"It's Who I Am . . . Really!" The Importance of Integrated Regulation in Exercise Contexts[1]

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The purpose of this series of studies was to evaluate a measure of integrated regulation specific to exercise contexts in line with Self-Determination Theory (SDT; Deci & Ryan, 1985, 2002). To address this purpose, three studies were conducted to test select psychometric and theoretical properties of four integrated regulation items created for use within the Behavioural Regulation in Exercise Questionnaire (BREQ). Confirmatory factor analyses conducted in Studies 1 and 2 supported the inclusion of integrated regulation within the expanded BREQ measurement model. Simultaneous multiple regression analyses (SMRAs) conducted in Study 2 indicated that greater need satisfaction promoted endorsement of autonomous exercise motives, including integrated regulation. Finally, SMRA conducted in Study 3 revealed that integrated regulation contributed to the prediction of exercise behavior and physical self-worth. Collectively, the results of this investigation suggest that the new integrated regulation items can be used in conjunction with the BREQ without compromising validity, and support Deci and Ryan's (1985, 2002) assertions regarding the importance of autonomous extrinsic motives, including integrated regulation in exercise domains.

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Despite the health benefits associated with regular physical activity (Bouchard, Blair, & Haskell, 2006), population health data indicate that most adults remain insufficiently active to offset chronic diseases or to promote quality of life (Biddle, Fox, & Boutcher, 2000; Craig & Cameron, 2004). Considering these participation trends, a greater focus has been placed on understanding why people engage in physical activity using theoretical frameworks that elucidate the processes shaping health behaviors (Biddle et al., 2000). A theoretical approach holding considerable appeal for understanding multiple health behaviors including physical activity is self-determination theory (SDT; Deci & Ryan, 1985, 2002).

Deci and Ryan (1985, 2002) proposed within SDT that motivation resides along an internalization continuum reflecting the degree to which the behavior has been integrated with the self. A person's relative position along the internalization continuum is fostered by the extent to which social contexts satisfy basic psychological needs for competence, autonomy, and relatedness (Ryan, 1995). The distal ends of the internalization continuum are anchored by amotivation and intrinsic regulation. *Amotivation* concerns a lack of intention to act and represents a state akin to learned helplessness (Deci & Ryan, 2002). Conversely, *intrinsic regulation* is the most autonomous form of motivation in which participation is regulated by fun, interest, or the behavior's self-rewarding nature (Deci & Ryan, 2002). Previous research has indicated that amotivation is associated with a reduction in effort and importance ascribed to exercise (Wilson, Rodgers, Fraser, & Murray, 2004) and greater dropout from sport (Pelletier, Fortier, Vallerand, & Brière, 2001). In contrast, intrinsic regulation is associated with greater intention to continue exercising (Wilson et al., 2004), persistent sport behavior (Pelletier et al., 2002), and enhanced physical self-worth (Wilson & Rodgers, 2002).

Deci and Ryan (1985, 2002) proposed four types of extrinsic motivation within SDT that vary considerably in terms of their integration with the self. *External regulation* and *introjected regulation* epitomize controlling internalizations that motivate behavior via a desire to appease others, avoid negative feelings, or maintain conditional self-worth (Deci & Ryan, 2002). Greater reliance on controlling motives has been linked with dropout from sport (Pelletier et al., 1995) and lower physical self-worth in female exercisers (Wilson & Rodgers, 2002). Identified regulation and integrated regulation represent more autonomous extrinsic motives proposed by SDT (Deci & Ryan, 1985, 2002). *Identified regulation* represents the lower limit of autonomous motivation in which participation is regulated by goal values or the importance of behavioral outcomes (Deci & Ryan, 2002). *Integrated regulation* represents the most autonomous form of extrinsic motivation, occurring when congruence exists between behavioral regulation and "personally endorsed values, goals, and needs that are already part of the self" (Deci & Ryan, 2002, p. 18). Previous research has indicated that identified regulation is associated with more frequent exercise

participation in university students (Wilson et al., 2004) and persistence behavior in athletes (Pelletier et al., 2001).

A limitation of physical activity research applying SDT to study motivational issues concerns the shortage of research focusing on integrated regulation. Previous research examining motivation in sport settings has indicated that integrated reasons for sport involvement were not relevant to university-based athletes (Pelletier et al., 1995). Nevertheless, research by Pelletier and colleagues has indicated that integrated regulation is associated with healthier eating patterns (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004) and predicts environmentally responsible behaviors (Green-Demers, Pelletier, & Ménard, 1997). Collectively, these studies indicate that integrated regulation may be an important motivational influence in promoting health behaviors, and it is surprising that limited research has examined this aspect of SDT's motivational continuum in exercise contexts.

A reason why research examining integrated regulation has been limited in exercise settings concerns the use of the Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingeldew, 1997) as the instrument of choice for SDT-based investigations. In their original article, Mullan et al. supported a four-factor measurement model capturing external, introjected, identified, and intrinsic regulations for exercise underpinning BREQ responses from diverse samples of sport-center attendees and workers in Great Britain. Subsequent research by Markland and Tobin (2004) has supported the construct validity of scores from the BREQ-2, which includes a subscale to assess amotivation toward exercise behavior. Additional research in North American samples has supported the structural validity of BREQ (Wilson, Rodgers, & Fraser, 2002) and BREQ-2 (Wilson & Rodgers, 2004) scores, and the ability of BREQ scores to differentiate between physically active and inactive groups (Landry & Solomon, 2004). Overall, the BREQ's construct validity evidence is impressive; however, one limitation of the instrument is the absence of an integrated regulation subscale that represents the most self-determined form of extrinsic motivation in SDT's framework (Deci & Ryan, 1985, 2002).[3]

[3]Li (1999) developed the Exercise Motivation Scale (EMS), which measures amotivation; extrinsic motivation according to SDT (external, introjected, identified, and integrated regulation); and intrinsic motivation to learn, experience sensations, and accomplish based on adaptations of Vallerand's (2001) hierarchical model. A new set of integrated-regulation items were created for these studies, rather than adopting the EMS items, for various reasons. First, Li reported global statistical results in his paper that make it difficult to discern clear psychometric support for the EMS or the integrated-regulation items. Second, the format of the EMS items does not fit comfortably with either the BREQ or the BREQ-2 and would require modification for use with either instrument. Finally, Li's data indicate that the correlations between extrinsic motives assessed with the EMS do not conform to the "quasi-simplex pattern" (Deci & Ryan, 2002, p. 18) advocated within SDT, given that integrated regulation is correlated more strongly with introjected regulation ($\phi = .46$) than with identified regulation ($\phi = .40$).

Considering the utility of SDT for understanding motivational processes in physical activity (Frederick-Recascino, 2002) and the evidence supporting the construct validity of BREQ scores (Landry & Solomon, 2004; Mullan et al., 1997; Wilson et al., 2002, 2004), it seems reasonable to suggest that further exploration of the role of integrated regulation in exercise may be worthwhile for at least two reasons. First, it is conceivable that while some individuals participate in exercise for intrinsic reasons, others may initiate or sustain exercise behavior for extrinsic reasons that, according to SDT, include participating because the behavior is congruent with their self-identity and thereby regulated for integrated reasons (Deci & Ryan, 1985, 2002). Second, research examining the feasibility of extending the BREQ's (Mullan et al., 1997) item pool to include an assessment of integrated regulation seems appropriate, given that the instrument was created initially to capture SDT's motivational continuum in exercise and previously was modified to include items that were not part of the BREQ's original development (Markland & Tobin, 2004). Consequently, the overall purpose of this investigation is to evaluate select measurement properties of a preliminary set of items designed to measure integrated regulation in exercise and to sit comfortably within the BREQ (Mullan et al., 1997).

Study 1

The purpose of Study 1 is to evaluate the structural and convergent/divergent validity of scores derived from the BREQ (Mullan et al., 1997) measurement model, including the new integrated regulation items.

Method

Participants

Participants were 61 male (M_{age} = 19.54 years, SD = 1.75; M_{BMI} = 23.73 kg/m^2; SD_{BMI} = 3.61; 68.5% ≤ 24.99 kg/m^2) and 146 female (M_{age} = 19.18 years, SD = 1.52; M_{BMI} = 21.88 kg/m^2; SD_{BMI} = 3.92; 85.4% ≤ 24.99 kg/m) undergraduate psychology students enrolled at a large Canadian university. Considerable variability in physical activity behavior was evident in the sample data (males: M_{METS} = 59.82, SD_{METS} = 44.93; females: M_{METS} = 70.58, SD_{METS} = 69.74; 44.6% of the overall sample engaging in 3 or more strenuous exercise sessions/week for past 7 days).[4]

[4]Estimates were derived from global responses to the Godin Leisure Time Exercise Questionnaire (Godin & Shepherd, 1985) that is described in Study 3.

Measures

Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan et al., 1997). Participants completed the 15-item BREQ as an index of SDT's exercise regulations. The BREQ contains four subscales measuring external, introjected, identified, and intrinsic exercise regulation. Following the stem "Why do you exercise?" participants responded to each item on a 5-point scale ranging from 0 (*not true for me*) to 4 (*very true for me*). Previous research has supported the BREQ's factor structure and subscale reliability (Cronbach's $\alpha s \geq .70$; Mullan et al., 1997), and the ability of BREQ scores to distinguish physically active from inactive groups (Landry & Solomon, 2004).[5]

Integrated regulation. Participants completed four items designed to assess integrated regulation in line with SDT (Deci & Ryan, 1985, 2002) and to fit comfortably with the BREQ (Mullan et al., 1997). The integrated regulation items were created based on theoretical considerations (Deci & Ryan, 1985, 2002) and adaptations of items from other instruments (Pelletier et al., 2004).

Exercise Motivation Scale (EMS; Li, 1999). Participants completed four EMS items assessing integrated regulation. The EMS contains eight subscales assessing amotivation, extrinsic motivation, and intrinsic motivation in accordance with Vallerand's (2001) hierarchical model. Following a stem ("Why are you currently participating in this exercise activity?"), participants responded to each item on a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Li provided evidence of reliability ($\alpha > .75$; 7-day test–retest $rs > .78$) and criterion validity linking integrated regulation with greater competence, locus of control, and social support in university students. We included the EMS items to assess convergent–divergent validity of the scores from the new integrated regulation items with an existing measure of integrated regulation for exercise.

Procedure

Data were collected in small groups ($n < 25$ in each instance) during prearranged times. Following arrival in a designated classroom, each student was informed about the nature of the study, given an opportunity to ask questions, and provided written informed consent prior to questionnaire distribution. The same researchers were responsible for all data collection in Study 1 and used standard instructions to reduce potential bias associated with multiple test administrators.

[5]We chose to use the BREQ in this investigation, as opposed to the BREQ-2, given our interest in current exercisers who theoretically could be motivated for various reasons. While the BREQ-2 is consistent with SDT (Deci & Ryan, 2002), we felt that the inclusion of an amotivation subscale is likely more relevant to sedentary populations or exercise initiates, such as the sample used by Markland and Tobin (2004) that consisted of patients referred by physicians to exercise on prescription programs.

Analyses

Data analysis proceeded in sequential stages. First, the distributional properties of each variable were examined to determine their conformity with statistical assumptions. Second, the suitability of the unidimensional integrated regulation measurement model and a multidimensional exercise regulation measurement model (BREQ items, plus integrated regulation items; Mullan et al., 1997) were tested using confirmatory factor analytic (CFA) procedures with AMOS 5.0 (Arbuckle, 1997). Finally, descriptive statistics, reliability estimates (Cronbach's α; Cronbach, 1951), and bivariate correlations were computed. Conventional standards were specified in the measurement 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.

Results

Preliminary Data Screening and Selection of an Estimator

Inspection of the data indicates that less than 6.8% of the data were missing on any one variable,[6] no out-of-range responses were observed, and univariate distributions approximated normality, although multivariate kurtosis was evident (Table 1). Therefore, maximum likelihood (ML) estimation procedures were used with the incremental fit index (IFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) to evaluate global model fit (West, Finch, & Curran, 1995). Although values indicative of satisfactory model fit in hypothesis testing CFAs remain ambiguous (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004), it generally is accepted that a plausible model maximizes CFI and IFI values ($\geq$.90) and minimizes RMSEA (values < .10).

CFA of the Exercise Motivation Measurement Models

The results of the CFA conducted to evaluate the fit of the integrated regulation items to a unidimensional measurement model indicate that the proposed measurement model differed from the reference model, $\chi^2(2, N = 207) = 30.92$, $p < .01$. However, a desirable pattern of model fit estimates was observed (CFI = .96; IFI = .96; RMSEA = .27; 90% CI = .19–.35), along with strong standardized

[6]Missing values were replaced using a mean imputation procedure. This procedure involved averaging the scored items per construct for each participant and imputing the resultant value per case prior to further data analysis. The majority of the missing data was evident in the EMS items, with less than 2.0% nonresponse error observed on other variables.

Table 1

Distributional Properties of Manifest BREQ and Integrated Regulation Items: Study 1

Latent subscales	*M*	*SD*	Skew-ness	Kurto-sis	*FL*	*SE*
BREQ—external regulation						
Because other people say I should.	0.65	0.93	0.94	-0.10	.78	.13
Because others say I should.	0.86	0.98	1.45	1.48	.74	.07
Because others will not be pleased with me.	0.51	0.83	1.82	2.99	.61	.06
I feel under pressure from others.	1.26	1.25	0.64	-0.77	.83	.07
BREQ—introjected regulation						
I feel guilty when I don't exercise.	1.83	1.31	0.18	-1.14	.66	.07
I feel ashamed when I miss exercise.	1.39	1.19	0.58	-0.54	.81	.14
I feel a failure when I haven't exercised.	1.88	1.16	0.00	-0.90	.84	.16
BREQ—identified regulation						
I value the benefits of exercise.	3.46	0.78	-1.76	3.81	.60	.20
It's important to me to exercise regularly.	3.39	0.78	-1.34	1.21	.86	.10
It's important to make an effort to exercise.	3.46	0.86	-1.83	4.12	.87	.11
I get restless if I don't exercise regularly.	2.09	1.30	-0.11	-1.20	.65	.09
Integrated regulation						
I exercise because it is consistent with life goals.	2.57	1.15	-0.67	-0.15	.78	.04
I consider exercise to be part of my identity.	2.10	1.43	-0.16	-1.27	.90	.06
I consider exercise a fundamental part of who I am.	2.05	1.43	-0.10	-1.28	.94	.07
I consider exercise consistent with my values.	2.29	1.28	-0.35	-0.93	.84	.07
BREQ—intrinsic regulation						
I exercise because it's fun.	2.65	1.16	-0.69	-0.32	.92	.05
I enjoy my exercise sessions.	2.85	1.10	-0.78	-0.25	.84	.05
I find exercise a pleasurable activity.	2.94	1.03	-0.87	0.31	.86	.05
I get pleasure/satisfaction from exercise.	3.19	0.97	-1.19	0.91	.89	.06

Note. BREQ = Behavioural Regulation in Exercise Questionnaire. *FL* = standardized parameter loading from CFA of the full measurement model. *SE* = standard error from the CFA of the full measurement model. Mardia's coefficient, integrated regulation measurement model = 6.69. Mardia's coefficient, BREQ and integrated regulation measurement model = 65.59.

Table 2

Descriptive Statistics, Reliability Estimates, and Bivariate Correlations From Variable Scores: Study 1

Variable	*M*	*SD*	1	2	3	4	5	6
1. BREQ—external regulation	0.82	0.82	.82					
2. BREQ—introjected regulation	1.28	0.78	.36	.81				
3. BREQ—identified regulation	3.09	0.74	.01	.46	.78			
4. Integrated regulation	2.25	1.19	-.03	.37	.70	.92		
5. BREQ—intrinsic regulation	4.49	0.98	-.18	.24	.67	.65	.93	
6. EMS—integrated regulation	4.49	0.98	-.04	.45	.67	.76	.65	.85

Note. BREQ = Behavioural Regulation in Exercise Questionnaire. EMS = Exercise Motivation Scale. Pearson correlations are reported in the lower triangle of the matrix. Internal consistency estimates (Cronbach's coefficient α) are reported on the diagonal. Correlation matrix is based on pairwise comparisons, and sample size is consistent across each element in the matrix. All rs > |.10| are significant at $p < .05$, two-tailed. All rs > |.15| are significant at $p < .01$, two-tailed.

parameter loadings on the target factor and minimal evidence of over- or under-estimation of fitted correlations in the distribution of standardized residuals (0% $z > |1.5|$). Subsequent analyses of the expanded BREQ measurement model including the integrated regulation items indicate that the model differed from the reference model, $\chi^2(142, N = 207) = 357.51, p < .01$. Notwithstanding this observation, satisfactory estimates of global model fit (CFI = .92; IFI = .92; RMSEA = .09; 90% CI = .08–.10) and parameter loadings were observed (Table 1), along with a distribution of standardized residuals showing little discrepancy between the observed and implied covariance matrices (92.4% $z < |2.0|$, 0% $z > |3.0|$).[7]

Descriptive Statistics, Reliability Estimates, and Bivariate Relationships

Descriptive statistics (Table 2) indicate that participants endorsed more autonomous than controlled motives for exercise. Reliability estimates ranged

[7]A separate CFA was conducted using the four-factor BREQ measurement model proposed by Mullan et al. (1997), with the addition of a latent factor representing the EMS integrated regulation items developed by Li (1999). Although the fit of this alternative measurement model was comparable with the data reported in Study 1, $\chi^2(142, N = 207) = 352.78, p < .01$ (CFI = .91; IFI = .91; RMSEA = .09; 90% CI = .07–.10), the observed correlation matrix among the latent factors did not demonstrate a quasi-simplex pattern, given that introjected regulation was correlated more strongly with integrated regulation ($\phi = .51$) than with identified regulation ($\phi = .48$).

from .78 to .93 in this sample. An examination of the bivariate correlations (Table 2) reveals that adjacent constructs on SDT's continuum were correlated most positively with one another, and scores on the new integrated regulation subscale were correlated most strongly with EMS integrated regulation subscale scores.

Discussion

The overall purpose of Study 1 was to establish the structural validity of an expanded BREQ measurement model, including the new integrated regulation items, and to examine the degree of convergence between two measures of integrated regulation for exercise. The results suggest that the integrated regulation items appear to be factorially distinct from other BREQ constructs, yet not mutually exclusive, which is consistent with SDT's notion of a regulatory continuum. Moreover, the pattern of correlations suggests reasonable support for the convergence of integrated regulation scores with an existing measure of the same construct and initial evidence of divergence from other motives assessed by the BREQ. It is noted, however, that magnitude of the discrepancy between the validity coefficients is most pronounced when comparing controlled to autonomous regulations.

Study 2

The primary purpose of Study 2 is to evaluate the expanded BREQ measurement in an independent sample of exercisers. The second purpose is to extend the construct validity evidence of the integrated regulation item scores by examining their relationships with a portion of SDT's nomological network. A *nomological network* represents an interconnected system of laws that comprise a theory (Cronbach & Meehl, 1955). One nomological network that SDT proposes includes the satisfaction of competence, autonomy, and relatedness needs, which foster the internalization process, resulting in autonomous motives that are well integrated with the self (Deci & Ryan, 2002).

Method

Participants

Participants (N = 132; 95.3% female; M_{age} = 47.5 years, SD = 8.23) were training to complete a marathon with a running club in central Canada. Body mass index (BMI) values approximated the healthy range for this age cohort (M_{BMI} = 24.34 kg/m^2, SD = 3.41 kg/m^2). However, 29.7% of the sample reported BMI values exceeding 26.00 kg/m^2. A total of 62.0% of the sample were married

or equivalent, and 26.5% were single. Most participants were employed full-time (75.8%), 37.0% held bachelor's degrees, while another 34.0% held postgraduate degrees or professional designations (e.g., LLB). Participants indicated that they had been involved with the running club for approximately 6 months ($M = 5.41$ months, range = 1–24 months).

Measures

Exercise motivation. Participants completed the same version of the BREQ and integrated regulation items that were used in Study 1.

Psychological need satisfaction. Participants completed three items designed to assess perceived competence ("feeling competent and capable in the exercises I attempt"), autonomy ("feeling autonomous and choiceful in the exercises I do"), and relatedness ("feeling related and connected to the people I exercise with"). Following the stem, "To what extent do you typically have these experiences when you exercise. . .," participants responded to each item on a 7-point scale ranging from 1 (*very little*) to 7 (*very much*). While such indexes remain controversial (Crocker & Algina, 1986), single items exhibiting normal distributions and representing the focal construct can be as useful as their multi-item counterparts (Gardner, Cummings, Dunham, & Pierce, 1998). Previous research has linked greater scores on these items with autonomous exercise motives (Wilson et al., 2002) and adjustment (Sheldon & Elliot, 1999). Considering that the items were developed for testing SDT-based hypotheses and exhibited no major distributional concerns in this sample (Table 3), their use in this study seems justified, given the absence of a suitable multi-item measure.[8]

Procedure

Administrators who were involved with the running group distributed questionnaires, including an information letter and informed consent form, to members of the group. Participants were provided with a stamped envelope to return the questionnaire, and a 50% response rate was observed.

Analyses

Data analyses proceeded in sequential stages. First, assessment of the unidimensional and multidimensional exercise motivation measurement models were

[8]At the time of data collection, the Psychological Need Satisfaction Exercise scale (PNSE; Wilson et al., 2006) was not developed or available for use. The PNSE is an instrument that was designed specifically to measure perceptions of competence, autonomy, and relatedness experienced in exercise contexts in line with SDT (Deci & Ryan, 1985, 2002).

Table 3

Distributional Properties of Manifest BREQ and Integrated Regulation Items: Study 2

Latent constructs	*M*	*SD*	Skew-ness	Kurto-sis	*FL*	*SE*
BREQ—external regulation						
Because other people say I should.	0.44	0.88	2.27	4.85	.76	.11
Because others say I should.	0.21	0.57	3.36	12.05	.78	.11
Because others will not be pleased with me.	0.18	0.52	3.54	13.97	.84	.06
I feel under pressure from others.	0.52	0.96	2.22	4.64	.93	.07
BREQ—introjected regulation						
I feel guilty when I don't exercise.	1.58	1.20	0.52	-0.56	.66	.21
I feel ashamed when I miss exercise.	0.72	1.09	1.55	1.59	.77	.16
I feel a failure when I haven't exercised.	1.52	1.34	0.45	-0.98	.65	.16
BREQ—identified regulation						
I value the benefits of exercise.	3.79	0.50	-2.32	4.66	.63	.07
It's important to me to exercise regularly.	3.41	0.89	-1.87	3.89	.57	.10
It's important to make an effort to exercise.	3.54	0.81	-2.11	5.01	.83	.13
I get restless if I don't exercise regularly.	2.50	1.29	-0.29	-1.20	.64	.07
Integrated regulation						
I exercise because it is consistent with life goals.	3.16	1.07	-1.36	1.32	.75	.06
I consider exercise to be part of my identity.	2.29	1.38	-0.27	-1.16	.93	.09
I consider exercise a fundamental part of who I am.	2.43	1.42	-0.42	-1.15	.92	.11
I consider exercise consistent with my values.	2.85	1.19	-0.92	-0.06	.81	.11
BREQ—intrinsic regulation						
I exercise because it's fun.	2.61	1.26	-0.66	-0.54	.89	.07
I enjoy my exercise sessions.	3.18	1.05	-1.15	0.39	.81	.07
I find exercise a pleasurable activity.	3.03	1.07	-1.09	0.54	.82	.09
I get pleasure/satisfaction from exercise.	3.33	0.95	-1.61	2.24	.89	.07

Note. BREQ = Behavioural Regulation in Exercise Questionnaire. *Skew* = univariate skewness. *Kurt.* = univariate kurtosis. *FL* = standardized parameter loading from CFA Mardia's coefficent (integrated regulation measurement model) = 11.05. Mardia's coeffecient (BREQ plus integrated regulation measurement model) = 94.10.

evaluated, consistent with Study 1. Model specification and identification procedures followed the conventional standards that were used in Study 1. Second, descriptive statistics and bivariate correlations were computed for all study variables. Finally, a series of simultaneous multiple regression analyses (SMRAs) were computed to determine the contribution of perceived competence, autonomy, and relatedness to exercise regulations.

Results

CFA of the Exercise Motivation Measurement Models

No out-of-range responses were observed in the sample data, and mean imputation was used to replace the small amount (≤2.23%) of nonresponse error evident in the sample. No grave concerns were evident in the data's univariate distributions (Table 3), although the external and identified regulation items were leptokurtic, and notable multivariate kurtosis was present. ML estimation procedures were used in conjunction with the same fit indexes that were reported in Study 1, given the distributions observed in this sample. The results of the CFAs indicated that both the integrated regulation only, $\chi^2(2, N = 132) = 26.37, p < .01$ (CFI = .94; IFI = .94; RMSEA = .28; 90% CI = .18–.39), and the expanded BREQ, $\chi^2(142, N = 132) = 253.82, p < .01$ (CFI = .93; IFI = .93; RMSEA = .09; 90% CI = .07–.09) measurement models provided an adequate account of the sample data. A pattern of strong parameter loadings on target latent factors (Table 3) was observed, along with a distribution of standardized residuals in both the integrated regulation only (83.33% $z < |1.0|$, 0% $z > |2.0|$) and expanded BREQ (97.07% $z < |2.0|$, 0% $z > |3.0|$) measurement models, which suggested no major discrepancies between the implied and observed covariance matrices.

Descriptive Statistics, Reliability Estimates, and Bivariate Relationships

Descriptive statistics indicate that participants felt a strong sense of perceived competence, autonomy, and relatedness in exercise; and reported a more autonomous (rather than controlled) motivational profile (Table 4). Reliability estimates (Table 4) ranged from .70 to .91 in this sample. The bivariate correlations (Table 4) indicate moderate to strong relationships between psychological need satisfaction scores; scores on adjacent regulations were correlated more positively with one another than distal regulations; and autonomous compared with controlling motives were linked with greater perceptions of psychological need satisfaction in exercise.

Table 4

Descriptive Statistics, Reliability Estimates, and Bivariate Correlations From Variable Scores: Study 2

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. PNS—competence	5.61	1.27	–							
2. PNS—autonomy	5.88	1.13	.75	–						
3. PNS—relatedness	5.61	1.25	.34	.31	–					
4. BREQ—external regulation	0.34	0.62	-.26	-.17	.00	.83				
5. BREQ—introjected regulation	1.27	0.98	-.06	.12	.13	.33	.75			
6. BREQ—identified regulation	3.15	0.80	.41	.44	.16	-.18	.18	.70		
7. Integrated regulation	2.69	1.13	.48	.55	.29	-.20	.16	.65	.89	
8. BREQ—intrinsic regulation	3.04	0.95	.54	.52	.25	-.19	-.02	.63	.62	.91

Note. PNS = Psychological Need Satisfaction (items used by Wilson et al., 2002). BREQ = Behavioural Regulation in Exercise Questionnaire. Internal consistency reliability estimates (Cronbach's coefficient α) are placed along the diagonal for all constructs measured using multi-item subscales. Correlation matrix is based on pairwise comparisons with equivalent sample sizes across each element in the matrix. All $rs > |.20|$ are significant at $p < .01$, two-tailed.

Regression Analyses Predicting Exercise Motivation From Perceived Psychological Need Satisfaction

The contribution of perceived competence, autonomy, and relatedness to predicting SDT's exercise regulations was examined using SMRA. There are five separate regression equations that were conducted using the BREQ and integrated regulation scores as criterion variables and perceived psychological need satisfaction scores as predictors. The a priori probability value for each F test was set at .01 to account for the number of models estimated (i.e., $p = .05/5$). The variance inflation factor (0.43–0.88) and tolerance values (1.14–2.34) suggest the presence of collinearity. However, when the condition index was high (i.e., ≥ 10.0), only the variance proportion values for competence and autonomy exceeded the 0.50 threshold (Pedhazur, 1997). Consequently, structure coefficients (r_s) were used to interpret the results of the SMRA, given their lack of distortion from collinearity within the sample data (Courville & Thompson, 2001).

The results of the SMRA (Table 5) reveal that perceived psychological need satisfaction exerted stronger effects on autonomous (adjusted R^2 values ranged from .19 to .31) than controlling (adjusted R^2 value = .06) motives. Moreover, the direction of the r_s correlations indicates that perceived competence predicted less controlling exercise regulations and greater intrinsic regulation, whereas perceived autonomy was the dominant predictor of identified and integrated regulations. Perceived relatedness predicted both autonomous and controlling exercise motives, while perceived autonomy and competence were the strongest predictors of introjected regulation.

Discussion

The purpose of Study 2 was to extend the construct validity evidence of the expanded BREQ measurement model by examining the structural validity of item scores and relationships with aspects of one nomological network drawn from SDT (Deci & Ryan, 1985, 2002). The results of the measurement model analyses support the tenability of the expanded BREQ measurement model, including the integrated regulation items developed in Study 1 in a community sample of exercisers. The regression analyses suggest that greater perceived psychological need satisfaction was associated positively with autonomous motives, including the new integrated regulation items in a manner consistent with SDT. Considering the fact that one argument stemming from SDT is that perceived psychological need satisfaction fosters the internalization of motives with the self (Ryan, 1995), it is encouraging to observe scores on the new integrated regulation items corresponding to this theoretical premise.

Study 3

The primary purpose of Study 3 is to examine the criterion validity of the integrated regulation items developed across Studies 1 and 2 by examining the contribution of extrinsic motives outlined within SDT to the prediction of physical self-worth and exercise participation (Deci & Ryan, 1985, 2002). Exercise behavior was included because motives are theorized to determine behavior (Vallerand, 2001), and previous research has indicated that autonomous extrinsic motives predict more frequent exercise participation (Wilson et al., 2004). Physical self-worth was chosen to reflect the degree of positive evaluations felt by the self and to represent an index of emotional adjustment and well-being that, according to Deci and Ryan (2002), should be associated more positively with more autonomous motives. The secondary purpose is to evaluate the stability of integrated regulation scores over a 2-week period. This time frame was chosen to reduce the likelihood of true change confounding score stability (Pedhazur & Schmelkin, 1991) when analyzing the motivational data.

Table 5

Simultaneous Multiple Regression Analyses Predicting Exercise Regulations: Study 2

Criterion variable / Predictor variables	$F(3, 129)$	Adjusted R^2	B	$SE\ B$	β	t	r_s
BREQ—external regulation							
PNS—competence			-.16	.06	-.34	-2.54**	-.90
PNS—autonomy			.03	.07	.05	0.35	-.58
PNS—relatedness	3.71**	.06	.06	.05	.13	1.39	.10
BREQ—introjected							
PNS—competence			-.29	.10	-.38	-2.84**	-.21
PNS—autonomy			.31	.12	.36	2.73**	.41
PNS—relatedness	3.75**	.06	.12	.07	.15	1.58	.44
BREQ—identified							
PNS—competence			.10	.07	.18	1.42	.89
PNS—autonomy			.21	.08	.31	2.55**	.97
PNS—relatedness	10.85**	.19	.01	.05	.01	0.09	.35
Integrated regulation							
PNS—competence			.12	.10	.13	1.16	.85
PNS—autonomy			.42	.11	.41	3.65**	.98
PNS—relatedness	19.51**	.31	.11	.07	.12	1.55	.52
BREQ—intrinsic regulation							
PNS—competence			.25	.09	.34	2.96**	.95
PNS—autonomy			.21	.10	.25	2.18**	.91
PNS—relatedness	19.43**	.31	.05	.06	.06	0.76	.44

Note. PNS = Psychological Need Satisfaction. BREQ = Behavioural Regulation in Exercise Questionnaire. Multiple R for BREQ—external regulation = .289; multiple R for BREQ—introjected regulation = .291; multiple R for BREQ—identified regulation = .459; multiple R for integrated regulation = .569; multiple R for BREQ—intrinsic regulation = .569; r_s = structure coefficients (Courville & Thompson, 2001; Thompson & Borello, 1985).
**$p < .01$, two-tailed.

Method

Participants

A total of 89 female (M_{age} = 19.35 years, SD = 2.55; M_{BMI} = 21.64 kg/m^2, SD = 2.59, 90.6% ≤ 24.99 kg/m^2) and 50 male (M_{age} = 20.06 years, SD = 3.82; M_{BMI} = 23.67 kg/m^2, SD = 3.15, 72.0% ≤ 24.99 kg/m^2) undergraduate psychology students participated in exchange for course credit (3 participants did not provide their gender). Substantial variability in physical activity behavior was evident (female, M_{METS} = 47.38, SD_{METS} = 28.09; male, M_{METS} = 36.32, SD_{METS} = 24.74; 48.0% of the total sample engaged in ≥ 3 strenuous exercise sessions during the past 7 days).

Measures

Exercise motivation. Participants completed 11 items assessing extrinsic motives from the BREQ, plus the 4 integrated regulation items used in Studies 1 and 2.

Exercise behavior. Participants completed a modified version of the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shepherd, 1985). This instrument assesses the frequency of mild, moderate, and strenuous exercise completed for 20 min or more per session over 7 days. A global exercise score expressed in METS (a unit representing the metabolic equivalent of physical activity in multiples of resting oxygen consumption) can be calculated using an equation proposed by Godin and Shepherd:

$$\sum [(\text{mild} \times 3) + (\text{moderate} \times 5) + (\text{strenuous} \times 9)] \quad (1)$$

Previous research has indicated that the GLTEQ (Godin & Shepherd, 1985) is understandable, responsive to exercise behavior change, and correlates in the expected direction with other physical activity and fitness indexes (Jacobs, Ainsworth, Hartman, & Leon, 1993). The global score (GLTEQ-METS) was used to determine the current physical activity level of the participants in METS according to Godin and Shepard. Participant responses to each GLTEQ item were weighted by their corresponding MET value using Godin and Shepherd's formula and aggregated into an omnibus exercise behavior score.

Physical self-worth. Participants completed six items from the physical self-concept subscale of the Physical Self-Description Questionnaire (PSDQ-PSC; Marsh, Richards, Johnson, Roche, & Tremayne, 1994). The PSDQ-PSC provides a global evaluation of the degree of positive feelings a person holds about his or her physical self (Marsh, 1996; Marsh et al., 1994). Research supports the structural validity of PSDQ-PSC scores and links higher PSDQ-PSC scores in

meaningful ways with other salient self-perceptions and physical activity behaviors (Marsh, 1996; Marsh et al., 1994). Participants responded to each item on a 6-point Likert scale ranging from 1 (*false*) to 6 (*true*). Consistent with previous recommendations (Marsh et al., 1994), consecutive PSDQ-PSC items were averaged to form item parcels (two items/parcel) that were summed to form a total PSDQ-PSC score.

Procedure

Data were collected using the same procedures outlined in Study 1.

Analyses

Data analyses followed sequential stages. First, descriptive statistics, reliability estimates, and bivariate correlations were computed. Second, SMRA estimated the contribution of each extrinsic motive to the prediction of PSDQ-PSC and GLTEQ-METS scores. Structure coefficients (r_s) evaluated the contribution of the predictor set (i.e., extrinsic motives) to the criterion variables (i.e., physical self-worth and exercise behavior) following Courville and Thompson's (2001) recommendations.

Results

Preliminary Analyses

No out-of-range scores were noted in the sample data, and minimal departure from univariate normality was evident (skewness values ranged from 0.16 to 0.89; kurtosis values ranged from 1.19 to 2.63). No consistent pattern was evident in the missing data (2.7% across all study variables). Therefore, missing values were estimated by averaging the scored items per construct for each participant and imputing the resultant value per case.

Main Analyses

Descriptive statistics reveal that participants endorsed identified regulation to a greater extent than integrated, introjected, and external regulations for exercise (Table 6). Moreover participants reported high perceptions of their physical self-worth and low to moderate physical activity behavior. Internal consistency reliability estimates ranged from .83 to .96 (Table 6). Bivariate correlations (Table 6) indicate that scores from adjacent extrinsic motives exhibited stronger relationships than distal regulations; identified and integrated regulations were the strongest correlates of physical self-worth and exercise behavior; and higher introjected regulation scores were linked positively with GLTEQ-METS scores.

Table 6

Descriptive Statistics, Reliability Estimates, and Bivariate Correlations From Variable Scores: Study 3

Variable	*M*	*SD*	1	2	3	4	5	6
BREQ—external regulation	0.62	0.82	.85					
BREQ—introjected regulation	1.84	0.97	.23	.85				
BREQ—identified regulation	2.73	0.93	.09	.61	.83			
Integrated regulation	1.76	1.24	.14	.54	.75	.93		
GLTEQ–METS	40.26	26.41	-.05	.39	.53	.53	–	
PSDQ–PSC	4.24	1.13	-.21	.08	.41	.43	.21	.96

Note. BREQ = Behavioural Regulation in Exercise Questionnaire. GLTEQ = Godin Leisure Time Exercise Questionnaire. PSDQ–PSC = Physical Self-Description Questionnaire–Physical Self-Concept. Pearson correlations are placed in the lower triangle of the matrix. Internal consistency estimates (Cronbach's coefficient α) are placed along the diagonal. Correlation matrix is based on pairwise comparisons, and sample size is consistent across each element in the matrix. All $rs > |.10|$ are significant at $p < .05$, two-tailed. All $rs > |.20|$ are significant at $p < .01$, two-tailed.

Variance inflation (0.37 to 0.95) and tolerance (1.06 to 2.69) values observed implied collinearity in the data. However, no two variance proportion factors exceeded Pedhazur's (1997) recommended threshold (0.50) when the condition index was high (>10). The results of the SMRA (Table 7) reveal that integrated regulation contributed positively to predicting both PSDQ-PSC and GLTEQ-METS scores irrespective of the contributions from other extrinsic motives. An examination of the r_s reveals that integrated regulation is the strongest predictor of both PSDQ-PSC and GLTEQ-METS scores. Of additional interest, the variance accounted for in each SMRA corresponds with Cohen's (1992) criteria indicative of medium effect sizes ($.15 < R^2 < .35$; Cohen, 1992).

Test–Retest Reliability Analysis

Intraclass correlation coefficients (ρ) were calculated using the two-way mixed-effect model to examine stability of BREQ and integrated regulation scores over a 2-week period. The results of this analysis suggest minimal fluctuation in score stability ($\rho_{external} = .78$; $\rho_{introjected} = .78$; $\rho_{identified} = .83$; $\rho_{integrated} = .84$; $\rho_{intrinsic} = .82$; 95% confidence intervals range from .70 to .88, respectively).

Table 7

Simultaneous Multiple Regression Analyses Predicting Motivational Consequences: Study 3

Criterion variable Predictor variables	*F* (4, 136)	Adjusted R^2	*B*	*SE B*	β	*t*	r_s
GLTEQ–METS	12.08						
BREQ—external regulation			-4.52	2.45	-.14	-1.84	-.16
BREQ—introjected regulation			1.54	2.59	.06	0.53	.60
BREQ—identified regulation			6.41	3.54	.22	1.81	.90
Integrated regulation		.25	6.44	2.48	.30	2.59**	.92
PSDQ–PSC	14.95						
BREQ—external regulation			-0.32	0.96	-.23	-3.31**	-.38
BREQ—introjected regulation			-0.31	0.10	-.27	-3.02**	.14
BREQ—identified regulation			0.39	0.13	.34	3.09**	.73
Integrated regulation		.32	0.32	0.09	.37	3.69**	.77

Note. BREQ = Behavioural Regulation in Exercise Questionnaire. GLTEQ–METS = Godin Leisure Time Exercise Questionnaire omnibus score. PSDQ–PSC = Physical Self-Description Questionnaire–Physical Self-Concept. Multiple *R* for GLTEQ–METS equation = .517; multiple *R* for PSDQ–PSC = .579. r_s = structure coefficients (Courville & Thompson, 2001).
*$p < .05$. **$p < .01$.

Using Vincent's (1995) guidelines for the behavioral sciences (i.e., acceptable ρs ranging from .70 to .80), the BREQ and integrated regulation scores appear to be stable in order and magnitude across test periods.

Discussion

The primary purpose of Study 3 was to examine the contribution of integrated regulation to the prediction of motivational consequences while considering the effects of other extrinsic motives specified by SDT (Deci & Ryan, 1985, 2002). The secondary purpose of Study 3 was to provide data attesting to the stability of

integrated regulation and BREQ scores over a 2-week interval. The results of the SMRA indicate that integrated regulation has some predictive capacity for understanding both exercise behavior and physical self-worth as motivational consequences beyond the effects of SDT's other extrinsic motives. The results of Study 3 also support the stability of BREQ and integrated regulation test scores over a short time interval. This is encouraging, given that although motivation as measured by the expanded BREQ measurement model is theorized to be dynamic, it is unlikely to change in the absence of intervention over short time frames.

General Discussion

The purpose of this investigation was to evaluate the construct validity of scores derived from a set of integrated regulation items designed to sit comfortably within the BREQ. The results of Studies 1 and 2 suggest that including the integrated regulation items in the expanded BREQ measurement model did not compromise the instrument's theoretical fidelity or the structural validity of BREQ scores. Additional support for the convergent/divergent validity of the integrated regulation items was evident in Study 1 based on observed correlations with scores from Li's (1999) EMS-Integrated Regulation subscale; as well as evidence of criterion validity in Studies 2 and 3 that linked scores from the integrated regulation items with indexes of need satisfaction, exercise behavior, and physical self-worth that comprise a nomological network derived from SDT (Deci & Ryan, 1985, 2002).

Corroborating the construct validity data for the integrated regulation items, evidence of internal consistency reliability in each study and stability across a 2-week period in Study 3 reveals that scores derived from the integrated regulation subscale and BREQ exhibit no obvious reliability concerns in these samples. Collectively, this investigation suggests that the new integrated regulation items display congeneric measurement properties and hold promise as an extension of the original BREQ to measure the full range of SDT's extrinsic motives (Deci & Ryan, 1985, 2002).

This investigation provides initial evidence for the construct validity of the expanded BREQ measurement model. In addition to model fit estimates suggesting that the implied measurement model accounted for the observed data, the results of both CFAs suggest that including the integrated regulation items did not compromise the theoretical underpinnings of the BREQ. A major proposition put forth by Deci and Ryan (1985, 2002) concerns the presence of a quasi-simplex pattern of associations, whereby scores on measures of adjacent motives proposed along SDT's internalization continuum are associated more positively than distal motives.

Given that theory and measurement are linked inextricably (Messick, 1995), it is particularly encouraging that the pattern of observed relationships in the

expanded BREQ measurement model is consistent with SDT (Deci & Ryan, 1985, 2002). Notwithstanding this observation, the CFAs indicate that two original BREQ items capturing external regulation ("I exercise because others will not be pleased with me if I don't") and identified regulation ("I get restless when I don't exercise regularly") exhibited a pattern of standardized residuals exceeding |2.0| in each sample, and the observed phi coefficients indicate considerable overlap between latent factors in the expanded BREQ measurement model, especially with respect to autonomous motives. Given that previous research in Canadian (Wilson et al., 2002) and British (Mullan et al., 1997) samples has reported similar findings with the BREQ, future research may consider examining the degree of item-content relevance and representation inherent in items comprising the expanded BREQ measurement model (Dunn, Bouffard, & Rogers, 1999).

Consistent with Messick's (1995) assertion that construct validity is an ongoing endeavor, the current study extends psychometric evidence of the expanded BREQ measurement model in two ways. First, we examined and supported structural validity of scores derived from the expanded BREQ measurement model in both university- and community-based exercisers. Second, this investigation provides initial evidence of internal consistency reliability and temporal stability of scores compiled from participant responses to the expanded set of BREQ items, including integrated regulation. Evidence of stability across short time periods is considered important in initial stages of item development and evaluation when true change in the variables of interest (i.e., BREQ subscale scores) is not anticipated on the basis of substantive theory (Pedhazur & Schmelkin, 1991).

Notwithstanding these observations, the process of construct validation is ongoing (Messick, 1995). The composition of our samples in this investigation was predominantly young active females, which limits the external validity of our data. Future research may consider extending this work by testing the expanded BREQ measurement model in different samples in which initiating and maintaining exercise behavior is an important issue (e.g., older adults, people with chronic disease).

The pattern of relationships observed between subscale scores from the expanded BREQ measurement model, indexes of need satisfaction, and motivational consequences offer convergent evidence of construct validity. According to Deci and Ryan (1985, 2002), contexts that support basic psychological needs facilitate the internalization of motives into more autonomous forms, which in turn promote enduring behavior and well-being. The data in Study 2 indicate that perceptions of competence and autonomy in particular demonstrated markedly stronger relationships with autonomous than controlled motives. This is in line with SDT, given that relatedness is considered to be the catalyst instigating the process of internalizing behavioral regulation and, therefore, is unlikely to be associated with integrated and intrinsic regulations that already have been assimilated with the self (Deci & Ryan, 2002). Although the results of Study 2 are

informative and consistent with theory (Deci & Ryan, 1985, 2002), the cross-sectional nature of the design prevents firm conclusions regarding the causal nature of the need-satisfaction/motivation relationship that future studies using true experimental or prospective longitudinal designs may wish to explore.

The predictive analyses conducted in Study 3 highlight an interesting pattern of relationships between motives varying in their degree of internalization and select consequences in the form of exercise behavior and physical self-worth. An inspection of the data presented in Table 7 makes it clear that integrated regulation scores exert the strongest predictive influence on each motivational consequence while controlling for the contributions of other extrinsic motives. According to Deci and Ryan (1985, 2002), autonomous regulations underpinned by greater psychological need satisfaction nurture more positive and enduring consequences in a given domain. compared with their controlling counterparts.

Our investigation supports this assertion and extends the literature in two ways. First, this study expands Li's (1999) work by providing empirical support linking integrated exercise regulations with exercise behavior and physical self-worth in a manner consistent with SDT (Deci & Ryan, 1985, 2002). Second, this study complements previous research (Landry & Solomon, 2004; Pelletier et al., 2004; Wilson et al., 2004) by providing additional support for the argument that autonomous motives, irrespective of their intrinsic or extrinsic orientation, are influential in the regulation of important health behaviors (Deci & Ryan, 1985, 2002). Nevertheless, these data should be interpreted cautiously prior to replication with more objective exercise behavior indexes, as suggested by Pelletier et al. (2004) to alleviate concerns regarding potential contamination of the criterion validity coefficients from common methods variance (Pedhazur & Schemlkin, 1991).

A number of important observations are evident and noteworthy in the present investigation that warrant further elaboration to advance the study of SDT in exercise contexts. From a theoretical perspective, the measurement and statistical treatment of the data provide insights into the differential role played by each extrinsic motive specified by SDT's regulatory continuum (Deci & Ryan, 1985, 2002). This supports arguments made by Koestner and Losier (2002) questioning the use of global motivational scores created by weighting then summing discrete points along SDT's regulatory continuum, given that such approaches mask important distinctions between sources of extrinsic motivation.

In addition to extending the evidence base informing the validity of SDT's motivational continuum in exercise, the present investigation also offers important practical information for health professionals who are interested in encouraging exercise participation and psychological well-being as part of an overall health-promotion program. Results from this investigation suggest that it is the quality not the intensity of motivation that is the critical ingredient associated with frequent exercise participation, and positive physical self-perceptions that

are considered an indicator of emotional adjustment and well-being (Biddle et al., 2000).

Health professionals should avoid structuring programs that promote feelings of isolation from others in early stages of behavioral adoption that likely undermine perceived relatedness, and resist imposing unrealistic deadlines or goals on participation that likely undermine perceptions of competence and autonomy. Alternatively, health professionals who listen with empathy, encourage self-initiated choices, and confer positive feedback in a genuine manner will likely support the satisfaction of basic psychological needs that promote integrated regulation that appears to be an influential process to consider in terms of both exercise behavior and physical self-worth.

In summary, the purpose of the current investigation was to evaluate select measurement properties associated with a set of preliminary integrated regulation items developed using SDT (Deci & Ryan, 1985, 2002) as a guiding framework. The results of three studies provide evidence supporting the construct validity of the new integrated regulation items when used alone and in conjunction with an expanded BREQ measurement model. The results also suggest that scores on the integrated regulation items appear to be stable over a 2-week interval, and converge in a theoretically expected direction with an existing measure of integrated regulation (Li, 1999), perceptions of psychological need satisfaction, and forms of extrinsic and intrinsic motivation aligning SDT's regulatory continuum (Deci & Ryan, 1985, 2002).

This investigation offers additional theoretical evidence for the multidimensional nature of extrinsic motivation, and provides insight into the function of motives that vary in the level of self-determination facilitating their development by demonstrating links between extrinsic motives and select consequences. On the basis of this study, it appears that integrated regulation can be measured in exercise contexts as a related yet distinct form of extrinsic motivation within the expanded BREQ measurement model. Future research employing this instrument in exercise settings appears to be justified.

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