19$). Participants had a mean of 7.47 years ($SD = 4.06$ yrs) of participation in their sport. Approval for the study was granted by the university ethics committee. Questionnaires for the study were administered and collected during an inter-varsity games day. All participants provided signed informed consent.

Measure

The instructions and the 15 BNSSS items were administered in Chinese, which was the participants' first language. English items were translated into Chinese by two bilingual people, and back translated by an independent pair (van Widenfelt, Treffers, de Beurs, Siebelink, & Koudijs, 2005). Minor discrepancies in the translations were resolved during a meeting of the two translation teams. Participants were asked to respond to the items using a 7-point Likert scale (1 = "Not true at all"; 7 = "Very true"). Participants specified their major sport and were asked to complete the questionnaire with reference to this sport.

Data analysis

Data were inspected to determine if there were any systematic patterns of missing cases. Missing data were then replaced using an Expectation Maximization algorithm. The internal consistency of subscale scores was examined using alpha coefficients (Nunnally & Bernstein, 1994). Confirmatory factor analysis (CFA, LISREL 8.5; Jöreskog & Sörbom, 1999), was used to examine factorial validity. Model identification was achieved by fixing the variance of each factor to 1.0. Item scores were only allowed to load on their intended construct, factors were allowed to correlate, but error terms were not. A selection of goodness-of-fit indices, including Chi-square (χ^2), NNFI, CFI, RMSEA, and SRMR, was used to evaluate the fit of the data to the hypothesized three-factor model. Traditionally, NNFI and CFI values $> .90$ and RMSEA $< .08$ have been used as cut-off criteria. More recently, Hu and Bentler (1999) suggested model fit required NNFI and CFI values $\geq .95$, with SRMR and RMSEA $< .08$ and .06, respectively. In this study, Hu and Bentler's (1999) criteria were used to denote good fit. Items were considered for deletion if they produced scores that had factor loadings $< .40$ (Mullan, Markland, & Ingledew, 1997). Modification indices were also examined to locate potential cross-loading items. CFAs were conducted by freeing paths indicated by these large modification indices and items were considered for deletion if the results suggested an improved fit (i.e., $\Delta CFI > -.01$; Cheung & Rensvold, 2002).

Results

Preliminary results

The data were inspected for any systematic patterns of missing cases. No such pattern was identified as ten missing data points (i.e., <0.25% of the data) were spread across ten different respondents' questionnaires, and corresponded to nine different items. Missing data were replaced using an Expectation Maximization algorithm. Significant multivariate non-normality was found in the data (Mardia's skewness coefficient = 24.22; Mardia's kurtosis coefficient = 14.59), hence a Satorra–Bentler correction to the χ^2 was employed. Alpha coefficients for subscale scores were: Competence = .87, Autonomy = .83, Relatedness = .80.

Factorial validity

The hypothesized three-factor model using the 15 items was examined and, despite a significant scaled $\chi^2(87, N = 273) = 161.60$, $p < .01$, the data showed very good fit to the model according to the approximate fit indices: NNFI = .98, CFI = .98, SRMR = .05, RMSEA = .06, RMSEA 90% CI = .04–.07. Item scores loaded strongly on the intended factor (mean $\lambda = .71$, range = .45–.88). Modification indices were also inspected, and no items appeared to cross-load. Strong correlations were found between factors ($\Phi = .63$–.83); however, none of the 95% confidence intervals (CI) surrounding the point estimates encompassed 1.0 (see Table C in supplementary document), thus supporting the discriminant validity of the factor scores.

Discussion

The first purpose of this study was to create a preliminary pool of items for the BNSSS and to assess their content relevance. A total of 32 items were created and 15 were retained after a review by nine experts in SDT research. Reviewers' ratings provided support for the content relevance of items to the constructs they were intended to measure.

The second purpose of this study was to examine the internal consistency and factorial validity of BNSSS scores. Alpha coefficients ranged from .80 to .87 and results of CFAs revealed that the data fit the hypothesized three-factor model well, with item scores showing strong loadings on the intended factors. These results provided evidence supporting the factorial validity of the BNSSS scores. Although the content relevance of items was assessed, the extent to which the items tapped all aspects of the intended constructs (i.e., construct coverage) was not examined. Other aspects of construct validity, such as nomological validity, were also not included in this study. Construct coverage and further aspects of construct validity were, therefore, examined in Study 2.

Study 2

Construct coverage refers to the extent to which a set of items represent an entire construct. Consequently, it was necessary to wait until the content review and the CFAs in Study 1 had been completed and the set of items designed to measure each of the three constructs had been established. The 15 items (five for each basic need) retained from Study 1 were grouped into the constructs they were intended to measure. The ten reviewers who took part in the content-coverage review in Study 1 were asked to "provide written feedback regarding the extent to which the retained items represent the entire construct of interest". Reviewers were also asked to "describe any aspects of the construct you feel are not represented well". Among the eight reviewers who provided responses, five indicated that all three constructs were fully covered by the items. However, three reviewers commented that there were aspects of the autonomy construct that were not well represented. Specifically, these three reviewers suggested that the items were too heavily focused on the perceived choice aspect of autonomy.

These reviewers' comments were in line with Reeve, Nix, and Hamm's (2003) argument that the autonomy construct contains three aspects, namely perceived choice, an internal perceived locus of causality (IPLOC), and volition. Other sport researchers have also measured perceived choice and IPLOC as distinct facets of autonomy (Reinboth & Duda, 2006). According to Reeve et al. (2003), perceived choice originates from a perception of having decision-making flexibility to choose what to do within an activity (i.e., decisional choice), while volition refers to an unpressured willingness to engage in an activity or not (i.e., action choice), and an IPLOC indicates whether a person believes that his or her actions are initiated and regulated by a personal force. Following the reviewers' suggestions, ten new items were created in English in order to measure the two untapped aspects of autonomy (see

Table D in supplementary document). These newly created items were shown to the six athletes who also provided feedback in the initial item creation process, to ensure the descriptions matched what they might feel when participating in their sport. Among these ten new items, four items were designed to measure IPLOC (e.g., "In my sport, I feel I am doing what I want to be doing."), and six items were intended to tap volition (e.g., "I feel I participate in my sport willingly.").

Content-relevance review of new items for autonomy subscale

The content relevance of these newly created autonomy items was assessed by the three reviewers who felt that the items in the autonomy subscale from Study 1 did not sufficiently cover the entire construct. Reviewers who did not respond to our request to review construct coverage and reviewers who did not identify the over-representation of choice in the original autonomy items were not invited to review the new items. The review procedures were identical to those employed in Study 1; the reviewers were asked to rate the content relevance of each of the new items in relation to the conceptual definitions of competence, autonomy, and relatedness.

According to Aiken (1985), when only three reviewers provide ratings, scores for an item are significant at $p < .05$ only when $V \geq .92$ (i.e., mean rating ≥ 4.68). To achieve this mean rating all three reviewers would have needed to provide a rating of 5 (or "Excellent match"). It would be unreasonable to use this perfect score as the criterion, thus a more subjective evaluation was necessary. It was decided that, at a minimum, items should be rated a "good match" to the construct and thus items that had a rating of 3.00 or higher were retained. Six of the ten items received a mean rating that met or exceeded this criterion. These items included three intended to tap IPLOC and three intended to measure volition. The ratings with respect to the construct of autonomy were substantially higher than the ratings given to the constructs of competence and relatedness, as shown by the large effect sizes (>.80; Cohen, 1977). As a result, these six items were retained while the other four items were discarded.

To evaluate nomological validity, we examined relations between BNSSS scores and scores derived from scales designed to measure hypothetical outcomes of basic needs satisfaction. According to SDT tenets, basic needs satisfaction should be positively related to more autonomous motivational regulations (Ryan & Deci, 2002). To measure relative autonomy, a self-determination index (SDI) was calculated by weighting and summing the scores derived from the various subscales measuring different forms of regulation (Lonsdale, Hodge, & Rose, 2009). Positive correlations between BNSSS subscale scores and more autonomous forms of behavioral regulations would support the nomological validity of BNSSS scores. Positive relations with the SDI would also provide evidence of nomological validity.

A measure of flow was also used to examine the nomological validity of BNSSS scores. Flow is an optimal psychological state characterized as an intrinsically rewarding and enjoyable experience (Jackson & Eklund, 2004). Deci and Ryan (2000) have suggested that intrinsic motivation and flow share a strong relationship, thus we considered a propensity to experience flow to be a likely theoretical outcome of basic needs satisfaction. Hence, a positive correlation between BNSSS scores and flow scores would provide support for the nomological validity of the BNSSS scores.

Finally, ill-being is hypothesized to be negatively associated with needs satisfaction (Deci & Ryan, 2000). In the sport context, athlete burnout has frequently been viewed as state of ill-being (Hodge et al., 2008; Perreault et al., 2007). As a result, negative correlations between BNSSS scores and scores derived from a measure of athlete burnout would provide support for the nomological validity of the BNSSS scores.

Method

Participants and procedures

Athletes ($n = 401$) from a university in New Zealand participated in this study. Participants were 237 females and 164 males (mean age = 18.97 yrs, $SD = 1.95$ yrs), from 39 different team (e.g., rugby, $n = 82$) and individual sports (e.g., tennis, $n = 11$). These athletes included national senior representatives ($n = 14$), provincial senior representatives ($n = 43$), national age-group representatives ($n = 46$), provincial age-grade representatives ($n = 167$), and other club level athletes ($n = 101$). This study focused on competitive athletes only, therefore responses from athletes who only participated in recreational sports or did not report their levels ($n = 30$) were excluded. The final sample of eligible participants included 371 athletes (218 female and 153 male). Approval was granted by the university's ethics committee. All questionnaires were administered following university lecture periods. All instructions and items in the questionnaires were in English. Signed informed consent was received from all participants.

Measures

Basic Needs Satisfaction in Sport Scale. Participants' perceptions of competence, autonomy, and relatedness were measured using the English version of the BNSSS. The original autonomy items from Study 1 were labelled 'Choice'. The other original ten items from Study 1 (i.e., five competence and five relatedness items) were retained and added to the six newly created volition and IPLOC items (see Table 1). Participants were asked to respond to the items using a 7-point Likert scale (1 = "Not true at all", 7 = "Very true"). They were asked to respond to the items with regard to their feelings and experiences in their major sport.

Behavioral Regulation in Sport Questionnaire-6. The Behavioral Regulation in Sport Questionnaire-6 (BRSQ-6; Lonsdale, Hodge, & Rose, 2008) was used to measure the six types of motivational regulation as specified in SDT. The BRSQ-6 includes subscales designed to measure amotivation (AM), external regulation (EX), introjected regulation (IJ), identified regulation (ID), integrated regulation (IG), and intrinsic motivation (IM). Evidence supporting the reliability and construct validity of the BRSQ-6 scores has been previously reported (Lonsdale et al., 2008). A SDI was calculated by weighting and summing the scores derived from BRSQ-6 subscales. In many studies, SDIs have been calculated using weightings of +2 (IM), +1(ID), −1(IJ) and −2(EX). However, the BRSQ-6 includes an integrated regulation subscale and therefore weightings must be adjusted to reflect the uneven number of weightings. In line with Lonsdale et al. (2009), we assigned weights of +2, +1, and +1 to IM, IG, and ID, respectively. We multiplied the EX, and IJ scores by −2 (see Sarrazin et al., 2002 for a similar method of weighting with an uneven number of subscales).[1] Amotivation scores were not included in the SDI calculations because amotivation reflects a lack of motivation, while other types of regulations demonstrate reasons for action. Since the SDI was used as a measure of the

[1] The weightings used in the formula for the SDI in the current study deviated slightly from the ones used in some previous studies. For example, Gagné et al. (2003) used the formula $2 \times \text{IM} + 1 \times \text{ID} + (-1) \times \text{IJ} + (-2) \times \text{EX}$, while Markland and Ingledew (2007) employed $3 \times \text{IM} + 2 \times \text{IG} + 1 \times \text{ID} + (-1) \times \text{IJ} + (-2) \times \text{EX} + (-3) \times \text{AM}$. To ensure our results were not confounded by the change in weightings in the formula, we have calculated the correlations between SDI and basic needs satisfaction scores using formulae used in previous studies. No significant changes were found. Interested readers may contact the authors for full details.

Table 1
Item-factor loadings and descriptive statistics of BNSSS item scores in Study 2.

Item		*M*	*SD*	Range	Skewness	Kurtosis	λ	Θ
Competence								
Comp1	I can overcome challenges in my sport.	5.71	0.91	2–7	−0.58	0.56	.37	.86
Comp2	I am skilled at my sport.	5.58	1.02	2–7	−0.78	0.66	.79	.38
Comp3	I feel I am good at my sport.	5.71	1.00	2–7	−0.73	0.53	.86	.27
Comp4	I get opportunities to feel that I am good at my sport.	6.07	0.90	2–7	−1.15	2.14	.53	.72
Comp5	I have the ability to perform well in my sport.	5.84	0.97	3–7	−0.70	0.17	.68	.54
Choice								
Choice1	In my sport, I get opportunities to make choices.	5.16	1.28	1–7	−0.43	−0.25	.62	.61
Choice2	In my sport, I have a say in how things are done.	5.56	1.25	1–7	−1.08	1.25	.70	.51
Choice3	In my sport, I can take part in the decision-making process.	5.67	1.14	1–7	−0.90	0.68	.74	.46
Choice4	In my sport, I get opportunities to make decisions.	5.96	1.08	2–7	−1.37	2.39	.84	.29
Internal perceived locus of causality (IPLOC)								
IPLOC1	In my sport, I feel I am pursuing goals that are my own.	5.83	1.31	1–7	−1.22	1.16	.50	.75
IPLOC2	In my sport, I really have a sense of wanting to be there.	5.81	1.16	2–7	−1.02	0.71	.81	.35
IPLOC3	In my sport, I feel I am doing what I want to be doing.	4.52	1.44	1–7	−0.15	−0.59	.90	.19
Volition								
Volition1	I feel I participate in my sport willingly.	4.79	1.34	1–7	−0.40	−0.12	.79	.37
Volition2	In my sport, I feel that I am being forced to do things that I don't want to do. (Reversed coding item.)	5.26	1.20	2–7	−0.41	−0.36	.36	.87
Volition3	I choose to participate in my sport according to my own free will.	5.81	1.13	1–7	−0.93	0.77	.73	.48
Relatedness								
Relate1	In my sport, I feel close to other people.	6.08	1.07	2–7	−1.38	2.11	.60	.64
Relate2	I show concern for others in my sport.	6.48	0.91	2–7	−2.17	5.04	.30	.91
Relate3	There are people in my sport who care about me.	5.71	1.23	1–7	−1.25	1.68	.69	.53
Relate4	In my sport, there are people who I can trust.	6.56	0.86	1–7	−2.62	8.68	.80	.36
Relate5	I have close relationships with people in my sport.	6.08	1.01	2–7	−1.21	1.44	.83	.31

Note. *M* = mean; *SD* = standard deviation, λ = item-factor loading, Θ = error term.

quality of motivation, but not its quantity, amotivation scores were not included in the calculation of the SDI.

Dispositional Flow Scale. To reduce participant burden the full 36-item scale (DFS-2; Jackson & Eklund, 2004) was not used. Autotelic experience refers to the intrinsically rewarding experience that flow brings to an individual and is considered to be the end result of the other dimensions of flow (Csikszentmihalyi, 1990) Therefore, the autotelic subscale (e.g., "I really enjoy the experience.") was chosen as an indicator of flow experiences. Supportive evidence concerning the internal consistency and construct validity of the DFS-2 scores has been provided by Jackson and Eklund (2004).

Athlete Burnout Questionnaire. The 15-item Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001) was used to measure athlete burnout (e.g., "I don't care as much about my sport performance as I used to."). The scale includes three 5-item subscales measuring emotional/physical exhaustion, reduced sense of accomplishment, and devaluation, which can be combined to form a global burnout score (e.g., Raedeke & Smith, 2001). The reliability and construct validity of the scores derived from the ABQ were supported in the study conducted by Raedeke and Smith (2001).

Data analysis

Data were examined to identify any pattern to the missing data points. The univariate normality of the items was assessed using the skewness and kurtosis of the responses. Mardia's coefficients for the skewness and kurtosis of the data were used to test the multivariate normality of the responses. The internal consistency of subscale scores was examined using alpha coefficients (Nunnally & Bernstein, 1994). The factorial validity of scale scores was assessed using CFAs (LISREL 8.5; Jöreskog & Sörbom, 1999). The analyses were conducted by fixing the variance of each factor to 1.0, and item scores were only allowed to load on their intended construct. Factors were allowed to correlate, but the error terms were not allowed to correlate.

Due to the addition of the six new items, the factor structure of the autonomy subscale was first examined. The first model tested was a three-factor model in which autonomy items were separated into three factors: Perceived choice, IPLOC, and volition. Reeve et al. (2003) found that scores derived from the IPLOC and volition subscales showed similar relationships with related constructs; therefore, we specified a second CFA in which these constructs were merged by constraining the covariance to 1.0 between the IPLOC and volition factors. In a third, and final, model the covariance of all three factors were constrained to 1.0. This model tested the hypothesis that all items could be subsumed under a single 'autonomy' factor. The fit between these nested models were then compared using the .01 ΔCFI criterion outlined earlier (Cheung & Rensvold, 2002).

Results

Preliminary results

Six missing (i.e., <.10% of the data) data points were found in the BNSSS responses. The missing data were found in responses to five different items, suggesting there was no pattern of non-responses. Missing data were replaced using an Expectation Maximization algorithm. Significant multivariate non-normality was found in the data (Mardia's skewness coefficient = 42.86; Mardia's kurtosis coefficient = 20.16) and a Satorra-Bentler correction to the χ^2 was employed. Alpha coefficients were used to examine the internal consistencies of subscale scores: BNSSS-Competence = .77, BNSSS-Choice = .85, BNSSS-IPLOC = .76, BNSSS-Volition = .61, BNSSS-Relatedness = .77, BRSQ-IM = .86, BRSQ-IG = .75, BRSQ-ID = .73, BRSQ-IJ = .88, BRSQ-EX = .85, BRSQ-AM = .88; Flow-Autotelic Experience = .78, Global Burnout = .88.

Factor structure of autonomy subscale

The factor structure of the autonomy subscale of the BNSSS was first examined using CFA. Both the two- and three-factor model showed good fit to the data, however, the scores of one item under

the choice aspect ("In my sport, I feel free to express my ideas") cross-loaded on the other aspects of autonomy in both CFAs (modification indices = 14.07–194.17). Hence the item was deleted and the analyses were re-run (alpha for this revised subscale was .82). The three-factor autonomy model showed the best fit to the data: scaled χ^2 (32, $N = 371$) = 57.16, $p < .01$, NNFI = .99, CFI = .99, SRMR = .05, RMSEA = .05, RMSEA 90% CI = .03–.07. However, the two-factor autonomy model also fit the data well: scaled χ^2 (33, $N = 371$) = 100.51, $p < .01$, NNFI = .97, CFI = .98, SRMR = .06, RMSEA = .07, RMSEA 90% CI = .06–.09. The one factor model had the poorest fit to the data: scaled χ^2 (35, $N = 371$) = 670.62, $p < .01$, NNFI = .82, CFI = .86, SRMR = .15, RMSEA = .17, RMSEA 90% CI = .15–.19. In the three-factor model, the estimated correlation between the factors containing items in IPLOC and volition aspect was strong ($r = .81$), but none of the 95% confidence interval of the correlation estimates between the factors encompassed 1.0. Results of a test of differences between fit indices also suggested that the model fit of the three-factor model was superior to the two-factor model: $\Delta\chi^2$ (2) = 80.04, $p < .01$, ΔCFI = .015. Since the data fit the three-factor model best, this model was used in subsequent analyses.

Factor structure of the BNSSS

The factor structure of the scores from the full 20-item BNSSS (i.e., including autonomy, competence, and relatedness items) was then examined. A five-factor BNSSS model was tested by allowing items from the competence and relatedness subscales, and all three aspects of autonomy to load on five different factors (see Fig. 1). The fit for this BNSSS model was examined using CFA: scaled χ^2 (160, $N = 371$) = 341.70, $p < .01$, NNFI = .96, CFI = .97, SRMR = .07, RMSEA = .06, RMSEA 90% CI = .05–.06, AIC = 441.70; however, scores on one item from each of the competence ("I can overcome challenges in my sport"), volition ("In my sport, I feel that I am being forced to do things that I don't want to do"), and relatedness ("I show concern for others in my sport") subscales showed loadings (see Table 1) that were slightly lower than the stated criterion ($\lambda > .4$; Mullan et al., 1997). A model in which these three items were omitted was also tested and showed similar fit (scaled χ^2 [109, $N = 371$] = 231.67, $p < .01$, NNFI = .97, CFI = .98, SRMR = .07, RMSEA = .06, RMSEA 90% CI = .05–.07, AIC = 319.67) to the originally hypothesized model. Three separate models in which each of the low-loading single item was removed on its own also showed similar fit to the original model (contact the second author for full details). As a result, there did not appear to be conclusive evidence to support permanent elimination of these three items. Furthermore, two of the items were included in Study 1 and showed strong loadings ($\lambda > .56$) in that sample. As a result, we decided to retain these three items, but suggest that further research may be needed on this issue.

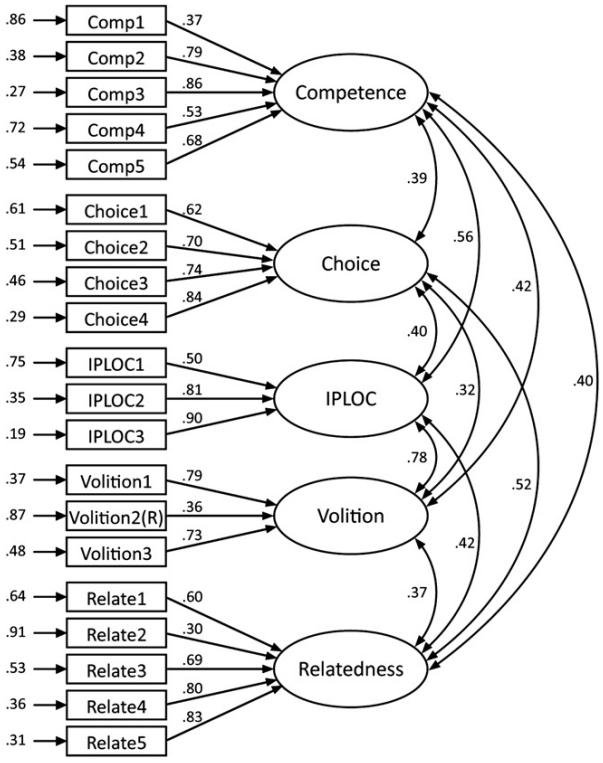

Fig. 1. Factor structure of BNSSS item scores in Study 2.

Nomological validity

To evaluate nomological validity we examined correlations with scores derived from measures of hypothesized outcomes of needs satisfaction (i.e., SDI, flow, and burnout scores; see Table 2). As hypothesized, positive correlations were found between BNSSS scores and the SDI ($r = .26–.58$), with needs satisfaction showing strong positive relations with more autonomous forms of regulations, and negative correlations with less autonomous regulatory styles. Positive relations were also found between the BNSSS scores and flow ($r = .30–.58$). Negative correlations were found between BNSSS scores and global burnout ($r = -.21$ to $-.55$).

Discussion

The purpose of Study 2 was to examine the construct coverage of the items of the BNSSS, while providing further evidence concerning the factorial validity and preliminary evidence regarding the nomological validity of the subscale scores. The construct coverage review revealed that the original autonomy subscale items likely did not adequately cover the IPLOC and volition aspects of autonomy (Reeve et al., 2003). This omission was in line with the general tendency, noted by McDonough and Crocker (2007), for autonomy measures to be focused more on the perceived choice concept than on the other aspects of autonomy (e.g., Hodge et al., 2008; for an exception to this statement see Reinboth & Duda, 2006). Consequently, our attempt in Study 2 to measure all three aspects of autonomy marked an improvement in construct coverage compared with Study 1 and other sport-based investigations employing needs satisfaction scales adapted from other contexts.

After adding and testing new items to tap the IPLOC and volition aspects of autonomy, we chose a three-factor autonomy model as the best fit to the data. Hence a five-factor BNSSS was employed in subsequent analyses. In Study 2 we also examined the nomological validity of the five-factor BNSSS. Results showed that all subscale scores derived from the BNSSS exhibited relationships with measures of other constructs (i.e., autonomous behavioral regulations, SDI, flow, and burnout) that were in line with hypotheses. These results provided initial evidence supporting the nomological validity of the scores derived from the BNSSS. However, compared to the IPLOC and volition, the scores of the Choice subscale had weaker correlations with constructs that were hypothesized to be related. This might suggest that the choice aspect plays a somewhat dissimilar role with the hypothesized constructs. Future research may make attempts to observe whether similar results are consistently found.

Table 2
Correlations amongst BNSSS subscale scores and related constructs in Study 2.

	α	*M*	*SD*	Range	BNSSS				
					Competence	Choice	IPLOC	Volition	Relatedness
BRSQ									
IM	.86	6.44	0.68	3.00–7.00[b]	.32	.26	.58	.57	.28
IG	.75	5.47	0.98	1.25–7.00[b]	.31	.28	.43	.28	.26
ID	.73	5.85	0.96	1.25–7.00[b]	.21	.09	.35	.27	.18
IJ	.88	2.83	1.56	1.00–7.00[b]	−.19	−.16	−.36	−.42	−.20
EX	.85	2.41	1.28	1.00–7.00[b]	−.19	−.19	−.45	−.49	−.20
AM	.88	2.06	1.20	1.00–7.00[b]	−.27	−.26	−.49	−.50	−.20
SDI	–	13.71	6.59	−17.04 to 24.00[a]	.30	.26	.58	.58	.29
Flow	.78	4.43	0.53	2.50–5.00[c]	.43	.30	.58	.40	.33
Burnout	.88	2.29	0.58	1.07–4.33[c]	−.44	−.31	−.55	−.47	−.21

Note. SDI = self-determination index; AM = amotivation; EX = external regulation; IJ = introjected regulation; ID = identified regulation; IG = integrated regulation; IM = intrinsic motivation; *M* = mean; *SD* = standard deviation. The SDI was calculated using behavioral regulations measured by the Behavioral Regulation in Sport Questionnaire-6 (Lonsdale et al., 2008).
All correlations (except between BNSSS-Choice and BRSQ-ID) are significant at $p < .05$.
[a] The possible range of SDI is −28.00 to 28.00.
[b] The possible range for BRSQ subscale scores are 1.00–7.00.
[c] The possible range for flow and burnout is 1.00–5.00.

Study 3

The purpose of Study 3 was to examine the test–retest reliability of the five-factor BNSSS. Participants were 63 athletes (25 females, 38 males; mean age = 21.22 years, *SD* = 1.96 years) who were also undergraduate students at a university in Hong Kong. Participants were asked to complete a Chinese version of the BNSSS on two occasions seven days apart. A seven-day time frame between the administrations was used in order to minimize changes in basic needs satisfaction. Therefore, any inconsistencies between the scores could be attributed to a lack of test–retest reliability of the scale scores (Pedhazur & Pedhazur-Schmelkin, 1991). A one-week time interval has also been used in previous studies measuring motivation-related constructs in sport, such as goal orientations (Lane, Nevill, Bowes, & Fox, 2005) and behavioral regulations (Lonsdale et al., 2008). The translation of the six new BNSSS items (see Study 2) was completed by two bilingual individuals, and was back translated by an independent bilingual pair. The back-translated version of the items matched the original items very well, thus no changes in the translated version were needed.

Intra-class coefficients (ICC) were used to assess the test–retest reliability of the scores between the two sets of responses. The coefficients for all five subscales were: Competence = .83, Choice = .78, IPLOC = .87, Volition = .83, Relatedness = .74. These results provided initial support for the test–retest reliability of the BNSSS scores.

General discussion

The purpose of this series of studies was to create items and test the reliability and validity of scores derived from a basic needs satisfaction scale developed specifically for use in the sport domain. Grounded in self-determination theory (Ryan & Deci, 2002, 2007), the 20-item five-factor BNSSS was created to measure satisfaction of the basic psychological needs of competence (five items), autonomy (ten items separated into three different aspects), and relatedness (five items). Although Reeve et al. (2003) suggested merging the IPLOC and volition aspects in the education domain, we initially hypothesized the three-factor autonomy model because relations between autonomy constructs may differ in the sport domain. A subsequent CFA supported the hypothesized five-factor BNSSS model (i.e., competence, relatedness, and the three aspects of autonomy). Aspects of construct validity were examined in the study, and results supported the content, factorial, and nomological validity of the scores derived from the BNSSS. Supportive evidence concerning the internal consistency and test–retest reliability of subscale scores was also found.

One important aspect of the BNSSS was that it was developed specifically for the sport domain. Previous sport studies have measured basic needs satisfaction in sport via the use of scales adapted from other life domains (e.g., Hodge et al., 2008; Perreault et al., 2007). Using the BNSSS may allow researchers to be more confident that all items are relevant in the sport context, that they are meaningful to athletes, and that the scores derived from the BNSSS are valid and reliable indicators of athletes' basic needs satisfaction.

Apart from the contribution that the BNSSS may make to the field, the studies outlined in this paper are also noteworthy from a methodological standpoint. Although suggestions have been made regarding ways to assess the content relevance of questionnaire items (e.g., Dunn et al., 1999), fewer guidelines have been offered regarding appropriate methods to examine construct coverage. Messick (1980) suggested that construct coverage is an important aspect of content validity and the expert review process in the current study certainly proved beneficial in this regard. Indeed, three expert reviewers in Study 2 suggested that items in the original version of the BNSSS autonomy subscale did not sufficiently tap the IPLOC and volition aspects of autonomy. As a result, in Study 2, we added items designed to tap these concepts. In the future, scale development researchers may also wish to include content-coverage assessments as part of their item creation procedures.

From a practical perspective, the differentiation of these aspects may provide insights to how feelings of autonomy may be promoted. For instance, instead of simply providing choices, athletes may also need to understand the rationale behind their activities in order to feel a complete sense of autonomy and promote optimal motivation towards their sport. Indeed, as we noted previously, Reeve et al. (2003) found that, compared with choice, volition and IPLOC were better predictors of intrinsic motivation. Similarly, Assor, Kaplan, and Roth (2002) found that, compared with "providing choice", teacher behaviour that "fostered relevance" (potentially a volition-enhancing strategy) was a stronger predictor of students' positive feelings and engagement. Investigations into the importance of each aspect of autonomy for athletes and strategies that promote these aspects might help

researchers and practitioners to design effective interventions that can enhance athletes' motivation, experiences and performance.

In terms of limitations, our decision to develop BNSSS items using samples from Hong Kong (Study 1) and New Zealand (Study 2) may not have been ideal. As noted by an anonymous reviewer, collecting data in these two countries introduced between sample variables (e.g., culture and language) that may have influenced the way items were interpreted by participants. Although it was not the aim of this study to test the cross-cultural invariance of BNSSS scores, this is an interesting issue that warrants further investigation.

Despite this limitation, the evidence presented in this report suggests that the BNSSS may serve as a useful tool in future research related to basic needs satisfaction in sport. Previously a variety of different instruments adapted from other life contexts have been employed to measure basic needs satisfaction in sport. Apart from validity concerns that we have previously noted, this practice has limited the comparisons that can be made across studies of different populations (McDonough & Crocker, 2007). If the BNSSS is adopted by researchers it would make these types of comparisons more meaningful. For example, the importance of needs satisfaction of participants from different ages, cultural backgrounds, and skill levels could be compared. The relative influence of the three needs on intrinsic motivation and other related outcomes (e.g., athlete engagement, athlete burnout, pro-social behaviour), could also be examined.

In general, results from these three studies demonstrated that the BNSSS produced scores that were reliable, with evidence supporting multiple facets of construct validity for subscales intended to measure perceived basic needs satisfaction of competence, autonomy, and relatedness specific to the sport domain. However, construct validation is an ongoing process and future research is needed to provide additional evidence regarding the validity of the BNSSS scores.

Appendix A. Supplementary data

Supplementary data associated with this article can be found in the online version, at doi:10.1016/j.psychsport.2010.10.006.

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