An examination of Dweck's psychological needs model in relation to exercise-related well-being

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Abstract

This two-part study examined Dweck's psychological needs model in relation to exercise-related well-being, and particularly focused on the basic need for *optimal predictability*, and compound needs for *identity* and *meaning*. In Part 1 (N = 559), using exploratory factor analysis, scores derived from items assessing optimal predictability (prediction of affect and instrumental utility in exercise) were empirically distinct from scores derived from items assessing competence, relatedness, and autonomy. In Part 2, participants from Part 1 (N = 403) completed measures of exercise-related well-being four weeks after baseline assessment. Prediction of affect was the most consistent predictor of subsequent exercise-related well-being. An implication of these findings is that optimal predictability (primarily prediction of affect) represents a unique experience that may be necessary for thriving in the context of exercise. Prediction of affect should be targeted in experimental designs to further understand its relationship with exercise-related well-being.

Key words: psychological need satisfaction, physical activity, optimal predictability, meaning, identity, subjective vitality

Just as humans have physical needs for food and water to maintain physiological functioning (Hull, 1943), humans have psychological needs that maintain the integrity and functioning of the psyche (Baumeister & Leary, 1995; Deci & Ryan, 2000; Dweck, 2017; Sheldon, 2011). The study of psychological needs has a long history, with different conceptualizations (Pittman & Zeigler, 2007) and new models of psychological needs regularly proposed (e.g., Dweck, 2017; Sheldon, 2011). Psychological needs can be broadly conceptualized as innate, universal psychosocial requirements for well-being and long-term psychological health and development that also play a functional role in shaping motivation and behaviour (Baumeister & Leary, 1995; Deci & Ryan, 2000; Dweck, 2017; Maslow, 1943; Sheldon, 2011).

Arguably, the most frequently used model of psychological needs corresponds to basic psychological need theory (Ryan & Deci, 2002, 2017) that is subsumed within self-determination theory (SDT; Ryan & Deci, 2002, 2017). SDT is a macro theory of human motivation, well-being, and personality development, with competence, relatedness, and autonomy identified as basic, universal, and fundamental psychological needs that need to be fulfilled in order for humans to thrive. Competence refers to feeling a sense of mastery and effectiveness in one's environment while having the opportunity to expand and build upon one's abilities (Ryan & Deci, 2017; White, 1959). Relatedness refers to feeling connected, cared for, and a sense of belonging among others in one's social milieu (Baumeister & Leary, 1995; Ryan & Deci, 2017). Finally, autonomy refers to feeling a sense of volition, self-endorsement, and choice over one's actions (de Charms, 1968; Ryan & Deci, 2017). Deci and Ryan (1991) proposed that these three needs constitute the necessary psychosocial experiences for maintaining intrinsically motivated behaviour (engaging in activities because they are inherently interesting and rewarding), and the capacity to internalise and integrate external social and cultural values as one's own in order to act as a self-determined agent in society. Intrinsic motivation and integration of psychosocial experiences are considered natural, organismic growth processes of the self (Deci & Ryan, 1991; Ryan, 1995), and

because psychological needs support these natural processes, Deci and Ryan (2000) propose they are necessary for well-being.

Research that has applied BPNT in exercise and health promotion settings has had some success explaining variability in exercise and physical activity related well-being (Gunnell et al., 2013; Mack et al., 2017; Sylvester et al., 2012; Wilson et al., 2009; Wilson, Longley, et al., 2006). There are, however, at least two caveats associated with this research that should be noted. First, patterns of relationships between these three ostensive needs have been notably inconsistent, with several studies failing to find support for the predictive utility of one or more of those needs in relation to both positive and negative well-being outcomes (e.g., Gunnell et al., 2014; McDonough & Crocker, 2007). Second, in light of the small-to-medium sized relationships between those needs and putative well-being outcomes (e.g., Wilson et al., 2008) researchers in social psychology (Sheldon, 2011) and exercise psychology (Wilson, Longley, et al., 2006) have suggested that other psychological experiences should be explored. For example, studies, in the context of exercise, examining perceived variety (Sylvester et al., 2014) and self-actualization and physical thriving (Wilson, Longley, et al., 2006) have explained additional variance in exercise-related well-being above and beyond the three SDT needs.

A promising psychological needs model that may be particularly useful in the context of exercise is that proposed by Dweck (2017), which provides the foundation for a theory of motivation, personality, and development. Dweck began with the assumption that psychological needs energize need-satisfying goals and support psychological well-being and health, and proposed there are three *basic psychological needs* present from birth (competence, acceptance, optimal predictability) and four emerging *compound needs* that arise from the combination of the basic needs (self-esteem/status, control, trust, self-coherence). See *Figure 1* for a visual representation of Dweck's psychological need model. By applying Baumeister and Leary's (1995) criteria of basic psychological needs, Dweck (2017) suggested that a psychological need (basic and compound) should have high universal value and contribute to well-being and ongoing psychological development. A basic need should not be derived from other needs or

motives, and should be present from, or shortly after, birth (Dweck, 2017). Dweck (2017) acknowledged that within the basic needs set, competence and acceptance map directly onto SDT's competence and relatedness needs, respectively; acceptance being the relatedness that infants need. Drawing from motivational concepts such as Higgins' (2012) motive for truth and Stevens and Fiske's (1995) motive for understanding, Dweck (2017) proposed the basic need for optimal predictability, which refers to the need to understand and predict the relationships between events in one's environment. Moreover, Dweck (2017) drew from the developmental literature, neuroscience, and animal studies to contend that (a) infants are able to integrate relevant information for making predictions about their environment; (b) predictable caregiving during infancy and childhood is necessary for well-being; (c) the brain naturally encodes predictive models; and (d) animals prefer, and benefit from, predictable stimuli in their environment. Dweck included the word *optimal* in order to reflect the notion that too much predictability is undesirable, and humans must engage with novel stimuli**.** Of particular note, optimal predictability represents a need that was not conceptualized in any form within SDT. Conceptually, however, optimal predictability shares similarities with *outcome expectancies*, which reflect expectations that an outcome will follow a given behaviour (Bandura, 1997).

According to Dweck (2017), as people mature psychologically and develop more complex cognitive schemas, compound needs subsequently emerge. The need for self-esteem/status (positive personal evaluations and respect from others), according to Dweck (2017), derives from the satisfaction of acceptance and competence needs. The need for control, which includes autonomy (from SDT), self-control (the ability to self-regulate one's actions and override impulses and agency; Tangney et al., 2004), and agency (the perception that one can intentionally influence their functioning and life circumstances; Bandura, 2006), is derived from the satisfaction of competence and optimal predictability. Again, according to Dweck's (2017) model, the need for trust emerges from the satisfaction of the need for acceptance and predictable caregiving. Finally, within this framework, the need for self-coherence (a stable and intact sense of self) is purported to emerge from the satisfaction of the basic and compound

needs described above. Self-coherence is conceptualized as a superordinate need for meaning (sense of congruence among events in one's world) and identity (self-perceived social roles and competencies), both of which are considered to bind one's sense of self (Dweck, 2017).

An important point to be made about Dweck's (2017) model is that it has key similarities and differences with the predominant SDT model proposed by Deci and Ryan (2000). As previously noted, within Dweck's (2017) basic need framework, competence and acceptance map directly onto the SDT needs of competence and relatedness, respectively. The key difference with Dweck's (2017) model when compared to SDT is the inclusion of optimal predictability, and the exclusion of autonomy, which is considered by Dweck (2017) to be a facet of the compound need for control. Given that competence, relatedness, and autonomy (from SDT) have been studied extensively in relation to exercise behaviour (Rhodes et al., 2019; Teixeira et al., 2012) and well-being (Wilson et al., 2008), the overall purpose of this two-part paper was to examine whether optimal predictability (when operationalized as a basic psychological need) accounts for unique variance in exercise-related well-being beyond those three SDT needs.

Specifically, in Part 1, based on Dweck's contentions that optimal predictability is a unique basic psychological need, we tested the hypothesis that scores derived from items assessing optimal predictability (in exercise) would be empirically distinct from scores derived from measures of competence, relatedness, and autonomy satisfaction in exercise settings. In Part 2, based on Dweck's contentions that optimal predictability has direct implications for well-being, we tested the hypothesis that scores derived from measures of optimal predictability would explain unique variance in scores derived from measures of exercise-related well-being (while simultaneously considering measures of competence, relatedness, and autonomy). Finally, based on Dweck's contention that each basic and compound need influences feelings of self-coherence (identity and meaning), which in turn influences well-being, we tested the hypothesis that identity and meaning would mediate the relationships between the basic psychological needs and exercise-related well-being. This involved examining indirect effects between

putative predictors (needs for optimal predictability, competence, autonomy, and relatedness) and well-being via exercise-related meaning and exercise identity.

Part 1

Methods

Participants

Participants (N = 559) were a community sample of adults (i.e., 18 – 77 years of age). The sample (M_{age} = 32.33 years; SD_{age} = 14.15 years) included 369 females, 189 males, and one individual who selected 'other' for gender. The majority of participants reported they were White or White/mixed race (70.10%), residents of Canada (93.40%), a student (40.40%) or employed full time (41.30%), and 65.80% of the sample reported an annual household income of less than $100,000. Participants either completed some high school (1.30%), a high school diploma (12.20%), some college/university (24.00%), a college diploma/university degree (34.50%), some graduate school (5.50%) or a graduate degree (22.50%). Participants also reported the number of times they engaged in mild, moderate, and vigorous exercise in the past week using the Godin leisure time exercise questionnaire (Godin & Shephard, 1985), and the average duration of mild, moderate, and vigorous exercise sessions (Courneya et al., 2004). Consistent with Courneya et al. (2004), we created an indicator of moderate-to-vigorous exercise minutes (in the past week) for each participant using the following equation: (number of moderate exercise bouts x average minutes per bout) + (number of vigorous exercise bouts x average minutes per bout). After removing out of range values (≥ 25 moderate and vigorous exercise sessions in the past week) and outliers with Z-scores above 3.29 (Tabachnick & Fidell, 1996), the mean minutes of moderate-to-vigorous exercise behaviour was 253.86 minutes (SD = 210.85 minutes; median = 210.00 minutes; skewness = 1.25; and kurtosis = 1.90). In short, by most standards, the sample would be considered an active one.

Procedure

After receiving University of British Columbia institutional ethical approval for the study, adults (18 years +) who were able to read, converse, and write in English were recruited for the study online

(social media posts, and advertisements) and in-person (university classes, local hiking trails, and community events). After providing informed consent, participants responded to an online survey assessing demographics and psychological need measures. Participants were entered into a prize draw to win one of six $50 gift cards to compensate them for their time.

Measures

Optimal Predictability in Exercise

We used a two-step process, including item development and focus groups, to develop and refine items that assess optimal predictability in the context of exercise. First, we used Dweck's (2017) definition of optimal predictability and the exercise psychology literature to inform item development. Dweck (2017) defines optimal predictability as "the desire to know the relationships among events and among things in your world: what follows what, what belongs with what, or what causes what" (p. 692). Two judgements/expectations that have been examined in exercise psychology are affective outcomes (Will I feel good?), and instrumental utility (Will it be useful for my health?) of participating in exercise (Gellert et al., 2012; Rhodes et al., 2009). By operationalizing affective and instrumental judgements/expectations, optimal predictability was assessed by asking participants to consider exercising the following day and predict their affective experience (unsatisfying-satisfying, unpleasant-pleasant, unenjoyable-enjoyable, and boring-exciting) and the instrumental utility of exercise for their health (useless-useful, unimportant-important, harmful-beneficial, worthless-valuable, not worthwhile-worthwhile) using a seven-point semantic differential scale (for example, *extremely unsatisfying* (1) , *moderately unsatisfying* (2), *slightly unsatisfying* (3), *neutral* (4), *slightly satisfying* (5), *moderately satisfying* (6), *extremely satisfying* (7)). The semantic differential descriptors were adopted from Conner et al. (2011).

Within Messick's (1995) integrative view of validity, gathering content and substantive evidence is important for score interpretation. Content validity refers to whether the elements of a measure adequately represent, and are relevant for, the construct of interest (Messick, 1995). The elements of

measures refer to question items, instructions, item framing, and administration (Sireci, 1998). The substantive aspect of construct validity refers to the degree to which individuals interact with a measure in a manner that is expected based on the theory of the construct purported to be assessed (Messick, 1995). Thus, in the second step of item development, focus groups were conducted to ensure the items were clear, interpreted appropriately by members of the target population (i.e., adults), and appropriate for the context of exercise.

After receiving University of British Columbia institutional ethical approval, four focus groups (N = 11; M_{age} = 27.36 years; SD_{age} = 9.30 years; 54.54% females) were conducted. A modified 'retrospective think-aloud' protocol (Oremus et al., 2005) was used to understand how participants interpret and provide responses to the items. After participants provided informed consent, they were instructed to complete questionnaire items independently and were then asked a series of questions to prompt their interpretation and understanding of those items. Participants were asked and responded to the following questions verbally: (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?" Immediately after each focus group was finished, the interviews were transcribed and coded using a constant comparison approach (Corbin & Strauss, 2008) to identify potentially problematic items, instructions, or response formats. In total, four focus groups were conducted. Modifications were made after each focus group until no further changes were necessary.

After item trimming and refinement (4 items for prediction of affect; 5 items for prediction of instrumental value for one's health), the phrase "When answering the following questions, please think about the exercise you typically perform and your personal health" was added to the instructions. An instrumental prediction item (how 'useful' exercise was predicted to be) was deleted, and an affective prediction item (how 'exciting' exercise was predicted to be) was changed to 'fun.' These revisions resulted in four prediction of affect items and four prediction of instrumental utility for health items (see a

full list of items in Table 1). Also, see Table S1 in the Supplementary Online Materials for a complete outline of changes made to the items, instructions, and scales of the optimal predictability items.

Competence, Autonomy, and Relatedness Satisfaction in Exercise

Competence was measured using five items from the competence subscale embedded in the Intrinsic Motivation Inventory (IMI; McAuley et al., 1989; Ryan, 1982). Autonomy was assessed using the six-item autonomy subscale from the Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson, Rogers, et al., 2006). Relatedness was assessed using the six-item Relatedness to Others in Physical Activity Scale (ROPAS; Wilson & Bengoechea, 2010). The ROPAS was modified for exercise participation by exchanging the word 'physical activity' for 'exercise' in the instructional stem preceding the items (see below).

The decision to not use the competence and relatedness subscales from the PNSE (Wilson, Rogers, et al., 2006) was based on their item content. Each item in the PNSE-competence subscale refers to the concept of challenge. Challenge may not be relevant for all people participating in exercise for leisure purposes and health benefits, and we sampled participants from the community ranging in age and exercise participation. We decided to use the IMI-competence subscale because the items reflect general perceptions of competence, and have been used in various samples including adult women ranging from 23 to 80 years in age (Markland & Tobin, 2010; Cronbach's alpha = .86), and university students (Wilson & Bengoechea, 2010; Cronbach's alpha = .90). Furthermore, there is external validity evidence for scores derived from the IMI-competence subscale, as scores have been found to explain unique variance in scores derived from various indices of well-being (Wilson & Bengoechea, 2010) and scores derived from autonomous motivation for exercise (Markland & Tobin, 2010). As for the PNSE-relatedness subscale (see Wilson, Rogers, et al., 2006), the items assume participants interact with others in structured exercise settings (example item: "I feel attached to my exercise companions because they accept me for who I am"). Again, because we sampled individuals from the community, as opposed to exercise classes or exercise groups specifically, we could not assume that participants predominantly exercised alone or with

others. The ROPAS was designed to measure perceptions of belonging in general physical activity settings without the assumption that participants would be exercising in structured settings (Wilson & Bengoechea, 2010). There is also content, structural, and external validity evidence to support the interpretation of scores derived from the ROPAS (Wilson & Bengoechea, 2010). Therefore, we considered the ROPAS items appropriate for our sample. Items for all three sets of measures were prefaced by: "The following statements represent different feelings people have when they engage in exercise. Please answer the following questions by considering how you typically feel when participating in exercise using the scale provided." Exemplar items of the scales included "I think I am pretty good at exercising" (competence), "I am included by others" (relatedness), and "I feel like I am the one who decides what exercises I do" (autonomy). Responses were anchored on 6-point scales with higher scores reflecting greater satisfaction of the corresponding need in the context of exercise.

Data Analysis

To examine whether scores derived from items assessing optimal predictability (prediction of affect and the instrumental utility for one's health) are empirically distinct from scores derived from items assessing competence, autonomy, and relatedness, we conducted an exploratory factor analysis. Models with different factor structures were compared to determine the best fit when simultaneously analyzing items assessing optimal predictability and competence, relatedness, and autonomy. Based on Dweck's (2017) theorizing that optimal predictability is a distinct psychological need, and that items assessing affective and health-related outcome expectancies load on separate factors (e.g., Gellert et al., 2012), we expected scores from items assessing prediction of affect and prediction of instrumental utility for health to load on two distinct factors (affect and instrumental prediction), and scores from items assessing competence, relatedness, and autonomy to load on three distinct factors, ultimately producing a five-factor model. Based on the three empirically-established psychological need factors of competence, relatedness, and autonomy (Vlachopoulos & Michailidou, 2006; Wilson, Rogers, et al., 2006), the five-factor model was compared with a four- and three-factor model. A four-factor model was examined to

determine whether the scores from optimal predictability items loaded on one factor (affect and instrumental items loading on a single factor), and the scores from items assessing competence, relatedness, and autonomy loaded on their own distinct factors. A three-factor model was examined to determine whether the scores from items used to assess optimal predictability could be subsumed by one or more of the three known factors of competence, autonomy, and relatedness (Vlachopoulos & Michailidou, 2006; Wilson, Rogers, et al., 2006).

The exploratory factor analysis was conducted using M*plus* (Version 8.4; Muthén & Muthén, Los Angeles, CA). First, assumptions (outliers, missing data, normality) for the analysis were examined (Tabachnick & Fidell, 1996). Due to measuring the variables with Likert-like categorical scales, we first addressed the possibility of analyzing the data using the polychoric correlation matrix (Zumbo et al., 2007). There was evidence of data sparseness in the multiway frequency data table, so we treated the data as continuous for all subsequent analyses (in Part 1 and 2). The three different factor models were estimated using robust maximum likelihood (RML) estimation and Geomin oblique rotation to account for the correlations among psychological needs in exercise settings (Vlachopoulos & Michailidou, 2006; Wilson, Rogers, et al., 2006). To determine the best fitting model, we analyzed multiple goodness of fit statistics (GOFS) alongside the χ^2 test (Marsh, 2007). The comparative fit index (CFI), Tucker Lewis index (TLI), and root mean square error of approximation (RMSEA) were examined for each of the proposed factor models, with higher CFI and TLI values (values closer to 1 along a 0-1 continuum) and lower RMSEA values (values closer to 0 along a 0 to 1 continuum) signifying better model fit (Marsh, 2007). We also examined the interpretability of factor loadings for the extracted factors.

Results

There were no missing data on any variables included for the analysis, as we used survey logic (via Qualtrics, Qualtrics, Provo, UT) to inform participants that they needed to complete each question to progress (same for Part 2). No outliers were present as all values were in the expected range. The five-factor model had superior fit indices (χ^2 (185) = 274.51, $p < .01$, CFI = .985, TLI = .975, RMSEA = .029,

90% confidence interval (CI) [.022-.037]) compared with a four-factor (χ^2 (206) = 782.59, $p < .01$, CFI = .902 , TLI = .857, RMSEA = .071, 90% CI [.066-.076]) and three-factor (χ^2 (228) = 1470.31, $p < .01$, CFI = .788, TLI = .721, RMSEA = .099, 90% CI [.094-.104]) model. For the five-factor model, the items loaded (> .3) on the specified *a priori* factors, and there was evidence of relatively small cross loading of items (< .3) with other factors (Kline, 1994). The pattern coefficients and estimated communalities (h^2) of the five-factor model are reported in Table 1. The inter-factor correlations in the five-factor model were also small to moderate in size (i.e., $.22 \leq r \leq .54$) suggesting the five factors are related but distinct from one another (see Table 2 for inter-factor correlations).

Part 2

Methods

Procedure

A prospective observational design was used. Participants who completed the assessments from Part 1 (operationalized as Time 1 in this study) were invited via email to complete measures of exercise-related well-being exactly four weeks after their baseline assessment (Time 2). To be included in the study, participants needed to complete the Time 2 measure of exercise-related well-being within 10 days of receiving the invitation email. We examined whether participants who were included in the sample at Time 2 (N = 403) were different from those who dropped out of the study after completing measures at Time 1 (N = 156) on relevant variables. Participants did not differ in age, $t(557) = -1.69$, $p = .09$, or Time 1 observed mean levels of prediction of affect, $t(557) = .63$, $p = .53$, prediction of instrumental utility for health, $t(557) = -.21$, $p = .83$, competence, $t(557) = 1.32$, $p = .19$, relatedness, $t(557) = -.12$, $p = .90$, autonomy, $t(557) = 1.83$, $p = .07$, exercise-related meaning, $t(557) = .82$, $p = .41$, and the gender distribution was similar between individuals included at Time 2 (33.25% male, 66.50% female) and individuals who dropped out after completing Time 1 measures (35.26% male, 64.74% female). There was a statistically significant difference in observed mean levels of exercise identity, $t(557) = 2.27$, $p =$

.02, d = .21, such that individuals who completed Time 2 measures (M = 4.50) reported, on average, higher exercise identity compared to individuals who dropped out at Time 2 (M = 4.20).

Participants

A total of 403 participants (M_{age} = 31.70 years; SD_{age} = 14.42 years) completed both Time 1 (from Part 1) measures of psychological needs and Time 2 (4 weeks later) measures of exercise-related well-being. Seventeen individuals were removed from the analysis due to completing the follow up measures eleven days or more after receiving the follow up email. The sample included 268 females, 134 males, and one individual who selected 'other' for gender.

Measures

Optimal Predictability, Competence, Autonomy, and Relatedness

The optimal predictability items utilized in Part 1 were operationalized in Part 2. The Composite Reliabilities (CRs) for the prediction of affect and instrumental utility scores were 0.83 and 0.87, respectively. Measures of competence (IMI; McAuley et al., 1989; Ryan, 1982), autonomy (PNSE autonomy subscale; Wilson, Rogers, et al., 2006), and relatedness (ROPAS; Wilson & Bengoechea, 2010) were those that were operationalized in Part 1. The CRs for scores derived from the competence, relatedness, and autonomy subscales were .90, .86, and .90, respectively.

Exercise-Related Meaning

To our knowledge, no measure of exercise-related meaning exists, and therefore we used a two-step process, including item adaption from a previous scale that has produced scores with validity evidence, and focus groups, to generate and refine items to assess exercise-related meaning. First, seven items were adapted from the positive meaning subscale and the meaning making through work subscale of the Work and Meaning Inventory (WAMI; Steger et al., 2012). The positive meaning subscale (4 items) assesses an individual's perception that their work is significant and meaningful, whereas the meaning making through work subscale (3 items) assesses the degree to which an individual perceives their work as contributing to their life's meaning. Although the items were adapted from two distinct but

correlated subscales of meaningful work, the items were adapted for the current investigation to assess one dimension of meaningful exercise engagement.

Second, the seven adapted items from the WAMI were assessed in focus groups, with different participants in each of the focus groups, to assess their interpretability, clarity, and appropriateness for the context of exercise. In total, three focus groups were conducted (N = 10; M_{age} = 30.90 years; SD = 9.24 years; 80.00% females). The same 'retrospective think-aloud' procedures, as per Part 1, were used to understand how participants interpret and provide responses to the exercise-related meaning items with the addition of providing participants with the definition of exercise-related meaning ("the subjective experience that exercising has personal significance, it matters, and it is meaningful") and the interview questions: "Did the items reflect exercise-related meaning?" and "Are the items appropriate for the context of exercise?" After item trimming and refinement, two items were deleted, and two items were refined to improve their clarity and relevance for the context of exercise, resulting in five items assessing exercise-related meaning (see Table S2; Supplementary Online Materials for outline of changes made to the items). The final five items (see Table S3; Supplementary Online Materials) were prefaced by: "Exercise can mean a lot of different things for different people. The following items ask about how you see the role of exercise in your own life. Please honestly indicate how true each statement is for you and your exercise." Responses to items were provided on a 6-point Likert-type scale anchored by 1 (*False*) to 6 (*True*) with higher scores reflecting greater perceptions of exercise-related meaning (exemplar item: "I have found a type of exercise that is meaningful to me"). Scores derived from the exercise-related meaning measure had a CR value of .87.

Exercise Identity

Exercise identity was assessed with the Exercise Identity Scale (EIS; Anderson & Cychosz, 1994). The EIS was originally designed to assess the degree to which an individual considers exercise an important aspect of their self-concept (Anderson & Cychosz, 1994). However, Wilson and Muon (2008) provided evidence that EIS scores are better represented by two dimensions; a role-identity dimension

and exercise beliefs dimension using confirmatory factor analysis. Wilson and Muon suggested that the role identity dimension was considered to assess the degree to which an individual integrates the social role of being an exerciser (example item: "I consider myself an exerciser"), whereas the exercise beliefs dimension assessed more general beliefs about exercising (example item: "For me, being an exerciser means more than just exercising"). In this study, using confirmatory factor analysis, the two-factor model, χ^2 (26) = 105.11, CFI = .951, TLI = .931, RMSEA = .087, 90% CI [.070-.105] had superior fit to the one-factor model, χ^2 (27) = 159.68, CFI = .917, TLI = .889, RMSEA = .110, 90% CI [.094-.127]. The two factors were also highly correlated (Φ = .89) in the two-factor model, so we only used the role identity factor in the mediation model to ensure model parsimony. The decision to use the items representing the role identity factor as opposed to the items representing the exercise beliefs factor was based on two considerations. First, Dweck (2017) conceptualized identity as "people's social roles, social categories, and areas of self-perceived competence – things that define and situate them" (p. 695); this definition is more in line with the role identity dimension. Second, the role identity items represent the original content domain (i.e., role identity) that was intended by Anderson and Cychosz (1994). Consistent with the other psychological need measures in this study, participants responded to the EIS using a six-point Likert-type scale anchored by 1 (*False*) to 6 (*True*) with higher scores reflecting a stronger exercise identity. Participants were presented with the following stem before responding to the items: "The following questions concern your personal beliefs about exercise. Please indicate the degree to which each statement is true for you when thinking about your exercise participation." The CR of scores derived from the three role identity items was 0.90.

Exercise-Related Well-Being

Well-being was assessed with the Scale of Positive and Negative Experience (SPANE; Diener et al., 2010) and the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997). The SPANE is a 12-item general measure of positive and negative experiences and feelings, with six items for each of the positive and negative experiences subscales, respectively. Participants were provided with the following

instructional stem adapted for the context of exercise: "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, during exercise, using the scale below. For each item, select a number from 1 to 5." The SPANE includes a Likert-type response format ranging from 1 (*Very Rarely or Never*) to 5 (V*ery Often or Always*).

The SVS was used to assess the degree to which participants feel they have energy and vitality when exercising. Based on the psychometric analysis of the SVS conducted by Bostic et al. (2000), the six-item version of the SVS was used (the negatively worded item was deleted) in the current study. Participants were provided with the instructional stem adapted for the context of exercise: "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 provided ratings to the items along a Likert-type scale ranging from 1 (*Not at All True*) to 7 (*Very True*). The CR values for scores derived from the exercise-related subjective vitality, positive exercise experiences, and negative exercise experiences scales were .90, .88, and .77, respectively.

Data Analysis

First, assumptions (outliers, missing data, normality) for the analysis were examined (Tabachnick & Fidell, 1996). Structural equation modelling with RML estimation was used to examine the degree to which optimal predictability (along with competence, relatedness, and autonomy) at Time 1 explained unique variance in exercise-related well-being at Time 2. Prediction of affect, prediction of the instrumental utility for health, and ratings of competence, relatedness, and autonomy satisfaction were specified as latent independent (exogenous) predictor variables. Each exercise-related well-being variable (subjective vitality, positive exercise experiences, and negative exercise experiences) was simultaneously included in the structural model as dependent (endogenous) variables.

The structural model was analyzed in *M*plus (version 8.4). Based on the recommendations of Marsh (2007), we used multiple Goodness-of-Fit statistics (GOFS) that included the CFI, TLI, and

RMSEA alongside the χ^2 statistic (Marsh, 2007). Applying Marsh's (2007) general guidelines of assessing model fit with GOFS, CFI and TLI values greater than .95 and .90 were considered to represent excellent and acceptable fit, respectively. RMSEA values less than .05 and .08 were considered to represent close and reasonable fit, respectively. To assess the internal consistency of scores produced by each scale, CR values were calculated using confirmatory factor analysis and RML estimation. We also examined the relative importance of each predictor in the structural model by calculating relative Pratt indices (Thomas et al., 1998) or each independent variable as per Zumbo (2007). The relative pratt indices were calculated by multiplying the standardized beta (β) weight by the raw correlation, and the resultant sum was divided by the variance explained in the model (i.e., R^2). An index less than 1/ (2 × number of predictor variables) is determined to be unimportant (Thomas, 1992), and the cutoff was .10 (i.e., 10.00% variance explained).

Finally, exploratory analyses were conducted to examine whether a latent exercise-related meaning variable and a latent exercise identity variable (Time 1) mediated the relationship between the predictors (i.e., Time 1 optimal predictability, relatedness, competence, and autonomy) and outcomes (i.e., Time 2 positive and negative exercise experiences and subjective vitality). In order to test mediation, a parallel multiple mediator model was estimated by examining the relationships between (a) predictors and mediators, (b) mediators and outcomes controlling for predictors, and (c) predictors and outcomes while controlling for mediators (Hayes, 2013). The indirect effects of prediction of affect, prediction of instrumental utility for health, competence, relatedness, and autonomy on Time 2 well-being outcomes (positive exercise experiences, negative exercise experiences, and subjective vitality) through exercise-related meaning and exercise identity were calculated using bootstrapping (k = 5000 samples) to produce bias-corrected confidence intervals (BCCIs) as per Preacher and Hayes (2008). RML estimation is not available when conducting bootstrapping in *M*plus software, and so the mediation model was estimated using Maximum Likelihood (ML) estimation.

Results

There were no missing data on any variables included in the analysis. No outliers were present as all values were in the expected range. The structural model of the candidate psychological needs and well-being outcomes had adequate model fit, χ^2 (832) = 1271.64, $p < .01$, CFI = .95, TLI = .94, RMSEA = .036, 90% CI [.032-.040]. With respect to the raw interfactor correlations (See Table S4; Supplementary online materials) among predictors and outcomes in the model, all five predictors were significantly correlated (i.e., $p < .01$) with each of the three well-being outcomes, and ranged from small to large in magnitude (*r*s = -.17 to .59). All correlations were in the expected direction, as each predictor was positively correlated with positive exercise experiences and subjective vitality, and negatively correlated with negative exercise experiences.

Positive Exercise Experiences

The complete model, including prediction of affect, prediction of instrumental utility for health, competence, relatedness, and autonomy satisfaction explained 39.10% of the variance in the latent variable positive exercise experiences. Prediction of affect (β = .456, $p < .01$) and relatedness (β = .155, p < .05) were significant prospective correlates. Prediction of instrumental utility for health (β = .032, p = 0.600), competence (β = .097, p = .174), and autonomy (β = .047, p = .403) were not significantly related to positive exercise experiences. Of the 39.10% variance explained by the model, prediction of affect, relatedness, and competence each accounted for 68.23%, 15.62%, and 10.77% of the explained variance, respectively.

Negative Exercise Experiences

The complete model, including prediction of affect, prediction of instrumental utility for health, competence, relatedness, and autonomy satisfaction explained 15.50 % of the variance in the latent variable negative exercise experiences. Prediction of affect (β = -.193, $p < .05$) and autonomy (β = -.177, $p < .01$) were significant prospective correlates, whereas prediction of instrumental utility for health (β = -.070, p = .296), competence (β = -.123, p = .144), and relatedness (β = .036, p = .629) were not significantly related to negative exercise experiences. Of the 15.50% variation explained by the model,

prediction of affect, autonomy, and competence accounted for 38.73%, 32.55%, and 22.93% of the explained variance in negative exercise experiences.

Subjective Vitality

The complete model, including prediction of affect, prediction of instrumental utility for health, competence, autonomy, and relatedness explained 30.10% of the variance in the latent subjective vitality variable. Prediction of affect ($\beta = .240$, $p < .01$), prediction of instrumental utility for health ($\beta = .132$, $p < .05$), competence ($\beta = .167$, $p < .05$), and relatedness ($\beta = .166$, $p < .05$) were significant prospective correlates, while autonomy was not significantly related to subjective vitality ($\beta = .056$, $p = .350$). Of the 30.10% variation explained by the model, prediction of affect, competence, relatedness, and prediction of instrumental utility for health accounted for 35.80%, 23.75%, 21.45%, and 13.90% of the explained variance, respectively.

Mediation Model

The mediation model including exercise-related meaning and exercise identity as mediators between the predictors and Time 2 well-being outcomes had adequate GOFS, χ^2 (1179) = 2104.876, $p <$ .01, CFI = .93, TLI = .92, RMSEA = .044, 90% CI [.041-.047]. The direct effects in the mediation model are presented in Figure 2 (significant effects) and Table S5 (Supplementary Online Materials). With respect to the mediation effects, exercise identity did not mediate any of the relationships between the predictors and well-being outcomes. Based on the *p* values for the mediation effects, exercise-related meaning did not mediate any relationships between the predictors and outcomes (all *p*s > .05). However, based on the BCCIs, prediction of affect ($\beta = .025$, 95% BCCI [.002 - .073], $p = .15$), prediction of instrumental utility for health ($\beta = .036$, 95% BCCI [.004 - .096], $p = .09$), relatedness ($\beta = .023$, 95% BCCI [.001 - .075], $p = .17$), and competence ($\beta = .066$, 95% BCCI [.003 - .154], $p = .08$), were indirectly related to subjective vitality via exercise-related meaning (i.e., BCCIs did not contain zero). The inconsistencies between the BCCIs and *p* values means that it remains inconclusive whether exercise-related meaning was a substantive mediator. Finally, it should be noted that the direct effect between

exercise-related meaning and subjective vitality was not statistically significant at $p < .05$ ($\beta = .167$, 95% BCCI [.001 - .344], $p = .06$), but the BCCI did not contain zero. See Table S5 (Supplementary online material) for all total and specific indirect effects.

Discussion

In this two-part study, we (a) developed measures to assess the need for optimal predictability in the context of exercise (prediction of affect and prediction of instrumental utility for health); (b) examined the extent to which scores from items assessing optimal predictability are empirically distinct from scores produced by items assessing competence, relatedness, and autonomy in exercise; (c) examined the extent to which measures of optimal predictability (prediction of affect, prediction of instrumental utility for health) prospectively explained unique variance in exercise-related well-being; (d) adapted items to assess exercise-related meaning; and (e) examined the degree to which exercise-related self-coherence (meaning and identity) mediated the effects of optimal predictability, competence, autonomy, and relatedness satisfaction on exercise-related well-being. To our knowledge, this is the first investigation to empirically examine Dweck's (2017) psychological needs model in the context of exercise behaviour. Our findings support Dweck's (2017) notion that optimal predictability is a unique psychological experience that has implications for future well-being outcomes, but failed to support exercise-related meaning and identity as mediators between the basic needs and well-being outcomes.

We conducted an exploratory factor analysis to test the hypothesis that scores derived from measures of prediction of affect and instrumental utility (in exercise) would be empirically distinct from scores derived from items assessing competence, relatedness, and autonomy satisfaction in exercise. The five-factor model represented the best fitting model based on model fit and interpretability of factor loadings for the three-, four-, and five-factor models. The five-factor model included distinct factors for competence, relatedness, autonomy, and two distinct factors for the prediction of affect and prediction of instrumental utility for health. These results support Dweck's (2017) contentions that optimal predictability is a distinct psychological experience from competence, relatedness, and autonomy in the

context of exercise. It also provides discriminant validity evidence for the two-dimensional measure of the prediction of affect and prediction of instrumental utility for health.

Upon examination of the interfactor correlations of the five-factor model, it was apparent that factors of optimal predictability had small to medium-sized correlations with competence, relatedness, and autonomy factors. Prediction of affect was most strongly correlated with competence ($r = .47$, $p < .01$) and relatedness ($r = .34$, $p < .01$), and to a lesser extent autonomy ($r = .23$, $p < .01$). When compared to prediction of affect, prediction of instrumental utility for health was correlated to a lesser extent with competence ($r = .22$, $p < .01$), relatedness ($r = .22$, $p < .01$), and autonomy ($r = .23$, $p < .01$). These small-to-medium-sized correlations also support Dweck's (2017) notions that these psychological needs are related but distinct constructs. These findings are consistent with previous investigations of psychological need measurement in the context of exercise behaviour, such that competence, relatedness, and autonomy satisfaction generally have moderately sized correlations with one another (Sylvester et al., 2014; Wilson, Rogers, et al., 2006). Finally, the finding that the prediction of affect had stronger relationships with competence and relatedness compared to autonomy is in line with Dweck's model, such that optimal predictability, competence, and relatedness represent the basic needs within Dweck's psychological needs model, whereas autonomy does not.

In order to test the hypothesis that optimal predictability (in exercise) would explain unique variance in exercise-related well-being, we used structural equation modelling to examine whether the two optimal predictability factors (prediction of affect and instrumental utility for health) prospectively explained unique variance in exercise-related well-being, four weeks later, alongside measures of competence, relatedness, and autonomy. Among the five exogenous variables, prediction of affect was the most consistent prospective correlate with exercise-related well-being, as it was the only variable to explain unique variance in each of the three well-being outcomes. Prediction of instrumental utility for health, competence, relatedness, and autonomy also explained variance in at least one well-being outcome. Prediction of affect also accounted for the most variance in each of the well-being outcomes

indicated by the Pratt indices. These results support the hypothesis that optimal predictability in exercise explains unique variance in exercise-related well-being. Relative to competence, relatedness, and autonomy, predicting how one will feel when engaging in exercise appears to be a robust prospective correlate of experiencing exercise-related well-being. The fact that prediction of affect was more important than prediction of instrumental utility for health in explaining variance in exercise related well-being is consistent with the current exercise psychology literature. For example, affective judgements appear to be a better predictor of exercise behaviour than instrumental judgements (Rhodes et al., 2009).

We also used structural equation modelling to test the hypothesis that exercise-related meaning and identity would mediate the relationships between the *a priori* psychological needs and well-being outcomes. Based on BCCIs, exercise-related meaning partially accounted for the effects of prediction of affect and relatedness on subjective vitality, and fully accounted for the effects of prediction of instrumental utility for health and competence on subjective vitality. However, the *p* values of the mediation effects were not significant at $p < .05$. When these findings are taken together, it remains inconclusive whether exercise related meaning acted as a substantive mediator in this instance. More research is needed to determine what role (if any) exercise-related meaning plays in contributing to exercise-related well-being.

There was no evidence to support exercise identity as a mediator between any of the predictors and well-being outcomes. This is interesting, as there is evidence that exercise-related integrated-regulation (i.e., exercising because it is part of one's identity), a conceptually similar construct to exercise identity, is related to indices of well-being such as physical self-concept (Wilson, Rodgers, et al., 2006) and subjective vitality (McLachlan et al., 2011). In a recent study, greater exercise identity-behavioural consistency (i.e., perception that exercise behaviour is in line with one's exercise identity) was also associated with life satisfaction and vitality (Guérin et al., 2019). However, these studies did not control for psychological need variables. In the current study, exercise identity was significantly correlated with positive ($r = .43$, $p < .01$) and negative ($r = -.20$, $p < .01$) exercise experiences, and subjective vitality ($r =$

.42, $p < .01$). These effects were negligible after controlling for psychological need variables. Taken together, a strong exercise identity may be more important in regulating an individual's behaviour (Rhodes et al., 2016) but is less important for how one feels in the context of exercise.

The implications of these findings are that optimal predictability (particularly related to affective outcomes) represents an additional experience, beyond the psychological needs subsumed within SDT, that individuals need in order to thrive in the context of exercise. However, it is necessary to conduct controlled designs such as randomized experiments and interventions that target change in optimal predictability before it is considered a necessary experience for thriving in the context of exercise. In related research, telling individuals that people experience positive feelings after exercise (vs not providing any information) had a positive effect on ratings of subsequent post-exercise mood (Helfer et al., 2015). Helfer et al. (2015) also reported that participants who reflected on the exercise-affect relationship experienced improvements in ratings of post-exercise positive feeling two weeks later. Asking individuals to focus on the positive affective experiences of exercise may enhance their prediction of positive affective outcomes, and in turn, their well-being. It would also be useful to determine the factors that explain individual difference in prediction of affective outcomes. There is evidence that experiencing more positive affect during exercise is associated with positive affective judgements (Rhodes & Kates, 2015). Manipulating exercise (e.g., managing intensity) to produce more positive affect is one method that may enhance an individual's prediction of positive affective outcomes for future exercise.

Although the current investigation has many strengths, there are limitations that should be addressed. First, this study used an observational design, which ultimately limits causal claims. Although there was time separation between the predictors and outcomes, an observational design does not permit one to claim that any of the predictors are causally linked to the outcomes. Moreover, we tested mediation effects in the context of an observational design. Mediation models are fundamentally directional causal models (Wu & Zumbo, 2008), such that the predictors are theorized to cause the

outcome by having an effect on the mediating variable(s). Due to the observational design, the mediation effects should not be interpreted from a directional/causal perspective, but rather interpreted as testing indirect relationships between predictors and outcome variables.

The second limitation corresponds to the assessment of optimal predictability. Dweck's conceptualization of optimal predictability as the need to understand and predict events in one's world is open-ended and general. With the intent of developing clear and specific items, we chose two highly relevant outcomes in the context of exercise for individuals to make predictions – their affective experiences and the instrumental utility of exercise for one's health. However, doing so could result in construct underrepresentation (i.e., the assessment is narrower than the full conceptual bandwidth of the construct), which represents a source of invalidity (Messick, 1995). Individuals may make a number of predictions when exercising (e.g., performance, social interactions with other exercisers) and future research should examine these predictions and their implications for well-being. Future research should also examine the link between prediction of affect and more distal outcomes such as exercise behaviour to further support the predictive utility of optimal predictability in exercise. Finally, an additional component of predicting outcomes refers to people's perceived certainty (or uncertainty) in an outcome occurring (see Windschitl & Wells, 1996). Future research should examine whether the certainty of an individual's prediction explains additional variance in well-being outcomes or influences the relationship between those predictions and exercise-related well-being.

In conclusion, our results provide partial and initial support for Dweck's (2017) model of psychological needs. Specifically, we provide support for the importance of predicting affective outcomes for experiencing well-being when exercising. The importance of competence and relatedness in explaining variance in well-being outcomes alongside optimal predictability measures also supports Dweck's basic psychological need framework. More research is needed to ascertain whether optimal predictability is a basic psychological need and that meaning and identity are compound psychological

needs. Future research is needed to establish any causal effects and applications across different life domains and cultural contexts.

References

Anderson, D. F., & Cychosz, C. M. (1994). Development of an exercise identity scale. *Perceptual and Motor Skills*, *78*, 747–751.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman and Company.

Bandura, A. (2006). Toward a psychology of human agency. *Perspectives on Psychological Science*, *1*(2), 164–180. https://doi.org/10.1111/j.1745-6916.2006.00011.x

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the subjective vitality scale using structural equation modelling. *Social Indicators Research*, *52*(3), 313–324. https://doi.org/10.1111/j.1541-0072.1977.tb01338.x

Conner, M., Rhodes, R. E., Morris, B., McEachan, R., & Lawton, R. (2011). Changing exercise through targeting affective or cognitive attitudes. *Psychology and Health*, *26*(2), 133–149. https://doi.org/10.1080/08870446.2011.531570

Corbin, J. M., & Strauss, A. L. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Sage Publications, Inc.

Courneya, K. S., Jones, L. W., Rhodes, R. E., & Blanchard, C. M. (2004). Effects of different combinations of intensity categories on self-reported exercise. *Research Quarterly for Exercise and Sport*, *75*(4), 429–433. https://doi.org/10.1080/02701367.2004.10609176

de Charms, R. (1968). *Personal causation: The internal affective determinants of behavior*. Academic Press.

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dienstbier (Ed.), *Nebraska symposium on motivation: Vol.38. Perspectives on motivation* (pp. 237–288). University of Nebraska Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D.-W., Oishi, S., & Biswas-Diener, R. (2010). New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research*, *97*(2), 143–156. https://doi.org/10.1007/sll205-009-9493-y

Dweck, C. S. (2017). From needs to goals and representations: Foundations for a unified theory of motivation, personality, and development. *Psychological Review*, *124*(6), 689–719. https://doi.org/10.1037/rev0000082

Gellert, P., Ziegelmann, J. P., & Schwarzer, R. (2012). Affective and health-related outcome expectancies for physical activity in older adults. *Psychology and Health*, *27*(7), 816–828. https://doi.org/10.1080/08870446.2011.607236

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Sciences*, *10*(3), 141–146.

Guérin, E., Strachan, S., & Fortier, M. (2019). Exercise and well-being: Relationships with perceptions of exercise identity-behaviour consistency, affective reactions to exercise and passion. *International Journal of Sport and Exercise Psychology*, *17*(5), 445–458. https://doi.org/10.1080/1612197X.2017.1421681

Gunnell, K. E., Crocker, P. R. E., Mack, D. E., Wilson, P. M., & Zumbo, B. D. (2014). Goal contents, motivation, psychological need satisfaction, well-being and physical activity: A test of self-determination theory over 6 months. *Psychology of Sport and Exercise*, *15*(1), 19–29. https://doi.org/10.1016/j.psychsport.2013.08.005

Gunnell, K. E., Crocker, P. R. E., Wilson, P. M., Mack, D. E., & Zumbo, B. D. (2013). Psychological need satisfaction and thwarting: A test of basic psychological needs theory in physical activity contexts. *Psychology of Sport and Exercise*, *14*(5), 599–607.

https://doi.org/10.1016/j.psychsport.2013.03.007

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. The Guilford Press.

Helfer, S. G., Elhai, J. D., & Geers, A. L. (2015). Affect and exercise: Positive affective expectations can increase post-exercise mood and exercise intentions. *Annals of Behavioral Medicine*, *49*(2), 269–279. https://doi.org/10.1007/s12160-014-9656-1

Higgins, E. T. (2012). *Beyond pleasure and pain: How motivation works*. Oxford.

Hull, C. L. (1943). *Principles of behaivor: An introduction to behavior theory*. Appleton-Century.

Kline, P. (1994). *An easy guide to factor analysis*. Routledge.

Mack, D. E., Gunnell, K. E., Wilson, P. M., & Wierts, C. (2017). Well-being in group-based exercise classes: Do psychological need fulfillment and interpersonal supports matter? *Applied Research in Quality of Life, 12*(1), 89–102. https://doi.org/10.1007/s11482-016-9454-y

Markland, D., & Tobin, V. J. (2010). Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychology of Sport and Exercise, 11*(2), 91–99. https://doi.org/10.1016/j.psychsport.2009.07.001

Marsh, H. W. (2007). Application of confirmatory factor analysis and structural equation modelling in sport and exercise psychology. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed., pp. 774–798). John Wiley & Sons, Inc.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396. https://doi.org/10.4324/9781912282517

McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport*, *60*(1), 48–58. https://doi.org/10.1080/02701367.1989.10607413

McDonough, M. H., & Crocker, P. R. E. (2007). Testing self-determined motivation as a mediator of the relationship between psychological needs and affective and behavioral outcomes. *Journal of Sport &*

Exercise Psychology, *29*(5), 645–663. https://doi.org/10.1123/jsep.29.5.645

McLachlan, S., Spray, C., & Hagger, M. S. (2011). The development of a scale measuring integrated regulation in exercise. *British Journal of Health Psychology*, *16*(4), 722–743. https://doi.org/10.1348/2044-8287.002009

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, *50*(9), 741–749. https://doi.org/10.1037//0003-066X.50.9.741

Oremus, M., Cosby, J. L., & Wolfson, C. (2005). A hybrid qualitative method for pretesting questionnaires: The example of a questionnaire to caregivers of Alzheimer disease patients. *Research in Nursing and Health*, *28*(5), 419–430. https://doi.org/10.1002/nur.20095

Pittman, T. S., & Zeigler, K. R. (2007). Basic human needs. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed., pp. 473–489). Guilford Press.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879–891. https://doi.org/10.3758/BRM.40.3.879

Rhodes, R. E., Fiala, B., & Conner, M. (2009). A review and meta-analysis of affective judgments and physical activity in adult populations. *Annals of Behavioral Medicine*, *38*(3), 180–204. https://doi.org/10.1007/s12160-009-9147-y

Rhodes, R. E., & Kates, A. (2015). Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. *Annals of Behavioral Medicine*, *49*(5), 715–731. https://doi.org/10.1007/s12160-015-9704-5

Rhodes, R. E., Kaushal, N., & Quinlan, A. (2016). Is physical activity a part of who I am? A review and meta-analysis of identity, schema and physical activity. *Health Psychology Review*, *10*(2), 204–225. https://doi.org/10.1080/17437199.2016.1143334

Rhodes, R. E., McEwan, D., & Rebar, A. L. (2019). Theories of physical activity behaviour change: A

history and synthesis of approaches. *Psychology of Sport and Exercise*, *42*, 100–109. https://doi.org/10.1016/j.psychsport.2018.11.010

Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, *43*(3), 450–461. https://doi.org/10.1037/0022-3514.43.3.450

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, *63*(3), 397–427.

Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). The University of Rochester Press.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press.

Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality*, *65*(3), 529–565. https://doi.org/10.1111/j.1467-6494.1997.tb00326.x

Sheldon, K. M. (2011). Integrating behavioral-motive and experiential-requirement perspectives on psychological needs: A two process model. *Psychological Review*, *118*(4), 552–569. https://doi.org/10.1037/a0024758

Sireci, S. G. (1998). The construct of content validity. *Social Indicators Research*, *45*, 83–117. https://doi.org/10.1111/j.1541-0072.1977.tb01338.x

Steger, M. F., Dik, B. J., & Duffy, R. D. (2012). Measuring meaningful work: The Work and Meaning Inventory (WAMI). *Journal of Career Assessment*, *20*(3), 322–337. https://doi.org/10.1177/1069072711436160

Stevens, L. E., & Fiske, S. T. (1995). Motivation and cognition in social life: A social survival perspective. *Social Cognition*, *13*(3), 189–214. https://doi.org/10.1521/soco.1995.13.3.189

Sylvester, B. D., Mack, D. E., Busseri, M. A., Wilson, P. M., & Beauchamp, M. R. (2012). Health-enhancing physical activity, psychological needs satisfaction, and well-being: Is it how often, how long, or how much effort that matters? *Mental Health and Physical Activity*, *5*(2), 141–147. https://doi.org/10.1016/j.mhpa.2012.10.004

Sylvester, B. D., Standage, M., Dowd, A. J., Martin, L. J., Sweet, S. N., & Beauchamp, M. R. (2014). Perceived variety, psychological needs satisfaction and exercise-related well-being. *Psychology and Health*, *29*(9), 1044–1061. https://doi.org/10.1080/08870446.2014.907900

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics* (3rd ed.). HarperCollins.

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, *72*(2), 271–322.

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(78), 1–30. https://doi.org/10.1186/1479-5868-9-78

Thomas, D. R. (1992). Interpreting discriminant functions: A data analytic approach. *Multivariate Behavioral Research*, *27*(3), 335–362.

Thomas, D. R., Hughes, E., & Zumbo, B. D. (1998). On variable importance in linear regression. *Social Indicators Research*, *45*, 253–275. https://doi.org/10.1017/CBO9781107415324.004

Vlachopoulos, S. P., & Michailidou, S. (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The Basic Psychological Needs in Exercise Scale. *Measurement in Physical Education and Exercise Science*, *10*(3), 179–201. https://doi.org/10.1207/s15327841mpee1003_4

White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, *66*(5), 297–333. https://doi.org/10.1037/h0040934

Wilson, P. M., & Bengoechea, E. G. (2010). The Relatedness to Others in Physical Activity Scale: Evidence for structural and criterion validity. *Journal of Applied Biobehavioral Research*, *15*(2), 61–

87. https://doi.org/10.1111/j.1751-9861.2010.00052.x

Wilson, P. M., Longley, K., Muon, S., Rodgers, W. M., & Murray, T. C. (2006). Examining the contributions of perceived psychological need satisfaction to well-being in exercise. *Journal of Applied Biobehavioral Research, 11,* 243–264. https://doi.org/10.1111/j.1751-9861.2007.00008.x

Wilson, P. M., Mack, D. E., Blanchard, C. M., & Gray, C. E. (2009). The role of perceived psychological need satisfaction in exercise-related affect. *Hellenic Journal of Psychology, 6,* 183–206.

Wilson, P. M., Mack, D. E., Gunnell, K., Oster, K., & Gregson, J. P. (2008). Analyzing the measurement of psychological need satisfaction in exercise contexts: Evidence, issues, and future directions. In M. P. Simmons & L. A. Foster (Eds.), *Sport and exercise psychology research advances* (pp. 361–391). Nova Science Publishers.

Wilson, P. M., & Muon, S. (2008). Psychometric properties of the Exercise Identity Scale in a university sample. *International Journal of Sport and Exercise Psychology*, *6*(2), 115–131. https://doi.org/10.1080/1612197X.2008.9671857

Wilson, P. M., Rodgers, W. M., Loitz, C. C., & Scime, G. (2006). "It's who I am … really!" The importance of integrated regulation in exercise contexts. *Journal of Applied Biobehavioral Research*, *11*(2), 79–104. https://doi.org/10.1111/j.1751-9861.2006.tb00021.x

Wilson, P. M., Rogers, W. T., Rodgers, W. M., & Wild, T. C. (2006). The Psychological Need Satisfaction in Exercise Scale. *Journal of Sport & Exercise Psychology*, *28*(3), 231–251. https://doi.org/10.1123/jsep.28.3.231

Windschitl, P. D., & Wells, G. L. (1996). Measuring psychological uncertainty: Verbal versus numeric methods. *Journal of Experimental Psychology: Applied*, *2*(4), 343–364. https://doi.org/10.1037/1076-898X.2.4.343

Wu, A. D., & Zumbo, B. D. (2008). Understanding and using mediators and moderators. *Social Indicators Research, 87*(3), 367–392. https://doi.org/10.1007/s11205-007-9143-1

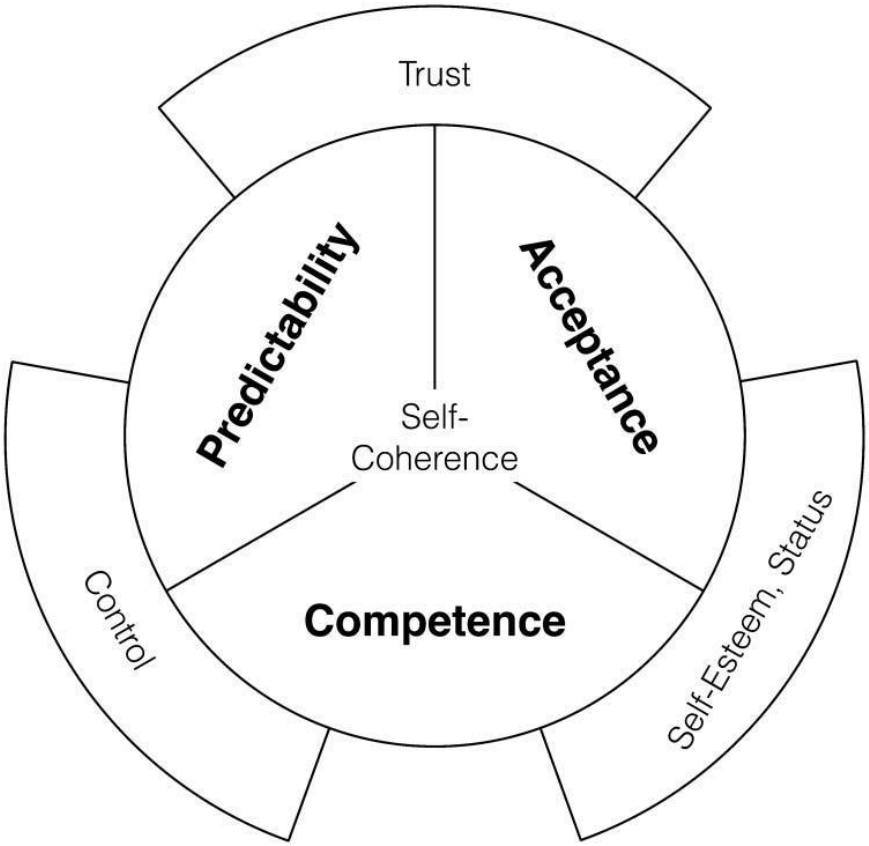
Zumbo, B. D. (2007). Validity: Foundational issues and statistical methodology. In C. R. Rao & S.

Sinharay (Eds.), *Handbook of Statistics: Vol. 26: Psychometrics* (pp. 45–79). Elsevier Science B. V.

Zumbo, B. D., Gadermann, A. M., & Zeisser, C. (2007). Ordinal versions of coefficients alpha and theta for Likert rating scales. *Journal of Modern Applied Statistical Methods*, *6*(1), 21–29. https://doi.org/10.22237/jmasm/1177992180

Figure 1

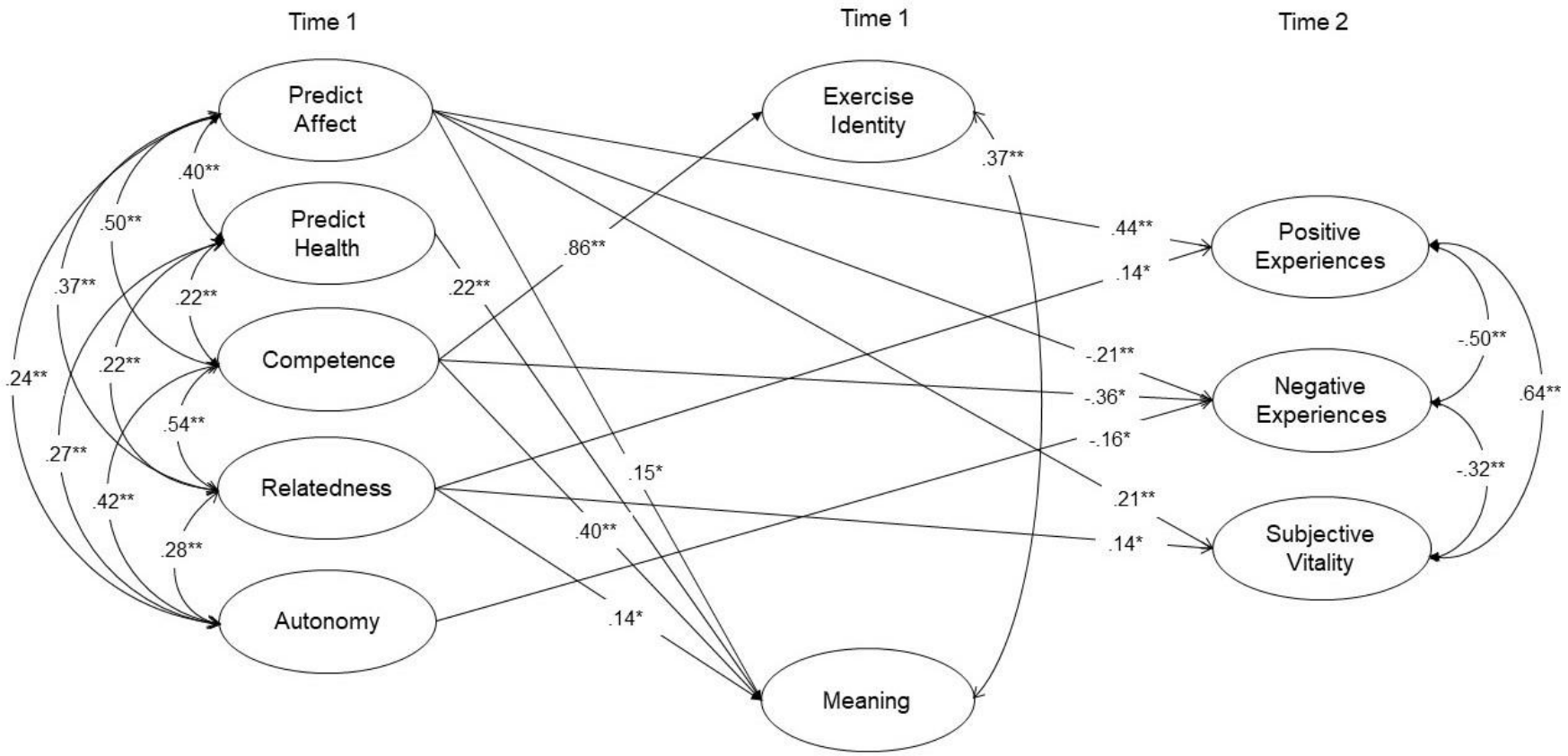
Dweck's (2017) Psychological Needs Model



Note. Dweck's(2017) psychological needs model. The model includes three basic needs (optimal predictability, acceptance, and competence), three compound needs (self-esteem/status, control, and trust), and the superordinate need for self-coherence at the epicenter of all needs within the model. Copyright © 2017 American Psychological Association. Reproduced with permission. Dweck, C.S. From needs to goals and representations: Foundations for a unified theory of motivation, personality, and development. Psychological Review, 124(6), 689–719.

Figure 2

Structural model of the relationships between prediction of affect, prediction of instrumental utility for health, competence, relatedness, exercise-related meaning, and exercise identity at Time 1, and exercise-related well-being at Time 2. Only significant standardized path coefficients are shown



Note. $^{**}p < .01$ $^{*}p < .05$

Table 1

Part 1 EFA Communalities and Geomin Rotated Pattern Coefficients of the Five-Factor Solution

Scale and Item	h^2	I	II	III	IV	V
Prediction of affect						
If you were to exercise tomorrow, please predict how satisfying it would be	.28	**0.31**	0.12	0.04	0.19	0.06
If you were to exercise tomorrow, please predict how pleasant it would be	.62	**0.78**	-0.03	-0.04	0.02	0.08
If you were to exercise tomorrow, please predict how enjoyable it would be	.88	**0.96**	0.00	-0.02	-0.04	-0.00
If you were to exercise tomorrow, please predict how fun it would be	.57	**0.64**	0.16	0.12	0.03	-0.08
Prediction of instrumental utility for health						
If you were to exercise tomorrow, please predict how beneficial it would be for your health	.48	0.06	**0.66**	-0.01	0.06	-0.04
If you were to exercise tomorrow, please predict how important it would be for your health	.63	-0.03	**0.81**	0.01	-0.07	0.01
If you were to exercise tomorrow, please predict how valuable it would be for your health	.87	-0.01	**0.94**	-0.00	-0.01	0.00
If you were to exercise tomorrow, please predict how worthwhile it would be for your health	.57	0.04	**0.72**	-0.02	0.03	0.04
ROPAS - Relatedness						
I am included by others	.71	-0.02	0.00	**0.88**	-0.08	0.06
I am part of a group who share my goals	.48	0.07	-0.01	**0.69**	0.01	-0.21
I am supported by others in this activity	.43	-0.01	0.06	**0.65**	0.01	-0.01
Others want me to be involved with them	.50	-0.14	0.00	**0.72**	0.04	0.01
I have developed a close bond with others	.56	0.01	-0.01	**0.74**	0.02	-0.06
I fit in well with others	.48	0.13	-0.02	**0.58**	0.08	0.06
IMI - Competence						
I think I am pretty good at exercising	.83	-0.02	0.02	0.01	**0.92**	-0.04
I think I do pretty well at exercising compared with others	.72	0.02	-0.01	-0.01	**0.85**	0.01
After working at exercise for a while, I feel pretty competent	.45	0.02	0.16	0.19	**0.41**	0.13
I am satisfied with my performance when exercising	.49	0.16	-0.02	0.08	**0.53**	0.09
I am pretty skilled at exercising	.79	-0.01	-0.01	-0.01	**0.91**	-0.02
PNSE - Autonomy						
I feel free to exercise in my own way	.62	0.00	-0.03	-0.02	0.17	**0.73**
I feel free to make my own exercise program decisions	.68	-0.03	0.01	0.01	0.03	**0.82**
I feel like I am in charge of my exercise program decisions	.67	0.05	-0.01	0.02	-0.01	**0.81**
I feel like I have a say in choosing the exercises that I do	.68	-0.01	0.04	0.01	0.00	**0.81**
I feel free to choose which exercises I participate in	.56	0.08	0.03	0.03	0.02	**0.70**
I feel like I am the one who decides what exercises I do	.62	-0.02	-0.00	-0.01	-0.04	**0.81**

Note. N = 559. ROPAS = Relatedness to Others in Physical Activity Scale; IMI = Intrinsic Motivation Inventory; PNSE = Psychological Need Satisfaction in Exercise Scale. Pattern coefficients in bold represent primary factor loadings of each item retained in the final solution.

Table 2

Part 1 Interfactor Correlations of the Five-Factor Solution

Variable	1	2	3	4	5
1. Prediction of affect	--				
2. Prediction of instrumental utility for health	0.37	--			
3. Relatedness	0.34	0.22	--		
4. Competence	0.47	0.22	0.54	--	
5. Autonomy	0.23	0.23	0.22	0.36	--

Note. All *p*s < .01

Supplementary Online Materials

Table S1

Findings from the Retrospective Think-Aloud Focus Groups Concerning the Optimal Predictability Items. Examples of Problems and Alterations to Items

Measure Component	Concern/suggestion	Examples	Action Taken
Instructions	The type of exercise is important when responding to the items	FG 1 "When I was thinking about this, I was thinking about the tough ones (exercise sessions), the ones that are not so pleasant." FG 1"If you have a different mindset and you're thinking of something fun (exercise) then it changes how you say how pleasant it would be, enjoyable it will be, depends on what you're thinking"	Included the instruction: "When answering the following questions, please think about the exercise you typically perform and your personal health"
Prediction of instrumental utility for health items	Participant indicated they were using general health knowledge as opposed to thinking about their own health when answering the instrumental health items	FG 1 "All the way to question 4 (affective items) like 4 was still personal from 5 and 6 it was more like general knowledge. Do you think exercise is good for you? Yeah	Included the instruction: "When answering the following questions, please think about the exercise you typically perform and your personal health"
FG 1 and 3 "if you were to exercise tomorrow, please indicate how useful it would be for your health"	Redundancy of the term 'useful' and 'beneficial'	FG 1 "useful and beneficial was very similar in my understanding" FG 3 "I thought of that one (beneficial) as exactly the same as useful, it (beneficial) meant the same thing as useful so I answered it in the same way"	Removed the item that used the term useful

FG 1 “if you were to exercise tomorrow, please indicate how exciting it would be”	Interpreting ‘exciting’ as before exercise as opposed to the experience while exercising.	FG 1 “Just how much I look forward to it.” FG 1 “just how much you are looking forward to it.” FG 2 “I always think about how exciting it would be as a before thing”	Changed the adjective from ‘exciting’ to ‘fun’
Question ordering	Response sets – responding the same way	FG 1 “The last questions at the end (instrumental items) I didn’t think much because it was like okay I got it	Participants are presented with the affect and instrumental items in an alternating fashion

Note: FG = Focus Group.

Table S2

Findings From The Retrospective "Think-Aloud" Focus Groups Concerning Exercise-Related Meaning Items. Examples Of Problems And Alterations To Items

Item	Concern/suggestion	Examples	Action taken
FG 5 "I understand how exercising contributes to my life's meaning"	Exercising is not the only thing that contributes to the meaning in one's life.	FG 5 "When you think of your life meaning you tend to think of one single purpose so then this is not my single purpose, not to exercise, but it still contributes in a meaningful way so I guess I wasn't sure" FG 5 "its how exercising contributes to part of my life's meaning" "is this my sole purpose?"	Adapted item to reflect that exercising is not the only source of meaning in one's life: "I understand how exercising can contribute my life's meaning"
FG 5 "I feel that exercising helps me make sense of the world around me"	Did not see the connection between exercising and making sense of one's world	"I feel like number 7, it's hard to make the connection between exercising and what's going on in the world. I didn't really know what to make of that"	Adapted item: I feel that exercising helps me make sense of my life. Eventually deleted item (see below)
FG 6 "I feel that exercising helps me better understand myself" "I feel that exercising helps me make sense of my life"	Items not relevant to exercise	FG 6 "But I don't feel like the exercise itself is the thing that makes me better understand myself or make sense of my life"	Deleted both items
FG 6 "I have found exercise that is meaningful to me"	The use of 'I have found exercise'	FG 6 "I found that it was related to the type of exercise. I have found exercise that is meaningful to me. Like I like doing Zumba because it's fun so it's meaningful to me or I accomplished a goal by doing a triathlon and that's meaningful to	Item changed to: "I have found a type of exercise that is meaningful to me"

	me. So maybe it needs to be that I have found a type of exercise or an exercise activity?”

Note: FG = Focus Group.

Table S3

Final Exercise-Related Meaning Items used in Part 2

Item
1. I have found a type of exercise that is meaningful to me
2. I understand how exercising can contribute to my life's meaning
3. I have a good sense of what makes exercising meaningful
4. I have discovered exercise that has a satisfying purpose
5. I feel that exercising contributes to my personal growth

Table S4

Part 2 Interfactor Correlations Among Latent Variables in Structural Equation Model

Variable	1	2	3	4	5	6	7	8
1. Prediction of Affect	--							
2. Prediction of Instrumental Utility for Health	.40	--						
3. Relatedness	.36	.22	--					
4. Competence	.50	.22	.54	--				
5. Autonomy	.24	.27	.28	.42	--			
6. Positive Exercise Experiences	.59	.28	.39	.43	.25	--		
7. Negative Exercise Experiences	-.31	-.21	-.17	-.30	-.29	-.56	--	
8. Subjective Vitality	.45	.32	.40	.43	.27	.75	-.43	--

Note. All *p*s < .01

Table S5

Part 2 Direct and Indirect (Total and Specific) Effects in Mediation Model

Variables	Standardized Estimate	Standard Error	*p*-Value	Bias Corrected Bootstrapped 95% Confidence Interval
Direct Effects				
Predictors to Exercise Identity				
Prediction of Affect	.065	.051	.202	[-.036, .162]
Prediction of Instrumental Utility	.002	.038	.948	[-.070, .083]
Relatedness	.013	.049	.785	[-.080, .109]
Competence	.862	.044	**<.001**	**[.773, .947]**
Autonomy	-.048	.044	.277	[-.137, .035]
Predictors to Exercise-Related Meaning				
Prediction of Affect	.151	.065	**.019**	**[.024, .277]**
Prediction of Instrumental Utility	.216	.055	**<.001**	**[.110, .328]**
Relatedness	.137	.066	**.037**	**[.010, .265]**
Competence	.396	.070	**<.001**	**[.261, .538]**
Autonomy	.069	.056	.219	[-.042, .183]
Predictors and Mediators to Positive Exercise Experiences				
Prediction of Affect	.435	.070	**<.001**	**[.298, .570]**
Prediction of Instrumental Utility	.001	.064	.982	[-.134, .119]
Relatedness	.137	.069	**.048**	**[.002, .277]**
Competence	.022	.148	.884	[-.256, .331]
Autonomy	.039	.058	.499	[-.076, .155]
Exercise Identity	.020	.152	.893	[-.271, .314]
Exercise-Related Meaning	.138	.084	.100	[-.024, .308]
Predictors and Mediators to Negative Exercise Experiences				
Prediction of Affect	-.212	.081	**.009**	**[-.368, -.050]**
Prediction of Instrumental Utility	-.073	.076	.340	[-.223, .075]
Relatedness	.031	.076	.682	[-.126, .173]
Competence	-.363	.168	**.030**	**[-.698, -.048]**
Autonomy	-.163	.074	**.026**	**[-.303, -.016]**
Exercise Identity	.278	.174	.110	[-.070, .617]
Exercise-Related Meaning	.005	.101	.963	[-.192, .205]
Predictors and Mediators to Subjective Vitality				
Prediction of Affect	.212	.071	**.003**	**[.073, .357]**
Prediction of Instrumental Utility	.096	.057	.094	[-.021, .201]
Relatedness	.143	.071	**.045**	**[.005, .284]**
Competence	.045	.152	.768	[-.242, .360]
Autonomy	.048	.063	.450	[-.080, .169]
Exercise Identity	.061	.148	.679	[-.232, .351]
Exercise-Related Meaning	.167	.088	.057	**[.001, .344]**
Indirect Effects				
Prediction of Affect to Positive Exercise Experiences				
Total Indirect Effects	.022	.017	.193	[-.004, .065]

Specific Indirect Effects				
Exercise Identity	.001	.013	.919	[-.020, .038]
Exercise-Related Meaning	.021	.016	.192	[-.001, .066]
Prediction of Instrumental Utility to Positive Exercise Experiences				
Total Indirect Effects	.030	.021	.157	[-.004, .084]
Specific Indirect Effects				
Exercise Identity	.000	.006	.993	[-.012, .014]
Exercise-Related Meaning	.030	.020	.144	[.000, .088]
Relatedness to Positive Exercise Experiences				
Total Indirect Effects	.019	.017	.259	[-.004, .067]
Specific Indirect Effects				
Exercise Identity	.000	.007	.971	[-.013, .019]
Exercise-Related Meaning	.019	.016	.223	[-.001, .067]
Competence to Positive Exercise Experiences				
Total Indirect Effects	.072	.120	.547	[-.155, .308]
Specific Indirect Effects				
Exercise Identity	.018	.132	.894	[-.236, .273]
Exercise-Related Meaning	.055	.035	.120	[-.008, .133]
Autonomy to Positive Exercise Experiences				
Total Indirect Effects	.009	.015	.578	[-.018, .046]
Specific Indirect Effects				
Exercise Identity	-.001	.010	.919	[-.028, .015]
Exercise-Related Meaning	.010	.011	.370	[-.003, .045]
Prediction of Affect to Negative Exercise Experiences				
Total Indirect Effects	.019	.024	.434	[-.021, .078]
Specific Indirect Effects				
Exercise Identity	.018	.021	.380	[-.006, .081]
Exercise-Related Meaning	.001	.017	.967	[-.031, .039]
Prediction of Instrumental Utility to Negative Exercise Experiences				
Total Indirect Effects	.002	.025	.946	[-.048, .058]
Specific Indirect Effects				
Exercise Identity	.001	.013	.957	[-.021, .034]
Exercise-Related Meaning	.001	.022	.963	[-.040, .050]
Relatedness to Negative Exercise Experiences				
Total Indirect Effects	.004	.022	.840	[-.039, .047]
Specific Indirect Effects				
Exercise Identity	.004	.016	.820	[-.022, .046]
Exercise-Related Meaning	.001	.015	.966	[-.030, .034]
Competence to Negative Exercise Experiences				
Total Indirect Effects	.241	.143	.091	[-.031, .535]
Specific Indirect Effects				
Exercise Identity	.239	.154	.120	[-.057, .552]
Exercise-Related Meaning	.002	.041	.964	[-.076, .086]
Autonomy to Negative Exercise Experiences				
Total Indirect Effects	-.013	.021	.540	[-.072, .018]
Specific Indirect Effects				

Exercise Identity	-.013	.018	.456	[-.074, .006]
Exercise-Related Meaning	.000	.009	.971	[-.017, .023]
Prediction of Affect to Subjective Vitality				
Total Indirect Effects	.029	.019	.117	**[.001, .075]**
Specific Indirect Effects				
Exercise Identity	.004	.013	.761	[-.013, .044]
Exercise-Related Meaning	.025	.017	.147	**[.002, .073]**
Prediction of Instrumental Utility to Subjective Vitality				
Total Indirect Effects	.036	.023	.113	[.000, .092]
Specific Indirect Effects				
Exercise Identity	.000	.006	.980	[-.011, .015]
Exercise-Related Meaning	.036	.022	.094	**[.004, .096]**
Relatedness to Subjective Vitality				
Total Indirect Effects	.024	.019	.209	[-.003, .076]
Specific Indirect Effects				
Exercise Identity	.001	.008	.919	[-.010, .026]
Exercise-Related Meaning	.023	.017	.173	**[.001, .075]**
Competence to Subjective Vitality				
Total Indirect Effects	.119	.117	.309	[-.115, .343]
Specific Indirect Effects				
Exercise Identity	.053	.129	.682	[-.204, .307]
Exercise-Related Meaning	.066	.038	.080	**[.003, .154]**
Autonomy to Subjective Vitality				
Total Indirect Effects	.009	.017	.616	[-.021, .049]
Specific Indirect Effects				
Exercise Identity	-.003	.010	.764	[-.037, .010]
Exercise-Related Meaning	.012	.013	.358	[-.003, .052]