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A Test of Self-Determination Theory in the Exercise Domain

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Abstract

In accordance with the theoretical propositions of Self-determination theory (SDT; Deci & Ryan, 1985), this study examined the relationship between autonomy support, psychological need satisfaction, motivational regulations, and exercise behavior. Participants (N = 369) were recruited from fitness, community and retail settings. Supporting SDT, fulfillment of the three basic psychological needs (i.e., competence, autonomy and relatedness) was related to more self-determined motivational regulations. Identified and introjected regulations emerged as significant positive predictors of strenuous and total exercise behaviors. Competence need satisfaction also predicted directly, and indirectly via identified regulation, strenuous exercise. For those participants engaged in organized fitness classes perceptions of autonomy support provided by exercise class leaders predicted psychological need satisfaction. Furthermore, competence need satisfaction partially mediated the relationship between autonomy support and intrinsic motivation. These findings support the application of SDT in the exercise domain.

Keywords: Physical activity, psychological need satisfaction, motivational regulations, perceived autonomy support.

A Test of Self-Determination Theory in the Exercise Domain

There is now worldwide acceptance among medical authorities that physical activity constitutes a fundamental element of healthy living (World Health Organization, 1995). Yet, despite well documented evidence advocating the benefits of exercise for physical and mental health, and numerous public health campaigns promoting its importance, data from developed countries show that the majority of the adult population is not sufficiently active to derive these benefits. Indeed, evidence suggests that more than 70% of adults fail to meet current physical activity recommendations (Department of Health, 2004; United States Department of Health and Human Services, 2000). Furthermore, physical inactivity now constitutes one of the major behavioral risk factors to health in modern society (United States Department of Health and Human Services, 1996). In view of this evidence, promoting physical activity is clearly an increasing public health priority (Pate et al., 1995).

Physical activity engagement involves a complex interaction between biological, environmental, social and psychological influences (Biddle & Mutrie, 2001). Examining the motivational determinants of exercise behavior has become a prominent topic in exercise psychology (Biddle & Mutrie, 2001). One theoretical approach to human motivation that is receiving increasing attention in the exercise domain is Self-Determination Theory (SDT; Deci & Ryan, 1985).

Essentially, SDT proposes that human motivation varies in the extent to which it is autonomous (self-determined) or controlling. Behaviors and actions that are autonomous are freely initiated and emanate from within one's self (Reeve, 2002). In contrast, when behavior is controlled it is regulated by an external force. The individual in this instance feels pressured to engage in the behavior. Based on these distinctions, SDT proposes that three forms of motivation exist, namely, intrinsic motivation, extrinsic motivation and

amotivation[1] which, based on the level of autonomy associated with them, lie on a continuum ranging from high to low self-determination respectively.

Intrinsic motivation constitutes the most autonomous form of motivation, and refers to an inherent tendency possessed by all humans to seek out novelty and challenges, to extend and exercise their capabilities, to explore and to learn (Ryan & Deci, 2000). An individual that pursues a goal or activity because it is enjoyable or intrinsically captivating would display intrinsic motivation (Koestner & Losier, 2002).

Not all human behaviors can be considered as enjoyable however. To understand how such behaviors are regulated SDT proposes extrinsic motivation as an additional motivational force, and a process called internalization. Extrinsic motivation refers to behaviors that are carried out to attain outcomes unrelated to the activity itself (e.g., social comparisons; Deci, 1971). Internalization refers to an inherent tendency possessed by all humans to integrate the regulation of extrinsically motivated activities that are useful for effective functioning in the social world, but are not inherently interesting (Deci, Eghrari, Patrick & Leone, 1994). SDT further proposes that the extent to which extrinsic motives are internalized can vary. A multidimensional conceptualization of extrinsic motivation is hypothesized to exist, consisting of external, introjected, identified and integrated regulations[2]. These regulations lie on a continuum from lower to higher self-determination, and reflect the extent of the internalization process (Deci & Ryan, 1985).

External regulation can be defined as exercising to either appease an external demand, or attain a reward (Ryan & Deci, 2000). “I exercise because my friends and family say I should” is an example of an external regulation in the exercise domain. Introjection, which is a slightly more self-determined form of extrinsic motivation, involves internalizing the behavior’s regulation, but not fully accepting it as one’s own (Ryan & Deci, 2000). It is a relatively controlling form of regulation, in which behaviors, such as exercise engagement,

are performed to avoid negative emotions, such as anxiety or guilt, to support conditional self-worth, or to attain ego enhancement (Ryan & Deci, 2000). Identified regulation reflects a more autonomous form of extrinsic motivation and reflects participation in an activity because one holds outcomes of the behavior to be personally significant, although one may not enjoy the activity itself. For example, an individual that exercises because he/ she values the benefits of exercise would display identified regulation in this domain.

In addition to specifying the different types of motivational regulations that may guide behavior, SDT (Deci & Ryan, 1985) also details specific conditions that are responsible for more or less self-determined motivation. Specifically, SDT assumes that all humans possess three basic psychological needs, that is, the need for competence, autonomy and relatedness. The need for competence implies that individuals have a desire to interact effectively with the environment, to experience a sense of competence in producing desired outcomes, and to prevent undesired events (Deci, 1975; Deci & Ryan, 1985). The need for autonomy reflects a desire to engage in activities of one's choosing and to be the origin of one's own behavior (deCharms, 1968; Deci, 1975; Deci & Ryan, 1985). Finally, the need for relatedness involves feeling connected, or feeling that one belongs in a given social milieu (Baumeister & Leary, 1995; Deci & Ryan, 1985). Essentially, SDT suggest that the most self-determined forms of regulation will guide behavior when the needs are satisfied. In contrast, low self-determination is a consequence of a thwarting of the three basic needs.

SDT (Deci & Ryan, 1985) also specifies that differential levels of psychological need satisfaction in a given domain will result in diverse cognitive, affective and behavioral consequences (e.g., interest, performance, creativity and general well being; Ryan & Deci, 2000). Further, need satisfaction has been postulated to influence outcomes indirectly via the promotion of different types of motivational regulation (Vallerand, 1997). It is assumed that

intrinsic motivation will engender the most positive consequences, followed by identification (Ryan & Deci, 2000; Vallerand, 1997)

However, some research findings in physical activity settings (e.g., Wilson, Rodgers, Blanchard & Gessell, 2003), as well as in other domains such as politics and education (e.g. Koestner & Losier, 2002), have been less conclusive regarding the positive implications of intrinsic motivation compared to other self-determined forms of regulation. Wilson, Rodgers, Blanchard and Gessell (2003) provided evidence suggesting that among participants recruited to engage in a 12-week structured exercise program, identified regulation was a stronger predictor of self-reported exercise behavior than intrinsic motivation, although both regulations predicted exercise behaviors, exercise attitudes and physical fitness. In addition, introjected regulation has been shown to be positively correlated with strenuous exercise behavior in some (e.g., Wilson, Rodgers & Fraser, 2002) but not in other studies (e.g., Wilson, Rodgers, Blanchard & Gessell, 2003).

Ryan (1995) proposed that the characteristics of the situation in question will determine the extent to which intrinsic and internalized extrinsic regulations will produce positive behavioral outcomes. With respect to the latter, in contexts in which the activities undertaken are important, but may lack in intrinsic appeal, it is assumed that the innate tendency to internalize the role of such activities will be witnessed (Ryan, 1995). In view of the considerable value that society bestows upon exercise, for health and aesthetic gains, research demonstrating that introjected and identified regulations positively predict exercise behavior may indicate that, for some individuals, exercise engagement is maintained via the process described by Ryan (1995). That is, exercise behavior constitutes an externally motivated activity that requires internalization to initiate and sustain action.

An additional tenet of SDT relevant to the current investigation concerns the social context in which individuals operate. According to SDT autonomy supportive contexts are

conducive towards need satisfaction and ensuing self-determined motivational regulations. Such contexts are characterized by the minimization of controls by significant others, the understanding of other people's perspectives, and the provision of choices that guide and facilitate the decision making process (Deci & Ryan, 1985; Ryan & Deci, 2000). Supporting these propositions Wilson and Rodgers (2004) found that among female students and staff enrolled in a team-based intramural physical activity event, perceived autonomy support from friends was positively associated with intrinsic motivation and identified regulation. Further, Standage, Duda and Ntoumanis (2003) recently demonstrated that, among secondary school physical education students, an autonomy supportive climate was positively related to the satisfaction of the need for competence, autonomy and relatedness, which, in turn, predicted greater self-determined motivation. However, as far as the present authors are aware, no study has yet to consider the implications of an autonomy supportive environment provided by an exercise class leader.

Aims and hypotheses

The first aim of the current study was to explore how satisfaction of the three psychological needs relates to the type of motivational regulations guiding exercise behavior. Furthermore, we examined the extent to which psychological need satisfaction and motivational regulations can predict exercise behavior. To date, published research in the exercise domain has determined only the direct effects of psychological need satisfaction on motivational regulations and motivational regulations on exercise behaviors (Wilson et al., 2002, 2003). Thus, extending previous research, the current study also explored the indirect effects of need satisfaction on behavioral outcomes, with motivational regulations being tested as potential mediators. The present research also examined whether, as assumed in SDT (Deci & Ryan, 1985), an autonomy supportive context provided by an exercise class

leader corresponds to greater intrinsic motivation and identified regulation, via the support provided for the three basic psychological needs.

Based on the propositions of SDT, and previous research in the physical, educational and political domains (Wilson et al., 2002, 2003; Wilson & Rodgers, 2004; Koestner & Losier, 2002), we hypothesized that positive relationships will be observed between psychological need satisfaction and identified and intrinsic motives, and a negative link will emerge between psychological need satisfaction and introjected and external regulations. Secondly, identified and introjected regulation and intrinsic motivation, were expected to positively predict exercise behaviors, and to mediate the relationship between psychological need satisfaction and exercise behaviors. In turn, external regulation was hypothesized to negatively predict exercise behaviors, and mediate the relationship between inadequate psychological need satisfaction and more negative behavioral outcomes. Thirdly, it was predicted that perceived autonomy support (PAS) provided by the exercise class leader would be positively related to satisfaction of the three basic needs and self-determined motivation. Finally, PAS was also hypothesized to predict intrinsic motivation and identified regulation via the satisfaction of the basic psychological needs.

Method

Participants

Participants (N = 369; 173 male, 192 female, 4 unspecified) ranged in age from 16 – 64 years (M = 31.86, SD = 11.28). The majority (88.7%) were White. One hundred and six of the participants reported taking part in regular exercise classes (37 male, 68 female, 1 unspecified) and thus constituted the ‘sub-sample’ with which we examined relationships between PAS, need satisfaction and motivational regulations. The sub-sample ranged in age from 16 – 62 years (M = 30.24, SD = 10.32).

An apriori power analysis, conducted using G*Power (version 2; Faul & Erdfelder, 1992), ensured that these sample sizes were sufficient to yield adequate statistical power for all statistical procedures planned, and subsequently conducted in the current study. More specifically, to detect a significant finding (at the .05 level) at a desired power level of .95, a minimum of 143 participants were required for analyses conducted on the total sample, and 41 for the sub-study analyses.

Measures

Psychological need satisfaction. Psychological need satisfaction was measured via the 21-item Basic Need Satisfaction at Work Scale (Deci et al., 2001), adapted by the authors to make relevant to the exercise domain. This 21-item scale is based on a 15-item measure developed by Kasser, Davey and Ryan (1992) to tap reported autonomy, relatedness and competence in the work domain. In the development of the original 15-item measure, some items were taken from the Intrinsic Motivation Inventory (IMI; Ryan, 1982), support for which has been garnered in the physical domain (McAuley, Duncan & Tammen, 1989). The 21-item Basic Need Satisfaction at work scale exhibited alphas of .73 for competence, .84 for relatedness and .79 for autonomy in a sample of US workers (Deci et al, 2001).

The 21-item scale utilized by Deci et al. (2001) includes 6 items that measure competence (e.g., “most days I feel a sense of accomplishment from exercising”), 8 to measure relatedness (e.g., “people I exercise with take my feelings into consideration”), and 7 to measure autonomy (e.g., “I feel like I am free to decide for myself how to exercise”) need satisfaction. Following the stem “Please indicate how true each of the following statements is for you given your experiences of exercise,” participants responded to each item on a 7-point scale ranging from 1 (*not true for me*) to 7 (*very true for me*).

Behavioral Regulation in Exercise Questionnaire (BREQ). Participants completed the BREQ (Mullan, Markland & Ingledew, 1997), a 15-item self-report measure assessing

the reasons why people exercise. The BREQ includes scales assessing external, introjected, identified and intrinsic regulations. Following the stem "Why do you exercise?" participants responded to each item on a 5-point scale ranging from 1 (*not true for me*) to 5 (*very true for me*). Previous research supports the BREQ's multidimensional four-factor structure, the invariance of this factor structure across gender, and the internal consistency of each subscale (i.e., α's ranged from .76 to .90; Mullan et al., 1997; Mullan & Markland, 1997).

Godin Leisure Time Exercise Questionnaire (GLTEQ). The GLTEQ (Godin & Shepard, 1985) was used to assess self-reported exercise behavior. The GLTEQ contains 3 questions assessing the frequency of mild, moderate and strenuous exercise engaged in, for a minimum of 15 minutes, during a typical week. Exercise behavior scores can be calculated by multiplying weekly frequencies of strenuous (e.g., running, vigorous gym workout), moderate (e.g., easy cycling) and mild activities (e.g., easy walking), by nine, five and three METS, respectively. An overall exercise behavior score (units of metabolic equivalence) is calculated by averaging the weighted product of each question as follows: (mild x 3) + (moderate x 5) + (strenuous x 9). Based on its correlations with objective indicators of exercise and physical fitness (e.g., exercise monitor and maximal aerobic capacity test scores) a previous study has concluded that the GLTEQ is a reliable and valid measure of leisure time exercise behavior (Jacobs, Ainsworth, Hartman & Leon, 1993).

Perceived autonomy support. PAS from the exercise class leader was measured using a short (6-items) version of the original 15-item Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan & Deci, 1996). The original scale assesses participants' perceptions of the degree of autonomy support provided by a relevant health care provider and includes items such as "I feel that my health care provider provides me with choices and options." In the current study the term 'my health care provider' was replaced with 'my exercise class leader' and participants were asked to respond to items in reference to the

exercise class in which they most commonly participated. Participants responded to each item on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Previous studies using the original HCCQ have revealed an one-factor solution measuring perceived autonomy support and an alpha value of .95 (Williams et al., 1996).

Procedures

The current research was approved by the ethics subcommittee of a University in the United Kingdom. Participants were recruited in a number of different settings, including sports clubs, public leisure centers, private fitness clubs, shops and supermarkets, in the West Midlands, UK. Participants were approached by the first author, who explained the purpose of the study, and asked if they were willing to complete a multi-section questionnaire packet. Those that agreed to take part provided informed consent. The first section of the questionnaire assessed psychological need satisfaction via exercise, motivational regulations and exercise behaviors. Those participants that reported taking part in regular exercise classes completed an additional section of the questionnaire tapping perceived autonomy support provided by the exercise class leader in the class which they most commonly participated.

Results

Preliminary Data Analysis

Data were screened according to the recommendations of Tabachnick and Fidell (2001). Four multivariate outliers were removed from the sample based on the Mahalonobis distance criterion (see Tabachnick & Fidell, 2001, p.92), leaving a final sample of 369 participants. Examination of the assumptions associated with regression analyses (i.e., normality, linearity and homoscedasticity) suggested that there were no particular problems in the data. More specifically, inspection of a scatterplot of the residuals indicated that both linearity and homoscedasticity assumptions were tenable. To explore whether the data were

marked by multicollinearity, both variance inflation (1.06 – 2.28) and tolerance (0.44 – 0.95) values were examined. No particular problems were found since the obtained values are within acceptable limits. In addition, based on Belsley (1991) and Belsley, Kuh, & Welsch's (1980) suggestions, the condition indexes (CI) and variance proportions factors (VPF) for all multiple regression analyses were explored. Using the criterion proposed in Pedhazur (1997), in no instances when the CI was greater than 10 did the VPF values observed exceed .5 for two or more predictors, suggesting that there was no collinearity in the data.

Reliability Analysis and Descriptive Statistics

Internal consistency estimates (Cronbach's coefficient α) and descriptive statistics were computed for all variables (see Table 1). Reliability analyses indicated that, in general, internal consistency coefficients were greater than .70. However, the alpha values observed for two of the need scales were marginal, i.e., autonomy (α = .65) and competence (α = .65). Thus, results based on these variables should be interpreted with caution.

All participants engaged in at least some form of mild exercise (range = 3 – 223 METS; *M* = 7.59, *SD* = 9.31). The mean level of total self-reported exercise (*M* = 57.28, *SD* = 36.83) was higher than that reported in previous studies examining the propositions of SDT in the exercise domain (e.g., Wilson et al., 2002, 2003). Autonomy was the most highly satisfied need, followed by relatedness and competence. Intrinsic motivation was the most strongly endorsed exercise regulation, closely followed by identified regulation.

Relationships between Psychological Need Satisfaction, Exercise Regulations, and Exercise Behaviors

Pearson correlations were computed between age, gender, autonomy, relatedness and competence need satisfaction, each of the BREQ subscales and reported exercise behaviors (Table 1). Small to moderate negative correlations were observed between all three psychological needs and external regulation. Autonomy was negatively correlated with

introjected regulation. Small to moderate positive correlations were observed between all three psychological needs and identified regulation and intrinsic motivation. Small to moderate positive relationships also emerged between the three needs and strenuous and total exercise behavior. Autonomy positively correlated with moderate exercise. No significant correlations emerged between the needs and mild exercise. Small to moderate positive relationships were observed between introjected and identified regulation and intrinsic motivation and strenuous and total exercise behavior. None of the motivational regulations were correlated with mild and moderate exercise.

Factors Predicting Total and Strenuous Exercise Behaviors

Separate regression analyses were carried out to predict total and strenuous self-reported exercise from psychological need satisfaction and motivational regulations. Mild and moderate exercise were not examined because they did not correlate with the needs or the regulations. Preliminary Multivariate Analysis of Variance (MANOVA) revealed significant age and gender differences in exercise behaviors (age $F(6, 686) = 8.51$, $p = .00$, Pillai's trace = .14; gender $F(3, 361) = 4.38$, $p = .01$, Pillai's trace = .04). In view of these results, as well as the fact that existing literature has linked these characteristics to exercise behavior (e.g., Department of Health, 2004, USDHHS, 1996), we controlled for their influence in the first step of the regression. By so doing, we could determine whether the theoretical constructs embedded in SDT accounted for additional variance in exercise behavior above and beyond important demographic variables. The needs were entered in the second step of the regression, as they are postulated to affect behavioral outcomes indirectly via the motivational regulations (Vallerand, 1997), which were entered in the final step.

As seen in Table 2, 18% of the variance in total exercise behavior was explained by this model. Two of the variables contributed independently to the prediction of total exercise behavior, namely age and introjected regulation. Six of the variables contributed

independently to the prediction of strenuous exercise behavior, gender, age, competence, external regulation, introjected regulation and identified regulation (Table 3). This set of predictors predicted 32% of the variability in strenuous exercise behavior[3].

Test of Mediation

The regression procedures of Baron and Kenny (1986) were employed to examine potential mediation effects. Three basic steps are proposed in establishing mediation: 1) the predictor variable (i.e., the psychological need) must have an effect on the criterion variable (i.e., exercise behavior), 2) the predictor variable (i.e., psychological need) must have an effect on the mediator variable (i.e., the motivational regulation), and 3) the mediator (i.e., regulation) must affect the outcome (i.e., exercise behavior), after controlling for the predictor (i.e., psychological need). To establish complete mediation, the effect of the predictor on the outcome should be zero in the third step of the analysis. Partial mediation occurs when this effect is reduced, but remains statistically significant.

Given that SDT assumes that the 3 psychological needs co-exist (Deci & Ryan, 1985), it was decided that it made theoretical sense to include all needs in the same step and not to examine them independently. We followed the same logic for the motivational regulations. Examining step 2 of the regression analyses results for total and strenuous exercise (see Tables 2 & 3), it is apparent that competence was the only need to predict behavioral outcomes and thus meet Baron and Kenny's (1986) first criterion for establishing mediation. Testing Baron and Kenny's (1986) second criterion for establishing mediation, competence was found to be a significant predictor of identified regulation ($ß = .46$, $p = .00$), but none of the other regulations (Note: these results are *not* included in Tables 2 & 3). Identified regulation was a positive predictor of strenuous, but not total exercise, and thus these findings ruled out the possibility of mediation effects with regards to total exercise. With respect to Baron and Kenny's (1986) third criterion for establishing mediation, the

standardized ß coefficient for competence dropped from ß = .36 (p = .00) to ß = .23 (p = .00) when strenuous exercise was being predicted and the motivational regulations were entered into the regression equation (Table 3), suggesting partial mediation. Using the Goodman I version of the Sobel test, as recommended by Baron and Kenny (1986), partial mediation was confirmed. The reduction in the effect of competence on strenuous exercise behavior due to identified regulation was significant (Z = 2.56, p = .01).

Preliminary Sub-study Data Analysis

One hundred and six participants of the participants reported being a member of an exercise group. Relevant data were screened according to the recommendations of Tabachnick and Fidell (2001). No problems were found. The assumptions associated with multiple regression analysis (i.e., normality, linearity and homoscedasticity) were examined, and again no problems were observed. Inspection of residual scatterplots indicated that both the linearity and homoscedasticity assumptions were tenable for all regression analyses. Furthermore, an examination of the variance inflation (1.01 – 1.65), tolerance (0.61 – 0.99), CI and VPF values revealed that the data were not marked by collinearity.

Reliability Analysis and Descriptive Statistics

Reliability analyses indicated that internal consistency coefficients were above .70 for all variables, except for autonomy (α = .64) and competence (α = .65). Thus, present results based on these variables should be interpreted with caution. PAS scores ranged from 1 -7 (M = 4.82, SD = 1.26). Autonomy was the most highly satisfied need (M = 5.25, SD = 0.82), followed by relatedness (M = 5.16, SD = 1.03) and then competence (M = 5.07, SD = 0.90). Intrinsic motivation was the most highly endorsed form of motivation (M = 3.65, SD = 1.00), followed by identified (M = 3.61, SD = 0.82), introjected (M = 2.20, SD = 0.95), and external (M = 1.38, SD = 0.51) regulation.

Pearson Correlations

Pearson correlations were calculated to examine relationships between age, gender, PAS, psychological need satisfaction, and motivational regulations. Low positive correlations were observed between PAS and autonomy (r = .26), and PAS and competence (r = .27). A moderate positive association was observed between PAS and relatedness (r = .45). In addition, low and moderate positive correlations were observed between PAS and identified regulation (r = .22) and intrinsic motivation (r = .36).

Hierarchical Regression Analyses

As positive correlations were observed between PAS and identified regulation and intrinsic motivation, hierarchical multiple regression analyses were conducted with each of these regulations as the criterion variable. Age and gender were entered in the first step of the analysis. PAS was entered in the second step, and each of the psychological needs in the third step. As seen in Table 4, PAS was found to be a significant predictor of intrinsic motivation, after controlling for demographic and psychological need satisfaction variables. Competence need satisfaction via exercise also significantly predicted intrinsic motivation. PAS was not associated with identified regulation after controlling for age, gender and the three needs (ß = .17, p = .11). Competence need satisfaction significantly predicted identified regulation (ß = .45, p = .00).

Test of Mediation

Next we examined the hypothesized mediating role played by psychological need satisfaction in the relationship between PAS and motivational regulations. PAS predicted intrinsic motivation (see step 2, Table 4), and thus met criterion 1 of Baron and Kenny's (1986) procedures. PAS also significantly predicted autonomy (ß = .28, p = 01), relatedness (ß = .46, p = .00) and competence (ß = .28, p = .01) need satisfaction via exercise, and thus met Baron and Kenny's (1986) second criterion for establishing mediation (Note: these findings are *not* reported in Table 4). Competence was the only need (i.e., mediator) to

predict intrinsic motivation (i.e., the criterion variable) after controlling for the effect of PAS (i.e., the predictor; see step 3, Table 4) After controlling for the effect of competence on the relationship between PAS and intrinsic motivation the ß coefficient for autonomy support dropped from ß = .35 (p= .00) to ß = .23 (p= .02), suggesting partial mediation. The Goodman I version of the Sobel test revealed that this effect was significant (Z = 2.59, p = .01).

Discussion

The results of the current research demonstrate the importance of motivation-related variables to understanding some of the variability in self-reported exercise behaviors. Overall, the findings indicate that the key constructs of SDT add to the prediction of exercise behaviors above what is accounted for by demographic characteristics, such as age and gender. In accordance with SDT, psychological need satisfaction derived from the exercise setting was positively correlated with more self-determined motivational regulations. Furthermore, satisfaction of the three psychological needs, introjected and identified regulations and intrinsic motivation, were positively associated with strenuous and total exercise behaviors. Moreover, regression analysis showed that, as hypothesized, external regulation was a negative predictor of strenuous exercise behavior, introjected regulation positively predicted total exercise, and introjected and identified regulation were positive predictors of strenuous exercise behavior. Identified regulation also partially mediated the relationship between competence need satisfaction and strenuous exercise. Contrary to expectations however, intrinsic motivation did not significantly predict either dimension of exercise behavior.

A further examination of study participants engaged in regular organized exercise classes revealed that perceived autonomy support (PAS) provided by the exercise class leader was positively associated with psychological need satisfaction and self-determined

motivation. Subsequent regression analyses also supported the role of PAS in predicting need satisfaction and intrinsic motivation. Competence need satisfaction partially mediated the relationship between PAS and intrinsic motivation. PAS did not predict identified regulation after controlling for age, gender and the three psychological needs.

Despite being the most highly endorsed form of motivation, as well as being positively correlated with self-reported exercise, intrinsic motivation did not make an independent significant prediction to exercise engagement when controlling for the other regulations in the regression analyses. In interpreting this finding it is important to consider similar findings that have emerged in the political and educational domains. For example, Koestner, Losier, Vallerand and Carducci (1996), and Losier and Koestner (1999) also presented evidence indicating that considering politics as important (i.e., reflecting identified regulation) was a more significant predictor of voting behavior than perceiving politics to be interesting (i.e., an indicator of intrinsic motivation). Generally speaking, such results suggest that intrinsic motivation may not be the most important predictor of engagement in the exercise domain, and support claims that people are unlikely to maintain regular exercise behavior, with all the organization and commitment it entails, purely for the intrinsic reasons of fun and enjoyment (Mullan et al., 1997).

In view of these arguments, the finding that identified regulation significantly predicted strenuous exercise behavior in the current study is not surprising. This finding suggests that in order to partake in strenuous exercise behaviors, which necessitate considerable physical and mental exertion and stamina, individuals have to place some value on the exercise, and recognize its importance in terms of health and well-being. Thus, similar to other activities that may lack in intrinsic appeal, recognizing the significance of physical activity and valuing its benefits (e.g., improved fitness and physique), appear relevant to active engagement in the exercise setting.

Given that, unlike identified regulation, intrinsic motivation was not a significant predictor of exercise behavior, one might wonder whether it is worth trying to cultivate intrinsic motivation for exercise. Might intervention efforts be more efficacious by focusing on the facilitation of identified regulation? Previous research in the exercise and sport domains would suggest that the former strategy is still a viable one as intrinsic motivation has been shown to be critical to behavioral persistence (Perrin, 1979; Ryan et al, 1997; Pelletier, Fortier, Vallerand, & Briere, 2001). Perrin (1979), for example, found that whereas new participants in physical activity programs reported health benefits as their reason for exercise adoption, long-term participants reported enjoyment as their principal reason for continuing. Indeed, as evidenced and advocated by Koestner and Losier (2002) in regard to educational and political behaviors, it is likely that promoting high levels of both intrinsic motivation and identification would also be most beneficial to optimal and continued behavioral engagement in exercise. Further longitudinal research is needed to examine this hypothesis. In addition, it is important to consider other potential outcomes associated with the different motivational regulations. Psychological need satisfaction and self-determined motives (especially intrinsic motivation) have been associated with indices of positive well-being in numerous contexts (Ryan & Deci, 2000, 2001), including the physical domain (e.g., Gagné, Ryan & Bargmann, 2003; Wilson & Rodgers, 2002). These findings suggest that intrinsic motivation contributes significantly to the quality of the exercise experience.

The finding that introjected regulation significantly predicted both strenuous and total exercise also warrants further discussion. Introjected regulation is a controlling form of motivation that lies towards the lower end of the self-determination continuum. Despite its positive role in predicting exercise behavior in the current cross-sectional study, there is evidence to suggest that introjected regulation will not bode well for long-term physical health (Frederick-Recascino, 2002), or sustained exercise involvement. Although the longer

term implications of being motivated by introjected regulation over time cannot be addressed in the current study, evidence from the sport and exercise domain has shown this type of motivation to be associated with poor adherence (Frederick & Ryan, 1993; Pelletier et al., 2001). Research in other domains (e.g., education) has also shown introjected regulation to be related to poor emotional functioning, such as high levels of distress and low levels of adjustment (Koestner & Losier, 2002). Longitudinal research is warranted to examine whether self-determined motivation, as opposed to introjected regulation, is positively linked to exercise adherence and indices of psychological and emotional health.

Lastly, as hypothesized, a negative relationship emerged between the least self-determined motivational regulation, namely external regulation, and strenuous exercise behaviors. This finding clearly supports the proposition of SDT that performing an activity to satisfy external demands will not result in behavioral investment.

No previous studies in the exercise domain have considered whether the relationships between psychological need satisfaction and behavioural outcomes are mediated by the motivational regulations. Providing some support for the propositions of Vallerand (1997), the relationship of competence need satisfaction to strenuous exercise was partially mediated by identified regulation in the current investigation. In addition to this mediating effect however, competence need satisfaction was also found to play a direct role in predicting strenuous exercise behaviour. Considering these direct and indirect effects, it seems prudent for exercise interventions to focus on increasing feelings of competence within participants so that there is an increased probability that self-determined motivation and adaptive behavioural outcomes will ensue.

According to Ryan and Deci (2000), understanding the conditions that foster versus undermine psychological need satisfaction holds great practical significance. Such awareness can contribute to the creation of social environments that satisfy the three needs and promote

self-determined motivational regulations, personal development, and well-being (Ryan & Deci, 2000). In a sub-study of regular exercise class participants, PAS from the exercise class leader was positively related to each of the three psychological needs, as well as identified regulation and intrinsic motivation. In addition, competence need satisfaction partially mediated the observed relationship between PAS and intrinsic motivation.

It should be noted that PAS did not predict identified regulation when we controlled for age, gender and three psychological needs. This finding, which is in contrast to theoretical propositions, may suggest that the provision of an autonomy supportive environment may not suffice to facilitate internalization processes. The distinction between autonomy support and structure features of environments (Deci & Ryan, 1985, 1990) may help to explicate these findings. In autonomy-supporting contexts choice is provided, pressure to engage in the behavior is minimized, and individuals are encouraged to initiate actions themselves. In contrast, structure concerns the degree to which the link between the behavior and salient outcomes is apparent, expectations are clear, and positive feedback is provided. Deci and Ryan (1985, 2000) and Koestner and Losier (2002) hypothesized that high levels of autonomy support, even without the provision of structure, will result in high levels of intrinsic motivation. However, autonomy support alone will not promote an understanding of why it is personally important and meaningful to perform certain activities, even the most uninteresting, which are nevertheless important to optimal functioning.

It is worth noting that, contrary to previous research (e.g., Wilson et al., 2002), the motivational regulations considered within SDT were not significantly correlated with moderate and mild forms of exercise behavior. One explanation for this finding is that, in the current study, the majority of mild and moderate exercise reported by the participants was in the form of easy or fast walking, or easy cycling. We suggest that these activities are usually habitual in nature, and thus may require less cognitive processing than more structured and

vigorous forms of exercise. Future research should examine whether the motivational processes embedded in SDT are more important for purposeful rather than incidental forms of exercise (e.g., walking for transportation, to the shops). Indeed, other social cognitive models have also been found to poorly predict habitual or low intensity behaviors such as walking (Sallis & Hovell, 1990).

Future work on motivational predictors may benefit from being more specific regarding the type of exercise behavior under examination. It remains possible that different activities may be guided by different psychological needs, and thus different regulatory styles. For example, for some individuals, playing squash, which is typically an interesting activity, may satisfy different needs, or be a far more intrinsically motivated activity, than a vigorous gym workout. In addition, the current research, like previous studies in this area (Wilson et al., 2002, 2003; Wilson & Rodgers 2004), incorporated only a self-reported measure of physical activity. Although shown to be valid and reliable (Jacobs et al, 1993), such an assessment may still be subject to reporting bias. Future work should focus on establishing the inter-relationships between psychological needs, motivational regulations and exercise behaviors using more objective measurements of physical activity (e.g., via the use of triaxial accelerometers) to ascertain whether the present findings can be replicated.

As the current study has provided preliminary evidence supporting the major tenets of SDT in the exercise domain, future research may extend this research to explore the recent propositions of Deci and Ryan (2000) and Koestner and Losier (2002). These authors identify specific patterns of psychological need satisfaction that will be most salient to the emergence and sustenance of each of the different forms of motivation. For the least self-determined forms of extrinsic motivation, relatedness and competence need satisfaction are postulated to be most important. Autonomy is believed to be central to intrinsic motivation and self-determined forms of extrinsic motivation. With respect to self-determined forms of

extrinsic motivation, autonomy is assumed to combine with relatedness. For intrinsic motivation autonomy and competence are proffered. If these different predictions are upheld, it would provide practitioners with valuable information regarding which needs to focus upon in attempting to facilitate a specific motivational orientation.

Inspection of the psychometric properties of the current assessments gave some cause for concern regarding one of the measurement tools utilized, i.e., the assessment of psychological need satisfaction. In the absence of a more psychometrically sound instrument to measure the three specific psychological needs proposed by SDT in the exercise domain, we chose a questionnaire that provided a comprehensive assessment of these constructs. However, the alpha values obtained for autonomy and competence need satisfaction in the present study were marginal. This latter finding highlights a need for new/improved assessments of psychological needs in the exercise domain.

In terms of the three psychological needs it was interesting to note that PAS was most highly correlated with satisfaction of the need for relatedness. This may lead to questioning the convergent validity of the PAS measure utilized, as one may expect PAS to be most highly correlated with autonomy need satisfaction. However, consistent with current findings, previous research in the sporting and health care domains suggests that autonomy support is an important nutrient in the satisfaction of all three psychological needs, not solely autonomy (e.g., Gagné, Ryan, & Bargmann, 2003; Sheldon, Williams & Joiner, 2003). With regard to relatedness specifically, autonomy support is believed to boost the quality of interpersonal relatedness between the patient and practitioner (Sheldon et al., 2003). Patients' sense of competence is also predicted by the health care providers' perceived autonomy supportiveness (Sheldon et al., 2003). In addition, evidence from research conducted in sport settings found autonomy support provided by the parents of young gymnasts to be significantly correlated with relatedness need satisfaction but not autonomy.

In contrast, autonomy support from the coach was correlated significantly with both relatedness and autonomy (Gagné et al., 2003). Given that other studies (e.g., Wilson & Rodgers, 2004) in the exercise domain have failed to examine the mediating role of psychological need satisfaction between PAS and each of the motivational regulations, we cannot discern whether this finding is indeed pertinent to the exercise domain, or the consequence of a poor measurement instrument, that consequently requires further psychometric validation. Even so, the finding that the autonomy support provided by the exercise class leader predicted competence need satisfaction should be considered as a promising finding, given that competence plays such a key/ central role in predicting exercise behavior in the current study.

It is also important to reinforce the point that the current study is cross-sectional in design. Thus, we cannot infer causality when considering the findings of the current investigation. To rectify this shortcoming, future research would benefit from employing longitudinal and experimental designs. In addition, subsequent studies might strive to recruit a sufficient number of participants so that the use of Structural Equation Modeling (SEM) techniques is appropriate. Unfortunately, given the small number of participants constituting the sub-sample in the current investigation it was not possible to test a model describing sequential links between autonomy support, psychological needs, motivational regulations and exercise behaviors. However, despite the limitations presented, the results of the present investigation support the tenability of the constructs and propositions embedded in SDT with respect to the prediction of total and, in particular, vigorous exercise behavior. Such work should help provide a theoretical base on which behavioral interventions aimed at increasing and sustaining levels of physical activity can be designed, tested and implemented.

References

Baron, R. M., & Kenny, D. A (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173 – 1182.

Baumeister, R., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117,* 497 - 529.

Belsley, D. A. (1991). *Conditioning diagnostics: Collinearity and weak data in regression.* New York: Wiley.

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression diagnostics: Identifying influential data and sources of collinearity.* New York: Wiley.

Biddle, J. H., & Mutrie, N. (2001*). Psychology of physical activity: Determinants, well-being and interventions.* London and New York: Routledge.

deCharms, R. (1968). *Personal causation: The internal affective determinants of behavior*. New York, NY: Academic Press.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18,* 105 – 115.

Deci, E. L. (1975). *Intrinsic motivation*. New York: Plenum.

Deci, E. L, Eghrari, H, Patrick, B. C., & Leone, D. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality, 62,* 119 – 142.

Deci, E. L., & Ryan, R. M., (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press.

Deci, E. L., & Ryan, R. M., (1990). A Motivational approach to the self: Integration in personality. In R. Dienstbier (Ed.), *Nebraska symposium on motivation. Vol. 38: Perspectives on motivation* (pp. 237 – 288). Lincoln: 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*, 227 – 268.

Deci, E. L., Ryan, R. M., Gagné, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former Eastern Bloc Country: A cross-cultural study of Self-determination. *Personality and Social Psychology Bulletin, 27,* 930 – 942.

Department of Health (2004). *Choosing Health? Choosing activity: A consultation on how to increase physical activity.* London: Department of Health/ Department of Culture Media and Sport.

Faul, F., & Erdfelder, E. (1992). GPOWER: A priori, post hoc, and compromise power analyses for MS. DOS (computer program). Bonn, FRG: Bonn University, Dep. of Psychology.

Frederick-Recascino, C. M. (2002). Self-determination theory and participation motivation research in the sport and exercise domain. In E. L., Deci & R. M., Ryan (Eds.), *Handbook of self-determination research.* Rochester, NY: University of Rochester Press.

Frederick, C. M., & Ryan, R. M. (1993). Differences in motivation for sport and exercise and their relations with participation and mental health. *Journal of Sport Behavior*, 16, 124 – 146.

Gagné, M., Ryan, R., & Bargmann, K. (2003). Autonomy support and need satisfaction in the motivation and well-being of Gymnasts. *Journal of Applied Sport Psychology, 15*, 372 – 390.

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

Jacobs, D. R., Ainsworth, B. E., Hartman, T. J., & Leon, A. S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine and Science in Sports and Exercise, 25,* 81 – 91.

Kasser, T., Davey, J., & Ryan, R. M. (1992). Motivation and employee-supervisor discrepancies in a psychiatric vocational rehabilitation setting. *Rehabilitation Psychology, 37,* 175 – 187.

Koestner, R., & Losier, G. F. (2002) Distinguishing three ways of being internally motivated: A closer look at Introjection, Identification, and Intrinsic motivation. In E. L., Deci & R. M., Ryan (Eds.), *Handbook of self-determination research.* Rochester, NY: University of Rochester Press.

Koestner, R., Losier, G. F., Vallerand, R. J., & Carducci, D. (1996). Identified and introjected forms of political forms of political internalization: Extending self-determination theory. *Journal of Personality and Social Psychology, 70,* 1025 – 1036.

Losier, G. F., & Koestner, R. (1999). Intrinsic versus identified regulation in distinct political campaigns: The consequences following politics for pleasure versus personal meaningfulness. *Personality and Social Psychology Bulletin, 25,* 287 – 298.

Markland, D., & Tobin, V. (2004). A modification of the behavioural regulation in exercise questionnaire to include an assessment of Amotivation. *Journal of Sport and Exercise Psychology, 26,* 191 – 196.

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 Sport and Exercise, 60,* 48 – 58.

Mullan, E., & Markland, D. (1997). Variations in self-determination across the stages of change for exercise in adults. *Motivation and Emotion, 21,* 349 – 362.

Mullan, E., Markland, D., & Ingledew, D. K. (1997). A graded conceptualization of self-determination in the regulation of exercise behavior: Development of a measure using confirmatory factor analytic procedures. *Personality and Individual Differences, 23,* 745 – 752.

Pate R. R., Pratt M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., Buchner D., Ettinger, W., Heath, G. W., King, A. C., Kriska, A., Leon, A. S., Marcus, B. H., Morris, J., Paffenbarger, R. S., Jr., Patrick, K., Pollock., M. L., Rippe, J. M., Sallis, J., & Wilmore, J. H. (1995). Physical activity and public health. A recommendation from the centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273,* 402 – 407.

Pedhazur, E. J. (1997). *Multiple regression in behavioral research: Explanation and prediction (3rd edition).* Orlando, FL: Harcourt Brace.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Briere, N. M. (2001). Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion, 25,* 279 – 306.

Perrin, B. (1979). Survey of physical activity in the regional municipality of Waterloo. *Recreation Research Review, 6,* 48 – 52.

Reeve, J. (2002). Self-determination theory applied to educational settings. In E. L., Deci & R. M., Ryan (Eds.), *Handbook of self-determination research.* Rochester, NY: University of Rochester Press.

Ryan, R. M. (1982). Control and information in the interpersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology, 43,* 450 – 461.

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

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55,* 68 – 78.

Ryan, R. M., & Deci, E. L (2001). On happiness and human potentials; A review of research in hedonic and eudaimonic well-being. *Annual review of Psychology, 52,* 141 – 166.

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.* Rochester, NY: University of Rochester Press.

Ryan, R. M., Frederick, C. M. Lepes, D., Rubio, N., & Sheldon, K. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology, 28,* 335 – 354.

Sallis, J. F., & Hovell, M. F. (1990). Determinants of exercise behavior. *Exercise and Sports Science Reviews, 18,* 307 – 327.

Sheldon, K. M., Williams, G., & Joiner, T. (2003). *Self-determination Theory in the clinic: Motivating physical and mental health.* Yale University Press: New Haven and London.

Standage, M., Duda, J. L., & Ntoumanis, N. (2003). A model of contextual motivation in Physical Education: Using constructs from self-determination theory and achievement goals to predict physical activity intentions. *Journal of Educational Psychology, 91,* 97 – 110.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed). Boston: Allyn & Bacon.

U.S. Department of Health and Human Services (1996). *Physical Activity and health; A report of the Surgeon General.* Executive summary. Pittsburgh, PA: Superintendent of documents.

U.S. Department of Health and Human Services (2000). *Healthy People 2010: Understanding and Improving Health* (2nd ed.). Washington, DC: U.S. Government Printing Office.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 271 – 360). New York: Academic Press.

Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology, 70*, 115-126.

Wilson, P. M., & Rodgers, W. M. (2002). The relationship between exercise motives and physical self-esteem in female exercise participants: An application of self-determination theory. *Journal of Applied Biobehavioral Research, 7,* 30 – 43.

Wilson, P. M., & Rodgers, W. M. (2004). The relationship between perceived autonomy support, exercise regulations and behavioral intentions in women. *Psychology of Sport and Exercise, 5,* 229 – 242.

Wilson, P. M., Rodgers, W. M., Blanchard, C. M., & Gessell, J. (2003). The relationship between psychological needs, self-determined motivation, exercise attitudes and physical fitness. *Journal of Applied Social Psychology, 33,* 2373 – 2392.

Wilson, P. M., Rodgers, W. M., & Fraser, S. N. (2002). Examining the psychometric properties of the behavioral regulation in exercise questionnaire. *Measurement in Physical Education and Exercise Science, 6,* 1 – 21.

World Health Organization (1995). Exercise for Health. WHO/FIMS Committee on Physical Activity for health. *Bulletin of the World Health Organization, 73,* 135 – 136.

Footnotes

[1] Amotivation has been defined by Markland & Tobin (2004) as representing "a state lacking of any intention to engage in behavior" and constitutes a completely non-self-determined form of motivation. Given that all participants in the current study engaged in at least some form of exercise, amotivation is not discussed in this study.

[2] Integrated regulation constitutes the most autonomous form of extrinsic motivation, occurring "when identified regulations have been fully assimilated to the self" (Ryan & Deci, 2000). However, integrated regulation was not examined in the current investigation, as the measurement instrument utilised in this study to tap the different forms of motivation proposed by SDT does not include a scale assessing this regulation.

[3] It could be argued that participants in the current study were recruited from two distinct settings, those associated with immediate/ current physical activity engagement (e.g., fitness clubs) and those that were not (e.g., community and retail settings). Therefore, analyses were conducted to determine whether individuals recruited from potentially 'active' (n = 126) versus 'non-active' (n = 243) settings differed with regards to their motivational profiles (available from the first author upon request). Despite some subtle differences between groups in the size of the predictions, no new predictor variables emerged (results can be obtained from the first author upon request). Thus, the findings suggest that competence need satisfaction, introjected and identified regulations are associated with increased exercise behavior, and that external regulation is negatively linked to physical activity. As we have no way of determining whether those individuals comprising the "non-active" setting group actually belonged to fitness clubs, this supplementary analysis must be interpreted with caution however.

Table 1

Reliability Analyses (Cronbach's coefficient α), Descriptive Statistics and Pearson Correlations for Age, Gender, Psychological Need Satisfaction via Exercise, Motivational Regulations for Exercise and Exercise Behaviors.

	α	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	-	31.86	11.28												
2. Gender	-	-	-	.05											
3. Autonomy via exercise	.65	5.49	0.82	.09	-.10										
4. Relatedness via exercise	.85	5.10	1.15	-.15**	-.08	.37**									
5. Competence via exercise	.65	5.02	0.95	-.17**	-14**	.45**	.52**								
6. External regulation	.70	1.30	0.48	-.08	-.05	-.33**	-.12*	-.22**							
7. Introjected regulation	.74	1.96	0.89	-.18**	.09	-.17**	-.00	.01	.35**						
8. Identified regulation	.78	3.47	0.90	-.15**	.05	.15**	.14**	.40**	-.02	.41**					
9. Intrinsic motivation	.92	3.55	1.02	-.13*	.00	.26**	.34**	.47**	-.14**	.14**	.64**				
10. Mild exercise	-	7.59	9.31	.06	.11*	.02	.05	-.09	.09	-.00	-.07	-.01			
11. Moderate exercise	-	14.51	19.82	.01	.10	.11*	-.01	-.02	-.06	-.05	.00	-.00	.20**		

12. Strenuous exercise	-	35.17	30.93	-.34**	-.15**	.11*	.17**	.38**	-.09	.28**	.41**	.33**	-.10	-.08	
13. Total exercise	-	57.28	36.83	-.27**	-..04	.16**	.15**	.29**	.-08	.20**	.32**	.27**	.28**	.52**	.77**

Note: N = 369. * p <.05. ** p <.01.

Table 2

Summary of Hierarchical Regression Analysis Predicting Total Exercise Behavior from Gender, Age, Psychological Needs and Motivational Regulations.

Independent variable	Adj. R^2	*ß*	*t*
Step 1: $F(2,344) = 13.10$, $p<.00$	.07		
Gender		-.03	-.56
Age		-.26	-5.06**
Step 2: $F(5,241) = 10.84$, $p<.00$	.13		
Gender		.01	.13
Age		-.24	-4.60**
Autonomy		.09	1.59
Relatedness		-.04	-.58
Competence		.22	3.51**
Step 3: $F(9,337) = 9.22$, $p<.00$	.18		
Gender		-.03	-.68
Age		-.21	-4.02**
Autonomy		.09	1.55
Relatedness		-.03	-.41
Competence		.12	1.72
External regulation		0.09	-1.58
Introjected regulation		.15	2.46*
Identified regulation		.14	1.89
Intrinsic motivation		.06	.82

Note: $N = 347$. * $p < .05$. ** $p < .01$.

Table 3

Summary of Hierarchical Regression Analysis Predicting Strenuous Exercise Behavior from Gender, Age, Psychological Needs and Motivational Regulations.

Independent variable	Adj. R^2	ß	*t*
Step 1: $F(2,344) = 26.36$, $p<.00$	.13		
Gender		-.13	-2.59**
Age		-.34	-6.66**
Step 2: $F(5,341) = 21.04$, $p<.00$	.23		
Gender		-.09	-1.85
Age		-.28	-5.76**
Autonomy		-.01	-.22
Relatedness		-.06	-1.11
Competence		.36	6.03**
Step 3: $F(9,337) = 19.06$, $p<.00$	.32		
Gender		-.14	-3.14**
Age		-.24	-5.15**
Autonomy		-.02	-.30
Relatedness		-.05	-.87
Competence		.23	3.72**
External regulation		-.14	-2.68**
Introjected regulation		.21	3.84**
Identified regulation		.17	2.56*
Intrinsic motivation		.05	.87

Note: $N = 347$. * $p < .05$. ** $p < .01$.

Table 4

Summary of Hierarchical Regression Analysis for Variables Predicting Intrinsic Motivation.

Independent variable	Adj. R^2	ß	*t*
Step 1: F (2, 97) = .81, p.45	.00		
Gender		.01	.09
Age		-.13	-1.28
Step 2: F (3, 96) = 5.18, p<.01	.11		
Gender		-.03	-.31
Age		-.11	-1.13
PAS		.35	3.70**
Step 3: F (6, 93) = 6.02, p<.00	.23		
Sex		.04	.41
Age		-.05	-.57
PAS		.23	2.30*
Autonomy		.02	.23
Relatedness		.02	.16
Competence		.38	3.43**

Note: N = 100. * p <.05. ** p <.01.