Psychology of Sport and Exercise 12 (2011) 99–105

Contents lists available at ScienceDirect

Psychology of Sport and Exercise

journal homepage: www.elsevier.com/locate/psychsport

Exploring motivation for physical activity across the adult lifespan

Jennifer Brunet, Catherine M. Sabiston*

Department of Kinesiology and Physical Education, McGill University, 475 Pine Avenue West, Montreal, Quebec, Canada H2W 1S4

ARTICLE INFO

Article history:
Received 20 April 2010
Received in revised form
15 September 2010
Accepted 18 September 2010
Available online 29 September 2010

Keywords:
Self-determination theory
Health behavior
Age

ABSTRACT

Purpose: This study examined mean differences in, and relationships among, motivational regulations and physical activity in three different age groups (young adults: 18–24, adults: 25–44, and middle-age adults: 45–64 years) using self-determination theory (Deci & Ryan, 1985).
Design: Cross-sectional study.
Methods: Data from 547 participants who completed a self-report questionnaire were analyzed.
Results: Based on multivariate analysis of covariance, motivational regulations and physical activity levels differed across age groups. Regression analyses were conducted while controlling for body mass index, gender, education level and ethnicity. Autonomous motivation (consisting of intrinsic motivation and identified regulation) was a positive correlate of physical activity behavior in each age group. Introjected regulation was a significant positive correlate of physical activity behavior, and external regulation was a significant negative correlate of physical activity behavior for young adults. These correlates were not significant in the models predicting physical activity behavior for adults and middle-age adults.
Conclusions: Findings highlight the importance of considering age when studying physical activity motivation since the strength of the associations between the motivational regulations and physical activity behavior varied across age groups. Identifying factors that influence intrinsic motivation and identified regulation for physical activity within each age segment is necessary to develop interventions to increase physical activity behavior across the lifespan.

Regular physical activity is associated with a number of physical, psychological, and social health benefits across the lifespan, which include decreased risk for cardiovascular diseases, diabetes, hypertension, obesity, depression, cancer, and improved social relationships, self-esteem, and quality of life (Warburton, Nicol, & Bredin, 2006). Unfortunately, the majority of adults are considered inactive (Haskell et al., 2007; Sisson & Katzmarzyk, 2008). Research has also shown that physical activity rates decrease steadily during adulthood (Haskell et al., 2007; Sallis, 2000). As such, increasing levels of physical activity to meet current guidelines during adulthood is a public health priority.

Identifying factors associated with adult physical activity behavior is important since it will help in informing future research and may guide the implementation of interventions aimed at promoting physical activity behavior across the lifespan. One promising approach is to focus on motivation since it is a factor believed to help individuals initiate and maintain behavior (Hagger & Chatzisarantis, 2007). Therefore, determining levels of motivation and its influence on physical activity behavior in various age groups across the adult lifespan would be beneficial.

Self-determination theory and physical activity

A theory that has been widely used to examine the relationship between motivation and physical activity is self-determination theory (SDT: Deci & Ryan, 1985; Edmunds, Ntoumanis, & Duda, 2006; Hagger & Chatzisarantis, 2008; Mullan, Markland, & Ingledew, 1997). SDT consist of several subtheories: cognitive evaluation theory (CET), organismic integration theory (OIT), causality orientations theory (COT), Goal Content theory (GCT), and basic needs theory (BNT; Deci & Ryan, 2002). Within the physical activity domain, OIT has gained popularity because it conceptualizes motivation as a multidimensional construct and proposes qualitatively distinct motivation types, rather than a unidimensional focus on quantity of motivation. Specifically, OIT highlights six types of motivational regulations (intrinsic, integrated, identified, introjected, external, and amotivation) that range from self-determined to non-self-determined, respectively (Deci & Ryan, 2002).

Intrinsic motivation occurs when an individual engages in an activity for the inherent feelings of pleasure, fun, and satisfaction gained from the participation. Next, Deci and Ryan (1985) outline

* Corresponding author. Department of Kinesiology and Physical Education, McGill University, 475 Pine Avenue West, Room 212, Montreal, Quebec, Canada H2W 1S4. Tel.: +1 514 398 4184x00890; fax: +1 514 398 4186.
E-mail addresses: jennifer.brunet@mail.mcgill.ca (J. Brunet), catherine.sabiston@mcgill.ca (C.M. Sabiston).

1469-0292/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.psychsport.2010.09.006

four types of extrinsic motivation, which are delineated in the continuum between the two extremes of intrinsic motivation and amotivation. The most self-determined type of extrinsic motivation is integrated regulation and occurs when an individual participates in an activity because it is congruent with his/her personal values, goals, and needs that are part of him/herself, but is not inherently enjoyable. Identified regulation occurs when an individual engages in an activity that he/she deems personally valuable and important to attain a desired outcome. In this case, a person endorses the behavior and performs it with a high degree of perceived autonomy. Introjected regulation is when an individual participates in an activity to avoid guilt and shame or to attain ego enhancements and feelings of worth. This type of regulation is considered controlling in nature rather than autonomous. The least self-determined regulation is external regulation and is manifested when an individual partakes in an activity to obtain rewards or avoid punishments. This type of regulation is present when an individual engages in an activity to satisfy an external demand or a socially constructed contingency (Deci & Ryan, 2002). Finally, amotivation, placed at the lower end of the self-determination continuum, is characterized as a relative absence of intrinsic or extrinsic motivation (Deci & Ryan, 1985, 2002). In this state, an individual lacks intention to engage in an activity (Deci & Ryan, 1985, 2002).

In general, intrinsic, integrated, and identified regulations are characterized as autonomous because they reflect a sense of personal volition and originate from an internal perceived locus of causality. In contrast, introjected and external regulations are characterized as controlled because they reflect external demands and originate from an external perceived locus of causality (Deci & Ryan, 2000, 2002). Studies using SDT as a framework have shown that regulations that are considered autonomous are positively associated with healthy behavioral outcomes such as greater physical activity participation and effort (e.g., Frederick & Ryan, 1993; Li, 1999; McDonough & Crocker, 2007; Sabiston et al., 2010; Standage, Sebire, & Loney, 2008; Thogersen-Ntoumani & Ntoumanis, 2006; Wilson, Rodgers, Blanchard, & Gessell, 2003; Wilson, Rodgers, Fraser, & Murray, 2004). In spite of this prominent evidence linking motivation and physical activity, the majority of studies have targeted adolescents, college-age students, or adult sub-groups without examining age differences in the link between the motivational regulations and physical activity. Consequently, little is known about motivation for physical activity across the adult lifespan (Hagger & Chatzisarantis, 2007).

Motivation for physical activity across the adult lifespan

The reasons why people engage in physical activity may be different during young, middle, and older adulthood as a result of changing values, life tasks, goals, and health circumstances over time (Miller & Iris, 2002). Although SDT distinguishes between goal content and motivational regulations, it is believed that certain reasons to be physically active are more conducive to autonomous regulations, whereas other reasons are more conducive to controlled regulations (Ingledew & Markland, 2008; Ingledew, Markland, & Medley, 1998; Markland & Ingledew, 1997). Common reasons for physical activity engagement among young adults around 20 years of age include weight control for appearance purposes, physical attractiveness, and social recognition (Ingledew & Sullivan, 2002; Sabiston, Crocker, & Munroe-Chandler, 2005; Strong, Martin Ginis, Mack, & Wilson, 2006). These reasons are likely the result of the increased pressure for young adults to 'look good' (Cash & Pruzinsky, 2002), which may make people feel that they need to meet the physical appearance ideals in society (Fogelholm & Kukkonen-Harjula, 2000). Based on SDT, individuals who engage in physical activity behavior for these reasons are governed by external forces and their underlying regulations would be controlled (i.e., introjected and/or external regulation; Ingledew & Markland, 2008).

In contrast, such reasons for engaging in physical activity do not appear as prominent later in life (Beck, Gillison, & Standage, 2010; Finch, 1997; Reboussin et al., 2000). As adults age, they often seek new challenges through physical activity, value being physically competent, and place more emphasis on physical function and ability benefits offered by engaging in physical activity rather than appearance reasons (Beck et al., 2010; Reboussin et al., 2000). For instance, Davis, Fox, Brewer, and Ratusny (1995) reported that age was positively related to fitness and health management motives for physical activity, but not appearance motives in adults aged 18–60 years. Similarly, Finch (1997) demonstrated that older adults over the age of 50 years reported physical ability to perform physical tasks, enjoyment and pleasure, fitness, and desire to reduce the effect of aging as physical activity motives. Based on SDT principles, these reasons are personally valued, and would reflect autonomous regulations (i.e., intrinsic motivation, identified and/or integrated regulations). Taken together, these findings suggest that adults may report different motivational regulations at different ages. As such, research adopting a lifespan approach in this context may provide valuable information about physical activity motivation in different age groups and may inform the development of tailored interventions. Specifically, interventions targeting specific age groups could focus on addressing the motivational regulations that are associated with physical activity behavior within each age group to ensure that behavior is being adopted and maintained.

Purpose, objectives and hypotheses

The purpose of this study was to explore motivation for physical activity across the adult lifespan. To this end, mean levels of the motivational regulations embedded in SDT and self-reported physical activity were first compared across a sample of adults who were stratified by age. Second, relationships among the motivational regulations and self-reported physical activity within each of these age groups were examined. In the current study, three age categories were created: 18–24 years (young adults), 25–44 years (adults), and 45–64 years (middle-aged adults). This age-stratification was based on Spirduso, Francis, and MacRae's (1995) suggestion that physical activity plays a different role in each of these age groups. In addition, these age groups have been widely used in national databases (Adams & Schoenborn, 2006; Ham & Ainsworth, 2010; Román-Viñas et al., 2007; Wilson, Elliott, Eyles, & Keller-Olaman, 2007), and therefore would allow comparison between the current data and population based data.

In line with the review of recent research presented in the introduction, it was hypothesized that reported levels of motivational regulations would vary according to age group, such that young adults would report the highest levels for the controlled regulations (i.e., external, introjected), and that adults and middle-age adults would report the highest levels for the autonomous forms of motivational regulations (i.e., intrinsic, identified). In line with the tenets of SDT, it was also hypothesized that intrinsic motivation and identified regulation would be positively associated with physical activity behavior, whereas introjected and external regulations would be negatively associated with physical activity behavior in each age group.

Material and methods

Procedures and participants

Following Research Ethics Board approval, e-mail listservs (i.e., workplace and university alumni) and advertisements in

various community centers around Montreal, Quebec and McGill University campus were used to recruit adults for this study. Interested individuals were asked to contact the researchers for more information about the study and to obtain the secured website address. Once participants logged in to the internet site, an electronic informed consent was filled in and a confidential username and password was created. After login, participants had access to the online survey. This type of survey method was used because it has a faster response rate, yields fewer missing responses, and provides equivalent scores when compared to paper-and-pencil survey methods (Lonsdale, Hodge, & Rose, 2006).

A convenience sample of 571 adult men and women completed the survey in the allocated one-month timeframe. Participants who had missing data on age ($n = 2$) or were above 65 years of age ($n = 22$) were excluded from this analysis. The final sample consisted of 349 young adults (63% female, mean age = 19.38 years; $SD = 1.68$; range 18–24 years), 118 adults (86% female, mean age = 31.14 years; $SD = 5.17$; range 25–44 years), and 80 middle-aged adults (86% female, mean age = 55.91 years; $SD = 5.90$; range 45–64 years). Participants were predominantly Caucasian (young adults: 77%; adults: 89%; middle-age adults: 100%) and the adults and middle-age adults were well-educated by reporting at least an undergraduate degree (adults: 78.8%, middle-age adults: 58.8%). Not surprisingly given the mean age in the young adults, only 12.6% of young adults had graduated with a university undergraduate degree at the time of this study. Young adults reported a mean body mass index (BMI) of 23.16 kg/m^2 ($SD = 3.99$) and this was significantly lower than adults' mean BMI (mean = 24.89 kg/m^2, $SD = 5.37$) and middle-age adults' mean BMI (mean = 27.09 kg/m^2, $SD = 5.78$) based on an analysis of variance [$F(2, 546) = 25.84$, $p < .001$, $n^2 = .09$].

Measures

Demographics

Self-reported age, height, weight, self-identified ethnicity, and education level were assessed and used as covariates in the current study since these variables were significantly linked to physical activity in previous research (see Trost, Owen, Bauman, Sallis, & Brown, 2002 for review). For the main analyses, ethnicity was recoded and scored as Caucasian or non-Caucasian. BMI was calculated as weight in kilograms divided by the square of height in meters.

Motivation

The Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan et al., 1997) was used to assess motivation for physical activity. It is commonly used to assess the different types of motivational regulations with the exception of integrated regulation (which is difficult to distinguish from identified regulation) and amotivation (which can be assessed using the BREQ-2 when amotivation is of interest to researchers; Markland & Tobin, 2004). The BREQ includes 15-items that assess external regulation (4 items; e.g., "I exercise because other people say I should"), introjected regulation (3 items, e.g., "I feel guilty when I don't exercise"), identified regulation (4 items, e.g., "I value the benefits of exercise"), and intrinsic motivation (4 items, e.g., "I exercise because it's fun"). Participants responded to each statement using a 5-point scale anchored at the extremes by (0) *not true for me* to (4) *very true for me*. A mean score for each motivational regulation was calculated by summing the respective items and dividing by the total number of responses for each subscale. The reliability and validity of the BREQ have been supported (Rose, Markland, & Parfitt, 2001; Wilson et al., 2003, 2004). The reliability (i.e., internal consistency) in the current study was demonstrated by Cronbach's alpha coefficients above .74 for all subscales (see Table 1).

Self-reported physical activity behavior

The Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) was used to assess self-reported physical activity behavior. Participants were asked to indicate the number of times they engaged in mild, moderate, and strenuous physical activity for more than 15 min during the past week. A total score was calculated by multiplying the weekly frequencies of strenuous, moderate, and mild activities by nine, five, and three respectively, which provided a total metabolic equivalent intensity level. In addition, participants were asked to report the frequency in which they engage in regular activity during a typical 7-day period that results in a fast heartbeat and sweating on a 3-point Likert scale ranging from (1) *often* to (3) *never*. However, this latter question was not used in the current study. Several studies have documented the reliability and validity of the LTEQ (Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993; Scerpella, Tuladhar, & Kanaley, 2002).

Data analyses

Data were screened for missing data, outliers, normality, linearity, and homoscedasticity. Mean value imputation was used to replace the minimal (less than 1%) missing values that appeared at random. Given the possible high intercorrelations between intrinsic motivation and identified regulation (Mullan et al., 1997; Sabiston et al., 2010; Standage et al., 2008; Wilson, Rodgers, & Fraser, 2002), multicollinearity was tested by examining the Variance Inflation Factor (VIF; greater than 2.00) and the variance proportions (no two variables with values greater than .50; Tabachnick & Fidell, 2007). Descriptive statistics (means, standard deviations, reliability coefficients), and correlations between the study variables were calculated. Multivariate analysis of covariance (MANCOVA), followed by univariate analysis of covariance (ANCOVA), was conducted to compare means for each of the motivational regulations and self-reported physical activity across age groups. If significant differences were observed, post-hoc analyses were performed, and effect sizes (Cohen's d) were calculated and interpreted as small ($d = .20$), medium ($d = .50$), and large ($d = .80$; Cohen, 1988). Last, separate multiple hierarchical

Table 1
Reliability analysis, mean (M) and standard deviations (SD) for young adults ($n = 349$), adults ($n = 118$) and middle-age adults ($n = 80$).

Variables	Young adults (18–24 years)		Adults (25–44 years)		Middle-age adults (45–64 years)[c]	
	α	M (SD)	α	M (SD)	α	M (SD)
Motivational regulations						
Intrinsic[a]	.93	3.18 (.79)	.93	3.21 (.83)	.94	2.85 (.95)
Identified	.78	3.14 (.66)	.79	3.33 (.65)	.83	3.12 (.74)
Introjected[a, b]	.81	2.32 (.86)	.79	2.51 (.81)	.74	2.18 (.71)
External	.76	1.50 (.54)	.81	1.53 (.62)	.83	1.58 (.67)
Autonomous motivation	.90	3.16 (.66)	.91	3.27 (.69)	.93	2.98 (.81)
Self-report physical activity behavior						
LTEQ1[a, b]	–	39.68 (25.31)	–	37.18 (25.32)	–	25.09 (19.41)

Note. Autonomous motivation = composite score of intrinsic motivation and identified regulation. LTEQ1 is the physical activity measure in METS. α = Cronbach's alpha coefficient for the raw scores. Possible score range for the behavioral regulations is 0–4.

[a] Indicates a significant difference between young adults and middle-age adults.

[b] Indicates a significant difference between adults and middle-age adults.

[c] Analyses involving middle-age adults could not control for ethnicity because all participants self-identified as Caucasian.

regressions were conducted to examine the associations between the motivational regulations and self-reported physical activity in each age group. MANCOVA, ANCOVA and regression analyses controlled for BMI, gender, education level and ethnicity.

Results

The distribution of the data indicated that each variable satisfied the assumptions for MANCOVA, ANCOVA and linear regression. However, intrinsic motivation and identified regulation were highly correlated for young adults ($r = .67$), adults ($r = .72$), and middle-age adults ($r = .82$), and multicollinearity was evident as demonstrated by the VIF values for these variables ranging from 2.11 to 3.68 in preliminary analyses. As such, an *autonomous motivation* variable was created by taking the mean of the eight items assessing intrinsic motivation and identified regulation (Deci & Ryan, 2002). This newly derived variable was used in the regression analyses instead of intrinsic motivation and identified regulation because violation of the assumption of multicollinearity is likely to result in biased results. However, since multicollinearity is not problematic when performing descriptive statistics, bivariate correlations and MANCOVAs, results from these analyses are presented for each subscale in addition to the combined index in order to enable comparisons across studies.

Descriptive statistics for all variables are presented in Table 1. Participants reported high levels of intrinsic motivation and identified regulation, moderate levels of introjected regulation, and low levels of external regulation relative to the scale range (i.e., from 0 to 4). Bivariate correlations indicated that self-reported physical activity had positive correlations of moderate magnitude with intrinsic motivation ($r = .35$ to $.63$, $p < .001$), identified regulation ($r = .35$ to $.55$, $p < .001$), and autonomous motivation ($r = .38$ to $.63$, $p < .001$), and non-significant or positive correlations of low magnitude with introjected regulation ($r = .07$, $p > .05$ to $.23$, $p < .001$). In contrast, self-reported physical activity had non-significant or negative correlations of low magnitude with external regulation ($r = -.07$, $p > .05$ to $-.15$, $p < .001$).[1]

After adjusting for BMI, gender, education level and ethnicity, the results of the MANCOVA revealed a significant main effect for age group on several of the study variables, Pillai's trace = .09, $F(10, 536) = 3.90$, $p < .001$, $n^2 = .04$ (see Table 1). Follow-up ANCOVAs revealed differences for intrinsic motivation [$F(2, 546) = 3.05$, $p < .05$, $n^2 = .01$], introjected regulation [$F(2, 546) = 5.14$, $p < .01$, $n^2 = .02$], and self-reported physical activity [$F(2, 546) = 10.76$, $p < .001$, $n^2 = .04$]. Post-hoc analyses indicated that young adults reported higher levels of intrinsic motivation ($d = .38$) compared to middle-age adults. Also, young adults and adults reported higher levels of introjected regulation ($d = .18$ and $.43$, respectively) and self-reported physical activity ($d = .65$ and $.54$, respectively) than middle-age adults.[2]

In hierarchical regression analyses, controlling for BMI, gender, education level and ethnicity, the variance accounted for in self-reported physical activity was 25%, 27%, and 46% for young adults, adults, and middle-age adults, respectively (see Table 2). Autonomous motivation and introjected regulation emerged as significant positive correlates of self-reported physical activity, and external regulation emerged as a significant negative correlates of self-reported physical activity in the young-adult age group. In contrast, only autonomous motivation emerged as a significant positive correlate of self-reported physical activity in the adult and middle-age adult groups.

Discussion

This study compared mean levels of the motivational regulations and self-reported physical activity across age groups, and examined the associations among the motivational regulations and self-reported physical activity behavior across three different age groups. In partial support of the first hypothesis, findings revealed several significant mean level differences in the expected direction between young adults (18–24 years), adults (25–44 years), and middle-age adults' (45–64 years) reports of motivational regulations and physical activity behavior. In addition, partial support was found for the second hypothesis and theoretical proposition that regulations characterized as autonomous are positively associated with, and regulations characterized as controlled are negatively associated with, physical activity behavior.

In general, participants reported high levels of identified regulation and low levels of external regulation and these scores did not differ across age groups. These findings suggest that regardless of age, individuals 18–64 years report being motivated to engage in physical activity because it is congruent with their personal values, goals, needs, and/or because they find it inherently enjoyable, and less so because they want to obtain rewards or avoid punishments. In contrast, middle-age adults reported lower levels of intrinsic motivation, introjected regulation and physical activity behavior than their younger counterparts. The lower levels of introjected regulation among middle-age adults are not surprising seeing as older individuals may not exercise for appearance and social recognition goals (Beck et al., 2010; Finch, 1997; Reboussin et al., 2000) – goals that have been linked to controlled regulations (Ingledew & Markland, 2008). Also, the lower levels of physical activity behavior are in line with previous research demonstrating that physical activity levels decrease gradually with age (Haskell et al., 2007; Sallis, 2000). There are also reports that intrinsic and extrinsic motivation for physical activity decrease with age (Frederick-Recascino, 2002), and that enjoyment for physical activity may also decrease with age (Wilcox & Storandt, 1996). These findings are in line with the current study such that intrinsic motivation was lowest in the oldest represented group (middle-age adults). Given that intrinsic motivation is a strong correlate of physical activity behavior (see Trost et al., 2002), identifying the mechanisms underlying these differences is an important focus for future research. Several theories (e.g., CET; Deci & Ryan, 1985; social cognitive theory, Bandura, 1986; competence motivation theory, Harter, 1981) suggest that perceptions of competence/self-efficacy play a key role in promoting physical activity, either directly or indirectly through their influence on motivation. As such, researchers should consider examining whether differences in perceptions of competence/self-efficacy across age groups explain the differences observed in reports of intrinsic motivation.

In support of the second hypothesis, autonomous motivation (consisting of intrinsic motivation and identified regulation) was a significant positive correlate, and external regulation was a significant negative correlate, of self-reported physical activity behavior among young adults. These findings suggest that young adults' physical activity levels increase as their beliefs that physical activity is inherently pleasurable and the value and importance they place on it increases. Conversely, those who focus on the extrinsic consequences

[1] A copy of the correlation table can be obtained from the corresponding author.

[2] Owing to the unbalanced sample sizes, Pillai's trace criterion was used for the overall test of significance. Furthermore, a secondary MANCOVA was conducted using a random young-adult sub-sample ($n = 120$, 18–24 years) along with the adult ($n = 118$, 25–44 years) and middle-age adult ($n = 80$, 45–64 years) samples to compare means for each of the motivational regulations and physical activity across age groups. This was repeated twice with two different young-adult sub-samples. Findings revealed no differences between the MANCOVA using the entire young-adult sample and the MANCOVAs using the young-adult sub-samples.

Table 2
Summary of regression analyses of the motivational regulations predicting self-report physical activity behavior.

	Young adults ($n = 349$; 18–24 years)					Adults ($n = 118$; 25–44 years)					Middle-age adults ($n = 80$; 45–64 years)				
	R^2	ΔR^2	B	SE	β	R^2	ΔR^2	B	SE	β	R^2	ΔR^2	B	SE	β
Step 1	.09					.10					.04				
Gender			−12.02	2.78	−.23*			.47	6.75	.01			−8.21	6.31	−.15
BMI			.27	.33	.04			−.66	.44	−.14			−.09	.38	−.03
Education level			−.43	1.33	−.02			8.82	3.33	.27*			2.18	1.98	.13
Ethnicity (Caucasian)[a]			13.17	3.18	.22*			−50.53	27.48	−.18*			–	–	–
Step 2	.25	.16*				.27	.16*				.46	.42*			
Gender			−10.11	2.59	−.19*			4.03	6.34	.06			−8.55	4.85	−.15
BMI			.45	.31	.07			−.03	.45	−.01			.40	.32	.12
Education level			−.94	1.22	−.04			5.14	3.16	.16			1.52	1.52	.09
Ethnicity (Caucasian)			11.88	2.91	.20*			−53.86	25.77	−.20*			–	–	–
Autonomous motivation			11.68	2.01	.31*			16.29	4.18	.44*			17.15	2.33	.71*
Introjected regulation			3.81	1.59	.13*			.78	3.15	.03			3.70	2.68	.14
External regulation			−6.51	2.31	−.14*			.07	3.59	.01			4.27	2.83	.15

Note. Autonomous motivation = composite score of intrinsic motivation and identified regulation. Young adults: Step 1: $F(4,344) = 8.91$, $p < .001$, Step 2: $F(7,341) = 16.33$, $p < .001$; adults: $F(4,113) = 2.24$, $p < .05$, Step 2: $F(7,110) = 5.70$, $p < .001$; middle-age adults: $F(4,76) = 1.08$, $p = .364$, Step 2: $F(6,73) = 10.26$, $p < .001$.
*$p < .05$. **$p < .001$.
[a] Analyses involving middle-age adults could not control for ethnicity because all participants self-identified as Caucasian.

and incentives of physical activity engage in less physical activity. Given that prolonged involvement in physical activity requires self-determined forms of motivation (Ryan & Deci, 2007), physical activity interventions may benefit from promoting or maintaining autonomous regulations within young-adult populations. Based on SDT and empirical studies, autonomous regulations can be fostered by increasing perceptions of an autonomy supportive environment (Deci, Eghrari, Patrick, & Leone, 1994; Deci & Ryan, 2002; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Wilson & Rodgers, 2004). Accordingly, it is important for individuals leading physical activity programs to provide choices to guide the decision making process, encourage self-initiation, and acknowledge their participants' perspectives, feelings and needs (Deci & Ryan, 2002). The manipulation of the social environment to be autonomy supportive and the adoption of these specific strategies may support the facilitation of autonomous regulations for physical activity.

In contrast to the second hypothesis, introjected regulation was a significant positive correlate of physical activity for young adults. While this finding departs from theoretical premise that controlled regulations are negatively associated with positive health outcomes (Ryan & Deci, 2007), there is empirical evidence of a positive relationships between introjected regulation and physical activity (e.g., Edmunds et al., 2006; Standage et al., 2008; Wilson et al., 2004). This may be a reflection of the body image concerns that young adults' experience (Cash & Pruzinsky, 2002). Specifically, it is possible that young adults engage in physical activity to satisfy self-imposed pressures to obtain and/or maintain a desired physical appearance and body shape (Fogelholm & Kukkonen-Harjula, 2000). Research has supported a positive link between body dissatisfaction and weight management motives for physical activity among young-adult populations (Gillison, Standage, & Skevington, 2006; Ingledew & Markland, 2008; Ingledew & Sullivan, 2002). Nonetheless, future research is warranted to understand the mechanisms that explain the inconsistency between SDT's postulations and empirical evidence before conclusions can be drawn.

Consistent with the results focused on correlates of young-adult physical activity behavior, findings revealed that autonomous motivation (combined intrinsic motivation and identified regulation) was a significant positive correlate of physical activity behavior for adults and middle-age adults. This finding is in line with previous research grounded in SDT (Edmunds et al., 2006; Wilson & Rodgers, 2004) and a literature review documenting that intrinsic motivation and health motives are strong correlates of physical activity behavior (see Trost et al., 2002). These findings suggest that adults and middle-aged adults participate in physical activity for the inherent enjoyment and fun aspects of leisure activity, and/or because it is congruent with their personal values, goals, and needs.

Contrary to theoretical underpinnings (Deci & Ryan, 1985), introjected regulation and external regulation were not significantly negatively linked to physical activity behavior within the adult and middle-aged adult groups. Intervention strategies aimed at increasing physical activity among men and women between 25 and 64 years of age should therefore be focused on increasing identified regulation and intrinsic motivation by targeting variables shown to increase these motivational regulations. Based on BNT, one of SDT's subtheories, increasing individuals' perceptions of competence (i.e., feelings of effectiveness in interacting with one's environment and in producing desired outcomes), autonomy (i.e., feelings of volition and that one has ability to make their own decisions) and relatedness (i.e., feelings of connectedness to others) may increase autonomous regulations, and in turn physical activity levels (Hagger & Chatzisarantis, 2007; Ryan & Deci, 2007). In addition, SDT emphasizes the importance of modifying the environment to be autonomy supportive in order to increase youth and young adults' perceptions of competence, autonomy, and relatedness, and in turn autonomous regulations for physical activity (Hagger et al., 2003; Wilson & Rodgers, 2004). However, although this theorizing presumes these constructs influence the motivational regulations across the lifespan, research is needed confirm if the associations are generalizable across varying age groups.

Given the nature of this study, there are certain limitations that should be acknowledged. First, participants were predominantly Caucasian, disproportionately female, and between the ages of 18 and 64 years. Additional studies should use purposeful sampling to obtain ethnically diverse samples, a higher proportion of males, and adults aged 65 years or more. Second, although participants' BMI, gender, education level and ethnicity were controlled for during the analyses, other sociodemographics (e.g., household income, occupation) may be potential confounders. Third, the cross-sectional design of this study precludes causal inferences. Prospective longitudinal studies, which involve repeated observation of the same individuals over time, are needed to determine trends in motivational regulations and physical activity behavior across the lifespan. This will contribute to the understanding of the temporal relationship patterns between the motivational regulations and physical activity. Finally, the use of

self-reported data for physical activity behavior may have inherent limitations such as social desirability.

Notwithstanding these limitations, there are a number of strengths to this study which have practical implications and provide some insights for future research. First, this study adds to the work of Deci and Ryan (1985) in the physical activity domain and suggests that SDT provides a framework to examine antecedents of physical activity behavior in various age groups. Second, many studies examining the motivational regulations have weighted and combined the motivational regulations into a single motivational index (e.g., Kowal & Fortier, 2000; Mullen & Markland, 1997), known as the relative autonomy index (RAI; Ryan & Connell, 1989). Although findings with the RAI have been theoretically and conceptually meaningful, the examination of the relative influence of autonomous motivation (comprised of intrinsic motivation and identified regulation), introjected regulation, and external regulation on physical activity behavior in the current study helped unveil differences in correlates of physical activity for each age group without the possible confounding due to issues of multicollinearity. This finding supports the importance of differentiating autonomous and controlled regulations, and within the controlled regulations (i.e., external, introjected) when examining physical activity since they appear to have relationships in opposite directions with physical activity. However, it also raised an important issue relating to the measurement of the intrinsic motivation and identified regulation because the combination of these two regulations in the current study may have resulted in the loss of information.

Although the BREQ has been subjected to rigorous psychometric evaluation to confirm that the motivational regulations could be independently assessed (Rose et al., 2001; Wilson et al., 2003, 2004), the current findings suggest more research is needed to examine the construct validity of the BREQ. In addition, given that integrated regulation is an important tenet of SDT, more studies focused on advancing the measurement of this regulation within the BREQ are needed (Wilson, Rodgers, Loitz, & Scime, 2006). Third, since the current findings highlighted difference in the motivational regulations and their links to physical activity among young adults, adults, and middle-age adults, it suggests that additional research is warranted to understand to mechanisms for these differences across age groups.

In conclusion, this study was an important first step in understanding differences in motivation and in the strength of the associations between the motivational regulations and physical activity behavior across the adult lifespan. In addition, the results of the current study present the message that promoting autonomous regulations (i.e., intrinsic motivation, identified regulation) may be an effective strategy of promoting physical activity in all the age groups investigated. Future research could extend this research by testing the links between all of SDT's subtheories within these age groups to determine whether there are mean differences in other SDT constructs (e.g., perceived competence, autonomy, relatedness) for each group and relationship differences between these constructs and the motivational regulations.

Acknowledgments

This work was supported by a McGill University Internal Social Sciences and Humanities Research grant awarded to Dr. Catherine M. Sabiston. The authors would like to thank Dr. Philip Wilson from Brock University for his preliminary review of this manuscript.

References

Adams, P., & Schoenborn, C. (2006). Health behaviors of adults: United States, 2002–04. National Center for Health Statistics. *Vital Health Statistics, 10*, 1–140.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall Inc.

Beck, F., Gillison, F., & Standage, M. (2010). A theoretical investigation of the development of physical activity habits in retirement. *British Journal of Health Psychology, 15*, 663–679.

Cash, T. F., & Pruzinsky, T. (2002). *Body image: A handbook of theory, research, and clinical practice*. New York, NY: Guilford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Davis, C., Fox, J., Brewer, H., & Ratusny, D. (1995). Motivations to exercise as a function of personality characteristics, age, and gender. *Personality and Individual Differences, 19*, 165–174.

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (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. (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. (2002). *Handbook on self-determination research*. Rochester, NY: University of Rochester Press.

Edmunds, J., Ntoumanis, N., & Duda, J. L. (2006). A test of self-determination theory in the exercise domain. *Journal of Applied Social Psychology, 36*, 2240–2265.

Finch, H. (1997). *Physical activity at our age: Qualitative research among older people*. London, UK: Health Education Authority.

Fogelholm, M., & Kukkonen-Harjula. (2000). Does physical activity prevent weight gain: a systematic review. *Obesity Reviews, 1*, 95–111.

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.

Frederick-Recascino, C. M. (2002). Self-determination theory and participant motivation research in the sport and exercise domain. In E. L. Deci, & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 278–294). Rochester, NY: University of Rochester Press.

Gillison, F. B., Standage, M., & Skevington, S. M. (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behavior: a self-determination theory approach. *Health Education Research, 21*, 836–847.

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

Hagger, M. S., & Chatzisarantis, N. L. D. (2008). Self-determination theory and the psychology of exercise. *International Review of Sport and Exercise Psychology, 1*, 79–103.

Hagger, M. S., & Chatzisarantis, N. L. D. (2007). *Self-determination in exercise and sport*. Champaign, IL: Human Kinetics.

Hagger, M. S., Chatzisarantis, N. L. D., Culverhouse, T., & Biddle, S. J. H. (2003). The processes by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behavior: a trans-contextual model. *Journal of Educational Psychology, 95*, 784–795.

Ham, S. A., & Ainsworth, B. E. (2010). Disparities in data on healthy people 2010 physical activity objectives collected by accelerometry and self-report. *American Journal of Public Health, 100*, 263–268.

Harter, S. (1981). A model of intrinsic mastery motivation in children: individual differences and developmental change. In W. A. Collins (Ed.), *Minnesota symposium on child psychiatry* (pp. 215–255). Hillsdale, NJ: Erlbaum.

Haskell, W. L., Lee, I.-M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*, 1081–1093.

Ingledew, D. K., & Markland, D. (2008). The role of motives in exercise participation. *Psychology & Health, 23*, 807–828.

Ingledew, D. K., Markland, D., & Medley, A. R. (1998). Exercise motives and stages of change. *Journal of Health Psychology, 3*, 477–489.

Ingledew, D. K., & Sullivan, G. (2002). Effects of body mass and body image on exercise motives in adolescence. *Psychology of Sport and Exercise, 3*, 323–338.

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

Kowal, J., & Fortier, M. S. (2000). Testing relationships from the hierarchical model of intrinsic and extrinsic motivation using flow as a motivational consequence. *Research Quarterly for Exercise and Sport, 71*, 171–181.

Li, F. (1999). The exercise motivation scale: its multifaceted structure and construct validity. *Journal of Applied Sport Psychology, 11*, 97–115.

Lonsdale, C., Hodge, K., & Rose, E. A. (2006). Pixels vs. paper: comparing online and traditional survey methods in sport psychology. *Journal of Sport & Exercise Psychology, 28*, 100–108.

Markland, D., & Ingledew, D. K. (1997). The measurement of exercise motives: factorial validity and invariance across gender of a revised exercise motivations inventory. *British Journal of Health Psychology, 11*, 361–376.

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

McDonough, M. H., & Crocker, P. R. E. (2007). Testing self-determined motivation as a mediator of the relationship between psychological needs and affective and behavioral outcomes. *Journal of Sport & Exercise Psychology, 29*, 645–663.

Miller, A. M., & Iris, M. (2002). Health promotion attitudes and strategies in older adults. *Health Education and Behavior, 29*, 249–267.
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.
Mullen, E., & Markland, D. (1997). Variations in self-determination across the stages of change for exercise in adults. *Motivation & Emotion, 21*, 349–362.
Reboussin, B. A., Rejeski, J. W., Martin, K. A., Callahan, K., Dunn, A. L., King, A. C., et al. (2000). Correlates of satisfaction with body function and body appearance in middle- and older aged adults: the activity counselling trial (ACT). *Psychology & Health, 15*, 239–254.
Román-Viñas, B., Serra-Majem, L., Ribas-Barba, L., Roure-Cuspinera, E., Cabezas, C., Vallbona, C., et al. (2007). Trends in physical activity status in Catalonia, Spain (1992–2003). *Public Health Nutrition, 10*, 1389–1395.
Rose, E. A., Markland, D., & Parfitt, G. (2001). The development and initial validation of the exercise causality orientations scale. *Journal of Sports Sciences, 19*, 445–462.
Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology, 57*, 749–761.
Ryan, R. M., & Deci, E. L. (2007). Active human nature: self-determination theory and the promotion and maintenance of sport, exercise, and health. In M. S. Hagger, & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 1–19). Champaign, IL: Human Kinetics.
Sabiston, C. M., Brunet, J., Kowalski, K. C., Wilson, P. M., Mack, D. E., & Crocker, P. R. E. (2010). The role of body-related self-conscious emotions in motivating women's physical activity. *Journal of Sport and Exercise Psychology, 32*, 417–437.
Sabiston, C. M., Crocker, P. R. E., & Munroe-Chandler, K. (2005). Examining current-ideal discrepancy scores and exercise motivations as predictors of social physique anxiety in exercising females. *Journal of Sport Behavior, 28*, 68–85.
Sallis, J. F. (2000). Age-related decline in physical activity: a synthesis of human and animal studies. *Medicine & Science in Sports & Exercise, 32*, 1598–1600.
Scerpella, T. A., Tuladhar, P., & Kanaley, J. A. (2002). Validation of the God-in–Shephard questionnaire in prepubertal girls. *Medicine & Science in Sports & Exercise, 34*, 845–850.
Sisson, S. B., & Katzmarzyk, P. T. (2008). International prevalence of physical activity in youth and adults. *Obesity Reviews, 9*, 606–614.
Spirduso, W. W., Francis, K. L., & MacRae, P. G. (1995). *Physical dimensions of aging*. Champaign, IL: Human Kinetics.
Standage, M., Sebire, S. J., & Loney, T. (2008). Engagement in objectively assessed bouts of moderate-intensity exercise: a self-determination theory perspective. *Journal of Sport & Exercise Psychology, 30*, 337–352.
Strong, H. A., Martin Ginis, K. A., Mack, D. E., & Wilson, P. M. (2006). Examining self-presentational exercise motives and social physique anxiety in men and women. *Journal of Applied Biobehavioral Research, 11*, 209–225.
Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (4th ed.). Boston, MA: Allyn and Bacon.
Thogersen-Ntoumani, C., & Ntoumanis, N. (2006). The role of self-determined motivation in the understanding of exercise-related behaviors, cognitions and physical self-evaluations. *Journal of Sports Sciences, 24*, 393–404.
Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: review and update. *Medicine & Science in Sports & Exercise, 34*, 1996–2001.
Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal, 174*, 801–809.
Wilcox, S., & Storandt, M. (1996). Relations among age, exercise, and psychological variables in a community sample of women. *Health Psychology, 15*, 110–113.
Wilson, K., Elliott, S. J., Eyles, J. D., & Keller-Olaman, S. J. (2007). Factors affecting change over time in self-reported health. *Canadian Journal of Public Health, 98*, 154–158.
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 & Exercise Science, 6*, 1–21.
Wilson, P. M., Rodgers, W. M., Fraser, S. N., & Murray, T. C. (2004). Relationships between exercise regulations and motivational consequences in university students. *Research Quarterly for Exercise and Sport, 75*, 81–91.
Wilson, P. M., Rodgers, W. M., Loitz, C. C., & Scime, G. (2006). "It's who I am. Really!" The importance of integrated regulation in exercise contexts. *Journal of Applied Behavioural Research, 11*, 79–104.