Testing Self-Determined Motivation as a Mediator of the Relationship Between Psychological Needs and Affective and Behavioral Outcomes

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Self-determination theory suggests that when psychological needs for autonomy, competence, and relatedness are met, participants experience more self-determined types of motivation and more positive outcomes. Limited research has examined this mediational role of self-determined motivation in adult physical activity participants, and very few studies have included assessments of relatedness. This study tested the hypothesis that self-determined motivation would mediate the relationship between psychological need fulfillment and affective and behavioral outcomes. Adult dragon boaters (N = 558) between the ages of 19 and 83 completed a questionnaire on motivational aspects of dragon boating. Competence, relatedness, and autonomy all significantly predicted self-determined motivation, but self-determined motivation only partially mediated their relationship with positive and negative affect. These findings demonstrate the importance of all three needs in adult activity motivation and suggest that the relationships between needs, self-determination, and outcomes may be complex.

Key Words: relatedness, competence, autonomy, dragon boat

Whereas there is a large body of research on physical activity motivation, few studies have explored the combined role of self and social perceptions in adult activity contexts. Self-determination theory (SDT; Deci & Ryan, 1985, 1991) provides one framework in which the relationships among self and social perceptions, physical activity motivation, behavior, and affective experiences can be understood. The theory suggests that (1) motivation is a multidimensional construct and that different types of motivation have different effects on cognitive, affective, and behavioral outcomes and (2) the type of motivation experienced is influenced by how well a person’s basic psychological needs for autonomy, competence, and relatedness are met in a particular context (Deci & Ryan, 1991). Vallerand and Losier (1999)
have outlined a motivational sequence based on SDT suggesting that aspects of the social context lead to psychological need fulfillment, which influences motivation, and motivation predicts cognitive, affective, and behavioral consequences. This model suggests that all three psychological needs contribute to the prediction of motivation and that motivation mediates the relationship between psychological need fulfillment and outcomes.

One of the central concepts in SDT suggests that there is a continuum of qualitatively different types of motivation. Amotivation occurs when one perceives that there is no connection between one’s actions and outcomes. There are four types of extrinsic motivation that represent increasingly self-determined motives: external, introjected, identified, and integrated regulation. External regulation is when behaviors are performed to fulfill an external demand, achieve a reward, or avoid punishment. Introjected regulation happens when an individual internalizes external demands and rewards or punishes his or her own behavior in accordance with those learned demands. In identification, behaviors are performed because they are seen to be of personal importance and value. Integrated regulation occurs when behaviors are considered part of the self, but are still performed for some instrumental value. Intrinsic motivation is at the most self-determined end of the continuum, and refers to performing a behavior for its own sake, because it is inherently satisfying, interesting, or enjoyable (Deci & Ryan, 1991).

More self-determined forms of motivation are associated with more positive cognitive, affective, and behavioral outcomes (Deci & Ryan, 1991). Specifically, more self-determined motivation is expected to link to affect and activity behavior because participating for personally valued reasons under one’s own control is expected to be a more satisfying, positive experience, and participation in activity should be higher if it is internally and volitionally driven (Deci & Ryan, 1985). Links to physical self-worth were predicted because self-determination implies that an individual is acting in line with their sense of self, and a strong sense of self has been shown to be linked to self-determined motivation (Kernis, Paradise, Whitaker, Wheatman, & Goldman, 2000). Research in the physical activity domain in particular has supported the links between self-determined motivation and positive affect, physical self-worth, and physical activity (e.g., Vlachopoulos, Karageorghis, & Terry, 2000; Wilson & Rodgers, 2002; Wilson, Rodgers, Blanchard, & Gessell, 2003).

Self-determination theory also proposes that the degree to which a participant’s needs for autonomy, competence, and relatedness are fulfilled in a physical activity context will promote the development of self-determined motivation and psychological well-being (Deci & Ryan, 1985; Ryan & Deci, 2000). The need for autonomy is met when people feel agentic and that they are the origin of their own behavior (Deci & Ryan, 1991). Feeling volitional is necessary to sustain motivated behavior and effective functioning (Deci & Ryan, 1985). Competence needs are satisfied when people feel effective at interacting with the social environment and achieving desired outcomes. Feelings of competence are necessary for individuals to approach optimal challenges that allow them to learn and develop (Deci & Ryan, 1985). The need for relatedness is satisfied when people authentically connect with others and feel involved in the social context (Deci & Ryan, 1991). Relatedness is essential for optimal social and emotional development (Baumeister & Leary, 1995). Autonomy, competence, and relatedness are considered basic needs because
their fulfillment is necessary for optimal psychological well-being and development (Ryan & Deci, 2002).

Numerous studies in the physical activity context support the links between competence and autonomy and self-determined motivation (Gagne, Ryan, & Bargmann, 2003; Kowal & Fortier, 1999, 2000; Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002; Wilson, Rodgers, & Fraser, 2002). There is, however, less evidence about the link between relatedness and self-determined motivation (Frederick-Recasino, 2002). Research in the physical activity context has been inconsistent across studies. Some research with adolescents in the sport context has found that relatedness is a weak (e.g., Ntoumanis, 2001; Sarrazin et al., 2002) or a nonsignificant (Reinboth, Duda, & Ntoumanis, 2004) predictor of self-determined motivation. Similarly, work with adults in exercise classes has found that relatedness is the weakest predictor of self-determined motivation of the three needs (Wilson et al., 2002), or is not associated with motivation (Wilson et al., 2003). In contrast, work with masters age swimmers (Kowal & Fortier, 2000) and physical education students (Standage, Duda, & Ntoumanis, 2003) found that competence and relatedness are stronger predictors of self-determined motivation than autonomy. These inconsistent results across different types and structures of activity support the suggestion that the importance of relatedness as a predictor may be influenced by the social nature of the activity (Vallerand, 2000), but this idea has not been tested. In addition, issues surrounding measuring psychological needs may be contributing to these varied findings. The studies cited above have used a variety of measures, and only recently has a tool been developed to measure psychological need fulfillment in a physical activity context specifically (Wilson, Rogers, Rodgers, & Wild, 2006).

Work in the physical activity context has not directly tested the proposition inherent in Vallerand and Losier’s (1999) model that self-determined motivation mediates the effects of psychological need fulfillment on affective and behavioral outcomes. Research has supported the mediator model (Kowal & Fortier, 2000; Ntoumanis, 2001; Sarrazin et al., 2002; Standage et al., 2003), but previous work has not fully tested the mediation hypothesis. In order to appropriately test mediation, it is necessary to demonstrate that (1) there is a significant relationship between psychological needs and outcomes; (2) there is a significant relationship between self-determined motivation and outcomes; and (3) when self-determined motivation is included in the model, the direct effects of psychological needs on outcomes is substantially reduced (i.e., partial mediation) or rendered nonsignificant (i.e., full mediation; Holmbeck, 1997). Most previous research has only tested a model where self-determined motivation is included and specified as a mediator, and has excluded testing direct effects between psychological needs and outcomes, and therefore also potential partial mediation (Kowal & Fortier, 2000; Ntoumanis, 2001; Sarrazin et al., 2002; Standage et al., 2003). Therefore, the mediation model has not been fully verified. It is important to test whether the effect of psychological needs on outcomes is fully mediated by self-determined motivation or whether there are also direct effects of psychological needs on outcomes so that we can begin to better understand the mechanisms occurring within SDT, and the role of psychological needs as predictors.

Examining how all three psychological needs impact motivation and outcomes in physical activity among adults could enhance the understanding of physical
activity motivation. The purpose of this study was to examine how relatedness, autonomy, and competence predict self-determined motivation and affective and behavioral outcomes (positive and negative affect, physical self-worth, and physical activity), and whether self-determined motivation acts as a mediator in this process. It was hypothesized that (1) relatedness, autonomy, and competence would be positive predictors of self-determined motivation, and (2) that self-determined motivation would mediate the relationships between psychological need fulfillment (autonomy, competence, and relatedness) and affective and behavioral outcomes (positive and negative affect, physical self-worth, and physical activity).

These questions were explored in the context of the physical activity of dragon boating. A dragon boat is a large canoelike boat that holds approximately 20 paddlers, a steersperson, and a drummer or caller. Dragon boating is a very popular activity among adults in Vancouver, where this study was conducted. It attracts a diverse range of adults with a variety of fitness and ability levels, ages, and gender because it is a novel activity that is both accessible to the novice and challenging to the more experienced paddler (McKenzie, 1998). It is also a large group physical activity that requires participants to work together to achieve a common goal, so questions pertaining to relatedness are likely relevant for participants.

Methods

Participants

A total of 558 dragon boat paddlers aged 19 to 83 years (M age = 45.09, SD = 14.74) from 75 different dragon boat teams took part in this study. The majority of participants (n = 400, 72%) were female and self-identified as primarily Caucasian (70%) and Asian (24%). Participants tended to be highly educated, with 88% of the sample having at least some postsecondary education. On average, they had been involved in dragon boating for 3.62 years (SD = 3.46), and on their current team for an average of 2.54 years (SD = 2.23). They typically practiced 1.90 times per week (SD = .66), an average of 6.80 (SD = 2.77) months per year.

Procedures

Following approval by the university research ethics board, coaches were contacted by e-mail. The researcher met with teams at practices to distribute consent forms and questionnaires to interested participants. Volunteers completed the questionnaires and returned them to the researcher by mail. Two reminder e-mails were sent, and 45% of questionnaires were returned.

Measures

The questionnaire package contained instruments assessing psychological need satisfaction, self-determined motivation, positive and negative affect, physical self-worth, physical activity, demographic information, and dragon boat history. As this study was part of a larger research program, questions pertaining to social
support, peer acceptance, and friendship quality were also included, but are not discussed here. All questions except for physical self-worth and physical activity were modified to ask participants to answer considering their experiences in dragon boat specifically.

**Psychological Need Satisfaction**

The Psychological Need Satisfaction in Exercise scale (PNSE; Wilson et al., 2006) was used to assess participants’ perceptions of how well their needs for autonomy, competence, and relatedness were satisfied in the dragon boat context. The PNSE was developed within the SDT framework for use in exercise contexts. The scale has 18 items, with 6 items assessing each of the three psychological needs on a 6-point Likert scale. Evidence supporting the three-factor structure of this scale, the reliability of each scale, and convergence with other measures of psychological needs has been found in research with undergraduate students (Wilson et al., 2006).

**Self-Determined Motivation**

The Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997) was used to assess motivation in the dragon boat context. The BREQ contains 15 items measuring four types of motivation: external regulation, introjected regulation, identified regulation, and intrinsic motivation. Participants responded to each question on a 5-point Likert scale. A composite index of self-determined motivation, the relative autonomy index (RAI; Grolnick & Ryan, 1987), was calculated to facilitate testing the hypotheses with a single index of motivation. The RAI is based on the premise that there is a quasi-simplex relationship among the motivation types on the self-determination continuum, and that more self-determined forms of motivation are more positive. It is calculated using the individual scale average scores as follows:

\[
RAI = (-2 \times \text{External}) + (-1 \times \text{Introjected}) + (1 \times \text{Identified}) + (2 \times \text{Intrinsic})
\]

Relative autonomy index scores range from −15 (strongly not self-determined) to 15 (highly self-determined). The RAI has been recommended as a conceptually meaningful way of scoring the BREQ (Mullan et al., 1997) and has been used frequently in physical activity research (e.g., Gagne et al., 2003; Ingledew, Markland, & Sheppard, 2004; Kowal & Fortier, 2000).

**Positive and Negative Affect**

Positive and negative affect was assessed using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The scale contains 20 items measuring two factors, positive and negative affect, on a 5-point Likert scale. This scale has been used extensively with adults across the lifespan (Mackinnon et al., 1999), and evidence supporting internal consistency and discriminant validity of the two factors has been found with adults in the general population (Watson et al., 1988).
Physical Self-Worth

The physical self-worth subscale of the Physical Self-Description Questionnaire (PSDQ; Marsh, Richards, Johnson, Roche, & Tremayne, 1994) was used to assess physical self-worth. The PSDQ contains six items scored on a 6-point Likert scale. It was originally developed with adolescents, but has since been employed successfully with adult populations in physical activity contexts (e.g., Marsh, Asci, & Tomas, 2002; Wilson & Rodgers, 2002). This research has found evidence supporting internal consistency and convergent validity when compared with other measures of physical self-worth (Marsh et al., 2002).

Physical Activity

The first three items of the Leisure Time Exercise Questionnaire (LTEQ; Godin & Shepherd, 1985) were used to assess physical activity behavior. These items assess the number of times in the last week that participants engaged in more than 15 min of mild, moderate, and strenuous physical activity, respectively. Total exercise is calculated by multiplying the frequency of exercise at each intensity by its associated metabolic equivalent of exercise (MET) value of 3 (mild), 5 (moderate), and 9 (strenuous) and summing the products to yield a total MET score. Previous research using this scale with adults of varying activity levels has demonstrated that it is easy for participants to understand and complete and it has expected relationships with other measures of physical activity and physical fitness (Jacobs, Ainsworth, Hartman, & Leon, 1993).

Data Analysis

The data were screened, and descriptive statistics, scale reliabilities, and Pearson product–moment correlations were calculated. Evidence for the structural validity of the scales was examined using confirmatory factor analysis. Mediation was tested using structural equation modeling with LISREL 8.50 (Joreskog & Sorbom, 2001). A measurement model was tested where all latent variables were allowed to freely correlate. Three structural models were tested based on recommendations by Holmbeck (1997). First, a direct effects model was tested where the independent variables (autonomy, competence, and relatedness) predicted the dependent variables (positive and negative affect, physical self-worth, and physical activity). The fit indices associated with this model had to be acceptable and the structural path coefficients had to be significant to support mediation. Second, a mediator model was tested with self-determined motivation mediating the relationships between the independent and dependent variables. Again, this model had to fit adequately and structural path coefficients had to be significant to support mediation. Third, a combined effects model with both direct effects and mediated effects was tested. A $\chi^2$ difference test was performed to test whether the model in Step 3 fit was significantly better than the model in Step 2. If the Step 2 model fit best, complete mediation is supported. If the Step 3 model fit best, there is only partial mediation. The direct effects path coefficients in Step 3 should be reduced to nonsignificance as compared with those in the Step 1 model in the case of full mediation, or reduced in magnitude but remain significant in the case of partial mediation (Holmbeck, 1997).
Maximum likelihood estimation was used, as it has been recommended for research focusing on theory testing, such as the present study, because it provides efficient parameter estimates and global indices of model fit (Anderson & Gerbing, 1988). Global fit was assessed by examining the root mean square error of approximation (RMSEA), comparative fit index (CFI), and standardized root mean residual (SRMR) indices. All fit indices have limitations, and some work better than others under certain conditions such as various types of misspecification and nonnormality. For example, RMSEA and CFI are the most sensitive to misspecified factor loadings, whereas SRMR is most sensitive to errors in the structural components of models, so a combination of these indices provides a more comprehensive sense of model fit than any one index alone (Tabachnick & Fidell, 2007). An RMSEA of ≤.05 was considered a good fit; >.05 to ≤.08, a reasonable fit; >.08 to ≤.10, mediocre; and >.10, poor (Byrne, 1998). Comparative fit index values equal to or greater than .90 were considered a good fit (Byrne, 1998). Standardized root mean residual values less than or equal to .05 were considered a good fit (Byrne, 1998). The magnitude of mediated relationships in the model was further examined using direct, indirect, and total effects in the final model.

**Results**

**Data Screening**

Only 0.6% of the data points were missing, and missingness was uncorrelated with any of the variables in the data set. Therefore, person mean substitution was used to impute missing data for items on all variables that had at least 50% of the items in a particular scale present (Hawthorne & Elliott, 2005). Listwise deletion was used in cases with greater than 50% of items missing on any scale, resulting in a total sample size of $N = 539$, or 97% of the original sample. The distributions of all variables were examined using skew and kurtosis statistics (see Table 1) and by examining box plots of each variable for outliers. All skew and kurtosis values except for skew of external regulation and the kurtosis of negative affect and external regulation were $<|2|$ and were therefore considered acceptable (Miles & Shevlin, 2001). Given that non-normal kurtosis values do not tend to bias results by underestimating variance when the sample size is larger than 200 (Tabachnick & Fidell, 2007) and external regulation was only used as part of the composite RAI score, which was not skewed, these departures from normality were not considered problematic in this study. Furthermore, no extreme outliers were identified during visual examination of the box plots.

**Scale Reliability and Structural Validity**

As shown in Table 1, all scales demonstrated adequate internal consistency (Nunnally, 1978) except for external regulation, which was very close to the .70 cutoff. Confirmatory factor analyses of the PNSE, BREQ, and PANAS were conducted to assess the structural validity of these scales as adapted for the dragon boat context. The PNSE had a mediocre overall fit—RMSEA = .10, CFI = .93, SRMR = .06—slightly poorer but similar to previous results with undergraduate students using the original exercise version of the scale (Wilson et al., 2006). The BREQ
### Table 1  Correlations, Descriptive Statistics, Skew, Kurtosis, Scale Reliabilities, and Scale Ranges

<table>
<thead>
<tr>
<th>Subscale</th>
<th>1</th>
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<th>11</th>
<th>12</th>
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<td>Autonomy</td>
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<td>.22*</td>
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<tr>
<td>External regulation</td>
<td>−.11*</td>
<td>−.18*</td>
<td>−.07</td>
<td>—</td>
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<tr>
<td>Introjected regulation</td>
<td>.01</td>
<td>−.12*</td>
<td>−.06</td>
<td>.25*</td>
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<tr>
<td>Identified regulation</td>
<td>.46*</td>
<td>.34*</td>
<td>.15*</td>
<td>−.10*</td>
<td>.19*</td>
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<tr>
<td>Intrinsic motivation</td>
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<td>.42*</td>
<td>.25*</td>
<td>−.18*</td>
<td>.04</td>
<td>.53*</td>
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<td>Motivation (RAI)</td>
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<td>.45*</td>
<td>.24*</td>
<td>−.61*</td>
<td>−.42*</td>
<td>.59*</td>
<td>.76*</td>
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<td>Positive affect</td>
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<td>.52*</td>
<td>.16*</td>
<td>−.15*</td>
<td>.06</td>
<td>.57*</td>
<td>.61*</td>
<td>.55*</td>
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<td>.21*</td>
<td>−.08*</td>
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<td>.09*</td>
<td>−.12*</td>
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<td>.18*</td>
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<td>.27*</td>
<td>.23*</td>
<td>−.17*</td>
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<td>.12*</td>
<td>.05</td>
<td>.10*</td>
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<td>.01</td>
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<td><strong>M</strong></td>
<td>5.11</td>
<td>5.30</td>
<td>3.87</td>
<td>1.20</td>
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<td>3.97</td>
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<td>1.22</td>
<td>.45</td>
<td>.98</td>
<td>.85</td>
<td>.62</td>
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<td>.54</td>
<td>.33</td>
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<td>3.26</td>
<td>.87</td>
<td>−.81</td>
<td>−1.80</td>
<td>−1.02</td>
<td>−.56</td>
<td>1.50</td>
<td>−.90</td>
<td>.80</td>
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<td>−.40</td>
<td>12.96</td>
<td>−.03</td>
<td>−.10</td>
<td>3.54</td>
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<td>.12</td>
<td>3.31</td>
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<tr>
<td><strong>α</strong></td>
<td>.88</td>
<td>.92</td>
<td>.86</td>
<td>.68</td>
<td>.73</td>
<td>.80</td>
<td>.90</td>
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<td>.97</td>
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<td>1 to 5</td>
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<td>−15 to 15</td>
<td>1 to 5</td>
<td>1 to 5</td>
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*p < .05.
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(RMSEA = .07, CFI = .96, SRMR = .07) demonstrated a reasonable fit to the data, and provided results very similar to those found with the original version of the scales with exercising adults (Mullan et al., 1997). The PANAS demonstrated a mediocre but acceptable fit (RMSEA = .09, CFI = .90, SRMR = .07).

Descriptive Statistics and Correlations

Means, standard deviations, and correlations were calculated for all variables and are reported in Table 1. Compared with previous work with the PNSE (Wilson et al., 2006), the mean score for competence was similar, whereas relatedness was somewhat higher and autonomy lower. In addition, the correlations among the three needs were higher for the associations between both competence and autonomy with relatedness, but lower between autonomy and competence. Despite these differences in magnitude, all the relationships were in the expected direction, and some differences may be due to the different populations examined, as Wilson and colleagues (2006) were studying undergraduate students’ motivation for exercise. Based on the mean RAI score, participants tended to be relatively self-determined. They were also fairly active, with physical activity means similar to the healthy, active adult population with which the LTEQ was originally developed (Godin & Shephard, 1985).

The three needs were all moderately and positively related to self-determined motivation, and correlations in the expected direction were found between the relative autonomy index and each of the four outcomes. Furthermore, the correlations among the individual BREQ subscales displayed a quasi-simplex pattern. That is, regulation types lying closer together on the self-determined continuum had more positive correlations than regulation types that were farther apart on the continuum. This pattern provides support for the use of the RAI as a summary index of motivation, as the weighting of regulation types in this score are based on the assumption of simplex structure. These correlation patterns are consistent with theoretically expected relationships and the hypotheses of this study. There were also moderate correlations between relatedness and competence need fulfillment and positive and negative affect and physical self-worth, suggesting that direct effects were also possible.

Testing Mediation

Structural equation modeling with maximum likelihood estimation was used to test the hypotheses. Given that the measurement model provided a reasonable fit to the data—RMSEA .06, CFI .88, SRMR .06—the structural models were tested without any further modification. Testing for mediation was a three-step process examining (1) a direct effects model; (2) a mediator model; and (3) a combined model with both direct effects and mediator effects, along with a comparison of the models and their pathways.2

The results of the direct effects model test are presented in Figure 1. The RMSEA indicated a reasonable fit, although the CFI was lower and SRMR slightly higher than the criteria for good fit, RMSEA = .06, CFI = .87, SRMR = .06. The model predicted 44% of the variance in positive affect, 13% of negative affect, 18% of physical self-worth, and 4% of physical activity. However, only 7 of the
12 direct paths were significant. Positive affect was predicted by competence and relatedness, negative affect was predicted by autonomy and competence, and physical self-worth and physical activity were predicted by competence. In cases where no direct relationship exists, it is impossible for self-determined motivation to be a mediator.

The results of the mediator model test are presented in Figure 2. This model provided a slightly worse fit than the direct effects model, with the RMSEA indicating a reasonable fit and the CFI and SRMR not meeting the good fit criteria, RMSEA = .07, CFI = .86, SRMR = .09. All the paths in this model were significant, suggesting that in cases where direct relationships were found in Step 1, mediation by self-determined motivation was possible. This model predicted 33% of the variance in motivation, 34% of positive affect, 17% of negative affect, 7% of physical self-worth, and 1% of physical activity. In all cases except negative affect, the variance accounted for was less than that accounted for in the direct effects model, suggesting that there is at least some direct effect in addition to the possible mediated effects, of the three psychological needs on the outcome variables.

The results of the combined effects test are found in Figure 3. This model again provided a reasonable fit based on RMSEA criteria, with the CFI and SRMR
indicating a less than good fit, RMSEA = .07, CFI = .86, SRMR = .09. A χ² difference test demonstrated that the combined effects model had a significantly better fit than the mediator model, Δχ²(−12) = −207.85, p < .01. This suggests that the relationships between the three psychological needs and the outcome measures were not mediated, or were only partially mediated by self-determined motivation. To determine whether particular relationships in the model were partially mediated by motivation or were better represented by direct paths, the completely standardized parameter estimates in the combined effects and direct effects models were compared, and direct and indirect effects from the final model were examined (Holmbeck, 1997).

In the combined effects model, positive affect (R² = .51) was predicted by competence (γ = .29), relatedness (γ = .28), and motivation (β = .32). Compared with the direct effects model, the path coefficient for competence predicting positive affect decreased by .10, suggesting that this effect is partially mediated by self-determined motivation. The significance of both the direct (see Figure 3) and indirect (see Table 2) effects of competence on positive affect further supports partial mediation by motivation. Indirect effects account for 24% of the total effects of competence on positive affect, suggesting that even though direct effects are dominant, indirect effects do account for a substantial portion of the prediction of positive affect. Similarly, the direct effect of relatedness on positive affect decreased by .10 in the combined versus direct effects model, also suggesting partial mediation

Figure 2 — Mediation model. RMSEA = .07, CFI = .86, SRMR = .09. Solid lines indicate significant relationships (p < .05), and dotted lines indicate nonsignificant relationships.
by motivation. Again, both indirect and direct effects were significant in the final model (see Figure 3 and Table 2), with 26% attributed to indirect effects. Competence ($\gamma = -0.22$) and motivation ($\beta = -0.43$) predicted 21% of the variance in negative affect. The direct effect of competence predicting negative affect decreased from $-0.32$ in the direct effects model to $-0.22$ in the mediator model, again suggesting that this relationship is partially mediated by motivation. In this case, 31% of the total effects were attributed to the indirect effect of competence on negative affect, supporting partial mediation (see Table 2). In the direct effects model, autonomy was also a significant predictor of negative affect ($\gamma = -0.12$; see Figure 1), but this effect was eliminated in the combined effects model, suggesting complete mediation of this relationship by motivation. An examination of the indirect effects supports full mediation of the effect of autonomy on negative affect.
Testing Mediation by Self-Determination

Table 2  Completely Standardized Indirect Effects and t Values for the Combined Effects Model

<table>
<thead>
<tr>
<th>Indirect relationship</th>
<th>Indirect effect</th>
<th>t value</th>
<th>Total effects</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy → Positive affect</td>
<td>.04</td>
<td>2.67*</td>
<td>−.01</td>
<td>−.17</td>
</tr>
<tr>
<td>Autonomy → Negative affect</td>
<td>−.04</td>
<td>−2.61*</td>
<td>−.13</td>
<td>−2.42*</td>
</tr>
<tr>
<td>Autonomy → Physical self-worth</td>
<td>.01</td>
<td>1.51</td>
<td>.03</td>
<td>.57</td>
</tr>
<tr>
<td>Autonomy → Physical activity</td>
<td>.00</td>
<td>.58</td>
<td>−.07</td>
<td>−1.38</td>
</tr>
<tr>
<td>Autonomy → Motivation (RAI)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Competence → Positive affect</td>
<td>.09</td>
<td>4.86*</td>
<td>.38</td>
<td>7.93*</td>
</tr>
<tr>
<td>Competence → Negative affect</td>
<td>−.10</td>
<td>−4.39*</td>
<td>−.32</td>
<td>−5.27*</td>
</tr>
<tr>
<td>Competence → Physical self-worth</td>
<td>.03</td>
<td>1.72</td>
<td>.40</td>
<td>7.56*</td>
</tr>
<tr>
<td>Competence → Physical activity</td>
<td>.01</td>
<td>.59</td>
<td>.22</td>
<td>4.23*</td>
</tr>
<tr>
<td>Competence → Motivation (RAI)</td>
<td>—</td>
<td>—</td>
<td>.29</td>
<td>6.46*</td>
</tr>
<tr>
<td>Relatedness → Positive affect</td>
<td>.10</td>
<td>5.01*</td>
<td>.38</td>
<td>7.45*</td>
</tr>
<tr>
<td>Relatedness → Negative affect</td>
<td>−.11</td>
<td>−4.34*</td>
<td>.00</td>
<td>.05</td>
</tr>
<tr>
<td>Relatedness → Physical self-worth</td>
<td>.03</td>
<td>1.70</td>
<td>.03</td>
<td>.57</td>
</tr>
<tr>
<td>Relatedness → Physical activity</td>
<td>.01</td>
<td>.59</td>
<td>−.02</td>
<td>−.45</td>
</tr>
<tr>
<td>Relatedness → Motivation (RAI)</td>
<td>—</td>
<td>—</td>
<td>.32</td>
<td>6.64*</td>
</tr>
</tbody>
</table>

*p < .05.

affect via motivation, as both indirect and total effects for this relationship are significant (see Table 2), but the direct effect from autonomy to negative affect is not (see Figure 3).

For physical self-worth and activity, competence was the only predictor in the combined effects model, predicting 18% and 4% of the variance in physical self-worth and physical activity, respectively. The lack of a relationship between motivation and these two outcomes when direct effects were included in the model eliminates the possibility of mediation.

Discussion

This study examined how satisfaction of the three psychological needs predict self-determined motivation and affective and behavioral outcomes among adult dragon boaters, and whether motivation acts as a mediator of these relationships. All three need satisfaction variables contributed significantly and uniquely to the prediction of motivation in this study and therefore are all worthy of attention in the area of activity planning, coach training, and intervention work to enhance motivation for physical activities among adults. Given that relatedness has previously been regarded as less important in some work, a major highlight from this study is that relatedness is an important construct in motivational processes in adult dragon boating. A second key finding was that self-determined motivation only partially mediated the effects on positive and negative affect and was unrelated to physical self-worth and physical activity. This raises some interesting questions for further inquiry about the role of self-determined motivation as a mediator, and suggests
that future research in this area should fully analyze the mediator relationship to explore this relationship in other activity contexts.

The results supported the hypothesis that satisfaction of all three needs would be a significant predictor of self-determined motivation. This is an important finding because it emphasizes the need to further our understanding of the combined role of autonomy, competence, and relatedness in motivational processes. Consistent with previous research on motivational processes in sport and physical activity, competence was a major predictor of motivation in this study. Relatedness was also a relatively strong predictor of self-determined motivation, which is of interest given the mixed findings about the strength of the relatedness–self-determination link across studies. The relatedness–motivation link has been explored with varying results with different ages, genders, physical activity contexts, competitive levels, social contexts, and levels of goal interdependence. Future work needs to address possible reasons for these disparate findings, as they suggest that the question is not whether relatedness is an important predictor, but under what circumstances does it significantly add to the prediction of self-determined motivation and outcomes above and beyond competence and autonomy. The differences across studies regarding the relative importance of relatedness may be also influenced somewhat by measurement differences. There are a handful of measures commonly used to assess self-determined motivation (e.g., Li, 1999; Mullan et al., 1997; Pelletier et al., 1995), but these instruments are quite similar, and largely represent adaptations for different physical activity contexts, and positions regarding the one-dimensional versus multidimensional nature of intrinsic motivation. There is far less consistency in the measurement of psychological needs across studies, and many of the measures used have not undergone rigorous development. The development of the PNSE (Wilson et al., 2006) is the first measure of psychological needs developed specifically for and validated in the physical activity context. If future work explores these questions using common measures designed for the activity context, it may better facilitate comparison of these relationships across studies.

The relationship between autonomy and self-determined motivation was modest, and somewhat weaker than associations between motivation and competence or relatedness. This finding was similar to other work with adults in a sport context (e.g., Kowal & Fortier, 2000), but there have been mixed findings about the strength of the autonomy–motivation relationship in various sport and exercise studies. Although this finding may indicate that the degree of autonomy felt by adult dragon boaters has only a small impact on their self-determined motivation above and beyond the role of competence and relatedness, it is also possible that measurement issues had an influence on the autonomy–motivation relationship in this study. The autonomy subscale of the PNSE emphasizes choice in many of its items; however, choice is only one component of autonomy and may not capture autonomy satisfaction well in circumstances such as the large team sport activity studied here. In a group activity such as dragon boating, where people are somewhat dependent on each other for performance and have a clear leader (i.e., the coach) making many decisions so that the group can operate efficiently, an individual does not necessarily have to abdicate their sense of autonomy to choose to follow group norms and decisions made by those in leadership positions. One can feel autonomous in the choice to join the group and allow leaders some degree of control over decisions that are not seen as important to make personally
or that are trusted to another person with a higher level of expertise. In this way, the autonomy items used in this study may confuse affective autonomy, feeling volitional, with decisional autonomy, having the opportunity for choice (Houlfort, Koestner, Joussemet, Nantel-Viver, & Lekes, 2002). Conversely, however, Wilson and colleagues’ (2006) work examining the validity of the PNSE scale found that the autonomy subscale was only moderately correlated with an exercise-specific version of Ryan’s (1982) perceived choice subscale of the intrinsic motivation inventory. Future work is needed to examine the associations among autonomy as measured by the PNSE, affective and decisional autonomy, and other measures of choice used in physical activity contexts to shed light on this issue.

The finding that self-determined motivation partially mediated the effects on positive and negative affect and was unrelated to physical self-worth and physical activity was a second key finding of this study. Although this finding must be taken with some caution owing to the mixed results of the global fit indices of the models, the results clearly indicated that the combined model was the best representation in this study. These findings raise questions for future research about the role of self-determined motivation as a mediator in this context, and about how this relationship is tested in activity research. Most previous work has not fully tested the mediator role of self-determined motivation. Previous studies that have tested models similar to that proposed in this study have found support for a mediational model (Kowal & Fortier, 2000; Ntoumanis, 2001; Sarrazin et al., 2002; Standage et al., 2003). However, these studies only tested the global fit of the mediator model. In that respect, the results of this study are not entirely inconsistent with those of previous work. If the strategy in the present study had been to only test the global fit of the mediator model, the conclusion would have been that the mediator model fit the data reasonably well, and that there was support for significance of all of the proposed pathways in the model. It was only in comparison to the direct effects and combined effects models that the problems with a full mediation model were highlighted. No other published work fully tests mediation in this model in an adult physical activity context, so these results are unique and provide new directions for future work. In particular, future work needs to examine this hypothesis using longitudinal and experimental designs to provide stronger support for the directionality of the proposed relationships (i.e., that need fulfillment predicts self-determination, which subsequently predicts affective and behavioral outcomes) and whether these links are causal relationships.

Even though the finding that competence was related to both physical self-worth and activity is consistent with previous literature (e.g., Hayes, Crocker, & Kowalski, 1999; Kowalski, Crocker, & Kowalski, 2001), activity levels and physical self-worth were not predicted by self-determined motivation. This finding is contrary to previous work with adult exercisers that has found that identified regulation and intrinsic motivation predict self-reported activity, and introjected regulation is also a predictor for women (Wilson, Rodgers, Fraser, & Murray, 2004). There are a number of possible explanations for this different finding. First, it is possible that exploring this question within the specific population of dragon boat paddlers as opposed to adult exercise behavior more generally may account for some of these differences. In particular, whereas both studies measured leisure time exercise behavior as an outcome, the present study assessed self-determined motivation within the dragon boat context specifically. It is possible that self-determined
motivation for physical activities may predict exercise behavior, but that information about self-determination in dragon boating is too specific to meaningfully account for physical activity behavior more globally. Vallerand (2000) has suggested that variables in the motivational sequence of SDT more closely relate to each other if they are measured at the same level of generality. Whereas all variables in this study pertained to the physical domain, unlike the other variables, physical self-worth and physical activity were not assessed specifically with respect to dragon boating. Therefore, it is possible that the different levels at which the variables were measured affected the ability of the model to predict physical self-worth and physical activity. A second explanation for this finding is that when competence is included in the model, self-determined motivation may not add to the prediction of physical activity behavior. The correlation analysis demonstrated that motivation was significantly, albeit weakly, associated with physical self-worth and physical activity, and in the mediator model, where competence was not modeled as a direct predictor of physical activity, motivation significantly predicted physical activity. Overall, however, very little variance in physical activity was predicted.

One interesting finding was that positive and negative affect did not have the same antecedent variables. Both were predicted with similar strength, but opposite signs, by self-determined motivation and competence. Positive affect was also predicted by relatedness but not autonomy. Conversely, relatedness did not predict negative affect, and autonomy had a weak indirect negative relationship. These differences could be viewed as support for operationalizing positive and negative affect as independent constructs rather than opposite ends of a continuum. They may also be a result of psychological need fulfillment being conceptualized as a positive construct at the exclusion of the negative elements of the social context of activity. For example, it should not be surprising that relatedness predicted positive affect, given that it is conceptualized in terms of positive aspects of social relationships such as feelings of acceptance and camaraderie. Low levels of these feelings of relatedness may be associated with lower positive affect, but may not contribute to distress, hostility, and irritability, all elements of negative affect. It may be that negative elements of social relationships in a broader sense, such as isolation, rejection, and conflict, could contribute to negative affect, but these are not encompassed in the concept of relatedness.

This study enhances understanding of the link between psychological need fulfillment, self-determined motivation, and affective and behavioral outcomes among adults involved in dragon boating. While there are limitations such as the cross-sectional design, self-report of physical activity, and response rate of potential participants, the testing of a theoretical model with a full test of mediation adds to the literature in this area and provides direction for future research. Although research on social processes in motivation for adult physical activity is still at a relatively early stage, the practical implication of this work is that coaches, participants, and organizers should be aware that social processes on adult teams can matter. Participants who have more positive social experiences tend to have more self-determined motivation and more positive affect associated with participation, at least in the dragon boat context. In sum, this project is an initial step toward addressing the need to expand research on incorporating all three needs from an SDT perspective (Frederick-Recascino, 2002) and to directly test the role of self-determined motivation in the needs–outcomes relationships.
Acknowledgments

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References


**Notes**

1. The data on friendship quality, social support, and peer acceptance were not included in this paper owing to problems with missing data. Specifically, participants who had been on their team for a shorter period of time disproportionately did not complete measures of friendship quality and social support for dragon boat.

2. We also examined whether need satisfaction was more appropriately modeled as an antecedent or an outcome of self-determined motivation by comparing one model where need fulfillment predicted motivation with a second model where motivation predicted need fulfillment. In the first model, the three needs together predicted 33% of the variance in motivation, with all three needs contributing significantly and positively, RMSEA = .10, CFI = .94, SRMR = .06. In the second model, motivation predicted the three needs significantly, accounting for 8% of the variance in autonomy, 22% of the variance in competence, and 25% of the variance in relatedness, RMSEA = .10, CFI = .93, SRMR = .11. Although the models had similar overall fit, the three needs were better predictors of motivation than vice versa, providing support for the model specifications used in the main analyses.

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