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Perceived Variety, Psychological Needs Satisfaction, and Exercise-Related Well-Being

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Abstract

Objective: Perceived variety represents a psychosocial experience that gives rise to, and supports the maintenance of, an individual's well-being. In this study, we developed an instrument to measure *perceived variety in exercise*, and examined whether ratings of perceived variety in exercise predict unique variance in indices of exercise-related well-being in addition to that explained by the three basic psychological needs (for competence, relatedness, and autonomy) embedded within self-determination theory (Deci & Ryan, 2002). We also examined the extent to which variance in perceived variety is empirically distinct from (or subsumed by), competence, relatedness, and autonomy in the context of exercise.

Methods: A convenience sample of community adults (N = 507) completed online surveys twice over a six-week period (n = 367).

Results: Perceived variety in exercise was found to prospectively predict unique variance in indices of exercise-related well-being, in addition to that explained by psychological needs for competence, relatedness, and autonomy. Using exploratory and confirmatory factor analytic procedures, perceived variety was found to be empirically distinct from perceived competence, relatedness, and autonomy.

Conclusion: Results from this work suggest that perceived variety holds potential for theoretical and applied advancements in understanding and predicting well-being in exercise settings.

Key words: basic psychological needs theory, variety, physical activity, well-being

Perceived Variety, Psychological Needs Satisfaction, and Exercise-Related Well-Being

Across multiple life domains the experience of *well-being* has been consistently found to result in a range of positive and adaptive responses among adults such as more fulfilling relationships, improvements in work success (Lyubomirsky, King, & Diener, 2005), as well as leading longer, healthier lives (Diener & Chan, 2011). Accordingly, it is not surprising that over the past two decades researchers have increasingly sought to better understand psychological factors that are necessary to develop and sustain well-being (Deci & Ryan, 2002). Well-being is characterized by the presence of positive feelings, the absence of negative feelings, and realizing human potentials to be fully functioning (Ryan & Deci, 2001).

One psychosocial experience that has garnered recent attention in the psychological well-being literature is the perception of *variety* (Sheldon, Boehm, & Lyubomirsky, 2012; Sheldon & Lyubomirsky, 2012). Variety refers to the pursuit and experience of diverse activities, behaviors, and opportunities in one's social milieu (cf. Kahn & Ratner, 2005; Sheldon & Lyubomirsky, 2012). While researchers have built support for the prevalence and value of varying one's experiences using various variety-like constructs (e.g., sensation-seeking and experiencing-seeking; Zuckerman, 1994), such constructs refer to personality traits in which one seeks complex, intense, and unconventional experiences in addition to experiences that are varied and novel. In the current study, experiencing variety was conceptualized as a psychological experience that included novel and/or alternating familiar experiences, which could also be simple, mundane, and conventional. Novel experiences stimulate interest (e.g., Silvia, 2006) and transiently support persistent behaviour, while alternating among familiar experiences reinforces learning and development (Hebb, 1949; also see McAlister and Pessemier's (1982), review on intrapersonal motives for varied behavior). For the sake of conceptual clarity it is important to distinguish between the *psychological experience* of variety (i.e., felt variety), and the provisions that allow variety to happen (i.e., variety support). The former corresponds to a person's *perception* of whether he or

she has experienced (or currently experiences) variety; whereas the latter corresponds to the range of opportunities that are (objectively) provided in a given social setting. It is the former — *experience of variety*— that forms the basis of enquiry in this paper.

Based on evidence that varied experiences are innately stimulating and rewarding (Berlyne, 1970; Pronin & Jacobs, 2008), researchers have examined perceptions of variety and found them to be instrumental in maintaining positive emotions derived from an activity through a *direct* relationship to well-being (Sheldon et al., 2012; Sheldon & Lyubomirsky, 2012). In their recent paper, Sheldon and colleagues (2012) suggested that through varied experiences well-being is bolstered by virtue of *prolonging the positive emotions* derived from an activity. In support of this contention, Sheldon et al. (2012, Study 2) found that participants who varied their experiences in an activity (i.e., providing varied acts of kindness to others via an experimental manipulation), were able to continue to experience well-being in that activity over time, whereas participants who did the same activity (i.e., routine/similar acts of kindness) in the same way each time, adapted to the positive effect and ceased to derive a boost in well-being from the activity. Although Sheldon et al.'s study specifically concerned acts of kindness, it is noteworthy that the experience of variety appears to be implicated as an antecedent of the experience of well-being.

One context which holds particular potential for developing well-being is through exercise (Biddle & Ekkekakis, 2005). Exercise refers to a subgroup of leisure behavior characterized by repeated bodily movements in planned and structured physical activity with the goal of maintaining or improving physical fitness (Bouchard, Blair, & Haskell, 2007). There is general consensus that participation in exercise is linked with higher levels of well-being (e.g., Netz, Wu, Becker, & Tenenbaum, 2005; Penedo & Dahn, 2005). Experiencing variety may be particularly salient in exercise contexts as the provision of variety has been found to be related to increased enjoyment of exercise (Dimmock, Jackson, Podlong & Magaraggia, 2013; Glaros & Janelle, 2001; Juvancic-Heltzel, Glickman, & Barkley, 2013). For example, Dimmock et al. (2013) found that participants

who received messages that emphasized the variety of experiences they could expect in the two halves of their upcoming exercise session (i.e., providing support for variety), reported higher ratings of enjoyment of the exercise session and greater interest and perceived internal locus of causality in repeating the exercise session compared to participants who received messages emphasizing that they could expect to have the same experience in both halves (i.e., absence of variety). It is noteworthy, however, that people in both conditions participated in the same (i.e., non-autonomous) exercise protocol, suggesting that the perception of variety may be particularly important for well-being in exercise.

In their review on variety-seeking behavior (i.e., the pursuit of varied experiences), Kahn and Ratner (2005) called for researchers to make use of psychological theory to measure the impact of variety-seeking behavior in relation to a range of outcomes (such as well-being). One theory that provides insight into the development and maintenance of well-being through psychosocial experiences is self-determination theory (SDT; Deci & Ryan, 1985, 2002). SDT is an organismic dialectic meta-theory of human motivation and personality that considers humans to have a natural, innate tendency for growth and development (Deci & Ryan, 1985). This natural propensity is supported (or undermined) by the extent to which social contexts provide support for three basic and universal psychological needs (cf. Vansteenkiste & Ryan, 2013). Indeed, Deci and Ryan (1985, 2000) posit that psychological growth, well-being, and optimal functioning are promoted and fostered by social contexts that satisfy needs for competence, relatedness, and autonomy. Conversely, social-environmental settings that thwart these essential nutriments to well-being and development, frustrate basic need satisfaction and are linked to experiences of ill-being, malfunctioning, and constricted functioning (Vansteenkiste & Ryan, 2013).

The concept and phenomena of basic psychological needs are explicitly addressed within basic psychological needs theory (BPNT), which is a mini-theory within the broader SDT framework. Within BPNT, Deci and Ryan (2002) propose that there are (at least) three basic

psychological needs (for competence, relatedness, and autonomy) and the degree to which each need is subjectively satisfied provides a basis for categorizing aspects of an experience as positive or negative in relation to one's psychological well-being, integrity, and growth. Competence refers to an individual's perception of their capability to effectively deal with challenges in their social environment (Deci & Ryan, 2002; White, 1959). Relatedness refers to positive interactions with others, and feelings of connectedness by caring for and being cared for by other people (Baumeister & Leary, 1995; Deci & Ryan, 2002). Finally, autonomy refers to feelings of self-governance, and feeling as though one is the causal agent of their own decisions and actions (deCharms, 1968; Deci & Ryan, 2002). The key principles that define the psychological needs within BPNT are that they are organismic necessities that apply to all people, are not derivatives of other psychological needs, and have fundamental and direct relations to wellness and health (Deci & Ryan, 2002; Standage & Ryan, 2012).

Understanding the role of basic psychological needs in exercise contexts in relation to well-being has been a longstanding focus of research in both exercise and health psychology (Fox & Wilson, 2008). Findings from previous studies in which researchers examined psychological needs in exercise contexts have generally been consistent with BPNT (Deci & Ryan, 2002) such that people who report feeling greater satisfaction of the need for competence, relatedness, and autonomy also report higher levels of well-being (i.e., small-to-moderate positive relationships; e.g., Edmunds, Ntoumanis, & Duda, 2007; Wilson, Mack, Gunnell, Oster, & Gregson, 2008).

Despite the strong theoretical foundation of the relationships between competence, relatedness, autonomy, and well-being, some scholars have highlighted the potential for other types of positive experiences to explain additional variation in well-being (Sheldon, 2011) and based on recent findings (e.g., Sheldon & Lyubomirsky, 2012), variety could be one such experience. Testing variety alongside the variables presented within BPNT appears warranted as the subjective perception of experiencing variety has also been found to have a *direct* effect on indices of

contextual well-being (Sheldon et al., 2012; Sheldon & Lyubomirsky, 2012). While we would expect that experiencing variety would be related to well-being at both *global* and *situational* levels (cf. Vallerand, 1997), we were specifically interested in examining the experience of variety in the context of exercise. In the current investigation, the contextual experience of variety was examined alongside (i.e., at the same level as) satisfaction of the needs for competence, relatedness, and autonomy because similar to the psychological needs, perceived variety in exercise is conceptualized as (a) a felt experience, (b) a predecessor of both intrinsic motivation (e.g., Dimmock et al., 2013) and well-being, (c) an indicator that helps categorize the extent to which an experience has a positive effect on well-being, and (d) having implications that extend beyond immediate psychological functioning (cf. Sheldon, 2011; Sheldon et al., 2012).

However, the variance in indices of well-being explained by variety may already be explained by satisfaction of the need for competence, relatedness, and autonomy, and perceived variety may have empirical overlap with (i.e., subsumed by) any or all of these psychological experiences. It seems prudent for researchers to investigate whether perceived variety explains unique variance in indices of well-being, in addition to that explained by competence, relatedness, and autonomy and subsequently, whether perceptions of variety are empirically *distinct from* perceptions of competence, relatedness, and autonomy. Despite conceptualizing variety at the same *level* as competence, relatedness, and autonomy, it was not our aim to test variety as a psychological need in the current investigation as we realize there are multiple considerations and criteria such as being *innate*, *universal*, and *necessary for well-being* (see Sheldon, 2011), that must be addressed prior to a construct being considered a psychological need.

The primary purpose of this study was to examine whether perceived variety in exercise predicts unique variance in exercise-related well-being over time, in addition to that explained by the three basic psychological needs embedded within BPNT (i.e., competence, relatedness, and autonomy). The secondary purpose was to examine whether perceived variety is empirically

distinct from perceptions of competence, relatedness, and autonomy in the context of exercise. In order to address the primary and secondary purposes of this study, and in the absence of an established questionnaire to assess perceived variety in exercise, we first sought to develop a measure of this psychological construct.

Methods

Participants

Participants (N = 507) were a community sample of adults (i.e., 18 to 83 years of age). Nine cases were deleted due to missing values (i.e., respondents who failed to provide information regarding perceived variety and satisfaction of the need for competence, relatedness, and autonomy in the context of exercise). The resulting sample was comprised of 329 females (M_{age} = 34.02 years; SD_{age} = 13.22 years) and 178 males (M_{age} = 33.61 years; SD_{age} = 13.30 years). The majority of participants lived in Canada (94.67 %), were single (51.20%), Caucasian (76.20%), had completed at least a college diploma or university degree (72.10%), had full or part-time employment (64.2%), had an annual household income less than $100,000 (74.70%) and on average, were classified as active at baseline ($M_{moderate\text{-}vigorous\ exercise}$ = 39.19 units; SD = 33.21; Godin Leisure-Time Exercise Questionnaire; Godin, 2011).

Procedure

Following institutional ethical approval, adults over the age of 18 years and able to read and converse in English were recruited online through postings (e.g., a blog) and in person at various events (e.g., recreational walks/runs and hiking areas) for this study. Using a prospective observational design, consenting participants completed the same online questionnaire (which included a battery of instruments and took approximately 15 minutes) at two time points, six weeks apart. In order to compensate participants for their time, all participants were entered into a draw to win one of six $50 gift certificates.

Measures

Perceived variety in exercise. We used a three-step process including item development, focus groups, and expert review to develop and refine items that assess perceptions of experiencing variety in exercise. First, we conducted an extensive literature review of research relating to perceptions of variety with a particular focus on the context of exercise. In their seminal paper on instrument development, Clark and Watson (1995) highlight that developing a precise and detailed conception of the target construct is a critical first step. We defined variety as the pursuit and experience of diverse activities, behaviors, and opportunities in one's social milieu (cf. Kahn & Ratner, 2005; Sheldon & Lyubomirsky, 2012). Using the conceptual framework provided by Kahn and Ratner (2005), Sheldon (2011), and Sheldon and Lyubomirsky (2012) and existing questionnaires measuring variety (e.g., Experience Seeking subscale; Zuckerman, 2007) a comprehensive list of items was generated and refined by the authors, resulting in a preliminary 8-item measure.

Consultation with members of the target population can provide important information regarding the *content* (Messick, 1995; Vogt, King, & King, 2004), and *substantive* aspects of validity (Messick, 1995). Content aspects of validity are concerned with content relevance and representativeness, whereas substantive aspects of validity are concerned with how respondents interpret and make sense of items, and how this might be affected by the structure of the questionnaire (Messick, 1995). Thus, in the second step, focus groups were conducted to further refine and pre-test the initial items and response options. In total, three focus groups were conducted, (N = 10; M_{age} = 31.3 years; SD = 14.37 years; 3 males, 7 females). A modified 'retrospective think-aloud' protocol (Oremus, Cosby, & Wolfson, 2005; Willis, 2005) was used in the focus groups in order to better understand how members of the target population interpret and respond to items. Specifically, participants in the focus groups were instructed to complete a copy of the initial measure independently and following this, a series of questions were used in order to prompt participants to discuss the preliminary measure (e.g., instructions, response format, and

wording of items). Questions included (a) "What, in your own words, does the question mean to you?" (b) "Did the answer choices include your answer?" (c) "Did you understand how to answer the questions?" and (d) "Did the questionnaire leave anything out you felt was important?" (Oremus et al., 2005; Willis, 2005). Conversations from the focus groups were transcribed by the first author to conduct a content analysis. We used a constant comparison approach (Strauss & Corbin, 1998) to identify and code sentences and phrases in which participants raised concern with one or more items. The analysis focused on problematic and alternative interpretations of items. This iterative process was repeated following each focus group and revisions were made to the questionnaire until no new suggestions emerged. As a result of the item trimming and instrument refinement process (to the original 8 items), one item was added, five items were reworked, and two items were eliminated, resulting in a 7-item instrument.

To ensure that the items were representative of the construct, the trimmed item-pool was subsequently reviewed in the third step by three individuals with expertise in instrument development and exercise psychology. This process resulted in modification to two of the items and omitting two more items due to redundancy. The final set of 5 items—hereafter referred to as the *Perceived Variety in Exercise* (PVE) questionnaire—had a Flesch-Kincaid (1948) readability score of 75.1, which corresponds to a reading level for those aged 10 and above (D'Alessandro, Kingsley, & Johnson-West, 2001). Items on the PVE questionnaire are anchored on the same 6-point Likert-type rating scale as that used with the Psychological Need Satisfaction in Exercise (PNSE; Wilson, Rogers, Rodgers, & Wild, 2006) questionnaire, with response options of 1 (*False*), 2 (*Mostly False*), 3 (*More False than True*), 4 (*More True than False*), 5 (*Mostly True*), and 6 (*True*; see Table 3 for specific items). Information on the structural properties (e.g., factorial validity) of data derived from the PVE questionnaire in the current study is presented in the results section (see Table 3 and Figure 1). Ordinal composite reliability (Zumbo, Gadermann, & Zeisser, 2007) for the variety scores used in the current study was .97.

Basic psychological needs satisfaction. Satisfaction of the psychological needs for competence, relatedness, and autonomy was measured using the PNSE (Wilson et al., 2006). This instrument includes 6 items that assess each of the three psychological needs (18 items in total). Exemplar items include "I feel that I am able to complete exercises that are personally challenging" (competence), "I feel connected to the people who I interact with while we exercise together" (relatedness), and "I feel free to make my own exercise program decisions" (autonomy). Reponses to each item were anchored by 1 (*False*) to 6 (*True*) with higher scores reflecting greater levels of perceived competence, relatedness, and autonomy in exercise. Wilson et al. (2006) reported evidence of structural and criterion validity for scores derived from each subscale of the PNSE. In the current study, ordinal composite reliability for scores from each subscale was .96 for competence, .96 for relatedness, and .95 for autonomy.

Exercise-Related Well-Being. Well-being was measured using two instruments, namely the Scale of Positive and Negative Experience (SPANE; Diener et al., 2010) as well as the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997). The SPANE is a 12-item instrument with six items assessing both positive and negative experiences, respectively. The word 'exercise' was added to the original SPANE instructions to refer to well-being in the context of exercise. Participants were asked, "Please think about what exercise you have been doing and experiencing during the past 4 weeks. Then report how much you experienced each of the following feelings, using the scale below." Items in the SPANE are anchored on a scale ranging from 1 (*Very Rarely or Never*) to 5 (V*ery Often or Always*). The positive and negative items are scored separately because of the partial independence of the two types of feelings (Diener & Emmons, 1985). Support for score reliability (e.g., α values of .87 for positive and .81 for negative feelings) and convergent validity (in relation to subjective happiness, satisfaction with life, and positive and negative affect) of measures derived from the SPANE were reported by Diener et al. (2010).

Ordinal composite score reliability in the current study was .91 for positive affect and .86 for negative affect.

The SVS (Ryan & Frederick, 1997) was used to assess the extent to which participants experience feelings of subjective vitality in exercise. Consistent with Bostic, Rubio, and Hood (2000) the instrument was comprised of six items. Following the instructions "Please respond to each of the following statements by indicating the degree to which the statement is true for you when you engage in exercise," participants were asked to rate each item on a 7-point Likert-type rating scale anchored by 1 (*Not at All True*) to 7 (*Very True*). A sample item used in this study was "I feel alive and vital." Researchers have found support for the internal consistency of scores derived from this instrument as an index of well-being in exercise contexts (Edmunds et al., 2007). The composite reliability estimate of scores from the SVS in this study was .93.

Data Analysis

First, relationships between perceived variety (along with competence, relatedness, and autonomy) at Time 1 were examined in relation to exercise-related positive affect, negative affect, and subjective vitality six weeks later (Time 2) through use of latent variable regression (LVR) analysis which is a specific type of confirmatory Structural Equation Model as it only includes latent variables. LVR allows for unique weighting of each item in the construction of unobserved (latent) variables (e.g., variety) from observed variables and simultaneously models the structural paths (i.e., relationships among latent variables) and measurement paths (i.e., relationships between a latent variable and its indicators). For this study, LVR analysis is preferable to techniques such as multiple regression analysis, because it is not based on the assumption that measurement of the variables is error-free and therefore we avoid potentially producing biased estimates (Muthén, 2002). Ratings of perceived variety, competence, relatedness, and autonomy in exercise were specified as separate independent latent predictors and each index of exercise-related well-being

(i.e., positive affect, negative affect, and subjective vitality) were examined simultaneously as latent dependent variables in a single LVR model.

This analysis was conducted using *M*plus (Version 6.11) software to account for the ordered categorical nature of the scores. We used weighted least squares mean and variance-adjusted (WLSMV) estimation with a polychoric correlation matrix as it is considered the best option for modeling with ordered categorical data (Beauducel & Herzberg, 2006; Muthén, 1993). Missing data were estimated based on all of the available data, using the WLSMV algorithm within *Mplus*. Geomin rotation (to produce an oblique solution; Tabachnick & Fidell, 2012) was selected based on findings from previous studies demonstrating small-to-moderate correlations between scores of the subscales measuring perceived competence, relatedness, and autonomy (Wilson et al., 2006). The χ^2 test was considered for the model, however a non-significant χ^2 statistic is considered unrealistic (Barrett, 2007) so supplementary fit indices were also examined.

To assess the model we compared the χ^2 goodness of fit indices, comparative fit indices (CFI), Tucker-Lewis indices (TLI), and the root mean square error of approximation (RMSEA) for each model. Criterion for evaluating good model-data fit were designated as CFI and TLI values > .90, and RMSEA values < .08, and excellent fit for CFI and TLI values > .95, and RMSEA values < .06 (Hu & Bentler, 1998, 1999).

In addition to fit indices, we examined the reliability of the scores and the quality of the individual items through composite reliability and average variance extracted. Composite reliability (CR) is an index of reliability in which scores from each item are individually weighted in the composite load (see Bollen, 1989). Ordinal composite reliability is based on the polychoric correlation matrix and was assessed to account for the Likert-type response formats used in the PNSE and PVE (Zumbo et al., 2007). We measured CR using the formula CR = $\sum$ (standardized (std.) loadings)^2 / $\sum$ (std. loadings)^2 + $\sum$ (1- std. loadings^2) (Fornell & Larcker, 1981). Finally, to measure the convergence among the items we calculated the average variance extracted (AVE). To

measure AVE we used the formula AVE = ∑ (std. loadings^2) / ∑ (std. loadings^2) + (1- std. loadings^2) (Fornell & Larcker, 1981). According to Hair, Black, Babin, and Anderson (2009) the factor loadings should be .50 or greater, the CR values should be .70 or greater, and Fornell and Larcker (1981) recommend that AVE values should exceed the squared correlation between that and any other construct.

To examine the relative importance of perceived variety in exercise (compared to the psychological needs) in predicting variance in indices of exercise-related well-being, a Relative Pratt Index (RPI; Thomas, Hughes & Zumbo, 1998) was calculated for each outcome variable, which partitions the explained variance into the relative proportion attributable to each independent variable. Zumbo (2007) introduced the RPI for LVR models. The RPI was computed in the following manner: the β weight is multiplied by the simple correlation then the sum is divided by the variance explained in the model (i.e., R^2). An index score less than 1/ (2 × number of predictor variables) classifies the variable as relatively unimportant (Thomas, 1992). The cut-off value was 0.13 (i.e., 13%) for the LVR analyses, indicating that any RPI value below this is considered unimportant (Thomas, 1992).

Second, to examine the extent to which perceived variety in exercise is empirically distinct from perceived competence, relatedness and autonomy in exercise, we conducted an exploratory factor analysis (EFA) using Time 1 data (N = 507). Models representing different factor structures were compared to determine the best fit for the data derived from the PNSE and PVE questionnaires. We examined our a priori four-factor model, expecting perceived variety to load onto one distinct factor and competence, relatedness, and autonomy to load onto their known factors (Wilson et al., 2006). We also compared the four-factor model to a one and three factor model to assess how variety fits alongside the known factors of competence, autonomy, and relatedness (Wilson et al., 2006). Psychological needs satisfaction has at times been operationalized as a single latent variable (e.g., Johnson & Finney, 2010) and so we compared the

four-factor model to a one factor model to examine whether empirically, these conceptualized variables were in fact measuring the same latent factor. A three factor model was examined to test the extent to which variety might be empirically synonymous (i.e., lacks discriminant validity) with one or more of the three psychological needs conceptualized within BPNT. Should empirical evidence suggest that perceived variety in exercise is highly correlated with, and undistinguishable from, one or more of the three psychological needs, then this would challenge the contention that perceived variety is a distinct construct from competence, relatedness, and autonomy in the context of exercise.

The EFA analysis was conducted on data derived from the PNSE and PVE using *M*plus (Version 6.11). We used weighted least squares mean and variance-adjusted (WLSMV) estimation with a polychoric correlation matrix (Beauducel & Herzberg, 2006; Muthén, 1993). Missing data were estimated based on all of the available data, using the WLSMV algorithm within *Mplus*. Geomin rotation (to produce an oblique solution; Tabachnick & Fidell, 2012) was selected based on the small-to-moderate correlations found between perceived competence, relatedness, autonomy, and variety in exercise. To determine which factor structure provided the best overall fit for the data, χ^2, CFI, TLI, and RMSEA fit indices were examined for each hypothesized model.

Finally, in order to verify the factor structure identified through the EFA, the four-factor measurement model (including perceived variety along with the three needs for competence, relatedness, and autonomy in exercise) was tested through a confirmatory factor analysis (CFA) on the data from Time 2 (n = 367). We used WLSMV method of estimation with a polychoric correlation matrix, whereby missing data were again estimated through the WLSMV algorithm. Model fit was assessed using the χ^2, CFI, TLI, and RMSEA fit indices.

Results

Relationships between Perceived Variety in Exercise (Along with Perceived Competence, Relatedness, and Autonomy) and Indices of Exercise-Related Well-Being

Overall, the LVR model had good fit (χ^2 (758) = 1746.98, $p < .001$, CFI = .974, TLI = .972, RMSEA = .060, 90% CI [.056-.063]) and standardized factor loadings ranged from .53 to .97. CR values were calculated for scores of independent and dependent variables and were found to be .97, .96, .96, and .95 for perceived variety, competence, relatedness, and autonomy, and .91, .86, and .93 for positive affect, negative affect and subjective vitality, respectively (Zumbo, et al., 2007)[1]. AVE values were also calculated and found to be .87, .79, .79, and .75, for perceived variety, competence, relatedness, and autonomy, and .64, .52, and .69 for positive affect, negative affect, and subjective vitality, respectively. Interfactor correlations between the latent variables are presented in Table 1.

Positive affect. Together, perceived variety, competence, relatedness, and autonomy in exercise explained 37.2% of the variance in exercise-related positive affect. Specifically, perceived variety ($\beta = .175$, $p < .01$), competence ($\beta = .265$, $p < .01$), relatedness ($\beta = .181$, $p < .01$), and autonomy ($\beta = .192$, $p < .01$) were found to be significant predictors of exercise-related positive affect. The RPI was calculated to determine relative variable importance. Of the 37.2% of variance accounted for by the model, variety, competence, relatedness, and autonomy accounted for 19.76%, 39.18%, 20.92%, and 20.65% respectively.

Negative affect. With regards to exercise-related negative affect, perceived variety in exercise and perceived competence, relatedness, and autonomy explained 13.5% of the variance. Specifically, autonomy ($\beta = -0.236$, $p < .001$) was found to be the only statistically significant predictor of negative affect. None of the other variables predicted significant variance to the overall model for exercise-related negative affect. Of the 13.5% of variance accounted for by the model, autonomy accounted for 55.94 %.

Subjective vitality. Finally, perceived variety, competence, relatedness, and autonomy in exercise explained 33.1% of the variance in exercise-related subjective vitality. Specifically, perceived variety ($\beta = .208$, $p < .001$), competence ($\beta = .240$, $p < .01$), relatedness ($\beta = .174$, $p <$

.01), and autonomy ($\beta = .143$, $p < .01$) were found to be significant predictors of exercise-related subjective vitality. The RPIs were calculated and of the 33.1% of variance accounted for by the model, variety accounted for 27.02%, competence accounted for 37.70%, relatedness accounted for 21.55%, and autonomy accounted for 14.69%.

Exploratory Factor Analysis

Using the criteria provided by Hu and Bentler (1998, 1999) to compare the models, we found the four-factor model to be superior to the unidimentional and three-factor models (see Table 2 for the fit statistics). In addition to the model fit indices, the interfactor correlations were small-to-moderate which suggests these factors are empirically distinct from each other. The four-factor model was interpretable because factors one through four were comprised of the items measuring feelings of competence, relatedness, autonomy, and variety, respectively (Gorsuch, 1983). Using Thurstone's principle for identifying meaningful cross-loadings of items onto factors (i.e., a pattern coefficient of |0.30| to serve as the lower bound of item meaningfulness per factor; Thurstone, 1947), in the four factor model we found that none of the perceived variety in exercise items loaded onto the subscales of competence, relatedness, or autonomy (see Table 3 for communality estimates, and Geomin rotated pattern coefficients of the four-factor solution). When taken together, the results of the EFA provide preliminary support for the contention that perceived variety in exercise is empirically distinct from but related to the basic psychological need variables in the context of exercise, as evidenced by small to moderate correlations between the perceived variety latent factor and the three latent factors representing the basic psychological needs. In sum, empirical support was found for a four-factor measurement model.

Confirmatory Factor Analysis

The four-factor measurement model based on Time 2 data, included factors representing perceived competence, relatedness, autonomy, and variety. The fit indices for this four-factor measurement model were as follows: χ^2 (224) = 859.72, $p < .01$, CFI = .986, TLI = .984, and

RMSEA = .088, 90% CI [.08, .09]. In addition, the conditions for convergent validity were met (i.e., all factor loadings were significant and ranged from .74 to .98; see Figure 1), CR values for perceived variety, competence, relatedness, and autonomy in the context of exercise were .98, .97, .96, and .97 while AVE values were .90, .83, .83, and .82 respectively. Since the four constructs were not highly correlated, (i.e., $0.17 < r < .46$; avoiding multicollinearity issues; see interfactor correlations in Figure 1), these findings complement the fit indices of the model and the reliability estimates to provide multiple sources of evidence that perceived variety in exercise is a distinct construct from perceived competence, relatedness, and autonomy in exercise.

Discussion

In the present study we (a) developed an instrument to measure perceived variety in exercise, (b) examined whether ratings of perceived variety in exercise (compared to competence, relatedness, and autonomy in exercise) prospectively predicted unique variance in indices of exercise-related well-being over time, (c) examined the extent to which perceived variety in exercise was empirically distinct from the established basic psychological needs for competence, relatedness, and autonomy in the context of exercise, and (d) tested a four-factor measurement model. The current findings are consistent with Sheldon and Lyubomirsky's (2012) conclusions that perceptions of variety directly predict indices of well-being. We extended their work by demonstrating that in the context of exercise, perceived variety complements the three psychological needs incorporated within BPNT in the prediction of exercise-related well-being. Furthermore, we found that perceived variety in exercise is empirically distinct from (i.e., not subsumed by) perceived competence, relatedness, and autonomy in the context of exercise.

Conceptualized within BPNT, Deci and Ryan (2002) contend that satisfaction of the needs for competence, relatedness, and autonomy is associated with higher scores of well-being. Results from the present investigation are consistent with BPNT (Deci & Ryan, 2002) and offer the construct of perceived variety in exercise as a potential complementary psychological experience

that explains an important amount of variance (as evidenced by the Pratt indices) in exercise-related positive affect and subjective vitality. Based on the Pratt indices, perceived variety in exercise was found to predict a relatively equal amount of variance to that of relatedness and autonomy in predicting exercise-related positive affect, and explained a greater relative amount of variance than relatedness and autonomy in predicting scores of exercise-related subjective vitality. However, the Pratt indices also indicated that perceived variety in exercise accounted for less relative variance in exercise-related positive affect and subjective vitality than perceived competence. Although the experience of variety in exercise was found to be related to both exercise-related positive affect and subjective vitality, it was unrelated to exercise-related negative affect (see Diener & Emmons, 1985). Therefore, perceived variety in exercise may be more related to the promotion of exercise-related well-being than buffering against the experience of negative affect.

In addition to our predictive analyses, we examined and found support for perceived variety in exercise as a unique factor separate from the three basic psychological needs conceptualized within BPNT. From a discriminant validity perspective, the results demonstrated that perceived variety in exercise was positively related yet empirically distinct from perceived competence, relatedness and autonomy in the context of exercise. From the perspective of SDT, this finding was not surprising as the experience of different behaviors and activities (i.e., manifested as felt variety) is conceptually distinct from feeling effective (i.e., competent), connected to others (i.e., relatedness) and volitional/self-governed (i.e., autonomous). The present findings support the notion that perceived variety in exercise is worthy of additional research attention as it appears to be a psychosocial variable that provides additional explanatory power to the satisfaction of competence, relatedness, and autonomy in the prediction of exercise-related well-being indices.

Balanced against the potential contributions of the present study, we recognize that limitations should also be noted. First, although a prospective observational design was utilized to examine the relations between perceived variety in exercise (and perceived competence, relatedness, and

autonomy) and indices of exercise-related well-being over time, the non-experimental nature of the design used in this study still precludes any inferences of causality. Experimental designs will be necessary in future research to examine the extent to which *changes (and frustration) in the experience of variety in exercise* relates to changes in exercise-related well-being (and ill-being) outcomes. A second limitation of the study corresponds to the *contextual* level through which we operationalized assessments of perceived variety. Specifically, in this study we were interested in how varied experiences with regard to exercise are prospectively related to subsequent experiences of exercise-related well-being. Regardless, we are acutely aware that both basic psychological needs and the experience of well-being operate and exist at both *episodic/situational* and *global* levels, as well as at the contextual level (e.g., Diener & Emmons, 1985; Vallerand, 1997). Specifically, although we would certainly expect that experiencing variety in the context of exercise would be related to various adaptive outcomes, the results of the study do not provide insight into the *acute effects* of perceived variety on the immediate/episodic experience of well-being, or any *global effects* of experiencing variety within life in general. Future investigations are required that test the effects of perceived variety at these different levels. A final limitation corresponds to the use of the same sample to verify the factor structure (albeit at different time points) and results should be interpreted with caution.

In spite of these limitations, the results of this study provide conceptual foundations and preliminary evidence for the construct validity of scores derived from the PVE in a sample of adults. Based on the present findings, we suggest that researchers start examining the determinants of the perception of experienced/felt variety in exercise to understand how to foster this potentially adaptive psychological construct. Research in this area provides exciting opportunities to test the external validity of experiencing variety in relation to well-being across other contexts (e.g., variety with regard to dietary behaviors, work/employment opportunities, and interpersonal relationships)

and to further examine whether understanding feelings of variety may complement the constructs embedded within SDT.

Footnotes

[1] In addition to the LVR model specified, at the recommendation of an anonymous reviewer we also tested a possible curvilinear relationship between perceived variety in exercise and each index of exercise-related well-being. Using maximum likelihood parameter estimates we constructed latent variables and examined the curvilinear relationships within a SEM. Perceived variety in exercise was not found to have a statistically significant curvilinear relationship with either positive affect (p = .959), negative affect (p = .138), or subjective vitality (p = .319).

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Table 1. Interfactor correlations

Variable	1	2	3	4	5	6	7
1. Variety-T1	--						
2. Competence-T1	.55*	--					
3. Relatedness-T1	.34*	.53*	--				
4. Autonomy- T1	.17*	.47*	.26*	--			
5. Positive Affect-T2	.42*	.55*	.43*	.40*	--		
6. Negative Affect-T2	-.19*	-.29*	-.23*	-.32*	-.53*	--	
7. Subjective Vitality-T2	.43*	.52*	.41*	.34*	.82*	-.49*	--

Note. T1 = Time 1; T2 = Time 2; * = $p < .01$.

Table 2. Results of EFA model testing

	Exploratory Factor Solution		
Fit indices	1 Factor	3 Factor	4 Factor
χ^2 (df)	7638.97 (230)	2612.65 (187)	1155.73 (167)
P value	< .01	< .01	< .01
Tucker-Lewis Index (TLI)	0.841	0.936	0.971
Comparative Fit Index (CFI)	0.855	0.953	0.981
Root mean square error of approximation (RMSEA) [90% CI]	0.252 [.25, .26]	0.160 [.16, .17]	0.108 [.10, .11]

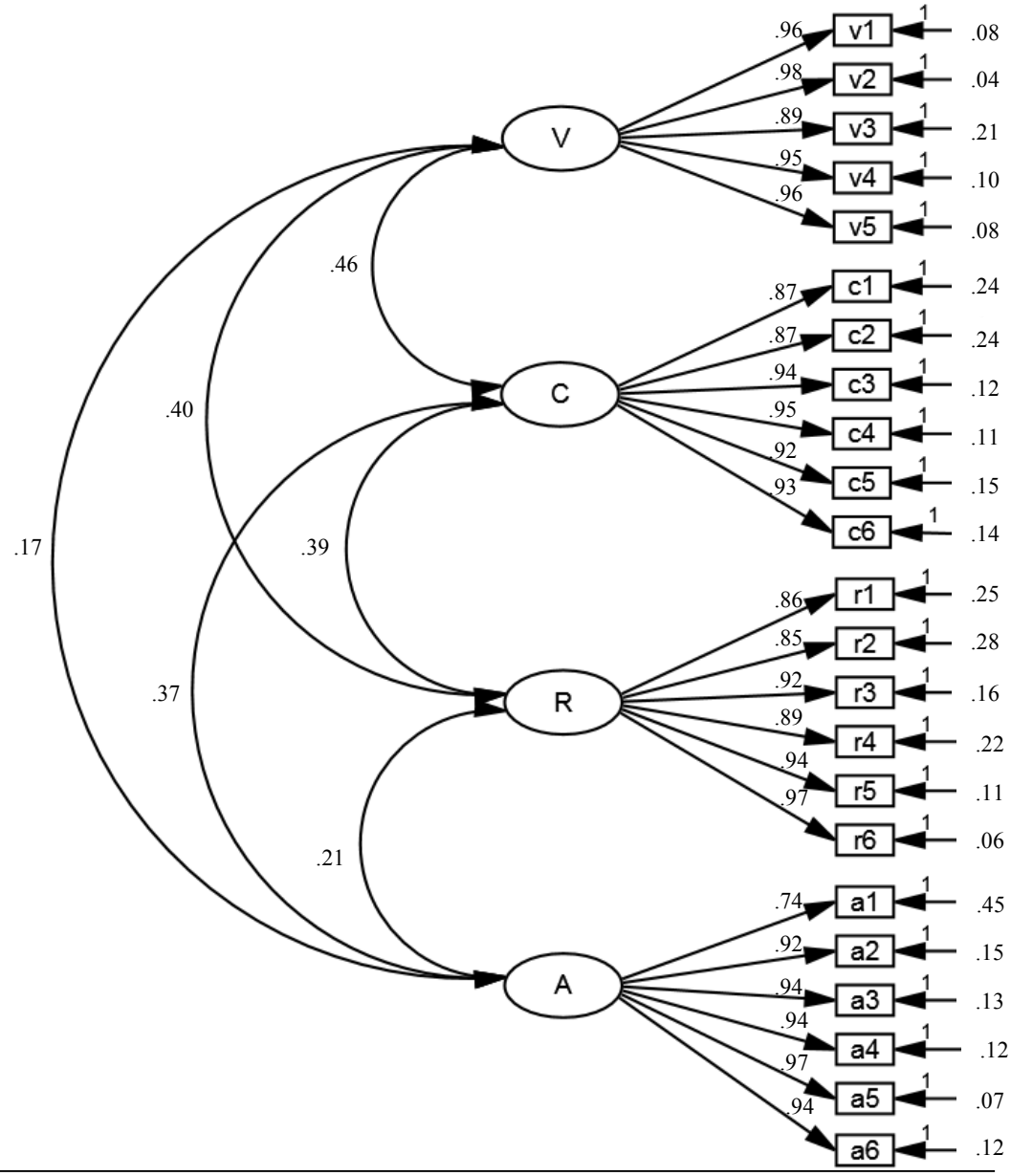
Note: n = 507. CI = confidence interval.

Table 3. EFA communalities and geomin rotated pattern coefficients of the four-factor solution

Scale and Item	h^2	I	II	III	IV
PVE- Variety					
1. I feel like I engage in a variety of exercises.	.88	**0.81**	0.25	-0.07	0.02
2. I feel like I try a range of exercises.	.91	**0.84**	0.25	-0.11	0.01
3. I feel like I change the types of exercise that I do.	.74	**0.82**	0.06	0.02	0.04
4. I feel like my exercise program is varied.	.97	**0.98**	-0.07	0.13	-0.03
5. I feel like I experience variety in my exercise.	.95	**0.95**	-0.01	0.12	-0.05
PNSE- Competence					
1. I feel that I am able to complete exercises that are personally challenging	.69	0.09	**0.67**	0.17	0.06
5. I feel good about the way I am able to complete challenging exercises	.65	0.07	**0.58**	0.20	0.15
10. I feel confident I can do even the most challenging exercises	.87	-0.04	**1.01**	0.00	-0.16
12. I feel capable of completing exercises that are challenging to me	.86	0.02	**0.85**	0.07	0.07
14. I feel confident in my ability to perform exercises that personally challenge me	.80	0.05	**0.77**	0.08	0.12
17. I feel like I am capable of doing even the most challenging exercises	.92	-0.03	**1.05**	-0.04	-0.16
PNSE- Relatedness					
2. I feel attached to my exercise companions because they accept me for who I am	.72	-0.03	-0.01	**0.87**	-0.07
4. I feel close to my exercise companions who appreciate how difficult exercise can be	.73	0.00	-0.05	**0.87**	-0.00
8. I feel a sense of camaraderie with my exercise companions because we exercise for the same reasons	.81	0.03	-0.03	**0.89**	0.05
9. I feel like I get along well with other people who I interact with while we exercise together	.81	0.08	0.08	**0.83**	0.01
15. I feel like I share a common bond with people who are important to me when we exercise together	.83	-0.05	0.10	**0.88**	0.01
18. I feel connected to the people who I interact with while we exercise together	.92	-0.01	0.12	**0.91**	-0.01
PNSE- Autonomy					
3. I feel like I am the one who decides what exercises I do	.63	-0.15	0.01	-0.07	**0.81**
6. I feel free to exercise in my own way	.74	0.04	0.14	-0.05	**0.80**
7. I feel free to make my own exercise program decisions	.87	-0.05	0.03	-0.04	**0.93**
11. I feel free to choose which exercises I participate in	.76	0.01	0.08	0.03	**0.83**
13. I feel like I am in charge of my exercise program decisions	.84	0.04	-0.04	0.05	**0.91**
16. I feel like I have a say in choosing the exercises that I do	.82	-0.01	-0.06	0.09	**0.91**

Note: n = 507. PNSE = Psychological Need Satisfaction in Exercise Scale; PVE = Perceived Variety in Exercise. h^2 = communality estimates for each item. Pattern coefficients in bold represent primary factor loadings of each item retained in the final solution.

Figure 1. CFA model, interfactor correlations, standardized factor loadings and residuals



Note: $n = 367$. All correlations have $p < .01$. V = Variety, C = Competence, R = Relatedness, A = Autonomy.