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ORIGINAL ARTICLE

Needs Satisfaction, Self-determined Motivation and Health-enhancing Physical Activity

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Abstract

Background: Previous studies have assessed physical activity participation from a self-determination theory perspective. However, no study has yet determined whether individuals who engage in sufficient physical activity to obtain substantial health benefits (i.e., health-enhancing physical activity or HEPA) differ from those who do not engage in such physical activity in terms of their motivational regulations and psychological needs satisfaction. Purpose: The primary purpose of the current study was to determine whether differences in motivation and psychological needs satisfaction exist between individuals who engage in HEPA and those who do not. Secondarily, we assessed whether each of the motivational regulations would mediate the relationships between needs satisfaction and HEPA. Method: The study employed a cross-sectional design, as 332 participants completed questionnaires assessing their psychological needs satisfaction, motivation to exercise, and self-reported physical activity. Results: As hypothesized, in comparison to the minimally active group, the HEPA group showed significantly greater levels of identified, integrated, and intrinsic regulations; lower levels of external regulation; and greater satisfaction of autonomy, competence, and relatedness. Simultaneous multiple mediator analyses revealed that external and integrated regulation mediated the autonomy – HEPA relationship, as well as the relatedness – HEPA relationship; the relationship between competence and HEPA was only mediated by external regulation. Conclusion: These results support self-determination theory by demonstrating that individuals who participate in HEPA have higher levels in the theory's key variables. In addition, the process by which to increase the likelihood of participating in HEPA was also partially supported. **Health & Fitness Journal of Canada 2012;5(3):3-17.**

Keywords: Self-determination; Health; Motivation; Physical activity; Exercise; Psychological needs

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Introduction

Engaging in routine physical activity is an effective primary and secondary preventive strategy against at least 25 chronic conditions (Warburton et al., 2006). Yet, it has been well documented that the majority of the world's population is not active enough to obtain optimal health benefits (World Health Organization, 2010). As a result, several national and international health organizations have constructed evidence-based physical activity guidelines in an attempt to increase physical activity. In Canada, for instance, it is recommended that adults engage in a minimum of 150 minutes of moderate-to-vigorous physical activity per week, with additional activity providing additional benefits (Tremblay et al., 2011). However, recent estimates indicate that only 15% of Canadians meet the physical activity guidelines (Colley et al., 2011). Meeting these physical activity guidelines provides substantial health benefits and reduces the risk for a wide array of negative health problems. As such, it is important to understand how correlates and predictors of physical

activity differ between individuals who participate in health enhancing physical activity (HEPA) and those who do not.

It has been reported that a lack of motivation is one of the biggest barriers to physical activity participation (Canadian Fitness and Lifestyle Research Institute, 2007). As such, it would be prudent to determine whether motivation differs between individuals who are active enough to obtain health benefits and those who are not. Self-determination theory (SDT; Deci and Ryan, 1985) is a motivational theory that is now recommended for understanding physical activity (Wilson et al., 2008). The overarching ideology of SDT is that humans have an innate desire and tendency towards growth and well-being. Within SDT, three basic psychological needs have been proposed—autonomy, competence, relatedness—where satisfaction of these needs lead to greater intrinsic motivation and well-being (Deci and Ryan, 2008). *Autonomy* is defined as individuals' sense of ownership and volition over their actions (e.g., believing that one can exercise how he/she desires); *competence* is the perception that one is capable of engaging in a specific behaviour (e.g., feeling as though one has the ability to complete a particular exercise); and *relatedness* refers to one's sense of belonging and interaction (e.g., perceiving a sense of social attachment to fellow exercisers; Ryan and Deci, 2000).

In addition, a motivational continuum from high self-determined motivation to low self-determined motivation is described in SDT. On the high end of this continuum lies *intrinsic motivation*, whereby an individual engages in a behaviour for pleasure or personal satisfaction (e.g., exercising because it is enjoyable). In contrast, *amotivation* lies on the low end of this continuum, where individuals lack any motivation to engage in a behaviour, such as physical activity. *Extrinsic motivation* falls between these two extremes and consists of four subtypes of motivation (from most self-determined to least self-determined): *integrated regulation*, where individuals engage in a behaviour to reinforce their sense of self (e.g., exercising to confirm one's identity as an exerciser); *identified regulation*, where individuals engage in a behaviour to achieve external outcomes or personal goals (e.g., exercising to be healthy); *introjected regulation*, where a behaviour is taken on to avoid guilt or anxiety or to obtain ego enhancements (e.g., exercising because it provides the individual with a sense of pride); and *external regulation*, where individuals behave to satisfy an external pressure or reward (e.g., individuals who exercise simply because a doctor says they should; Ryan and Deci, 2000).

Numerous studies have been conducted to determine whether motivational regulations are related to physical activity participation. Wilson and colleagues (2004) revealed that identified regulation was the most important predictor of physical activity levels. More recently, Markland and Tobin (2010) found that physical activity was only correlated with identified and intrinsic regulation. In addition, Duncan and colleagues (2010) found that identified and integrated regulations were the only predictors of exercise frequency. Despite some mixed results in these studies, physical activity was linked to more self-determined forms of regulations. In fact, physical activity has been consistently related to identified regulation (Teixeira et al., 2012; Wilson et al., 2012).

In these studies, physical activity levels are often assessed as a continuous

variable while only a limited number of studies have attempted to determine whether levels of motivational regulation differ specifically between individuals who participate in physical activity versus those who do not. Some SDT-based studies have compared motivational regulations along the stages of change continuum and revealed that individuals in the action and maintenance stages report greater levels of self-determined motivation (Buckworth et al., 2007; Daley and Duda, 2006; Landry and Solmon, 2004). However, to our knowledge, only one recent study has attempted to specifically compare active versus inactive individuals' motivation (Aaltonen et al., 2012). Although not rooted in SDT, the motives selected by the authors were similar to some of the motivational regulations of SDT. Specifically, moderate to large effect sizes were found favoring active individuals who had higher levels of enjoyment (i.e., intrinsic motivation) and value for the physical and psychological benefits of physical activity (i.e., identified regulation). Conversely, inactive individuals reported higher levels of motivation to meet others' expectations (i.e., external regulation; Aaltonen et al., 2012).

Researchers have also begun analyzing the interrelationships between physical activity, psychological needs satisfaction, and motivational regulations. Confirming the tenets of SDT, numerous studies have shown that psychological needs are related to the motivational regulations within a physical activity context (e.g., Wilson and Rogers, 2008; Barbeau et al., 2009; Markland and Tobin, 2010). Furthermore, Silva and colleagues (2010) demonstrated that intrinsic motivation mediated both the autonomy – physical activity and competence – physical activity relationships. In another study, identified regulation was the only motivational regulation that mediated the competence – physical activity relationship (Edmunds et al., 2006). It is important that further research be conducted to determine if the motivational regulations mediate the relationships between each of the psychological needs and individuals' physical activity levels.

While previous studies have reported differences in behavioural regulations based on various physical activity outcomes, research has yet to assess whether psychological needs satisfaction and motivation differs between individuals who participate in HEPA compared to those who do not. Accordingly, the primary purpose of this study was to determine whether individuals who exercise to the extent at which substantial health benefits are obtained (hereafter referred to as the "HEPA group") differ in their motivational regulations and needs satisfaction compared to individuals who do not exercise or exercise at a level that provides little or only minimal health benefits (hereafter referred to as the "minimally active group"). In line with the tenets of SDT, we hypothesized that—relative to the minimally active group—the HEPA group would have higher scores on each of the three psychological needs and on identified, integrated and intrinsic motivation, while holding lower levels of amotivation, and external and introjected regulation. Secondarily, we evaluated whether each motivational regulation predicted the likelihood than an individual participates in HEPA and whether each mediated the relationships between the three psychological needs and membership to the HEPA group. We, therefore, conducted multiple mediator analyses with all six regulations as

mediators between the three psychological needs and the HEPA group. Consistent with SDT, we hypothesized that the motivational regulations would mediate these relationships.

Methods

Participants

Undergraduate students (n = 332) from a Canadian university taking a first-year psychology course were recruited to participate in this study. The sample consisted of 236 females, 85 males, and 11 who did not specify. Participants ranged in age from 17 to 41 years (M = 18.97, SD = 2.74). Of these participants, 166 indicated English as their first language, 76 indicated French, 80 indicated another language, and 10 did not specify.

Measures

Psychological Needs Satisfaction

Participants completed the Psychological Need Satisfaction in Exercise Scale (Wilson et al., 2006) to assess their perceived satisfaction for autonomy, competence, and relatedness within the context of physical activity. This questionnaire consists of 18 questions, with six items assessing autonomy (e.g., "I feel free to exercise in my own way"), six items assessing competence (e.g., "I feel that I am able to complete exercises that are personally challenging"), and six items assessing relatedness (e.g., "I feel attached to my exercise companions because they accept me for who I am"). For each question, participants indicated the degree to which they agree with the statement from 1 ("false") to 6 ("true"). This scale has been shown to be valid and reliable in assessing psychological needs satisfaction in physical activity contexts (Wilson et al., 2006; Wilson et al., 2008). In the current study, Cronbach's alpha was adequate for all three subscales ($\alpha \leq 0.88$).

Motivation to Exercise

The Behavioural Regulation Exercise Questionnaire-2 (BREQ-2; Markland and Tobin, 2004)—including Wilson and colleagues' (2006) 4 additional integrated items—was used to measure participants' motivations for partaking in physical activity. This questionnaire begins with the question "usually why do you engage in physical activity?" followed by 23 items. Four items assess amotivation (e.g., "I think participating in physical activity is a waste of time"), four items assess external regulation (e.g. "I take part in physical activity because my friends/family/partner say I should"), three items assess introjected regulation (e.g., "I feel guilty when I don't participate in physical activity"), four items assess identified regulation (e.g., "It's important to me to participate in physical activity"), four items (added by Wilson et al., 2006) assess integrated regulation (e.g., "I consider exercise consistent with my values"), and four items assess intrinsic regulation (e.g., "I get pleasure and satisfaction from participating in physical activity"). Participants indicate the degree to which each statement is representative of them from 0 ("not true for me") to 4 ("very true for me"). This scale has been shown to be valid and reliable in assessing motivation for being physically active (Markland and Tobin, 2004; Murcia et al., 2007). In the current study, Cronbach's alpha was adequate for all six subscales ($\alpha \leq 0.74$).

Self-reported Physical Activity

Participants completed the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin and Shephard, 1985) as a measure of their physical activity. In this

questionnaire, participants indicate the average number of times they engage in mild (e.g., yoga, fishing, golf), moderate (e.g., baseball, easy biking, easy swimming), and strenuous (e.g., running, basketball, cross country skiing) physical activity for more than 20 minutes during their free time over a 7-day period when considering the previous four weeks. Recently, Godin (2011) suggested that only moderate and strenuous activities be taken into consideration, as, overall, mild activities are not strong contributors to health. As such, only moderate and strenuous physical activities were included in our resulting quantitative assessment of physical activity. The frequency of moderate physical activity is multiplied by 5 METS (units of metabolic equivalence) and the frequency of strenuous activity is multiplied by 9 METS; these scores are then summed to produce a composite total of physical activity per week. A composite score of 24 units or greater denotes substantial health benefits, while scores between 14-23 indicate some benefits, and scores below 14 imply little or no benefits (Godin, 2011). This questionnaire has been used extensively in physical activity research, as it has proven to be a valid and reliable measure of physical activity (e.g., Jacobs et al., 1993).

Procedure

The current study received approval from the university's research ethics board. The study was completed online and was one of many research projects that students enrolled in a first year psychology course had the option to participate in as part of the course curriculum. A description of the study explained that the research objective was to test motivational variables within the context of physical activity. After selecting our study and providing electronic consent, participants proceeded to complete the three study questionnaires online. Participants were informed that their results would remain anonymous, and that they were free to withdraw from the study at any time.

Data Analysis

All data were first downloaded from the Integrated System for Participants in Research website, and converted to an SPSS file. Analyses were then conducted using SPSS v. 20 (IBM SPSS Predictive Analytics, Chicago IL). The data were then examined for univariate outliers using frequencies and z-scores. Data screening was conducted to test for normality. Composite scores for all variables were then computed. As mentioned, a score above 24 on the GLTEQ is considered health enhancing physical activity (Godin, 2011). While there is a dose-response relationship with physical activity and health benefits, we were interested in assessing differences among various SDT variables specifically between individuals who participate in HEPA and those who do not. Therefore, participants were assigned to one of two groups based on their composite physical activity score on the GLTEQ: individuals whose composite score was below 24 would fall in the "minimally active" group, while those with a score of 24 or higher would fall in the HEPA group. Correlations between the six motivational regulations were then conducted to assess the simplex pattern of the motivational regulations.

To test our first hypothesis, one-way ANOVAs were carried out to determine whether the HEPA group differed significantly on scores of needs and regulations from the minimally active group. Tests for homogeneity of variance were simultaneously conducted for all

ANOVA tests. If this assumption was violated, the Welch's F test for ANOVA was used, as this test is robust to the assumption of homogeneity (Field, 2009). Multiple mediation procedures were carried out according to Hayes (2012) to test our second hypotheses. Three models were computed, with our independent variable being one of the three needs (i.e., autonomy, competence, or relatedness). For each model, the outcome variable was the HEPA group, and there were six mediators: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation. The SPSS macro PROCESS provided by Hayes (2012) uses logistic regression-based path analysis for estimating direct and indirect effects in parallel multiple mediator models. For each mediation model, PROCESS provides: a model summary of the independent variable regressed onto each mediating variable; a logistic regression model summary for the independent variable and each mediator regressed onto the outcome variable; the total direct and indirect effects of the independent variable on the outcome variable; and the indirect effect of the independent variable on the outcome variable via each of the mediating variables.

Results

Preliminary Analyses

The amotivation variable was not normal (skewness = 2.00; kurtosis = 3.87) but rendered normal with a square-root transformation (skewness = 1.12; kurtosis = -0.20). This transformed variable was, therefore, used in all subsequent analyses that included amotivation. Computation of the composite physical activity scores revealed that the sample was highly active, as 276 participants fell in the HEPA group, while only 52 participants were minimally active. The simplex pattern of the motivational regulations was supported as revealed in the correlations in Table 1. Specifically, the relationships between the more proximal regulations were stronger and positive compared to regulations that are more distal.

Psychological Needs and Motivational Regulations

As shown in Table 2, a series of one-way ANOVAs and associated effect sizes revealed several differences between groups in psychological needs and motivational regulations. Because the sample size between both groups is not equal, the F-test is particularly vulnerable to violation of the homogeneity of variance assumption. For all psychological needs and motivational regulations homogeneity of variance assumption was met, except for amotivation. As a result, the conventional F-test was used except for amotivation where a Welch's F test was utilized. With respect to the psychological needs, the HEPA group scored significantly higher than the minimally active group in terms of autonomy, perceived competence, and relatedness. Medium to large effects were found for all three psychological needs. In regards to motivational regulations, the HEPA group scored significantly lower than the minimally active group for external regulation; in addition, the HEPA group had significantly higher scores than the minimally active group for identified regulation, integrated regulation, and intrinsic regulation. Moderate to large effects were also found for the motivational regulations except for amotivation where small effects were found.

Table 1: Correlations between motivational regulation variables.

Variable	1	2	3	4	5	6
1. Amotivation	-					
2. External	0.39**	-				
3. Introjected	-0.06	0.33**	-			
4. Identified	-0.46*	-0.08	0.41**	-		
5. Integrated	-0.33**	-0.08	0.37**	0.73**	-	
6. Intrinsic	-0.46**	-0.21**	0.13*	0.69**	0.65**	-

Note. *$p < 0.05$; **$p < 0.01$.

Table 2. Analyses of Variance for the differences in SDT variables between the Minimally Active group and the Health-Enhancing Physical Activity group.

	Minimally Active		HEPA			Effect Size
	Mean	SD	Mean	SD	*F*	(Cohen's D)
Autonomy	4.75	0.88	5.28	0.69	23.77***	-0.67
Competence	4.02	0.95	4.83	0.82	40.52***	-0.91
Relatedness	4.16	0.82	4.58	0.87	10.46**	-0.50
Amotivation	0.39	0.57	0.32	0.50	0.73[a]	0.13
External	1.45	0.89	1.00	0.88	11.51**	0.51
Introjected	1.88	0.92	1.97	1.04	0.39	0.86
Identified	2.61	0.79	3.10	0.68	21.21***	-0.66
Integrated	1.92	0.88	2.67	0.95	27.93***	-0.82
Intrinsic	2.70	0.81	3.18	0.70	19.294***	-0.63

Note. *$p < .05$; **$p < .01$; ***$p < .001$. [a]: amotivation did not meet the assumption of homogeneity of variance and, therefore, the *F*-value reflects Welch's *F*.

Multiple Mediator Analyses

Table 3 provides the results of the multiple mediator analyses for the effects of needs satisfaction predicting group membership via motivational regulations.

Autonomy

In regards to autonomy predicting motivational regulations, there were significant negative relationships between autonomy and amotivation (R^2 = 0.15, F(1, 326) = 61.71, $p < 0.001$), and autonomy and external regulation (R^2 = 0.07, F(1, 326) = 25.40, $p < 0.001$). In addition, autonomy was significantly positively related to integrated regulation (R^2 = 0.10, F(1, 326) = 35.43, $p < 0.001$), identified regulation (R^2 = 0.17, F(1, 326) = 67.07, $p < 0.001$), and intrinsic regulation (R^2 = 0.21, F(1, 326) = 86.16, $p < 0.001$). Autonomy was not significantly related to introjected regulation (R^2 = 0.001, F(1, 326) = 0.42, $p = 0.51$).

In regards to motivational regulations predicting HEPA, the overall model was significant (Model LL = 54.88, df = 7, p < 0.05, Nagelkerke's R^2 = 0.26). Amotivation and integrated regulation emerged as significant predictors, indicating that higher levels of these variables resulted in a greater likelihood of HEPA group membership. Higher levels of external regulation resulted in a greater likelihood of belonging to the minimally active group. A suppression effect occurred with amotivation as this variable is uncorrelated with HEPA group (r = -0.05, $p = 0.35$), but becomes significant when included in the model. Therefore, its effect in the model has been inflated and will not be interpreted in the subsequent analyses. Introjected regulation, identified

regulation, and intrinsic regulation were not unique predictors of group membership.

of the autonomy – HEPA relationship, whereby greater autonomy predicted greater integrated regulation, which, in

Table 3: Mediated regression analyses for the effects of needs satisfaction predicting health-enhancing physical activity via motivational regulation.

Independent variables (needs) to mediators (regulations)									
	Autonomy			Competence			Relatedness		
	B	SE	t	B	SE	t	B	SE	t
Amotivation	-0.27	0.03	-7.86***	-0.20	0.03	-6.54***	-0.12	0.03	-3.70***
External	-0.32	0.06	-5.04***	-0.25	0.05	-4.58***	-0.11	0.06	-1.89
Introjected	0.05	0.08	0.66	0.08	0.06	1.27	0.17	0.06	2.73**
Identified	0.40	0.05	8.19***	0.38	0.04	9.79***	0.27	0.04	6.38***
Integrated	0.41	0.07	5.95***	0.60	0.05	11.77***	0.43	0.06	7.63***
Intrinsic	0.45	0.05	9.28***	0.49	0.04	13.41***	0.39	0.04	9.26***
Mediators (regulations) to outcome variable (HEPA)									
	Autonomy			Competence			Relatedness		
	B	SE	Z	B	SE	Z	B	SE	Z
Amotivation	1.26	0.41	3.11**	1.12	0.40	2.80**	1.01	0.38	2.65**
External	-0.68	0.21	-3.18**	-0.69	0.22	-3.20**	-0.73	0.21	-3.47***
Introjected	-0.02	0.21	-0.08	0.03	0.22	0.13	-0.07	0.21	-0.34
Identified	0.22	0.43	0.51	0.43	0.42	1.03	0.51	0.41	1.24
Integrated	0.83	0.29	2.92**	0.53	0.28	1.87	0.70	0.27	2.57*
Intrinsic	0.14	0.33	0.41	-0.04	0.35	-0.12	0.15	0.33	0.45
Independent variables (needs) to outcome variable (HEPA) via mediators (regulations)									
	Autonomy			Competence			Relatedness		
	B	SE	Z	B	SE	Z	B	SE	Z
TDE	0.73	0.25	2.91**	0.81	0.24	3.32***	0.23	0.20	1.14
		95% CI			95% CI			95% CI	
	Effect	Lower	Upper	Effect	Lower	Upper	Effect	Lower	Upper
TIE	0.36[a]	0.05	0.68	0.41[a]	0.04	0.77	0.45[a]	0.18	0.74
Amotivation	-0.35[a]	-0.63	-0.09	-0.22[a]	-0.42	-0.06	-0.12[a]	-0.29	-0.02
External	0.22[a]	0.06	0.42	0.17[a]	0.05	0.33	0.08[a]	0.00	0.21
Introjected	-0.00	-0.06	0.03	0.00	-0.04	0.06	-0.01	-0.12	0.07
Identified	0.09	-0.31	0.51	0.16	-0.17	0.58	0.14	-0.10	0.43
Integrated	0.34[a]	0.08	0.71	0.31	-0.08	0.71	0.31[a]	0.07	0.62
Intrinsic	0.06	-0.28	0.40	-0.02	-0.44	0.32	0.06	-0.23	0.38

Note. *p < .05; **p < .01; ***p < .001. [a]: 95% confidence interval does not include zero. HEPA: health-enhancing physical activity; TDE: Total direct effect; TIE: Total indirect effect; 95% CI: 95% confidence interval.

The total direct effect of autonomy predicting HEPA via motivational regulations was significant, as was the total indirect effect. Specifically, external regulation was a significant mediator of the autonomy – HEPA relationship, such that greater autonomy resulted in a greater likelihood that individuals would be in the HEPA group by lowering levels of external regulation. Integrated regulation was also a significant mediator

turn, predicted a greater likelihood that individuals would be in the HEPA group.

Competence

In regards to competence predicting motivational regulations, there were significant negative relationships between competence and amotivation (R^2 = 0.12, F(1, 326) = 42.83, p < 0.001), and competence and external regulation (R^2 = 0.06, F(1, 326) = 20.98, p < 0.001).

Competence was also significantly positively related to identified regulation (R^2 = 0.23, F(1, 326) = 95.91, p < 0.001), integrated regulation (R^2 = 0.30, F(1, 326) = 138.43, p < 0.001), and intrinsic regulation (R^2 = 0.36, F(1, 326) = 179.93, p < 0.001). Competence did not significantly predict introjected regulation (R^2 = 0.01, F(1, 326) = 1.62, p = 0.20).

In regards to motivational regulations predicting HEPA, the overall model was significant (Model LL = 57.64, df = 7, p < 0.05, Nagelkerke's R^2 = 0.28). Amotivation emerged as a significant predictor, indicating that a higher level of amotivation was related to a greater likelihood of HEPA group membership. Higher levels of external regulation resulted in greater likelihood of belonging to the minimally active group. Once again, a suppression effect occurred with amotivation as this variable is uncorrelated with HEPA group (r = -0.05, p = 0.35), but becomes significant when included in the model. Therefore, its effect in the model has been inflated and will not be interpreted in the subsequent analyses. Integrated regulation approached significance as a positive predictor of HEPA (p = 0.06). Introjected regulation, identified regulation, and intrinsic regulation were not unique predictors of group membership.

The total direct effect of competence predicting HEPA via motivational regulations was significant, as was the total indirect effect. External regulation was the only variable to meditate the competence – HEPA relationship, whereby greater competence resulted in a greater likelihood that individuals would be in the HEPA group by lowering levels of external regulation.

Relatedness

In regards to relatedness predicting motivational regulations, there were significant negative relationships between relatedness and amotivation (R^2 = 0.04, F(1, 326) = 13.69, p < 0.001). The negative relationship between relatedness and external regulation approached significance (R^2 = 0.01, F(1, 326) = 3.56, p = 0.06). Relatedness was also significantly related to introjected regulation (R^2 = 0.02, F(1, 326) = 7.46, p < 0.01), identified regulation (R^2 = 0.11, F(1, 326) = 40.73, p < 0.001), integrated regulation (R^2 = .15, F(1, 326) = 58.24, p < 0.001), and intrinsic regulation (R^2 = 0.21, F(1, 326) = 85.80, p < 0.001).

In regards to motivational regulations predicting HEPA, the overall model was significant (Model LL = 47.44, df = 7, p < 0.05, Nagelkerke's R^2 = 0.23). Amotivation and integrated regulation were significant positive predictors of group membership, indicating that greater levels of amotivation and integrated regulation increased the likelihood of belonging to the HEPA group. Consisent with the other two models, a suppression effect occured with amotivation as this variable is uncorrelated with HEPA group (r = -0.05, p = 0.35), but becomes significant when included in the model. Therefore, its effect in the model has been inflated and will not be interpreted in the subsequent analyses. Higher levels of external regulation resulted in greater likelihood of belonging to the minimally active group. Introjected regulation, identified regulation, and intrinsic regulation did not significantly predict HEPA.

The total direct effect of relatedness predicting HEPA via motivational regulations was not significant but the total indirect effect was. External regulation mediated the relatedness – HEPA relationship, such that greater

relatedness resulted in a greater likelihood that individuals would be in the HEPA group by lowering levels of external regulation. Additionally, integrated regulation emerged as a significant mediator, whereby greater relatedness predicted greater integrated regulation, which, in turn, predicted a greater likelihood that individuals would be in the HEPA group.

Discussion

The primary purpose of this study was to determine whether individuals who engage in HEPA differed from individuals who engage in little or no physical activity in terms of their perceived needs satisfaction and motivational regulations. Secondly, we sought to determine whether the relationships between needs satisfaction and engagement in HEPA would be mediated by motivational regulations. The results of these analyses yielded several notable findings.

Firstly, regarding group differences, the HEPA group showed significantly higher satisfaction of autonomy, competence, and relatedness compared to the minimally active group, as hypothesized. The HEPA group also had greater levels of identified regulation, integrated regulation, and intrinsic regulation, as well as lower levels of external regulation compared to the minimally active group. These findings are in line with SDT and a similar study by Aaltonen and colleagues (2012). The results also support the consistent relationship between more self-determined types of motivation and physical activity (Teixeira et al., 2012). Whereas most previous studies have analyzed physical activity as a continuous variable, we have demonstrated that individuals who are active enough to obtain substantial health benefits are more likely to show greater needs satisfaction and self-determined motivation than those who are not. Based on these results and the theoretical underpinnings of SDT, interventions should aim to foster greater self-determined types of motivation to aid in increasing participation in HEPA.

Secondly, the results of our multiple mediator analyses provided partial support our hypotheses and the tenets of SDT. As theoretically expected, the mediation effect of external regulations was significant. The mediation demonstrated that higher levels of each psychological need were related to lower levels of external regulation. These lower levels of external regulation then translated to increased likelihood of HEPA participation. Regarding integrated regulation, significant mediation was consistent with SDT as more internalized types of regulations should be related to more physical activity participation. The fact that this type of regulation did not mediate the competence – HEPA group relationship was somewhat surprising. However, Deci and Ryan (2000) do claim that although competence is important for internalization, autonomy is needed for "a regulation to become integral to one's self" (p. 238). Therefore, it is possible that competence may play less of a role than autonomy in predicting more internalized types of motivation.

Contrary to expectation, neither identified nor intrinsic regulations were not found to be significant mediators. Empirically, intrinsic has been inconsistently linked with physical activity. However, evidence of mediation of intrinsic motivation exists (Silva et al., 2010). One explanation why the mediation was not found in this study is that intrinsic could be more linked with

physical activity in the long-term (Teixeira et al., 2012). Due to the cross-sectional nature of this article, we did not observe physical activity participation over the long-term. Future studies looking at 12-months or more could help determine how intrinsic regulation may evolve over time. Although identified regulation is often linked with physical activity (e.g., Wilson et al., 2004; Edmunds et al., 2006) and partial mediation between competence and strenuous physical activity has been shown in previous research (Edmunds et al., 2006), significant mediation was not found in this study. Despite being contrary to our expectations, identified regulation has rarely been assessed alongside integrated regulation in the SDT – physical activity literature. As a result, it remains difficult to ascertain whether identified regulation would still be significant mediator with the addition of integrated regulation. The findings of this study appear to favour integrated regulation. In their systematic review, Teixeira and colleagues (2012) found only six studies where they were able to compare the relationship of identified and integrated regulation with physical activity. Five of the six articles did not reveal differences between the patterns of association between both regulations and physical activity, but few studies took a multivariate approach to their analyses. Therefore, more studies are needed to determine the extent to which integrated regulation is related with physical activity and how that relationship differs from the other regulations.

Implications

The results of this study provide further evidence of the importance of fostering psychological needs, as higher needs were indirectly related with the more active HEPA group, via motivational regulations. One way to facilitate the satisfaction of the psychological needs is to be need supportive. Within the context of physical activity, an individual (such as a personal fitness trainer or significant other) who is need supportive would minimize control by: offering choices and encouraging individuals to partake in physical activity for their own personal reasons; outlining and explaining behaviour-outcome contingencies; and providing positive feedback and non-judgmental positive regard (Fortier et al., 2007). Being need supportive has been demonstrated as being linked with psychological needs and motivation in correlational (Markland and Tobin, 2010) and intervention (Silva et al., 2010) studies. Future interventionists could, therefore, ground their intervention protocol in SDT and specifically train their physical activity counsellors to be need supportive. Early evidence of the effectiveness of these SDT-based interventions has been reported (Fortier et al., 2012).

To our knowledge, this is the first study to assess whether differences exist between individuals who engage in enough physical activity to obtain substantial health benefits and those who do not from a self-determination theory perspective. These results give us a practical look at the role of SDT in the physical activity setting. By analyzing differences in physical activity participation in a dichotomous manner, these findings complement the results of previous studies that have analyzed physical activity participation from a SDT perspective. That is, the results of the current study demonstrate that those with greater psychological needs satisfaction and self-determined motivation are more likely to engage in

HEPA. This is important, as it supports the notion that greater needs satisfaction and self-determined motivation is not only associated with greater engagement in physical activity in general, but greater physical activity participation to the extent that it provides substantial health benefits. Therefore, SDT variables should be included in future interventions as they can help differentiate individuals who participate in HEPA than those who do not. Moreover, the multiple mediator analysis employed allowed us to look at the role of each of the motivational regulations simultaneously, which is important because it allowed us to observe the multivariate relationship between the regulations and HEPA. This study is, therefore, one of the few that has taken this multivariate approach by including all six motivational (Teixeira et al., 2012). As a result, integrated regulation was found to be a significant mediator over the other self-determined motivational regulations.

Limitations

Despite the strengths and noteworthy findings of this study, there are some limitations that should be mentioned. For one, we used a convenient student population as our sample. It, therefore, remains to be seen whether these results generalize to other populations. There was also an overrepresentation of individuals in the HEPA group compared to the minimally active group. While as little as 15% of Canadians meet the physical activity guidelines (Colley et al., 2011), nearly 83% of our participants met the cut-off for falling into the HEPA group (i.e., 24 MET value). Although the rates are disproportionally high, they reflect physical activity levels reported in previous studies using a post-secondary student sample (e.g., M = 51.80, SD = 17.80; Wilson et al., 2012). Therefore, caution is warranted when interpreting results from self-reported physical activity measures, especially from this sample. Although the groups were still homogeneous within themselves and did not compromise the analyses, a more representative sample would have, nonetheless, increased the generalizability of the results to the general population. Finally, the cross-sectional nature of this study prevents us from asserting that improving individuals' perceived needs satisfaction and motivational regulations will necessarily result in greater participation in HEPA. However, it has been argued that cross-sectional physical activity remains a very close proxy to future physical activity (Rhodes and Plotnikoff, 2005).

Future Directions

To improve the generalizability of the findings from the current study, it would be valuable to conduct similar research with a community-based sample. In addition, it is possible—based on our findings and others studies grounded in SDT (e.g., Barbeau et al., 2009; Markland and Tobin, 2010)—that minimally active individuals' physical activity may increase to sufficient physical activity to incur substantial health benefits by improving their perceived needs satisfaction and motivational regulations. However, this hypothesis would need to be tested in a study that utilizes a controlled experimental design. In conjunction with a multiple mediator analysis, this type of study would allow researchers to determine whether increasing one's competence, autonomy, and relatedness would result in more self-determined forms of motivation, which, in turn, would increase one's HEPA behaviour. Future

studies could also retest the mediational models with longitudinal data. Using longitudinal data could help identify if the mediation effects are stable over time (Mackinnon et al., 2007).

Conclusions

The results of the current study provide further support for SDT variables within a physical activity context. Specifically, these findings demonstrate that those who participate in HEPA have greater psychological needs satisfaction and self-determined behavioural regulation. They also point to the significance of external and integrated regulation in mediating the relationships between needs satisfaction and engagement in HEPA. On a practical level, physical activity counsellors or health behaviour interventionists should attempt to foster the psychological needs and integrated regulation in individuals to help them derive the health benefits obtained from participating in HEPA.

Authors' Qualifications

The author's qualifications are: Desmond McEwan, MSc, BA (Hons), Shane N. Sweet, PhD, BA (Hons).

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