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Chapter 3

WHAT ROLE DOES PSYCHOLOGICAL NEED SATISFACTION PLAY IN MOTIVATING EXERCISE PARTICIPATION?

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ABSTRACT

The purpose of this study was to examine Vallerand's (2001) contention that perceptions of psychological need satisfaction underpin the endorsement of different motives, which in turn, predicts behavioural intentions in the context of exercise. Participants (N = 176; 51.2% female) involved in a group-based intramural event completed a self-administered cross-sectional survey comprised of demographic questions, the Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson et al., 2006), the Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan et al., 1997), and a behavioural intention scale (Courneya & McAuley, 1993). Bivariate correlations indicated stronger relationships between fulfillment of the psychological needs for competence, autonomy, and relatedness with identified and intrinsic regulations (r's ranged from 0.47 to 0.67) compared to external and introjected regulations (r's ranged from -0.30 to 0.19). Multivariate analysis using structural equation modeling supported the tenability of a model explaining behavioural intentions (R^2 = 0.17) as a function of a person's relative autonomy motivational index (γ = 41) which in turn was predicted by perceived competence (γ = 0.25), autonomy (γ = 0.53), and relatedness (γ = -0.12) in exercise contexts (χ^2 = 399.47; df = 183; *CFI* = 0.92; *IFI* = 0.92; *RMSEA*

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= 0.08 [90% *CI* = 0.07 to 0.10]). Overall, the results of the present investigation partially support Vallerand's argument regarding the sequences that shape motivational processes in exercise contexts. Furthermore, the results of the present investigation provide support for the importance of psychological need satisfaction for internalized motivation in an applied context which is in line with more general arguments set forth within the framework of self-determination theory (Deci & Ryan, 1985; 2002).

Keywords: Construct Validity, Basic Psychological Needs subtheory, Physical Activity

It is well documented that physical activity reduces all-cause mortality and morbidity (Bouchard, Blair, & Haskell, 2007) while enhancing quality of life in various populations (Biddle, Fox, & Boutcher, 2000). Given the importance of physical activity to health promotion, it is surprising that over half (51.0%) of the Canadian population remain inactive (Cameron, Craig, & Paolin, 2005). Complimenting these trends, previous research notes high attrition rates from structured involvement in exercise within 6 months of initial adoption (Craig, Cameron, Russell, & Beaulieu, 2001). Considering the contribution of regular physical activity to population health goals, it seems clear that research examining the reasons why people sustain engagement in physical activity is important. Towards this end, theory-based research addressing participation issues in physical activity has been advocated (Bauman, Sallis, Dzewaltowski, & Owen, 2002; Biddle, Fox, & Boutcher, 2000). One theoretical framework that may be useful for understanding physical activity motivation is self-determination theory (SDT; Deci & Ryan, 2002).

According to Deci and Ryan (2002), motivation lies on a continuum marking distinct regulatory structures responsible for motivating behaviour. The distal ends of the continuum are anchored by amotivation which concerns a lack of intentionality to perform the behaviour or passive compliance, and intrinsic motivation which posits that interest, enjoyment, and novel curiosity regulate behaviour (Deci & Ryan, 2002). Ryan (1995) notes, however, that not all behaviours are amenable to intrinsic motivation and therefore SDT has developed a differentiated approach to extrinsic motivation. At one end of the continuum, extrinsic motives control behaviour through a desire to maximize rewards and avoid punishments (external regulation; Deci & Ryan, 2002) or coerce task persistence through their desire to avoid negative feelings such as guilt or maintain contingent self-worth (introjected regulation; Deci & Ryan, 2002). By contrast, more autonomous processes characterize motivation at the other end of the continuum whereby behaviour is regulated by personal values (identified regulation; Deci & Ryan, 2002) or congruence between a person's identity and the behaviour itself (integrated regulation; Deci & Ryan, 2002). Emerging evidence supports the distinction between these motivational structures in exercise (Mullan, Markland, & Ingledew, 1997) and indicates that autonomous motives predict adaptive consequences including positive self-perceptions (Wilson & Rodgers, 2002), habitual exercise patterns (Mullan & Markland, 1997), and reduced likelihood of exercise dependence (Edmunds, Ntoumanis, & Duda, 2006).

One aspect of SDT that holds considerable appeal for understanding physical activity behaviour is the proposition that basic psychological needs serve as a unifying framework for understanding motivational processes and their impact on health and well-being (Deci & Ryan, 1985; 2002; Ryan 1995). Deci and Ryan (2002) have advocated that basic psychological needs within SDT act as synergistic "nutriments" (p.7) within and across contexts to foster integrative tendencies such as adaptation and adjustment (Ryan, 1995).

While other theories equate psychological needs with any desire or drive (Deci & Vansteenkiste, 2004), the view embraced within SDT is that psychological needs are separate from motives and represent the foundation upon which motivational development is either optimized or forestalled (Deci & Ryan, 2002; Ryan, 1995).

Deci and Ryan (1985; 2002) proposed that the psychological needs for competence, autonomy, and relatedness promote the internalization of social norms and values including the regulatory structures motivating behaviour and impacting well-being. Competence refers to interacting effectively within one's environment while mastering challenging tasks or expressing one's capacities (White, 1959). Autonomy involves feeling a sense of personal agency or volition such that one's behaviour is perceived to emanate from an internal locus of causality as opposed to feeling controlled by external agendas (deCharms, 1968). Finally, relatedness involves feeling a meaningful connection to important others within one's social milieu that is characterized by nurturing social relationships or a sense of belongingness to others embedded within a broader community (Baumeister & Leary, 1995).

While the number and function of basic psychological needs remains controversial (Schwartz, 2000), this aspect of SDT has practical appeal given the ability of psychological needs to explain a broad spectrum of human functioning (Deci & Ryan, 2002; Sheldon, Elliot, Kim, & Kasser, 2001) while offering targets for intervention to illicit behavioural or psychological change (Sheldon, Williams, & Joiner, 2003). Research in exercise settings has consistently supported the importance of perceived competence in terms of shaping motivation and subsequent behaviour (Roberts, 2001), and to a lesser extent, a factor impacting well-being (Frederick & Ryan, 1993). However, investigations examining Deci and Ryan's (2002) contentions regarding the link between satisfying autonomy and relatedness needs and exercise motivation has yielded mixed results (Edmunds et al., 2006; Vlachopoulos & Michailidou, 2006; Wilson, Rodgers, Blanchard, & Gessell, 2003). For example, Edmunds et al. (2006) note that only perceived competence predicted intrinsic motivation in British exercisers while Vlachopoulos and Michailidou (2006) report no relationship between perceived autonomy and relatedness with indices of motivation in Greek exercisers. Furthermore, Wilson et al. (2003) reported no meaningful relationship (r's range from .01 to .19; all p's > 0.05) between perceived relatedness and any point along SDT's motivation continuum in a sample of Canadian exercisers.

Considering the importance of basic psychological needs to SDT-based views on motivation, it is difficult to reconcile the aberrant results of investigations conducted in exercise contexts. One plausible explanation for these observations concerns the difficulty of measuring psychological need satisfaction in general (Sheldon, 2002) and in exercise contexts in particular (Wilson et al., 2003). Previous investigations have modified instruments designed to measure psychological need satisfaction in work (Edmunds et al., 2006) or education (Wilson et al., 2003) contexts which may account for the troublesome score reliability evidence observed in these studies (Cronbach's α's ranged from 0.53 to 0.65 respectively) and attenuate the relationship between psychological need satisfaction and exercise motivation. Ryan (1995) has emphasized the importance of domain-specific investigations to determine the degree to which basic principles advanced within SDT generalize across contexts where idiosyncrasies likely impact motivation. Extrapolating from Ryan's (1995) contentions, and previous exercise-based studies, Wilson and colleagues have developed the Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson, Rogers, Rodgers, & Wild, 2006) as a domain-specific instrument capturing variability in the

fulfillment of competence, autonomy, and relatedness needs within exercise settings. Adopting a construct validation approach (Messick 1995), Wilson et al. (2006) provided evidence supporting the structural and convergent validity, as well as, the internal consistency reliability of PNSE subscale scores in a sample of active Canadian exercisers. However, no attempt was made to link PNSE constructs with exercise motives or other variables implied within SDT's nomological network (Cronbach & Meehl, 1955) to determine the manner in which PNSE scores corroborate Deci and Ryan's (2002) arguments concerning the function of psychological needs within SDT.

The overall purpose of this study was to examine the relationship between perceptions of competence, autonomy, and relatedness in exercise settings with exercise motives and behavioural intentions to continue exercising. A secondary purpose was to extend the construct validity evidence associated with PNSE by linking scores from this instrument with exercise motives and behavioural intentions drawn from a nomological network (Cronbach & Meehl, 1955) implied within the SDT literature (Deci & Ryan, 2002; Vallerand, 2001). Intentions were included in this study for two reasons. First, intentions are considered a proximal determinant of planned behaviour and have been linked with subsequent behaviour in a number of contexts including exercise (see Ajzen, 2005). Second, intentionality is considered a hallmark of motivated behaviour (Ryan, 1995) and poses less measurement problems than indexing actual exercise behaviour (Connor & Sparkes, 2005). Our hypotheses were developed from Deci and Ryan's (1985; 2002) theorizing and previous studies examining issues of psychological need satisfaction in exercise (Edmunds et al., 2006; Vlachopoulos & Michailidou, 2006; Wilson et al., 2003). It was hypothesized that (a) greater satisfaction of psychological needs would be more positively associated with autonomous than controlling forms of exercise motivation and stronger intentions to continue exercising in the future, (2) exercise motivation scores would display a graded pattern of relationships such that proximal motives on SDT's continuum would be more positively associated than distal motives, and (c) autonomous exercise motives would be more positively associated with behavioural intentions to continue exercising than controlled motives.

METHOD

Participants

A total of 176 students and staff drawn from teams enrolled in a university-based physical activity event participated in this study. Participants received no academic credit or remuneration for their involvement. The sample consisted of 84 males (M_{age} = 22.73; SD = 3.51) and 91 females (M_{age} = 22.23; SD = 3.27). One participant did not provide their gender. Participants in this study reported body mass index (BMI) values approximating the healthy range for this age cohort (M_{BMI} males = 23.95; SD = 4.66; M_{BMI} females = 22.12; SD = 2.88) and varied exercise behaviour across the past 7 days ($M_{GLTEQ\text{-}METS}$ Males = 40.61; SD = 34.58; $M_{GLTEQ\text{-}METS}$ Females = 53.27; SD = 61.74) based on their responses to the Godin Leisure Time Exercise Questionnaire (Godin & Shepherd, 1985). Considering Rodgers and Gauvin's (1998) classification scheme, 51.7% of this sample represents "regular exercisers" given their

participation in three or more strenuous exercise sessions/week and 68.2% of the sample reported engaging in exercise on three or more days/week over the past six months.

Measures

Psychological Need Satisfaction in Exercise Scale (PNSE)

Participants completed the 18-item PNSE (Wilson et al., 2006) as an index of their perceived competence, autonomy, and relatedness experienced in exercise contexts. A stem statement anchored each item in terms of how participants usually felt while exercising (i.e., "The following statements represent different feelings people have when they exercise. Please answer the following questions by considering how you typically feel while you are exercising."). Participants responded to each PNSE item (see Table 1) on a scale anchored by 1 (False) and 6 (True). Wilson et al. (2006) supported the structural and convergent validity of PNSE scores and reported internal consistency reliability values exceeding 0.90 across PNSE subscale scores.

Table 1. Standardized loadings and distributional characteristics of PNSE items used in the measurement model analysis

PNSE Latent Factors Item abbreviations	*M*	*SD*	*Skew.*	*Kurt.*	*FL*	*EV*
PNSE – Perceived Competence						
able complete challenging exercises	5.05	0.90	-0.95	1.44	.61	.50
confident I can do challenging exercises	4.59	1.13	-0.65	0.37	.77	.51
confident in exercise ability	4.85	1.08	-1.00	1.01	.85	.33
capable of completing exercises	4.91	1.09	-1.22	1.95	.88	.28
capable of doing challenging exercises	4.70	1.16	-0.90	0.46	.84	.40
feel good about the way I exercise	4.85	1.10	-0.90	0.79	.83	.37
PNSE – Perceived Autonomy						
free to exercise in own way	4.97	1.20	-1.10	0.75	.79	.53
free to make own exercise decisions	4.94	1.15	-1.04	0.98	.87	.31
feel like I am in charge of exercise program	4.90	1.13	-0.90	0.48	.90	.24
I have a say in choosing exercises I do	4.96	1.15	-1.27	1.59	.86	.35
feel free to choose exercise I participate in	4.99	1.11	-1.03	0.83	.87	.31
I decide what exercises I do	5.01	1.14	-1.19	1.29	.88	.30
PNSE – Perceived Relatedness						
feel attached to exercise companions	4.41	1.26	-0.88	0.75	.73	.74
share common bond with important others	4.40	1.27	-0.63	-0.03	.85	.45
feel sense of camaraderie	4.34	1.37	-0.57	-0.27	.78	.74
close to exercise companions	4.41	1.21	-0.62	0.27	.78	.58
feel connected with those I interact with	4.49	1.24	-0.63	-0.02	.85	.42
get along well with other exercisers	4.54	1.26	-0.79	0.51	.84	.46

Note. *PNSE* = Psychological Need Satisfaction in Exercise Scale (Wilson et al., 2006). *Skew*. = Univariate Skewness. *Kurt*. = Univariate Kurtosis.). *FL* = Factor Loading; *EV* = Error Variances. *FL* and *EV* values are from the CFA of the *PNSE* measurement model. All *FL*'s are statistically significant at $p < .01$ (two-tailed significance).

Behavioural Regulation in Exercise Questionnaire (BREQ)

Participants completed the BREQ (Mullan et al., 1997), a 15-item self-report measure assessing the reasons why people exercise consistent with SDT. The BREQ operationalizes exercise motivation along a graded self-determination continuum, and includes subscales assessing external, introjected, identified, and intrinsic regulations. Following the stem, "Why do you exercise?", participants respond to each item (see Table 2) on a 5-point Likert scale anchored at the extremes by 1 (Not true for me) and 5 (Very true or me). Previous research has supported the structural validity of BREQ scores (Mullan et al., 1997), and provided evidence of the BREQ scores ability to distinguish active from inactive groups (Mullan & Markland, 1997).

Table 2. Standardized loadings and distributional characteristics of BREQ items used in the measurement model analysis

Instrument Variables Item Abbreviations	*M*	*SD*	*Skew.*	*Kurt.*	*FL*	*EV*
BREQ - External Regulation						
I feel pressured to exercise by friends/family	1.34	1.27	0.49	-0.89	.67	.89
I exercise because others say I should	1.03	1.17	0.92	-0.06	.74	.61
I exercise because others would not be pleased	0.85	1.16	1.22	0.52	.80	.49
I exercise because others say I should	0.91	1.19	1.16	0.26	.84	.41
BREQ - Introjected Regulation						
I feel ashamed when I miss an exercise session	1.63	1.28	0.29	-1.00	.82	.53
I feel guilty when I don't exercise	2.05	1.33	-0.06	-1.11	.80	.62
I feel like a failure when I don't exercise	1.77	1.40	0.20	-1.21	.74	.86
BREQ - Identified Regulation						
I get restless if don't exercise regularly	2.78	1.20	-0.83	-0.19	.67	.78
I think it's important to exercise regularly	3.22	0.94	-1.31	1.67	.88	.20
It's important to me to exercise regularly	3.18	0.99	-1.23	1.09	.88	.22
I value the benefits of exercise	3.34	0.91	-1.66	3.22	.76	.35
BREQ - Intrinsic Regulation						
I find exercise is a pleasurable activity	3.16	0.96	-1.38	1.95	.91	.17
I get pleasure/satisfaction from exercising	3.24	0.93	-1.40	2.00	.87	.22
I exercise because it is fun	3.15	1.02	-1.35	1.51	.80	.37
I enjoy my exercise sessions	3.08	0.98	-1.10	0.93	.86	.25

Note. *BREQ* = Behavioural Regulation in Exercise Questionnaire (Mullan & Markland, 1997). *FL* = Factor Loading; *EV* = Error Variances. *FL* and *EV* values are from the CFA of the *BREQ* measurement model. All *FL*'s are statistically significant at $p < .01$ (two-tailed significance).

Behavioural Intentions (BI)

Participants completed three items based on Courneya and McAuley's (1993) recommendations to capture intentions to continue exercising over the next 4 months. Following the stem, "These questions concern your exercise plans for the next 4 months', participants responded to each item on a 7-point Likert scale anchored at the extremes by 1 (Strongly Disagree) and 7 (Strongly Agree). Each item was chosen to reflect general intentions ('I intend to exercise regularly during the next 4 months', 'I intend to participate in physical exercise as much as I can every week during the next 4 months') or specific

intentions ('I intend to exercise at least 3 times per week over the next 4 months'). Courneya, Nigg, and Estabrooks (1998) supported the criterion validity of scores from these items in terms of their predictive relationship with exercise behaviour.

Procedures and Analyses

Data were collected in small groups (n < 25 in all instances) after participants had been informed about the nature of the investigation and provided the opportunity to ask questions. All participants provided written informed consent prior to participation. Standard instructions were given to each group by the principal investigator to reduce the potential for between groups effects associated with test administration. Subscale scores were created for the PNSE and BREQ subscales, as well as BI, by averaging the relevant items per latent factor (Morris, 1979).

Data analysis proceeded in sequential stages. First, the data were screened for aberrant responses and examined for conformity with statistical assumptions. Second, two confirmatory factor analyses (CFA) using AMOS 6.0 were examined to test the structural validity of PNSE and BREQ responses. Third, descriptive statistics, internal consistency reliability estimates (Coefficient α; Cronbach, 1951), and bivariate correlations were calculated. Fourth, a full measurement model was examined using CFA prior to estimating a structural model that posited behavioural intentions as a function of the degree of relative autonomous exercise motivation which in turn was underpinned by perceived psychological need satisfaction. Conventional standards were specified in all measurement and structural model analyses including correlating latent factors, loading manifest items exclusively on target latent factors, constraining uniqueness values to zero, and fixing a single item loading to unity to define the scale of each factor. A selection of fit indices recommended for use with structural equation modeling (SEM) in small samples were employed to evaluate model fit in both the measurement and structural model analyses (i.e., χ^2, Comparative Fit Index [CFI], Incremental Fit Index [IFI], Root Mean Square Error of Approximation [RMSEA]; West, Finch, & Curran, 1995). While threshold values indicative of acceptable model fit in applications of SEM remain contentious (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004), CFI and IFI values exceeding 0.90 and 0.95 are considered indicative of acceptable and excellent model fit (Hu & Bentler, 1999). RMSEA values less than 0.05 are desirable whereas values exceeding 0.10 are rarely acceptable (Browne & Cudeck, 1993).

RESULTS

Preliminary Analyses

Only 1.14% missing data was evident across PNSE, BREQ, and BI data with no systematic pattern of non-response evident therefore sample means were imputed (Hawthorne & Elliot, 2005). No extreme responses (> 3 *SD*'s away from the mean per variable/construct) were evident. Item level descriptive statistics indicated some departure from univariate normality in PNSE (see Table 1) and BREQ (see Table 2) scores and notable multivariate

kurtosis was evident (Mardia's Coefficient's ranged from 72.67 to 215.40). While alternative estimation procedures exist for data that violate normality assumptions, they require large sample sizes to produce stable parameter estimates and prevent distortion of global model fit estimates (Hu & Bentler, 1999). Maximum likelihood (ML) estimation procedures were employed based West et al.'s (1995) recommendations.

Measurement Model Analysis

Examination of the fit indices (see Table 3) partially supports the tenability of the PNSE and BREQ measurement models. Minimal evidence of over- or under-estimation of fitted correlations in either the PNSE (92.81% $z < |1.0|$; 0% $z > |2.0|$) or BREQ (98.10% $z < |2.0|$; 0% $z > |3.0|$) measurement models were noted in the distribution of standardized residuals. A pattern of moderate-to-strong (all p's < 0.05) standardized parameter estimates were observed across target latent factors scores for each manifest PNSE (Mean $\lambda = 0.82$; $SD = 0.07$) and BREQ (Mean $\lambda = 0.80$; $SD = 0.07$) item. Phi-coefficients from both CFA's indicated a pattern of weak-to-strong relationships between PNSE factors ($\phi_{\text{competence.autonomy}} = 0.88$; $\phi_{\text{competence.relatedness}} = 0.69$; $\phi_{\text{autonomy.relatedness}} = 0.59$; all p's < 0.05) and BREQ factors ($\phi_{\text{external.introjected}} = 0.62$; $\phi_{\text{external.identified}} = -0.09$; $\phi_{\text{external.intrinsic}} = -0.16$; $\phi_{\text{introjected.identified}} = 0.41$; $\phi_{\text{introjected.intrinsic}} = 0.28$; $\phi_{\text{identified.intrinsic}} = 0.88$). Collectively, these results imply that the PNSE and BREQ measurement models appear partially tenable in this sample.

Table 3. Global model fit indices for the measurement and structural models comprised of PNSE, BREQ, and behavioural intentions scores

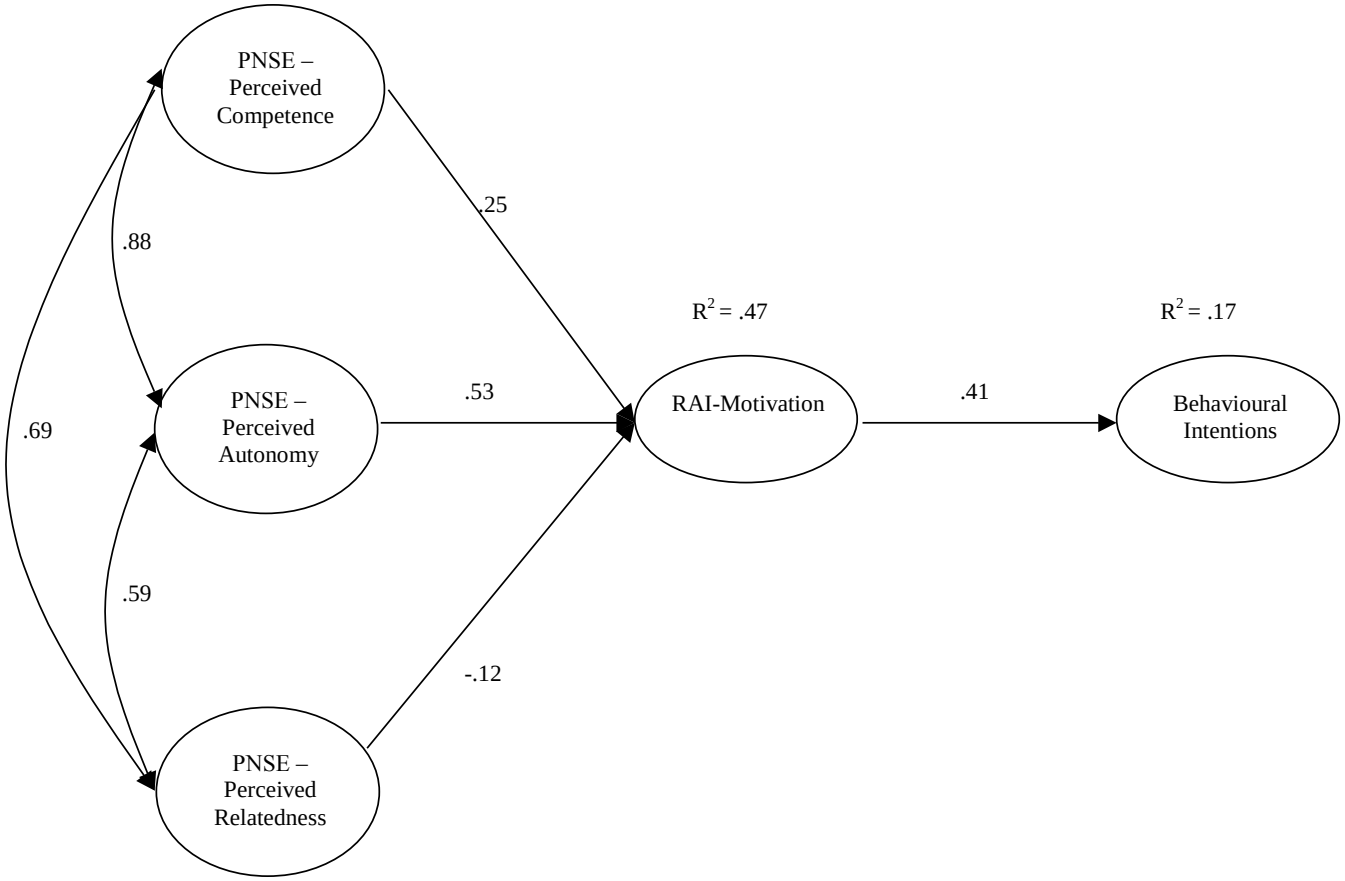
Models	χ^2	*df*	*p*	*CFI*	*IFI*	*RMSEA (90% CI)*
Measurement Models						
Psychological Need Satisfaction in Exercise Scale	334.36	132	< 0.01	0.92	0.92	0.10 (0.08-0.11)
Behavioural Regulation in Exercise Questionnaire	171.79	84	< 0.01	0.94	0.94	0.08 (0.06-0.10)
Full Measurement Model	514.65	242	< 0.01	0.92	0.92	0.08 (0.07-0.09)
Structural Model	399.47	183	< 0.01	0.92	0.92	0.08 (0.07-0.10)

Note. χ^2 = chi-square statistic. *df* = degrees of freedom. *p* = probability value. *CFI* = Comparative Fit Index. *IFI* = Incremental Fit Index. *RMSEA* = Root Mean Square Error of Approximation. 90% *CI* = Ninety-percent confidence interval around RMSEA point estimate.

Table 4. Descriptive statistics, internal consistency reliability estimates, and bivariate correlations

Latent Variables	M	SD	Skew.	Kurt	α	1	2	3	4	5	6	7	8
1. PNSE-Perceived Competence	4.82	0.90	-0.82	1.28	0.91	-							
2. PNSE-Perceived Autonomy	4.97	1.00	-0.96	1.19	0.95	.82	-						
3. PNSE-Perceived Relatedness	4.44	1.04	-0.60	0.86	0.92	.65	.58	-					
4. BREQ-External Regulation	1.03	0.99	0.85	0.08	0.85	-.22	-.30	-.06	-				
5. BREQ-Introjected Regulation	1.82	1.15	0.01	-0.91	0.83	.12	.06	.19	.51	-			
6. BREQ-Identified Regulation	3.13	0.85	-1.20	1.72	0.86	.63	.64	.47	-.09	.36	-		
7. BREQ-Intrinsic Regulation	3.16	0.87	-1.47	2.48	0.92	.67	.67	.53	-.15	.23	.79	-	
8. Behavioural Intentions	5.76	1.29	-1.00	0.64	0.89	.49	.43	.32	-.14	.22	.55	.44	-

Note: PNSE = Psychological Need Satisfaction in Exercise scale (Wilson et al., 2006). BREQ = Behavioural Regulation in Exercise Questionnaire (Mullan et al., 1997). *M* = Univariate Mean. *SD* = Standard Deviation. *Skew*. = Univariate Skewness. *Kurt*. = Univariate Kurtosis. α = Internal consistency reliability estimates (Cronbach's α; 1951). Bivariate correlations (*r*) are placed in the lower diagonal of the matrix. Sample size is consistent across each element in the lower triangle of the matrix. All *r*'s are based on pairwise comparison across the elements in the matrix. Each $r \geq |.15|$ is significant at $p < .05$ (two-tailed significance).



Note: Ellipses represent latent variables used in the SEM analyses. Solid lines indicate ϕ and γ coefficients are significant at $p < .05$ in this sample. R^2 = percentage of variance accounted for in each endogenous latent variable in the SEM analyses.

Figure 1. SEM predicting behavioural intentions from relative autonomous motivation and perceptions of psychological need satisfaction.

Descriptive Statistics, Reliability Estimates, and Bivariate Correlations

Internal consistency reliability estimates ranged from 0.81 to 0.93 across PNSE, BREQ, and BI scores (see Table 4). Participants endorsed greater fulfillment of autonomy followed by competence then relatedness needs in exercise although the magnitude is less pronounced than previously reported (Wilson et al., 2006). Participants reported more autonomous than controlled reasons motivating exercise participation based on the greater endorsement of identified and intrinsic regulations compared with external and introjected regulations, and indicated strong intentions to continue exercising over the next 4 months. An inspection of the bivariate correlations (see Table 4) reveals several interesting patterns of relationships. First, positive relationships were evident between PNSE subscale scores. Second, a quasi-simplex pattern of correlations was evident between BREQ subscale scores whereby regulations adjacent to one another on the SDT continuum are more positively associated with one another than distal regulations. Finally, it appears that greater PNSE scores exhibit more positive correlations with identified and intrinsic regulations than external and introjected regulations.

Structural Equation Modeling Analysis Predicting Exercise Intentions

Consistent with the recommendations of Anderson and Gerbing (1988), a full measurement model was examined prior to evaluating a structural model depicted in Figure 1 drawn from Vallerand's (2001) arguments and theorizing forwarded by Deci and Ryan (2002) in the context of SDT. The full measurement model contained 3 exogenous latent factors (PNSE-Perceived Competence, PNSE-Perceived Autonomy, PNSE-Perceived Relatedness) defined by 6 manifest items/factor, and 2 endogenous latent constructs representing relative autonomous exercise motives (RAI-Motivation) and BI. The latent RAI-Motivation construct was created based on Niemic et al.'s (2005) recommendations. In brief, 3 manifest items were created by computing the average of transformed BREQ item-level responses to define a latent RAI-Motivation factor. The transformation involved weighting the response to each manifest BREQ using the following formula to create transformed items that reflect the degree of relative autonomy underpinning behavioural regulation: (a) External Regulation $\times$ -2; (b) Introjected Regulation $\times$ -1; (c) Identified Regulation $\times$ 1; and (d) Intrinsic Regulation $\times$ 2. One transformed item was then selected from each BREQ subscale and averaged to form one of three manifest indicators defining a latent RAI-Motivation construct.

Inspection of the global model fit indices suggested that the full measurement model specified in this analysis differed significantly from the reference independence model (see Table 3). Nevertheless, the pattern of fit indices imply that the full measurement model is tenable and an inspection of the distribution of standardized residuals (99.28% $z < |2.0|$; 0% $z > |3.0|$) suggested little evidence of over- or under-estimation of fitted correlations. A pattern of moderate-to-strong positive loadings were observed for each manifest items on their target latent factors (Mean $\lambda = 0.83$; SD = 0.06; all p's < 0.05).

A structural model articulating the relationships between perceived psychological need satisfaction, exercise motivation, and behavioural intentions was specified and tested using SEM procedures advocated for the testing of theory-based models. The model was drawn from Vallerand's (2001) contentions regarding the nature of motivational processes and Deci

and Ryan's (2002) development of SDT whereby behavioural intentions were conceptualized as a function of relative autonomous motivation for exercise, which in turn, was underpinned by the satisfaction of competence, autonomy, and relatedness needs. Examination of the structure coefficients (see Figure 1) revealed several noteworthy patterns in the data. First, fulfillment of autonomy needs makes the strongest contribution to predicting exercise motivation followed by perceived competencies while perceived relatedness was negatively associated with endorsement of relative autonomous exercise motivation. Second, greater autonomous motivation for exercise was positively associated with increased intentions to continue exercising over the next 4 months. Finally, the amount of variance accounted for in each endogenous construct corresponds with moderate-to-large effect sizes based on Cohen's (1992) guidelines.

CONCLUSION

The purpose of this study was to examine the contributions of perceived psychological need satisfaction to motivational processes linked with exercise participation. Based on the measurement model analyses, it seems apparent that the PNSE and BREQ display many laudable psychometric characteristics that render both instruments useful for investigating SDT-based arguments in exercise. Perhaps of greater interest in this study is the SEM results that imply the tendency to hold stronger exercise intentions is greater when exercise is autonomously motivated, which in turn, appears to be a function of satisfying psychological needs as suggested within SDT (Deci & Ryan, 2002). Overall, this investigation supports Deci and Ryan's (2002) contention that satisfaction of competence, autonomy, and relatedness needs represent "nutriments" (p.7) essential to motivation and extend their arguments to exercise settings where understanding the processes shaping behaviour has important health implications (Bouchard et al., 2007).

Psychometric Properties of PNSE and BREQ Scores

The measurement model analyses partially supported the structural validity of PNSE and BREQ scores, as well as, the internal consistency reliability of PNSE and BREQ subscale scores. Furthermore, the direction of the inter-factor correlations observed in the CFA's of PNSE and BREQ scores is consistent with SDT and our hypotheses. Notwithstanding this observation, the 95% confidence intervals for the ϕ coefficients between PNSE-Perceived Competence and PNSE-Perceived Autonomy scores and the BREQ-Identified and BREQ-Intrinsic Regulation scores encompassed unity. While this is inconsistent with previous studies (Mullan et al., 1997; Wilson et al., 2006), it highlights the merit of further construct validation research with both instruments. Messick (1995) suggests that construct validation is an ongoing process requiring the constellation of evidence from multiple sources to inform test score interpretation. One avenue to consider in future research concerns the degree of content relevance and representation inherent in the PNSE and BREQ items to determine the unique portion of the content domain captured by each item (Dunn, Bouffard, & Rogers, 1999).

Importance of Motivational Processes

While the results of the SEM analyses support our hypotheses and suggest that autonomous motives are associated with stronger exercise intentions, a substantial portion of the variance in behavioural intentions was left unaccounted for in the structural model. It is possible that a number of other factors influence behavioural intentions that extend beyond the scope of SDT. For example, evidence supporting social ecological approaches for understanding exercise behaviour have been forthcoming (Bauman et al., 2002) and warrant consideration alongside SDT-based claims. Nevertheless, it also seems plausible that the amalgamation of weighted BREQ items into separate manifest indicators for use in the SEM-analyses failed to fully capture subtle variations in extrinsic and intrinsic motivation evident in exercise contexts and impacting behavioural intentions. Koester and Losier (2002) proposed that the use of a single latent construct to represent motivation offers merely global information about reasons for participation. Exemplifying this point, Wilson and colleagues (Wilson & Rodgers, 2002; Wilson et al., 2004) supported the importance of distinguishing between SDT-based motives for understanding the influence of autonomous and controlled motives in exercise contexts on continuance intentions. Nonetheless, the results of this investigation make it apparent that the autonomous (versus controlled) nature of exercise motivation seems crucial for understanding intentional activity, and future studies may wish to counterbalance their desire to use data analytical techniques such as SEM with the potential for losing important information regarding exercise motivation.

The observation that perceived competence and autonomy predict greater reliance on autonomous exercise motivation is consistent with arguments concerning the function of psychological needs during internalization (Deci & Ryan, 2002; Vallerand, 2001). The finding that perceived relatedness was negatively associated with autonomous exercise motivation when considered jointly with other SDT-based needs is less straightforward to reconcile with previous research (Vlachopoulos & Michailidou, 2006). One possible interpretation concerns the degree of statistical overlap inherent in the measurement of latent psychological need satisfaction constructs in the present sample that resulted in net suppression effects in the SEM (Tabachnik & Fidell, 2007). Another plausible interpretation concerns the role of perceived relatedness in exercisers who have internalized their reasons for exercise participation such that behaviour is self-determined and thereby underpinned by authentic perceptions of competence and a sense of volitional agency (Deci & Ryan, 2002). Future studies would do well to address the role of perceived relatedness, in conjunction with other psychological needs outlined by SDT, in those initiating and terminating exercise to determine the salience of social connections to others on motivational processes. Such endeavors will need to be mindful of specifying structural models that represent psychological need satisfaction in global terms (Hagger et al., 2006) versus modeling SDT-based psychological needs individually as exemplified in the present study to prevent the loss of information pertinent to understanding the role played by psychological needs in the nuances of exercise motivation.

Limitations and Future Directions

While the results of this investigation have theoretical and practical merit, a number of limitations require acknowledgement alongside future research directions that may advance our understanding of psychological need satisfaction in exercise contexts. First, this study utilized non-probability based sampling procedures that offer limited external validity. Future research would do well to replicate our study in more diverse populations where exercise motivation is an important issue (e.g., older adults, children) using sampling methods that afford greater confidence in generalizability. Second, despite the tenability of Vallerand's (2001) arguments concerning the temporal sequencing implied in the SEM analyses, the non-experimental nature of the design restricts the causal interpretations that can be made from this study. Future studies could investigate covariation over time between psychological need satisfaction and exercise motivation to provide a more stringent test of Vallerand's contentions. Longitudinal designs would also provide insight into the rate and direction of change inherent in SDT-based psychological needs within exercise settings. Finally, this study focused exclusively on behavioural intentions as a criterion of interest within exercise contexts. Ryan and Deci (2001) argue that psychological needs exert direct and universal effects on well-being (Ryan & Deci, 2001). Future research may wish to examine this assertion to extend the validity evidence of the PNSE and determine the range of well-being markers influenced by the satisfaction of competence, autonomy, and relatedness needs through exercise.

In summary, the purpose of this study was to examine the relationship between perceived psychological need fulfillment in exercise contexts with motives for exercise and behavioural intentions. The results partially supported Vallerand's (2001) assertions regarding the sequence of motivational processes stemming from the satisfaction of SDT-based psychological needs and corroborate Deci and Ryan's (2002) contention that competence, autonomy, and relatedness represent key foundations for the development of more autonomous motives and adaptive consequences in the context of exercise. Furthermore, the results of the measurement model analyses provide mixed support for the validity of PNSE and BREQ scores and suggest continued investigation into the merit of both instruments in exercise contexts would be useful. Overall, the results of this investigation do nothing to undermine Ryan's (1995) assertion that the critical motivational factor responsible for understanding adaptive consequences, such as continuance intentions in exercise settings, concerns the distinction between controlled and autonomous functioning as opposed to the intrinsic or extrinsic nature of the motivation itself. Taken together with previous exercise-based studies (Edmunds et al., 2006; Wilson et al., 2003; Wilson et al., 2006), it seems that SDT may be a useful framework to advance our understanding of motivational issues in exercise contexts and future investigations adopting this theoretical orientation appear worthwhile.

AUTHORS' NOTE

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