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The Relatedness to Others in Physical Activity Scale: Evidence for Structural and Criterion Validity

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The purpose of this study was to test the structural and criterion validity of scores derived from the Relatedness to Others in Physical Activity Scale (ROPAS). The participants ($n_1 = 893$; $n_2 = 522$) completed the ROPAS in addition to demographic questions (study 1) and well-being indicators (study 2) using cross-sectional, nonexperimental surveys. Confirmatory factor analysis (study 1) supported the tenability of a 6-item ROPAS measurement model that was invariant across gender. Higher ROPAS scores were associated with greater perceived autonomy and competence and greater well-being (study 2). Overall, these findings suggested the ROPAS displays a number of psychometric properties that render the instrument useful for investigating issues of belonging and connectedness with others in global physical activity settings.

Self-determination theory (SDT; Deci & Ryan, 2002) has become a popular framework for understanding motivational issues in physical activity contexts such as sport and exercise (Hagger & Chatzisarantis, 2007). This is not surprising given the macro-level approach taken within SDT that specifies the nature and function of human motivation as well as the conditions that facilitate (or thwart) motivational development and enhance well-being (Deci & Ryan). The approach embraced within SDT centers around an "organismic-dialectic" (Deci & Ryan, p. 5), which assumes that humans are active growth-orientated organisms who seek out opportunities for assimilation within their social world. The development of human potentials central to SDT does not occur in a social vacuum but relies on ambient supports that interface with the organism's innate tendencies to optimize motivation and promote greater well-being (Deci & Ryan).

The concept of basic psychological needs is central to Deci and Ryan's (2002) meta-theory and is formally explicated within Basic Psychological Needs Theory (BPNT). Deci and Ryan extolled the importance of feeling competent,

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autonomous, and related globally and within specific life contexts to facilitate the internalization process and enhance well-being (Ryan, 1995). Competence refers to the need to interact effectively with one's environment when engaged in optimally challenging tasks (Deci & Ryan). Autonomy involves experiencing a sense of personal ownership over behavior such that the person feels similar to the origin of one's actions rather than a pawn to external agenda (Deci & Ryan). Relatedness concerns establishing and sustaining meaningful connections with others in one's social milieu such that a person feels socially connected with, and accepted by, important others (Deci & Ryan).

The functional appeal of BPNT concerns the ability to integrate and understand diverse phenomena ranging from behavioral persistence issues to optimizing well-being (Deci & Ryan, 2002). Deci and Ryan contended that fulfilling each psychological need has a "direct relation to well-being" (p. 22) such that enhanced psychological need satisfaction is associated with greater well-being and concomitantly less ill-being. Greater fulfillment of competence, autonomy, and relatedness needs is also considered vital for internalization whereby persistence behavior is motivated for more self-determined than controlled reasons (Deci & Ryan). Ample evidence supports the link between fulfillment of basic psychological needs in relation to both well-being and more self-determined motives for behavior in domains such as education, social relationships, and the workplace (Deci & Ryan). Closer inspection of the research applying BPNT to study issues of well-being and behavioral persistence within physical activity settings is not wholly consistent with Deci and Ryan's contentions particularly with regard to the role of perceived relatedness.

This study outlines the development and initial construct validation of a new instrument designed to measure perceived relatedness in physical activity settings using BPNT as a guiding framework. The Relatedness to Others in Physical Activity Scale (ROPAS) is a multi-item instrument designed to assess the degree of meaningful connection and belonging experienced by individuals with other people when they partake in physical activity.

Justification for the ROPAS

Examination of the published studies concerned with perceived relatedness in physical activity settings provided the impetus to develop the ROPAS. First, inspection of the physical activity literature offers less convincing support for Deci and Ryan's (2002) assertions regarding the role of perceived relatedness in relation to well-being markers and motivation. Longitudinal studies offer no evidence for changes in perceived relatedness predicting variation in positive/negative affect (Edmunds, Ntoumanis, & Duda, 2008) or global markers of well-being (Edmunds, Ntoumanis, & Duda, 2007). Alternatively, cross-sectional studies indicate that perceived relatedness predicts positive affect but seems unrelated to physical self-worth when examined conjointly with perceived autonomy and competence (McDonough & Crocker, 2007). Additional studies demonstrate a weak association between perceived relatedness and enhanced physical self-worth that is not moderated by gender (Wilson, Mack, & Lightheart, 2008) and limited support for the association between perceived relatedness and positive affect when controlling for perceived competence and autonomy in young adult exercisers (Wilson, Rodgers, Murray, Muon, & Longley, 2006).

Previous studies examining the role of perceived relatedness in relation to physical activity motives also note equivocal findings. Cross-sectional investigations have reported no relationship between perceived relatedness and intrinsic motivation for exercise (Wilson, Rodgers, Blanchard, & Gessell, 2003) or a positive albeit weak association in conjunction with the contributions of autonomy and competence (Wilson & Rogers, 2008). Additional studies provide no support for the perceived relatedness–intrinsic motivation relationship in exercisers when perceived competence and autonomy are included in predictive analyses (Peddle, Plotnikoff, Wild, Au, & Courneya, 2008; Vlachopoulus & Michailidou, 2006). One longitudinal study reported no support for change in perceived relatedness across time, predicting motivational changes in exercise class members (Edmunds et al., 2008). Conversely, McDonough and Crocker (2007) represented one example from the literature supporting the role of perceived relatedness in terms of predicting more self-determined motives for physical activity within a group-based physical activity context (i.e., dragon boating).

A second line of reasoning supporting the development of the ROPAS concerns the continued use of items modified from instruments developed for use in other contexts (e.g., education) to assess perceived relatedness in physical activity. Crocker and Algina (1986) cautioned that using instruments outside the context (or target population) they were intended for presents problems based on item content relevance and/or content representation. Item content relevance is concerned with the extent to which an item is relevant to the focal construct of interest whereas item content representation concerns the degree to which a set of content relevant items cover (or omit) the full conceptual breadth of the focal construct within the sample under study (Messick, 1995). Messick contended that failure to fully represent constructs with relevant items can obfuscate relationships within a broader nomological network (Cronbach & Meehl, 1955). Given that previous studies of exercisers (e.g., Wilson et al., 2003) and athletes (e.g., Kowal & Fortier, 2000) have used items to assess perceived relatedness that were modified from instruments designed for use in other contexts (e.g., education), it seems plausible that the inconsistencies observed in the SDT literature concerning perceived relatedness with reference to both physical activity motivation and well-being as criterion of interest could be a consequence of inadequate content representation.

A third line of reasoning supporting the development of the ROPAS stems partly from the emergence of instruments designed exclusively for use within exercise settings (see Wilson, Mack, Gunnell, Oster, & Gregson, 2008), namely the Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson, Rogers, Rodgers, & Wild, 2006) and the Basic Psychological Needs in Exercise Scale (BPNES; Vlachopoulus & Michailidou, 2006). The BPNES was developed using Greek-speaking exercisers (Vlachopoulus & Michailidou), while the PNSE was developed specifically for use in structured exercise contexts (Wilson, Rogers et al., 2006). Although a few studies have modified the PNSE-Relatedness items for use in physical activity contexts (e.g., McDonough & Crocker, 2007), closer inspection of the item content from both instruments raises concerns regarding the degree to which the items can (or should) be modified for use outside the context of exercise. Items constituting the relatedness subscale of the PNSE and BPNES target particular social agents (e.g., "exercise participants," "exercise companions") or identify specific behaviors that promote relatedness (e.g., "exercise together") that do not lend themselves readily to modification without calling into question the meaningfulness and technical quality of the items. For example, modifying the PNSE item "I feel attached to my exercise companions because they accept me for who I am" by discarding the term "exercise companion" renders the item unclear for the participant and technically poor on the basis of the modified item's structure. On the basis of these arguments, it seems reasonable to suggest that the relatedness items constituting both the PNSE and BPNES do not lend themselves easily to modification for use in contexts beyond structured exercise, which potentially limits their scope.

A final line of reasoning concerns the development of instruments within the framework of SDT from "first principles" (Hagger & Chatzisarantis, 2008, p. 85). In a synopsis of measurement research applying SDT to exercise, Hagger and Chatzisarantis echoed Crocker and Algina's (1986) earlier recommendations for a two-pronged approach to inform and enrich item generation. During this early phase of instrument development, joint consideration of the conceptual boundaries defining the focal construct specified by relevant theory (e.g., BPNT) along with open-ended techniques capturing salient experiences of the target population with reference to the focal construct can be useful in shaping the item content. Considering that relatively few instruments have been developed in this way within the exercise psychology literature using SDT (Hagger & Chatzisarantis), it seems apparent that there is scope for further research targeting the development of new instruments to capture the focal constructs set forth within Deci and Ryan's (2002) framework.

Aims of the Present Investigation

The aim of this investigation is to provide initial construct validity evidence for scores derived from the ROPAS, a new instrument designed to measure perceived relatedness in physical activity contexts aligned with BPNT (Deci &

Ryan, 2002). Two studies were designed to address within- and between-network (Marsh, 1997) aspects of construct validation. Within-network studies focus on the internal composition of responses to a particular instrument (Marsh). Messick (1989) contended that within-network (or internal validity) studies represent an integral part of the construct validation process because they provide evidence concerning the extent to which test items reflect both content and structure of responses to the instrument in line with the theory informing the instrument's development. Between-network evidence (Marsh) is concerned with testing patterns of relationships between the focal construct of interest (i.e., perceived relatedness measured by the ROPAS) and other constructs within a nomological network theorized to be linked with the focal construct in particular ways based upon relevant theory (Cronbach & Meehl, 1955).

Within-network evidence for the ROPAS scores was sought in study 1 by testing the structural validity of responses to the ROPAS, by testing the invariance of the final 6-item ROPAS measurement model across gender, and by evaluating the internal consistency reliability of ROPAS scores. Confirmatory factor analysis (CFA) was used to test the structural validity and invariance of ROPAS scores across gender. Assessment of invariance concerns the extent to which responses to test items (e.g., ROPAS scores) retain their meaning across particular subgroups (e.g., males and females; Chueng & Rensvold, 2002; Hoyle & Smith, 1994). Gender was selected as a subgroup of interest across which invariance of the ROPAS measurement model was tested for three reasons. First, Deci and Ryan (2002) specified gender as one important subgroup of interest with reference to the functional role played by fulfilling psychological needs such as perceived relatedness. Second, comparisons across gender appear to be commonplace in the broader field of psychological research conducted in physical activity domains. Such comparison require evidence of invariance in construct measurement in order to have confidence that any observed differences noted are not an artifact of the measurement process triggered by differential item interpretation across male and female cohorts. Third, previous studies of instruments designed to measure BPNT-based constructs in exercise have sought evidence of measurement model invariance across gender (e.g., Wilson, Rogers et al., 2006), and therefore, it was deemed logical to be consistent with these investigations.

Between-network evidence was sought in study 2 by examining two issues stemming directly from Deci and Ryan's (2002) theorizing with reference to BPNT. The first issue concerned a hypothesized pattern of relationships expected between perceived relatedness assessed with the ROPAS and indices of well-being. Deci and Ryan clearly articulated that a defining characteristic of basic psychological needs within the SDT approach is the direct relationship between fulfilling each psychological need and enhanced well-being. On the basis of these arguments, it was expected that scores from the ROPAS would be positively associated with greater endorsement of well-being and negatively associated with markers of ill-being. The second issue concerned the pattern of convergent/divergent relationships expected between scores derived from the ROPAS and indices used to measure perceived competence and autonomy experienced as a result of engaging in physical activity. Deci and Ryan contended that fulfilling the psychological needs housed within BPNT should be complimentary, not mutually exclusive in nature. Extrapolating from this line of reasoning, previous studies have demonstrated positive associations of varying magnitude between indices of psychological need satisfaction suggestive of convergence between scores repenting each psychological need (Wilson & Rodgers, 2007). Between-network evidence of construct validity of ROPAS scores was tested in study 2 using bivariate correlations and multiple regression analyses.

Study 1—Structural Validity of ROPAS Scores

The purpose of study 1 was to develop an initial set of items designed to assess feelings of relatedness to others in physical activity contexts, to test the structural validity and invariance of these items across gender, and to estimate the internal consistency reliability of ROPAS scores.

Methods

Study 1—Participants

The total sample ($n = 893$; $M_{age} = 20.13$ years; $SD = 2.19$ years) was university students in Canada. Twelve participants did not provide their gender and were removed from further consideration. No course credit was provided for participation. Most of the sample indicated they were White/Caucasian (89.10%) with limited representation of Asian (3.00%) and Aboriginal (0.40%) cohorts (the remainder of the samples reported "other" as their ethnic origin). Self-reported height and weight values were converted to body mass index (BMI) scores. Most of the samples were classified as normal weight ($M_{BMI} = 23.61$ kg/m^2; $SD_{BMI} = 3.12$ kg/m^2) using Health Canada's (2003) guidelines with the remainder of the samples classified accordingly based on BMI cut-points: underweight = 2.10%, normal weight = 75.00%, overweight = 18.70%, and obese = 4.10%.

The male subsample ($n = 276$; $M_{age} = 20.12$ years; $SD = 1.92$ years; 90.90% aged between 17 years and 22 years) displayed, on average, minimal health risk ($M_{BMI} = 24.59$ kg/m^2; $SD_{BMI} = 2.79$ kg/m^2; 64.70% classified as "normal" weight and 27.50% classified as "overweight"). Self-report estimates of physical activity over a typical week varied considerably in the male cohort ($M_{GLTEQ\text{-}METS} = 74.15$; $SD_{GLTEQ\text{-}METS} = 47.99$).[1] One male was removed from further consideration for

[1]These scores were derived from the Godin Leisure Time Exercise Questionnaire.

reporting that he engaged in no regular physical activity during a typical week (i.e., GLTEQ-METS score = 0).

The female subsample ($n = 582$; $M_{age} = 20.04$ years; $SD = 2.26$ years; 92.40% aged between 17 years and 22 years) reported, on average, little health risk ($M_{BMI} = 23.13$ kg/m^2; $SD_{BMI} = 2.26$ kg/m^2; 78.10% classified as "normal" weight and 15.00% classified as "overweight"). Self-reported physical activity across a typical week was also diverse in the female cohort ($M_{GLTEQ\text{-}METS} = 59.33$; $SD_{GLTEQ\text{-}METS} = 51.48$).[1] Nine females were removed for indicating they regularly engaged in no physical activity across a typical week.

Instruments

Demographics. The participants completed a series of self-report questions concerning age, height, weight, gender, and ethnicity.

ROPAS. A pool of 16 items was created using an iterative process to assess perceived relatedness with the ROPAS. First, written accounts of personal experiences of relatedness to others in physical activity contexts were derived from a purposive sample of young, physically active adults ($n = 131$; 64.88% female; $M_{age} = 19.60$ years; $SD = 2.89$ years; 93.90% aged between 18 years and 22 years; 26.80% classified as "minimally active;" 73.20% classified as "active" based on self-report estimates of weekly physical activity).[2] Each participant responded to an elicitation question using a critical incident approach (Flanagan, 1954) that was followed by two additional questions designed to probe their experiences, which enhanced (or dissuaded) feelings of relatedness when engaged in physical activity behavior.[3] The second stage of the item generation process used the theoretical boundaries provided by Deci and Ryan (2002) to establish domain clarity (Messick, 1995) while creating an initial pool of ROPAS items derived from thematic analyses of participant-based experiential accounts. Personal experiences provided by the participants that lacked clarity or bridged the theoretical antecedents of perceived relatedness (i.e., "involvement," Deci & Ryan) were not included in the development of the ROPAS items. Generation of the original ROPAS items unfolded across four iterations with a domain expert

[2]The activity classifications were based upon scores from the International Physical Activity Questionnaire. This sample was not a portion of the larger sample of participants included in the test of structural validity used in study 1.

[3]Each participant was presented with a conceptual framework defining relatedness that was followed by these questions: "Who makes you feel this way when you are participating in regular physical activity?"; "Think about a time when you felt a sense of relatedness while participating in physical activity. Please give as much detail about the context in which you felt a sense of relatedness while participating in physical activity. How old where you? Where were you? Who were you with? What were you doing? Please describe in your own words what specifically made you feel this way."; and (3) "What specifically would make you feel more or less related while participating in physical activity?"

offering constructive feedback concerning item content at each stage of the item writing process.

The original 16 ROPAS items were presented to the participants in a random order in an attempt to offset response set biases (Crocker & Algina, 1986). An instructional stem preceded the ROPAS items to contextualize participant responses. The stem read as follows: "The following statements represent different feelings people have when they engage in physical activity. Please answer the following questions by considering how you typically feel when participating in physical activity using the scale provided . . ." The participants responded to each item with one of the following response options: 1 (false), 2 (mostly false), 3 (more false than true), 4 (more true than false), 5 (mostly true), or 6 (true). The design of the response options used with the ROPAS was based on the following considerations: instruments with relatively few response options (i.e., <4) typically produce lower reliability estimates, affixing a verbal anchor to each response option can enhance item interpretability, avoidance of end aversion bias, and the nature of the construct being measured suggested no requirement for a neutral position in response options (Streiner & Norman, 2004).

Data Collection Procedures and Data Analyses

Data were collected via an electronic interface hosted on a secure Internet site. The eligible participants were sent a letter of information (LOI) that included a Uniform Resource Locator (URL) via e-mail. Those choosing to participate selected the URL that directed the participant to a secure Web site containing an informed consent form and the study questionnaire. The participants were informed about the nature of the study in the LOI and encouraged to ask questions of the investigators via e-mail or telephone prior to consenting to participate. Informed consent was secured from each participant prior to accessing the survey by having each participant select a box indicating they had read the LOI and informed consent page and were consenting to participate. The participants who chose not to provide informed consent were thanked for their interest and redirected away from the survey page to a random URL. Standard instructions were given in the LOI to minimize the likelihood of between-groups effects introduced on the basis of test administration. All aspects of this study received clearance from two research ethics boards prior to initial participant contact.

Data analyses proceeded sequentially. First, data were screened for outliers and missing values. Second, missing values were examined to detect any systematic patterns. Third, a multiple imputation procedure using an expectation maximization algorithm (EMA) was utilized to replace all missing data. Fourth, CFA tested the structural validity of scores derived from the ROPAS. CFA was chosen as the analytical method for this stage of the investigation based on MacCallum and Austin's (2000) contentions for testing measurement issues such as structural validity in models derived from psychological theory (such as the ROPAS) using a hypothesis testing rather than data-driven (or "exploratory") approach. An item-reduction approach was taken in the CFA whereby troublesome items were identified and removed if any of the following criteria were observed: large ($z > |2.00|$) elements in the matrix of standardized residuals; low ($<|0.40|$) standardized factor loadings, or modification indices (MIs) that could not be substantiated using BPNT but would improve model fit, implying ambiguity in ROPAS item responses in this sample. This approach has been used in previous instrument development studies using SDT as a theoretical framework (e.g., Markland & Hardy, 1997). Problematic items were identified and removed sequentially followed by recalibration and reestimation of the ROPAS measurement model until no additional items were deemed problematic. Fifth, a series of CFAs tested the sensitivity of the ROPAS measurement model to gender using simultaneous multigroup covariance analysis (SMCA). A series of restrictive constraints was imposed on an unrestricted ROPAS measurement model to evaluate invariance across gender. Evidence of score invariance is tenable when no noticeable decrement in model fit is observed after the imposition of an equality constraint for the model parameter being tested (Chueng & Rensvold, 2002). Three hypotheses were tested in sequential order as follows: equality of factor loadings, equality of factor variances, and equality of error variances. Each hypothesis assumed empirical support for less constrained models. Sixth, descriptive statistics and internal consistency reliability estimates (Cronbach's α; Cronbach, 1951) were computed. Lastly, independent sample *t* tests and Cohen's *d* values (Cohen, 1988) were calculated to evaluate the magnitude and direction of gender differences in perceived relatedness assessed by the ROPAS.

In all the CFAs reported in study 1, the items were loaded exclusively on a single target latent factor, error terms were not free to correlate, and the loading of one manifest item was fixed at unity to define the scale. The comparative (CFIs) and incremental (IFIs) fit indices were used alongside the root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMSR) to evaluate global model fit. These fit indices were selected on the basis of their expected performance in small samples where the data likely deviate from normality (West, Finch, & Curran, 1995). CFI/IFI values exceeding 0.90 and 0.95 are typically considered representative of good and excellent fit of a specified model to sample data (Hu & Bentler, 1999). RMSEA values less than 0.05 suggest an excellent fit, while values that exceed 0.10 are typically undesirable (Browne & Cudeck, 1993). Values approximating 0.08 or less for the SRMSR are typically considered satisfactory (Hu & Bentler). The same global model fit indices were employed to evaluate the results of the SMCA, with greater emphasis placed on interpreting changes in the CFI values between more restrictive models as evidence of invariance. Chueng and Rensvold (2002) recommended that a model is likely not invariant if the change in CFI exceeds

–0.01 in more restrictive models. Considering that threshold values indicative of model fit remain a contentious issue in CFA (Marsh, Hau, & Wen, 2004), the assortment of global model fit indices was used in conjunction with the z distributions, standardized parameter loadings, and MIs to evaluate the results of each CFA. Such an approach is consistent with Markland's (2007) contentions regarding the use of an informed approach to model testing in CFA whereby excessive focus on any solitary global model fit index or "conventional" threshold value can obscure judgments concerning model tenability.

Results

Preliminary Analyses and Replacement of Missing Data

No out-of-range responses for any ROPAS item were noted. Missing data were evident across ROPAS items in the male (5.10%–5.80%) and female (3.70%–4.00%) subsamples. Interpretation of Little's (1988) tests ($\chi^2_{male} = 42.09$, $df = 63$, $p = .98$; $\chi^2_{female} = 132.20$, $df = 75$, $p < .01$) suggested that the missing data could be considered missing at random. All missing values were replaced with a value imputed from an EMA that used ROPAS data provided within gender-specific subsamples to replace missing values.

Distributional Characteristics of ROPAS Item Scores and Selection of an Estimator

The observed distributions for manifest ROPAS items were as follows: total sample ($M = 4.98$; $SD = .96$; range = 4.27–5.19; $M_{Skewness} = -1.15$; $M_{kurtosis} = 1.95$), male subsample ($M = 5.04$; $SD = .89$; range = 4.83–5.20; $M_{Skewness} = -1.20$; $M_{kurtosis} = 2.56$), and female subsample ($M = 4.96$; $SD = .99$; range = 4.66–5.19; $M_{Skewness} = -1.11$; $M_{kurtosis} = 1.70$). Kurtosis was evident in ROPAS scores within the males (values ranged from 1.11 to 5.21) and the females (values ranged from 0.65 to 2.83). Mardia's (1970) coefficient indicated substantial multivariate kurtosis (total sample = 256.85; males = 211.42; females = 248.74). Maximum likelihood (ML) was chosen as the estimation method in all CFAs given that this approach is less sensitive to deviations from normality when the sample size is small (West et al., 1995). The ML estimation method was used in conjunction with bootstrapping procedures (Preacher & Hayes, 2008) that provide more stable parameters estimates in applied CFA studies (Nevitt & Hancock, 2001). Bootstrap-based samples ($n = 5{,}000$; Preacher & Hayes) were requested from the total sample providing data for study 1.

CFA of the ROPAS Measurement Model

The results of the iterative CFA tests concerning the structural validity of ROPAS scores conducted on the total sample are presented in Table 1. In brief,

Table 1

Global Model Fit Indices From CFA Models Testing Structural Validity of the ROPAS

Models	χ^2	*df*	*p*	CFI	IFI	RMSEA (90% CI)	SRMSR
Model 1 (16 ROPAS items)	1137.55	104	<0.01	0.90	0.90	0.11 (0.10–0.11)	0.04
Model 2 (15 ROPAS items)	914.42	90	<0.01	0.92	0.92	0.10 (0.10–0.11)	0.04
Model 3 (14 ROPAS items)	793.60	77	<0.01	0.92	0.92	0.10 (0.10–0.11)	0.04
Model 4 (13 ROPAS items)	686.04	65	<0.01	0.93	0.93	0.11 (0.10–0.11)	0.04
Model 5 (12 ROPAS items)	571.50	54	<0.01	0.94	0.94	0.11 (0.10–0.11)	0.04
Model 6 (11 ROPAS items)	489.98	44	<0.01	0.94	0.94	0.11 (0.10–0.12)	0.04
Model 7 (10 ROPAS items)	393.19	35	<0.01	0.94	0.94	0.11 (0.10–0.12)	0.03
Model 8 (9 ROPAS items)	255.33	27	<0.01	0.96	0.96	0.10 (0.09–0.11)	0.03
Model 9 (8 ROPAS items)	178.93	20	<0.01	0.97	0.97	0.10 (0.08–0.11)	0.03
Model 10 (7 ROPAS items)	111.60	14	<0.01	0.98	0.98	0.09 (0.08–0.11)	0.03
Model 11 (6 ROPAS items)	52.50	9	<0.01	0.99	0.99	0.08 (0.06–0.10)	0.02

Note. ROPAS = Relatedness to Others in Physical Activity Scale; χ^2 = chi-square test 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 = 90% confidence interval around RMSEA point estimate; SRMSR = standardized root mean square residual.

large elements were observed in the *z* matrix along with substantial MIs noted in the fit of the original 16-item ROPAS measurement model (model 1 in Table 1). Sequential removal of 10 ROPAS items (see models 2–11 in Table 1) resulted in a measurement model that provided a tenable account of the ROPAS data. While the final ROPAS measurement model deviated from the reference model based on the observed χ^2 statistic, the pattern of global model fit indices combined with the moderate-to-strong standardized factor loadings ($M = .81$; $SD = .03$;

range = .76–.85) and distribution of standardized residuals (93.33% $z < |1.00|$; 0.00% $z > |2.00|$) suggested minimal discrepancy between the observed and implied covariance matrices for this 6-item ROPAS measurement model.[4]

SMCA Tests of Gender Invariance for the ROPAS Measurement Model

The results of the SMCA testing the sensitivity of the 6-item ROPAS measurement model to gender are presented in Tables 2 and 3. The pattern of standardized factor loadings and bootstrap-based standard errors (see Table 2) supports the tenability of this measurement model in both males and females. While significant χ^2 test statistics are observed at each stage other than the model 2 of the SMCA (see Table 3), the change in CFI did not exceed |0.01| across even the most restrictive models (see model 4 in Table 3). Further examination of the global model fit indices provides no support for deterioration in model fit across increasingly restrictive models (models 2–4 in Table 3), suggesting the ROPAS scores were invariant across gender.

Reliability Estimates and Descriptive Statistics

Cronbach's α-values (Cronbach, 1951) ranged from 0.89 (males) to 0.93 (females) in Study 1 ($\alpha_{\text{Total Sample}} = .92$). Females ($M = 4.92$; $SD = .86$) reported slightly lower values of perceived relatedness on average compared to their male counterparts ($M = 5.00$; $SD = .71$) however this difference was not statistically significant ($t(846) = -1.44$, $p = .15$, Cohen's (1988) $d = -0.10$).

Summary of Study 1

The main aim of study 1 was to develop and test the structural validity of scores from the ROPAS. A secondary aim was to estimate the internal consistency of the newly formed ROPAS and examine potential gender differences in perceived relatedness experienced while physically active. Overall, the results of study 1 suggest that the 6-item ROPAS measurement model is congeneric in nature and invariant across gender. Internal consistency reliability estimates

[4]We conducted a supplemental CFA testing a correlated, two-factor ROPAS measurement model to determine the viability of the discarded items comprising a second factor. The results did not provide convincing evidence to support the viability of this latent two-factor measurement model ($\chi^2 = 1048.93$, $df = 103$, $p < .01$, CFI/IFI = .91, RMSEA = .10 [90% confidence interval = .09–0.11], SRMSR = .04). The discarded items constituting the second factor in this measurement model were as follows: I am really close to others who I know well; I share many things in common with others around me; I am comfortable with others doing the same activities; I share a sense of togetherness with others doing the same activities; others accept me for who I am; I get along with others around me; I belong to a group that shares a common purpose; I am part of a group that counts on me; I am respected by others; and I have developed a strong connection with others.

Table 2

Distributional Properties and Factor Loadings of Manifest ROPAS Items Used in the SMCA

ROPAS item abbreviations	*M*	*SD*	Skew.	Kurt.	FL	*SE*
Total Sample (*n* = 858)						
I am included by others	5.01	0.91	–1.12	1.94	0.85	0.02
I am part of a group who share my goals	4.91	0.96	–1.02	1.46	0.81	0.02
I am supported by others in this activity	5.05	0.86	–1.03	2.03	0.82	0.02
Others want me to be involved with them	4.87	1.02	–1.07	1.53	0.82	0.02
I have developed a close bond with others	4.83	1.05	–0.86	0.59	0.76	0.02
I fit in well with others	4.99	0.97	–1.12	1.57	0.82	0.02
Male subsample (*n* = 276)						
I am included by others	5.10	0.80	–1.13	2.71	0.81	0.04
I am part of a group who share my goals	4.95	0.82	–1.05	1.62	0.72	0.04
I am supported by others in this activity	5.10	0.80	–0.99	2.15	0.79	0.04
Others want me to be involved with them	4.95	0.89	–1.05	2.26	0.81	0.03
I have developed a close bond with others	4.84	0.97	–0.81	0.72	0.67	0.05
I fit in well with others	5.07	0.93	–1.34	2.84	0.75	0.04
Female subsample (*n* = 582)						
I am included by others	4.97	0.96	–1.07	1.60	0.87	0.02
I am part of a group who share my goals	4.88	0.98	–1.01	1.39	0.84	0.02
I am supported by others in this activity	5.03	0.89	–1.03	1.92	0.83	0.02
Others want me to be involved with them	4.83	1.08	–1.03	1.18	0.82	0.02
I have developed a close bond with others	4.83	1.08	–0.88	0.52	0.78	0.02
I fit in well with others	4.96	0.98	–1.02	1.13	0.85	0.02

Note. ROPAS = Relatedness to Others in Physical Activity Scale; *M* = mean; *SD* = standard deviation; Skew. = univariate skewness; Kurt. = univariate kurtosis; FL = standardized factor loading from the baseline CFA model test; *SE* = bootstrap-based standard error from the baseline CFA model test.

suggest that the scores derived from the ROPAS contain minimal amounts of error variance in this sample of physically active young adults. Finally, no gender differences in perceived relatedness to others when engaged in physical activity were apparent.

Table 3

SMCA Testing Invariance of ROPAS Scores Across Gender

Models	χ^2	*df*	*p*	χ^2_d	df_d	*p*	CFI	ΔCFI	IFI	RMSEA (90% CI)	SRMSR
Model 1	66.24	18	<0.01	—	—	—	0.99	—	0.99	0.06 (0.04–0.07)	0.03
Model 2	67.94	23	<0.01	1.70	5	0.89	0.99	0.00	0.99	0.05 (0.04–0.06)	0.03
Model 3	81.04	24	<0.01	13.10	1	<0.01	0.98	–0.01	0.98	0.05 (0.04–0.07)	0.07
Model 4	105.29	30	<0.01	24.25	6	<0.01	0.98	0.00	0.98	0.05 (0.04–0.07)	0.08

Note. ROPAS = Relatedness to Others in Physical Activity Scale; χ^2 = chi-square test statistic. *df* = degrees of freedom; CFI = comparative fit index; IFI = incremental fit index; RMSEA = root mean square error of approximation;. 90% CI = 90% confidence interval around RMSEA point estimate; SRMSR = standardized root mean square residual; χ^2_d = chi-square difference; df_d = difference in degrees of freedom for increasingly restrictive models; *p* = probability value; ΔCFI = change in comparative fit index across increasingly restrictive models; Model 1 = baseline (unrestricted) model; Model 2 = assuming model 1, testing for equivalence of factor loadings; Model 3 = assuming Model 2, testing for equivalence of factor variances; Model 4 = assuming Model 3, testing for equivalence of error variances.

Study 2—Criterion Validity of ROPAS Scores

The purpose of study 2 was to expand the available construct validity evidence informing the interpretation of ROPAS scores by testing relationships with various dimensions of well-being and markers of perceived competence and autonomy felt when engaged in physical activity. Deci and Ryan (2002) contended that a central feature defining psychological needs within the approach taken in BPNT concerns the direct relationship between satisfaction of competence, autonomy, and relatedness needs with greater well-being. Extrapolating from Deci and Ryan's contentions, it was hypothesized that stronger feelings of relatedness demonstrated by higher ROPAS scores would be positively associated with greater competence, autonomy, and well-being.

Methods

Study 2—Participants

The sample included 156 males ($M_{age} = 19.95$ years; $SD = 2.18$ years; range = 17–33 years; 91.70% White/Caucasian) and 343 females ($M_{age} = 20.16$ years; $SD = 2.68$ years; range = 17–38 years; 89.50% White/Caucasian) university students who did not receive course credit or financial incentives for participation. Twenty-three respondents did not provide their gender. BMI values ranged from 12.93 to 42.51 kg/m^2 (males $M_{BMI} = 24.44$ kg/m^2, $SD = 3.02$ kg/m^2; females $M_{BMI} = 23.15$ kg/m^2, $SD = 3.37$ kg/m^2). Self-reported physical activity behavior varied among the men ($M_{METS} = 77.43$; $SD = 54.28$) and the women ($M_{METS} = 59.28$; $SD = 52.79$).[1] No sedentary activity patterns (i.e., zero activity) were evident with most of the male (96.10%) and the female (91.80%) respondents indicating they had been physically active within the previous 6 months prior to data collection.

Instruments

Perceived psychological need satisfaction. The participants completed the 6-item ROPAS developed in study 1 to measure perceived relatedness to others experienced via participation in physical activity. Perceived competence was assessed with the 6-item subscale from the Intrinsic Motivation Inventory (IMI-PC; sample item: "I think I am pretty good at physical activity," McAuley, Duncan, & Tammen, 1989). Perceived autonomy was assessed with the seven items modified from the autonomy subscale of the Basic Psychological Needs in Life Scale (BPNLS-A; sample item: "I feel like I can pretty much be myself," Gagné, 2003). The participants responded to both the IMI-PC and BPNLS-A items using a 7-point Likert scale with verbal anchors affixed to 1 (not at all true), 4 (somewhat true), and 7 (very true). The ROPAS, IMI-PC, and BPNSL-A items were preceded by the instructional stem used with the ROPAS reported previously in study 1.

Well-being. The participants completed items from five instruments designed to measure multiple facets of well-being that are commonplace in SDT research (Wilson & Rodgers, 2007). The Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) and the Global Self-Esteem subscale of the Physical Self-Description Questionnaire (PSDQ-GSE; Marsh, Richards, Johnson, Roche, & Tremayne, 1994) were included alongside the short form of the Positive Affect Negative Affect Schedule (PANAS; Mackinnon et al., 1999) and the Physical Self-Worth subscale of the PSDQ (PSDQ-PSW; Marsh et al.). The instruments were selected to assess well-being based on two criteria: previous use in SDT-based research examining links between competence, autonomy, and relatedness with markers of well-being (Deci & Ryan, 2002; Wilson & Rodgers) and inclusivity of domain-free or "global" well-being markers (PSDQ-GSE and SVS) along with context-specific indices of well-being (PANAS and PSDQ-PSW; see Fox & Wilson, 2008, for a review).

Data Collection Procedures and Data Analyses

Data collection procedures were identical to those outlined in study 1. Data analyses proceeded in sequential order. First, data were screened for outliers and conformity with relevant statistical assumptions. Second, missing data were replaced using the EMA procedures described in study 1. Third, internal consistency reliability (Cronbach, 1951) estimates were calculated followed by creation of subscale scores using the average score for the items constituting each subscale (Morris, 1979). Fourth, bivariate correlations were calculated to examine patterns of convergence/divergence between indices of psychological need satisfaction experienced when physically active and markers of well-being. Finally, multiple regression analyses using simultaneous variable entry was used to examine the contributions of perceived relatedness to indices of well-being taking into account the contributions of perceived autonomy and competence derived from engaging in physical activity.

Results

Preliminary Analyses

No out-of-range values were evident in participant responses and limited evidence of missing data was noted with no more than 11.40% of the data missing on any given item. No systematic pattern of nonresponse was noted in the data, and all missing values were replaced using an EMA that generated estimated values from the data provided by the sample used in study 2. Internal consistency reliability values ranged from 0.70 to 0.97 (see Table 4). Pearson correlations indicated several patterns of relationships at the bivariate level (see Table 4). Notably, perceived relatedness was positively correlated with both competence and less so with autonomy experienced in physical activity contexts. Greater fulfillment of each psychological need within physical activity was associated with lower levels of negative affect and correspondingly higher levels of positive affect, subjective vitality, physical self-worth, and global self-esteem, although the magnitude of these relationships varied considerably (see Table 4).

Main Analyses

Five multiple regression models were specified in which perceived competence, autonomy, and relatedness experienced in physical activity served as the predictor variables entered simultaneously in each equation, while indices of well-being served as the criterion variable. Scatter plots of the standardized residuals suggested linearity and homoscedasticity were tenable assumptions in each regression model. Variance inflation factor (range = 1.21–1.47) and tolerance (range = .68–.83) values indicated collinearity may be evident in the sample data. Further inspection of the variance proportion values (VPVs range = .00–.76) when the condition index exceeded 10.00 revealed that no pair of VPVs exceeded the 0.50 criterion suggested by Pedhazur (1997) to denote concerns with collinearity. Summary findings from each regression model tested are presented in Table 5. Perceived relatedness as measured by the ROPAS accounted for variance in each well-being criteria despite the contributions of perceived autonomy and competence. Interestingly, relatedness was the dominant contributor in the model predicting positive affect and the weakest contributor in the model predicting negative affect. Collectively, small-to-modest amount of variance (see Table 5) in the well-being criterion variables were accounted for in the regression models, which corresponds to effect sizes ranging from 0.11 to 0.82 in the present study.

Summary of Study 2

The main aim of study 2 was to extend the construct validity evidence for ROPAS scores by examining a nomological network of associations with indices of global and context-specific well-being. A secondary purpose was to examine patterns of association with indices of perceived competence and autonomy experienced within physical activity settings. The results of study 2 indicate that greater relatedness as measured by higher ROPAS scores was associated with higher overall well-being and lower ill-being in the form of negative affect. Perceived relatedness assessed with the ROPAS was positively linked with perceived competence, and autonomy experienced when physically active is in line

Table 4

Reliability Estimates, Descriptive Statistics, and Bivariate Correlations for Study 2

Variables	*M*	*SD*	Skew	Kurt	α	1.	2.	3.	4.	5.	6.	7.	8.
Relatedness	4.90	0.81	–1.03	2.10	0.94	—							
Competence	5.64	1.15	–1.30	1.87	0.90	0.49	—						
Autonomy	5.61	0.79	–0.65	0.48	0.75	0.28	0.40	—					
Vitality	5.12	1.01	–0.47	0.40	0.88	0.42	0.48	0.28	—				
Self-esteem	5.29	0.58	–1.55	3.38	0.87	0.43	0.39	0.39	0.47	—			
Positive affect	4.03	0.61	–1.18	2.66	0.80	0.51	0.55	0.30	0.57	0.42	—		
Negative AFFECT	1.54	0.52	1.38	2.34	0.70	–0.14	–0.19	–0.31	–0.19	–0.25	–0.11	—	
Physical self-worth	4.46	1.08	–1.04	1.16	0.97	0.45	0.60	0.38	0.57	0.59	0.55	–0.23	—

Note. *M* = mean; *SD* = standard deviation; Skew = univariate skewness; Kurt = univariate kurtosis. α = Cronbach's (1951) coefficient alpha estimate of internal consistency reliability. Pearson correlations are shown in the lower diagonal of the matrix for the total sample. Sample size is consistent across each element in the lower diagonal of the matrix ($n = 522$). All *r* reported in the lower diagonal of the matrix were statistically significant at $p < .01$ (two-tailed significance) in this sample.

Table 5

Simultaneous Multiple Regression Analysis Predicting Well-Being Indices in Study 2

	Physical self-worth (adj. $R^2 = .45$)			Self-esteem (adj. $R^2 = .32$)			Subjective vitality (adj. $R^2 = .31$)			Positive affect (adj. $R^2 = .43$)			Negative affect (adj. $R^2 = .09$)		
Predictor variables	β	t	r_s	β	t	r_s	β	t	r_s	β	t	r_s	β	t	r_s
Competence	0.46	11.43	0.93	0.16	3.59	0.74	0.36	8.09	0.92	0.33	7.95	0.85	–0.07	–1.46	–0.61
Autonomy	0.13	3.71	0.58	0.32	7.80	0.79	0.10	2.38	0.55	0.09	2.41	0.51	–0.27	–5.78	–0.97
Relatedness	0.23	6.11	0.74	0.27	6.33	0.75	0.23	5.38	0.78	0.38	9.70	0.87	–0.03	–0.52	–0.43

Note. β = Standardized beta coefficients. $t = t$ values for each standardized beta coefficient. r_s = Structure coefficients (Courville & Thompson, 2001). The multiple R values used in the computation of r_s values were as follows: $R_{Subjective\ vitality} = .556$; $R_{\text{Self-esteem}} = .572$; $R_{\text{Positive affect}} = .658$; $R_{\text{Negative affect}} = .314$; $R_{\text{Physical self-worth}} = .671$, respectively. The F statistics from the ANOVA for each of the five regression models shown earlier were as follows: $F_{\text{physical self-worth}}$ (3,510) = 139.54, $p < .01$); $F_{\text{self-esteem}}$ (3,494) = 80.09, $p < .01$); $F_{\text{subjective vitality}}$ (3,510) = 139.54, $p < .01$); $F_{\text{positive affect}}$ (3,505) = 128.39, $p < .01$); and $F_{\text{negative affect}}$ (3,503) = 18.39, $p < .01$). Degrees of freedom varied across regression models because of the removal of outliers (standardized results exceeding |3.00|) per regression model. The t values associated with each standardized regression coefficients ranged from –5.78 to 11.43 across regression models ($p < .05$ in all models for each t value). Specific f^2 values per criterion variable examined in study 2 ranged from small to large including the following values: PSDQ-PSW $f^2 = .82$; PSDQ-GSE $f^2 = .45$; SVS $f^2 = .49$; PANAS-Positive Affect $f^2 = .76$; PANAS-Negative Affect $f^2 = .11$, respectively.

with Deci and Ryan's (2002) contentions that fulfillment of the basic psychological needs central to BPNT work in a synergistic not antagonistic fashion.

General Discussion

The purpose of this study was to examine select aspects of construct validity associated with scores derived from the newly formed ROPAS. Observations from two studies revealed that the ROPAS displays several properties that render the instrument useful for understanding the functional role afforded perceived relatedness within physical activity settings. Observations from study 1 provided evidence supporting the structural validity and reliability of ROPAS scores that do not appear unduly affected by participant gender. Further evidence for the convergent/divergent and criterion validity of ROPAS scores is evident in study 2 with positive associations noted between perceived relatedness measured by the ROPAS and markers of perceived competence, autonomy, in conjunction with a range of well-being indices that is consistent with the nomological network (Cronbach & Meehl, 1955) set forth by Deci and Ryan (2002) within BPNT. In brief, this investigation provides initial evidence supporting the viability of the ROPAS as an instrument to measure perceived relatedness experienced in physical activity that can be used with both male and females to test propositions set forth in BPNT.

Within-Network Evidence of Construct Validity for the ROPAS

Marsh (1997) contended that within-network evidence informing appraisals of construct validity represents "a logical prerequisite" (p. 28) for instruments prior to testing questions imbued with more theoretical and pragmatic appeal. Observations from studies 1 and 2 offer initial evidence of structural validity, invariance across gender, and internal consistency reliability that support the internal structure of ROPAS scores. The structural validity and reliability evidence suggest that ROPAS scores form a congeneric test whereby each item measures a single underlying construct (Anderson & Gerbing, 1988). Congeneric tests are useful insofar as they reduce ambiguity when interpreting the focal construct being measured that can mask (or distort) relationships with other variables outlined by relevant theory (Anderson & Gerbing). It is encouraging at this stage of the instrument development process to note that ROPAS scores appear invariant across gender. Demonstration of invariance does not preclude the possibility that different factors contrive to enhance (or diminish) perceived relatedness in men and women separately. On the contrary, the present findings imply the ROPAS items were interpreted uniformly across gender, which renders greater confidence in using this instrument to test assertions regarding the role of perceived relatedness in men and women using the BPNT as a framework for interpretation. In brief, Deci and Ryan (2002) implied that authentic fulfillment of psychological needs (including relatedness) should have a direct impact on well-being that is not moderated across subgroups including gender. Items measuring perceived relatedness (or autonomy and competence) that do not demonstrate invariance make it difficult to test this theoretical issue with confidence that the results are not contaminated by differential item interpretation across the subgroups under study.

One notable concern arising from the within-network approach taken in study 1 is the removal of 10 original ROPAS items from the final instrument. While an item reduction approach is not uncommon within the physical activity literature when developing instruments using BPNT (e.g., Vlachopoulus & Michailidou, 2006 discarded 61.29% of their original items), such an approach calls into question two aspects of content validity that remain integral to measuring psychological constructs (Messick, 1995). First, it is conceivable that the content expressed by the discarded ROPAS items was redundant to those items that were ultimately retained. Redundant items can artificially inflate reliability estimates without contributing meaningful information to construct assessment because of increased scale length therefore warrant removal (Crocker & Algina, 1986). Second, the degree to which the six retained ROPAS items represent the full conceptual bandwidth defining perceived relatedness within BPNT (Deci & Ryan, 2002) remains partially unresolved. It is tempting (albeit plausible) to interpret support for Deci and Ryan's contentions in study 2 regarding the interplay between perceived relatedness and well-being markers as indirect evidence supporting the item content represented by the ROPAS. Closer inspection of the item content for the 6-item ROPAS suggests consistency between this instrument and the conceptual boundaries that define relatedness set forth by Deci and Ryan, which include connections with others (sample item: "I have developed a close bond with others") along with broader social assimilation (sample ROPAS item: "I fit in well with others"). Given the importance of domain clarity (Messick) to advances in measurement, it is recommended that both content validity issues be examined directly using analytical methods designed to test relevance and representation of item content (see Dunn, Bouffard, & Rogers, 1999 for further details).[4]

Between-Network Evidence of Construct Validity for the ROPAS

Marsh (1997) argued that between-network sources of construct validity evidence can be informative when appraising the utility of instruments measuring psychological constructs such as the ROPAS. Central to the development of BPNT has been the notion that one defining feature characterizing psychological needs within the approach taken by Deci and Ryan (2002) concerns the direct relationship that satisfying competence, autonomy, and relatedness has with enhanced well-being. Evidence from study 2 provided initial support for the hypothesis that perceived relatedness as measured by the 6-item ROPAS is positively linked with greater contextual and domain-free markers of well-being. Further evidence supporting the positive association between ROPAS scores and indices of perceived competence measured with the IMI-PC and perceived autonomy measured with items modified from the BPNLS-A subscales is also consistent with Deci and Ryan's assertions regarding the functional interplay the psychological needs constituting BPNT. In brief, it seems reasonable to contend on the basis of study 2 that scores from the ROPAS are linked with both well-being and other psychological needs in a manner consistent with the theory underlying the instrument's development. Marsh argued that theory and measurement are intertwined such that observations noted in study 2 imply that the ROPAS holds promise as an instrument for measuring perceived relatedness within the framework of BPNT.

One important observation noted within the regression models tested in study 2 concerned the contribution of perceived relatedness measured via the ROPAS to predicting variance in well-being markers beyond the contributions of perceived competence and autonomy. Previous studies have offered either no support for the predictive role of this psychological need in relationship to variability in well-being over time in exercisers (Edmunds et al., 2007, 2008) or limited support in relation to positive affect but not physical self-worth in adult dragon boat participants (McDonough & Crocker, 2007). Such inconsistent findings with regard to the functional role of perceived relatedness within physical activity settings were noted by McDonough and Crocker, who speculated that variability in the instrumentation used to measure relatedness across studies may be partly responsible for these observations. Deci and Ryan (2002) had been clear in asserting that from the standpoint of BPNT, the fulfillment of "each" psychological need when satisfied authentically promotes well-being. Combining this theory-based argument with the observations noted by McDonough and Crocker, it seems reasonable to suggest that the ROPAS holds the potential to make a useful contribution to the ongoing debate regarding the role of perceived relatedness in the broad spectrum of behaviors that constitute physical activity participation.

Study Limitations and Future Directions

While the results of this study are novel and advance the literature in terms of assessing perceived relatedness, a number of limitations warrant consideration when interpreting the findings of this investigation. First, this study used nonprobability-based sampling that relied exclusively on self-report assessments. Future studies would do well to consider more sophisticated sampling strategies to enhance the external validity of the data in conjunction with assessment of variables amenable to measurement using more diverse methods than self-report.

One fruitful avenue to explore would be assessing well-being (or ill-being) using biological markers (e.g., Interleukin-6) to omit common methods variance as a limiting factor in terms of advancing our understanding of the link between perceived relatedness and well-being. Second, the range of psychometric issues tested in the present study was confined to select aspects of within- and between-network construct validation. Since the process of construct validation is an ongoing venture (Messick, 1995), future studies should extend the findings reported herein by testing the invariance of ROPAS scores across other subgroups of interest (e.g., age, ethnicity) and examining hypothesized links between relatedness measured with the ROPAS and indices of motivation that span the full gamut of internalizations proposed by Deci and Ryan (2002) within SDT.

In summary, this study tested aspects of construct validity pertaining to the interpretation of scores derived from the ROPAS, a new instrument designed to measure perceived relatedness experienced in physical activity settings in line with BPNT (Deci & Ryan, 2002). The findings reported in this study offer initial evidence for the structural validity of ROPAS scores, which do not appear unduly influenced by diverse interpretations of ROPAS items across gender and produce scores that contain, at best, limited error variance. Additional evidence suggests that perceived relatedness measured with the ROPAS is linked with indices of perceived competence and autonomy in a manner consistent with Deci and Ryan's assertions and predicted variance in global and contextualized well-being markers in line with broader arguments central to BPNT (Deci & Ryan). The unique contribution of this study is the creation of a new and potentially useful instrument (the ROPAS) that could be useful in studies designed to investigate the role of perceived relatedness in physical activity contexts where issues of social connectedness (and isolation) remain ripe for further inquiry in relation to physical activity behavior.

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