

## INTENTIONS AND ACTUAL PHYSICAL ACTIVITY BEHAVIOR CHANGE IN A COMMUNITY-BASED SAMPLE OF MIDDLE-AGED WOMEN: CONTRIBUTIONS FROM THE THEORY OF PLANNED BEHAVIOR AND SELF-DETERMINATION THEORY

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### ABSTRACT

This two-study research assessed intentions and actual physical activity behavior change in a community-based sample of Canadian middle-aged women by integrating concepts from two strong and complimentary psychological theories: the Theory of Planned Behavior (TPB) and Self-Determination Theory (SDT). Specific objectives were 1) to examine associations among TPB variables, motivation, and intention to increase physical activity and 2) to examine the relative influence of intentions and motivation on reported physical activity behavior change over time. First, in a cross-sectional study, French-speaking women ( $n = 109$ ) recruited from community-based facilities completed validated measures of TPB variables (attitudes, perceived behavioral control, subjective norms, and intentions) and motivation (autonomous and controlled). In a follow-up longitudinal study, one hundred and forty-nine English-speaking women from similar facilities completed these measures and reported on actual physical activity at baseline and at six months. In the first study, attitudes, perceived behavioral control, and autonomous motivation were significantly associated with physical activity intentions. In the second study, attitudes, subjective norms, and autonomous motivation were significantly related to intentions to increase physical activity. In turn, intentions predicted change in physical activity behavior over time; however, the relationship was modest. Results highlight the role of intentions in physical activity behavior change among middle-aged women and are discussed in light of current research and theory. Future research directions are proposed.

Keywords: physical activity, behavior change, intentions, self-determination, women

The physical and mental health benefits of regular participation in physical activity are well documented (Roberts & Barnard, 2005). Nevertheless, less than half of adult women are sufficiently active (Cameron, Craig, Stephens, & Ready, 2002; Statistics Canada, 2006; U.S. Department of Health and Human Services, 1996). Among middle-aged and older Canadian women, only about fifteen percent currently meet physical activity recommendations (Craig & Cameron, 2004). This is of particular concern because women in this age group are at risk for developing a wide range of health problems, such as heart disease, cancer, and depression, that could be prevented or attenuated by increased physical activity (Merrill & Weed, 2001; Public Health Agency of Canada, 2003; CDC, 2007). To address the physical inactivity issue, researchers have examined an array of variables associated with the adoption and maintenance of physical activity across various groups (Sallis & Owen, 1999), including middle-aged women (Brownson, Eyster, King, Brown, Shyu, & Sallis, 2000; King, Castro, Wilcox, Eyster, Sallis, & Brownson, 2000; Speck & Harrell, 2003). Past studies have shown that a broad array of factors are associated with physical activity behavior change over time (Sallis & Owen, 2002) and that social-cognitive and motivational variables are of significant influence (Troost et al., 2002). Although this information is informative, much remains unknown about how and why individuals change their physical activity behavior. Thus, additional theory-directed research in this area is needed.

In this two-study project, we propose to integrate the concepts from two strong and complimentary psycho-social theories, the Theory of Planned Behavior (TPB) and Self-Determination Theory (SDT), to increase our understanding of physical activity behavior change and to advance knowledge in this area. Both of these conceptual frameworks have good explanatory power and focus on malleable psychological variables that can subsequently be incorporated into an intervention study to promote physical activity (Baranowski et al., 2003). Additionally, they incorporate social influence factors. What distinguishes them, and thus makes them well suited for integration, is that TPB focuses more on socio-cognitive variables, whereas SDT is a humanistic motivational theory. Integrating these two theories has recently been advocated (Hagger et al., 2006) and answers the call for theory integration to optimize our understanding of the underpinnings of the behavior change process (Nigg et al., 2002).

## **TPB**

One theoretical framework that has been used to study a wide range of health behaviors is the Theory of Planned Behavior (TPB; Ajzen, 1991). According to the TPB, the most salient predictor of behavior (e.g., physical activity) is intention. Intentions are predicted by three key variables: attitudes (the extent to which physical activity is perceived as favorable or unfavorable), perceived behavioral control (the perceived ease or difficulty of performing physical activity), and subjective norms (the perceived social expectations associated with physical activity participation).

The TPB has been well supported in physical activity and other health-related contexts (see Armitage & Conner, 2001; Godin & Kok, 1996; Hausenblas, Carron, & Mack,

1997 for reviews). What has been less studied is the salience of the purported TPB relationships in the context of physical activity behavior change. Theoretically, attitudes, perceived behavioral control, and subjective norms should predict intention to increase physical activity, which, in turn, should predict change in physical activity behavior over time. This has been supported in a limited number of investigations. For example, in a cross-sectional study of adult exercisers, Courneya (1995) found intentions, attitudes, and perceived behavioral control to be significantly related to stage of readiness for regular physical activity. On a temporal basis, Courneya and colleagues (Courneya, Nigg, & Estabrooks, 2000; Courneya, Plotnikoff, Hotz, & Birkett, 2001) have further supported the utility of the TPB in examining exercise stages and exercise stage progression. In the context of cardiac rehabilitation, intentions have been found to significantly predict exercise adherence over time (Blanchard, Courneya, Rodgers, Daub, & Knapik, 2002).

### **SDT**

Another conceptual framework that has been used to study how and why individuals change health behaviors is Self-Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000). According to SDT, there are two main types of motivation: autonomous and controlled. Behaviors for which motivation is autonomous are performed out of choice and are regulated by the self. The behaviors may also be engaged in for pleasure and/or satisfaction. Behaviors for which motivation is controlled are not performed out of choice but are regulated by internal and/or external pressures. Numerous investigations have supported SDT in the study of physical activity (Frederick-Recascino, 2002; Hagger & Chatzisarantis, 2007) and other health behaviors (Sheldon, Williams, & Joiner, 2003; Williams, 2002). It has also been proposed that SDT is a highly relevant organizational framework for examining physical activity in women (Landry & Solmon, 2002).

In the context of physical activity behavior change, individuals in higher stages of change were found to be more autonomously motivated than individuals in lower stages of change (Ingledew, Markland, & Sheppard, 2003; Mullan & Markland, 1997). These cross-sectional results were recently replicated in middle-aged African-American women (Landry & Solmon, 2004). Controlled motives have been associated with the initial adoption of physical activity, whereas autonomous motives have been associated with stage progression and maintenance of physical activity over time (Ingledew, Markland, & Medley, 1998). Further, autonomous physical activity motives were predictive of physical fitness level over a 12-week exercise program (Wilson, Rodgers, Blanchard, & Gessell, 2003). In the health domain, autonomous motivation has been associated with weight loss (Williams, Grow, Freedman, Ryan, & Deci, 1996), smoking cessation (Williams et al., 2006), positive changes in diabetes self-care and glycemic control (Williams, McGregor, Zeldman, Freedman, & Deci, 2004), and lifestyle change (Williams, Gagne, Mushlin, & Deci, 2005).

## **INTEGRATION**

Although much research pits theories against each other in search of a winner, we are proposing to integrate the key constructs from the TPB and SDT to increase our understanding of physical activity behavior change and subsequently improve the effectiveness of physical activity behavior change interventions. Specifically, we are suggesting that SDT variables be integrated into the TPB model and are proposing to conduct moderation and mediation analyses to determine the exact mechanisms. A number of investigations have demonstrated associations between autonomous motivation and physical activity intentions (Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2003; Wilson & Rodgers, 2004). It has been shown that, over time, the motivation-physical activity behavior relationship is mediated by intentions (Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002). Similar findings have been obtained in educational settings (Vallerand, Fortier, & Guay, 1997). Moreover, there is evidence that autonomous and controlled motives mediate the relationship between perceived competence and physical activity intentions (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). Other studies have provided preliminary support for the moderating influence of motivation on the intention-behavior relationship (Chatzisarantis & Biddle, 1998; Orbell, 2003; Sheeran, Norman, & Orbell, 1999).

Given the importance of motivation and intentions to physical activity behavior and, potentially, physical activity behavior change, additional research is needed to further examine mediating and/or moderating influences. This will also serve to optimize the integration of the TPB and SDT.

## **PURPOSES AND HYPOTHESES**

The overall purpose of this research was to examine physical activity intentions and actual behavior change in a community-based sample of Canadian middle-aged women by integrating concepts from the TPB (Ajzen, 1991) and SDT (Deci & Ryan, 1985; Ryan & Deci, 2000). The first purpose was to examine associations among TPB variables (attitudes, perceived behavioral control, and subjective norms), SDT variables (autonomous and controlled motivation), and intentions to increase physical activity to ascertain whether autonomous and controlled motives contributed to the variance in intentions above and beyond the three TPB variables. Consistent with research and theory (Ajzen, 1991; Courneya, 1995; Godin & Kok, 1996; Hagger, Chatzisarantis, & Harris, 2006; Ntoumanis, 2001; Sarrazin et al., 2002), it was hypothesized that attitude, perceived behavioral control, and subjective norms would be positively related to physical activity intentions. Autonomous motivation was predicted to contribute to intentions above and beyond the three TPB variables.

Building on the first purpose, the second purpose was to examine the relative influence of intentions and motivation on actual physical activity behavior change over time. In line with previous studies (Courneya et al., 2000, 2001; Ntoumanis, 2001; Sarrazin et al., 2002; Standage et al., 2003), it was predicted that intentions would mediate the relationship between autonomous motivation and physical activity behavior change. The

possibility that motivation would moderate the relationship between intentions and physical activity behavior change was also explored. Based on past research (Chatzisarantis & Biddle, 1998; Orbell, 2003; Sheeran et al., 1999), we hypothesized that the interaction between intentions and autonomous motivation would significantly predict physical activity behavior increase beyond intentions and autonomous motivation. To these ends, two studies, one cross-sectional and one longitudinal, were conducted. The first purpose was addressed in Study 1 (and replicated in Study 2), and the second purpose was addressed in Study 2.

One of the main contributions of this study is the integration of concepts from the TPB and SDT, which are two strong and complimentary theories with their respective strengths. Although other studies have combined these two theories, none have examined both mediating and moderating influences in the same study, and none to our knowledge have integrated these theories to understand physical activity behavior change over time. By using a longitudinal design in Study 2, the current investigation allows for an examination of change over time in physical activity and of the temporal relationships among study variables.

This program of research extends past physical activity research (e.g., Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Hagger et al., 2006; Ntoumanis, 2001; Sarrazin et al., 2002), advances knowledge on the temporal interplay of these key theoretical variables, and increases the effectiveness of physical activity interventions. Finally, this study specifically examines a sample of middle-aged women, an important group that is not adequately active and is at risk for health problems (Brownson et al., 2000; U.S.D.H.H.S., 1996).

## STUDY 1

### METHOD

#### Participants

Participants were middle-aged French-speaking women recruited from community-based facilities in the Ottawa, Canada region, including community centers, fitness clubs, and bingo halls so that they would have a range of physical activity levels. One hundred and thirty-four women initially agreed to participate. Twenty-five of these cases were excluded because of missing data or because the women had no intention to increase their level of physical activity and, subsequently, were unable to complete the questionnaire. The final sample consisted of 109 women ranging in age between 36 and 72 years ( $M = 51.0$ ,  $SD = 7.6$ ). Over 95 percent of these women were Caucasian, over half were married, and the majority (68%) had attended college or university (see Table 1 for additional socio-demographic characteristics).

#### Procedures

Permission to recruit participants was obtained from the respective community-based facilities. Potential participants were approached by a trained researcher, typically at the beginning of a class or group, and informed of the study goals and issues of

**Table 1.** Socio-demographic characteristics of French-speaking and English-speaking samples.

Variable	French-speaking	English-speaking
	Sample Study 1 (n=109)	Sample Study 2 (n=149)
Age; Mean (SD)	51.04 (7.62)	51.80 (6.70)
<b>Marital Status (%)</b>		
Married	56%	67%
Common-law	13%	9%
Single	6%	7%
Separated	18%	15%
Widowed	6%	2%
<b>Education</b>		
Primary or secondary	32%	16%
College	19%	26%
University undergraduate	28%	34%
University graduate	15%	24%
<b>Annual Household Income</b>		
< \$60,000	40%	29%
\$60,000-579,999	18%	16%
> \$80,000	43%	55%

*Note.* Percentages may not sum to 100 due to rounding errors

confidentiality. All women provided written informed consent prior to completing the questionnaire. Women were offered the opportunity to complete measures on-site; however, most (94%) opted to complete the questionnaire at home and return it in a postage-paid envelope. The questionnaire required approximately 30 minutes to complete. This study was approved by the research ethics board of the University of Ottawa.

### Measures

Measures included TPB variables (attitudes, perceived behavioral control, subjective norms, and intentions) and SDT variables (autonomous and controlled motivation). Participants were asked to respond to items in light of physical activities they intended to increase over the next six months. All variables were assessed via self-report.

*TPB variables.* The TPB variables were measured using previously validated and reliable scales (Ajzen & Madden, 1986; Courneya, 1995; Courneya et al., 2000). Items were slightly adapted to pertain to physical activity behavior increase. For example, instead of asking participants about their attitudes towards physical activity involvement, participants were asked about attitudes towards increasing their level of physical activity over the next six months. Attitudes were measured by asking participants to respond to the general statement: "For me, increasing my level of physical activity over the next six months would be..." Examples of the six bipolar adjectives used were: "good-bad," "useful-useless," and "beneficial-harmful." Perceived behavioral control was measured with three items (e.g. "Over the next six months, I have control over whether or not I increase my level of physical activity"). An example item from the two-item subjective norms scale was: "People who are close to me think I should increase my level of physical activity over the next six months." Finally, intention to increase physical activity was assessed with three items (e.g. "I intend to increase my physical activity level over the next six months"). These questions were measured with a seven-point Likert scale from 1 (disagree very much) to 7 (agree very much). Coefficient alpha for these scales ranged between .81 and .97.

*Motivation.* Autonomous and controlled motivation were assessed using a slightly adapted version of the Treatment Self-Regulation Questionnaire (TSRQ; Ryan & Connell, 1989). Participants were asked to rate items based on the following general statement: "Why do you want to increase your physical activity involvement over the next six months?" An example from the four-item autonomous motivation scale was: "Because I want to take responsibility for my health." Controlled motivation was also measured using four items (e.g. "Because I would feel guilty if I did not"). These two scales yielded coefficient alphas of .91 and .73, respectively. The validity and reliability of these scales has been demonstrated in several studies (e.g., Ryan & Connell, 1989; Williams et al., 1996; Williams, Rodin, Ryan, Grolnick, & Deci, 1998). This scale was chosen (instead of the Behavioral Regulation in Exercise Questionnaire - 2) because it has fewer items (creating less of a burden on participants), as well as the fact that we did not want information on each of the five specific types of regulations from SDT but more on the two broader forms: autonomous and controlled.

## RESULTS

All analyses were performed using SPSS, version 11. Initial data screening did not reveal any univariate or multivariate outliers, and all variables approximated normal distributions. An examination of bivariate scatter plots revealed linear relationships among variables. Table 2 presents basic descriptive statistics and correlations among variables.

To examine the utility of including motivation within the framework of the TPB, associations among attitudes, perceived behavioral control, subjective norms, autonomous motivation, controlled motivation, and intention to increase physical activity behavior were examined using a hierarchical multiple regression analysis. In the first step, attitudes, perceived behavioral control, and subjective norms were entered as predictors

**Table 2.** Descriptive statistics for, and correlations among, Study 1 variables (n = 109).

Variable	Mean (SD)	1	2	3	4	5	6
1. Attitudes	5.62 (1.51)	--					
2. Perceived behavioral control	4.56 (1.48)	.20*	--				
3. Subjective norms	3.72 (1.85)	.12	.26**	--			
4. Autonomous motivation	5.49 (1.32)	.31***	.22*	.09	--		
5. Controlled motivation	2.73 (1.33)	.03	.12	.23*	.29**	--	
6. Intention to increase PA	4.47 (1.93)	.40***	.52***	.22*	.51***	.25**	--

Note. All variables were assessed on 7-point Likert-type scales, with higher values indicative of higher levels of each variable. PA=physical activity. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

of intention to increase physical activity. In the second step, autonomous motivation and controlled motivation were entered to ascertain whether these two types of motivation significantly predicted intentions after controlling for the three TPB variables.

On the first step, attitudes, perceived behavioral control, and subjective norms explained 37% of the variance in intention to increase physical activity ( $F$ -change = 20.51,  $p < .001$ ). Of these three variables, attitudes ( $b = .31$ ,  $p < .001$ ) and perceived behavioral control ( $b = .44$ ,  $p < .001$ ) were positively related to intentions. Subjective norms, although positively associated with intentions, were a non-significant predictor ( $b = .07$ ,  $p = .37$ ). Autonomous and controlled motivation, when entered on the second step, uniquely accounted for 12% of the variance in intention ( $F$ -change = 11.74,  $p < .001$ ). Whereas autonomous motivation was a significant positive predictor ( $b = .33$ ,  $p < .001$ ), controlled motivation was not ( $b = .09$ ,  $p = .25$ ). Collectively, all variables explained 49% of variance in intention to increase physical activity participation.

To assess the possible confounding influence of socio-demographic variables, all analyses were re-run after statistically controlling for age, education level, and income. No differences in the pattern of results were obtained. The sample was also split by marital status, and no significant differences were observed between married women ( $n = 61$ ) and unmarried women ( $n = 48$ ).

## DISCUSSION

This study examined intentions to increase physical activity in a community-based sample of middle-aged, French-speaking, Canadian women by integrating variables from the TPB (Ajzen, 1991) and SDT (Deci & Ryan, 1985; Ryan & Deci, 2000). Theory integration is a novel and recommended approach to increase understanding. The current investigation also adds to a limited number of studies (e.g., French et al., 2005) by specifically examining intentions to increase physical activity and targeting middle-aged women. Attitudes and perceived behavioral control were associated with physical



activity intentions, and this is in line with past research in multiple domains (Armitage & Conner, 2001; Godin & Kok, 1996; Hausenblas et al., 1997). The fact that attitudes, perceived behavioral control, and subjective norms collectively explained 37% of the variance in physical activity intentions is also consistent with previous work.

More interestingly, autonomous motivation uniquely contributed to intentions to increase physical activity. This concurs with past research linking autonomous motives to physical activity intentions (Chatzisarantis, Biddle, & Meek, 1997; Hagger et al., 2006; Ntoumanis, 2001; Standage et al., 2003; Vallerand et al., 1997; Wilson & Rodgers, 2004). It also indicates that autonomous motives contribute to physical activity intentions above and beyond attitudes, perceived behavioral control, and subjective norms, which provides support for SDT (Deci & Ryan, 1985; Ryan & Deci, 2000). Further, it demonstrates the utility of integrating concepts from different theoretical frameworks as a means of understanding important phenomena, such as physical activity intentions.

The influence of intentions and/or motivation on actual physical activity behavior or physical activity behavior change was not assessed in this study. According to the TPB, the primary determinant of behavior is intention; whereas in SDT, behavior is primarily determined by motivation. It is possible that both intentions and motivation are directly related to physical activity behavior when assessed at the same level of generality. Another possibility is that, in line with the current findings and other research (Sarrazin et al., 2002), intentions mediate the relationship between motivation and physical activity behavior. It is also possible that the relationship between intentions and behavior is moderated by motivation (Chatzisarantis & Biddle, 1998; Orbell, 2003; Sheeran et al., 1999). Although the current study design did not allow for an evaluation of these possibilities, mediating and moderating influences were addressed in Study 2, a follow-up longitudinal study.

## STUDY 2

### METHOD

#### Participants

Participants were middle-aged, English-speaking, Canadian women enrolled in classes, groups, or programs at community centers (27%), community health centers (11%), fitness clubs (31%), and from professional women's groups (31%). To examine behavior change, only women who expressed a desire to increase their physical activity level were recruited. Five hundred and nine women were initially approached and, of these women, 237 (46.6%) completed the Time 1 questionnaire. Eight women (3.4%) failed to provide written consent or a return address, thus leaving 229 eligible participants at Time 1. One hundred and seventy-eight women (77.7%) subsequently completed and returned the Time 2 questionnaire. Twenty-nine cases (16.3%) were dropped because women indicated that they had no intention to increase their physical activity level or because of missing data. The final sample thus consisted of 149 women, ranging in age between 39 and 68 years ( $M = 51.8$ ;  $SD = 6.7$ ). The majority of these women were of Caucasian descent, married, and had attended college or university (see Table 1).

### **Study Design and Procedures**

A two-wave, longitudinal design was used. At Time 1, women participating in classes or activities at community-based facilities were recruited by trained researchers. Participants were informed about the study objectives and issues of confidentiality. Although women were offered the opportunity to complete the Time 1 questionnaire package on-site, 95% completed it at home and returned it in a postage-paid envelope. All women provided written informed consent. The Time 1 questionnaire package assessed current physical activity level, TPB variables, motivation, and socio-demographic variables. Women were also asked to provide their names and addresses so a follow-up questionnaire could be sent via postal mail. At Time 2, six months later, physical activity was re-assessed. The questionnaires required approximately 30 minutes to complete. The time periods of October (Time 1) and May (Time 2) were chosen because they are similar with respect to climate normals, as daily averages range from 8.2°C to 13.6°C respectively (Environment Canada, 2002), which could influence activity levels. This study was approved by the research ethics board of the University of Ottawa.

### **Measures**

The questionnaire package was composed of previously validated scales that were slightly re-worded to apply to the context of physical activity behavior change. Participants were asked to identify specific physical activities they intended to increase over the next six months and to respond to items in light of these activities. All variables were assessed via self-report.

*Physical activity.* Physical activity at Time 1 and Time 2 was assessed with the Community Health Activities Model Program for Seniors (CHAMPS; Stewart, Mills, King, Haskell, Gillis, & Ritter, 2001). Participants were presented with a comprehensive list of leisure-time, sports, and home-based activities and asked to specify the frequency and duration of their participation in each activity during a typical week over the past month. An "other" category was included for activities not listed. Total energy expenditure was calculated by multiplying the frequency, duration (in hours), and estimated metabolic rate (i.e., MET intensity; Ainsworth et al., 2000) for each activity. These totals were summed across activities and multiplied by self-reported weight. This yielded a weight-corrected total energy expenditure in  $\text{kcal} \cdot \text{kg}^{-1} \cdot \text{week}^{-1}$ . The mean total energy expenditures at Time 1 and Time 2 were 2804.6 ( $SD = 1831.9$ ) and 3112.2 ( $SD = 2084.9$ ), respectively. Previous research has demonstrated the satisfactory levels of discriminant validity, concurrent validity ( $r$ s ranged from .55 to .73), and sensitivity to change of the CHAMPS. Six-month stability coefficients range between .58 and .68 across different physical activity groups (Stewart et al., 2001).

To assess physical activity behavior change, a standardized residual change score (Cohen & Cohen, 1983) was calculated by regressing the Time 2 total physical activity score on the Time 1 total physical activity score. This resulted in a physical activity behavior change score with a mean of 0 and a standard deviation of 1.

*TPB variables.* All TPB variables were assessed using previously published measures (Ajzen & Madden, 1986; Courneya, 1995; Courneya et al., 2000). To measure

attitudes, participants respond to the general stem: "For me, increasing my level of physical activity over the next six months would be..." Six bipolar adjectives were used, including "good-bad," "useful-useless," and "beneficial-harmful." Perceived behavioral control was assessed using three items. A sample item was: "Over the next six months, I have control over whether or not I increase my level of physical activity." Two items measured subjective norms (e.g., "People who are close to me think I should increase my level of physical activity over the next six months."). Intention to increase physical activity was assessed with three items. An example item from this scale was: "I intend to increase my physical activity level over the next six months." Internal consistency of these scales (i.e., coefficient alpha) was satisfactory, ranging between .88 and .89. The validity of these scales has been established in numerous studies (Ajzen & Madden, 1986; Courneya, 1995; Courneya et al., 2000, 2001).

*Motivation.* The Treatment Self-Regulation Questionnaire (TSRQ; Ryan & Connell, 1989) was used to measure autonomous and controlled motivation. Participants were asked to respond to the general question, "Why do you want to increase your physical activity involvement over the next six months?" Six items were used to assess both autonomous motives (e.g., "Because I want to take responsibility for my health") and controlled motives (e.g., "Because I would feel guilty if I did not"). Coefficient alpha for these scales were .89 and .75, respectively. Past research in the areas of achievement-related, prosocial, and health behaviors has demonstrated the sound psychometric properties of this scale (Ryan & Connell, 1989; Williams et al., 1996, 1998, 2004).

### **Statistical Analyses**

The SPSS, version 11, statistical software package was used for all statistical analyses. Basic univariate and multivariate statistical assumptions were initially evaluated using established data screening techniques (Tabachnik & Fidell, 2005). Univariate outliers were brought into three standard deviations from the mean. Missing data were imputed using mean replacement. Pearson correlations were calculated to assess bivariate associations among variables. To predict intentions to increase physical activity, hierarchical multiple regressions were used. The relationships among intentions, motivation, and physical activity behavior change was also assessed using multiple regression and hierarchical multiple regression analyses. Mediating and moderating influences between intentions, motivation, and physical activity behavior were tested using procedures outlined by Baron and Kenny (1986). Path analysis (Pedhazur, 1982) was used as an alternative means of testing direct and indirect pathways among intentions, motivation, and change in physical activity behavior. Statistical significance was set at  $p < .05$  for all univariate and multivariate analyses.

## **RESULTS**

### **Preliminary Analyses**

Independent samples t-tests and chi-square analysis were used to compare participants who completed the Time 1 questionnaire and those who completed both the Time 1 and

Time 2 questionnaires. Women who dropped out of the study after Time 1 were less educated than those women completing the study ( $p < .05$ ). No other significant differences were observed. Weather data at Time 1 and Time 2 were obtained from Environment Canada (2002) to examine the possibility that changes in physical activity level were attributable to seasonal effects. Parametric and non-parametric analyses did not reveal any significant differences with respect to daily average temperature, daily average relative humidity, daily total precipitation, and total number of rainy days.

### **Predicting Physical Activity Intentions**

Table 3 presents descriptive statistics for, and Pearson correlations among, variables. Significant correlations were obtained between physical activity intentions and attitudes, subjective norms, and autonomous motivation ( $ps < .05$ ). To further assess associations among TPB variables, motivation, and intentions to increase physical activity, hierarchical multiple regression was used. Attitudes, perceived behavioral control, and subjective norms were entered on the first step, and together, they explained 9% of the variance in the criterion variable ( $F$ -change = 4.97,  $p < .01$ ). Whereas attitudes ( $b = .18$ ,  $p < .05$ ) and subjective norms ( $b = .20$ ,  $p < .05$ ) were significant predictors of intentions, perceived behavioral control ( $b = .06$ ,  $p = .49$ ) was not. Neither autonomous motivation ( $b = .09$ ,  $p = .31$ ) nor controlled motivation ( $b = .04$ ,  $p = .68$ ), when entered on the second step, uniquely contributed to the prediction of physical activity intentions, explaining 1% of its variance ( $F$ -change = .73,  $p = .49$ ).

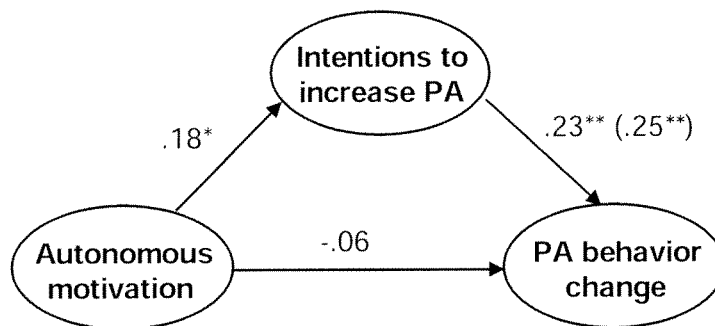
### **Predicting Physical Activity Behavior Change**

Bivariate correlations demonstrated a significant, but modest, positive association between intentions to increase physical activity and change in physical activity behavior over time ( $p < .01$ ; Table 3). The mediating influence of intentions on the relationship between motivation and behavior change was tested in a series of three multiple regression analyses (Baron & Kenny, 1986). Initially, intentions were regressed onto autonomous motivation. Physical activity behavior change was then regressed onto autonomous motivation. Finally, physical activity behavior change was regressed onto both intentions and autonomous motivation. The three requirements for a test of mediation are: 1) the predictor (autonomous motivation) is significantly associated with the mediator (intentions) in the first regression, 2) the predictor (autonomous motivation) is significantly associated with the outcome variable (behavior change) in the second regression, and 3) the mediator (intentions) is significantly associated with the outcome variable (behavior change); however, the predictor (autonomous motivation) is no longer associated with the outcome variable in the third regression (Baron & Kenny, 1986). Autonomous motivation significantly and positively predicted intentions to increase physical activity ( $p < .05$ ); however, it failed to predict change in physical activity behavior ( $p = .50$ ). The requirements for mediation were therefore not met. Nevertheless, when intentions and autonomous motivation were entered together, only intentions significantly contributed to physical activity behavior change ( $p < .01$ ). Collectively, these two variables accounted for 6% of variance in the outcome variable. Results are presented in the path model depicted in Figure 1.

**Table 3.** Descriptive statistics for and correlations among, Study 2 variables (n = 149).

Variable	Mean (SD)	1	2	3	4	5	6	7
1. Attitudes	5.59 (1.19)	--						
2. Perceived beh. control	5.61 (1.41)	.03	--					
3. Subjective norms	3.97 (1.72)	.24**	.10	--				
4. Autonomous motivation	6.02 (1.01)	.18*	.22**	.27**	--			
5. Controlled motivation	2.49 (1.05)	.04	-.07	.29**	.25**	--		
6. Intention to increase PA	4.66 (1.71)	.23**	.08	.24**	.18*	.11	--	
7. PA behavior change	0.00 (1.00)	.11	-.10	-.14	-.06	.06	.23**	--

*Note.* The physical activity behavior change variables are based on a residual difference score with a mean of 0 and a standard deviation of 1. All other variables were measured using 7-point Likert-type scales. PA=physical activity. Beh=behavioral. \* $p < .05$ . \*\* $p < .01$ .



**Figure 1.** Path diagram for the model testing the mediating role of intentions to increase physical activity on the association between autonomous motivation and physical activity behavior change. Values on paths are standardized beta weights (B). Path coefficients outside parentheses are for variables entered individually. Path coefficients in parentheses are for variables entered in the model concurrently.

\* $p < .05$ . \*\* $p < .01$ . PA=physical activity.

To evaluate the moderating influence of autonomous motivation and intention on physical activity behavior change, a hierarchical multiple regression was conducted (Baron & Kenny, 1986). Intentions and autonomous motivation were entered in steps 1 and 2, respectively, and the intentions by autonomous motivation interaction term was entered in the third step. To eliminate possible multicollinearity between first-order terms (intentions and autonomous motivation) and second-order terms (intentions by autonomous motivation interaction), the data were “centered” using procedures outlined by Aiken and West (1991). Intentions significantly predicted physical activity behavior change ( $p < .01$ ), accounting for 5% of its variance ( $F$ -change = 8.31,  $p < .01$ ; Table 5). Neither autonomous

**Table 4.** Mediating influences between intentions and autonomous motivation in the prediction of physical activity behavior change.

Criterion Variable	Predictor Variable	Stand	<i>b</i>	<i>t</i>	<i>R</i> <sup>2</sup>	<i>F</i>
Intentions	Autonomous motivation		.18	2.21*	.04	4.90*
PA behavior change	Autonomous motivation		-.06	-.68	.00	.46
PA behavior change	Autonomous motivation		-.10	-1.24	.06	4.93**
	Intentions		.25	3.06		

Note. Stand=standardized. PA=physical activity. \* $p < .05$ . \*\* $p < .01$ .

motivation ( $p = .21$ ) nor the interaction term ( $p = .20$ ) were significant predictors of physical activity behavior change, both accounting for 1% of its variance. This hierarchical multiple regression analysis was repeated for controlled motivation. Neither controlled motivation ( $p = .64$ ) nor the controlled motivation by intention interaction ( $p = .58$ ) were significantly associated with physical activity behavior change.

## DISCUSSION

This follow-up, longitudinal study extended Study 1 by assessing TPB (Ajzen, 1991) and SDT (Deci & Ryan, 1985; Ryan & Deci, 2000) determinants of physical activity behavior change over time and by testing mediating and moderating influences among intentions, motivation, and physical activity behavior change. In line with results of our first study, as well as past research and theory (Ajzen, 1991; Armitage & Conner, 2001; Godin & Kok, 1996; Hausenblas et al., 1997), attitudes were positively associated with intentions to increase physical activity in this study. Contrary to Study 1, however, perceived behavioral control was not significantly associated with physical activity intentions, although the relationship was in the hypothesized direction. This unexpected result could be attributable to the suitability of the sample and specifically the combination of their high levels of perceived behavioral control and high levels of physical activity over time. It could also be attributable to the operational definition of perceived behavioral control. Specifically, research on multiple components of perceived behavioral control has shown that self-efficacy is a better predictor of intentions than a general controllability factor (Rhodes & Courneya, 2003; Trafimow, Sheeran, Conner, & Finlay, 2002). Future research might include barrier self-efficacy (McAuley, 1992) as a predictor of intentions instead of PBC, as several investigations have shown its predictive power in the physical activity context (Troost, Owen, Bauman, Sallis, & Brown, 2002).

Of the three TPB variables, subjective norms were most strongly related to physical activity intentions. This runs contrary to the results of Study 1 and many investigations demonstrating that, relative to attitudes and perceived behavioral control, subjective norms are a weaker predictor of intentions (Armitage & Conner, 2001; Godin & Kok, 1996; Hausenblas et al., 1997). There is some evidence that the relationship between

**Table 5.** Moderating influences between intentions and autonomous motivation in the prediction of physical activity behavior change.

Step	Predictor Variable	Stand <i>b</i>	<i>t</i> for within step predictors	<i>R</i> <sup>2</sup>	<i>F</i> - change
1	Intentions	.23	2.88**	.05	8.31**
2	Autonomous motivation	-.10	-1.24	.01	1.53
3	Intention by autonomous motivation interaction	-.11	-1.28	.01	1.63

Note. Stand=standardized. \*\* $p < .01$ .

subjective norms and intentions is moderated by gender (Courneya & Friedenreich, 1999). For obvious reasons, this possibility was not assessed here. However, it might be that, for middle-aged women of this status, subjective norms are a more salient predictor of intentions than attitudes or perceived behavioral control. This might also be due to the sample that was active.

Congruent with our first study, autonomous motivation and intentions to increase physical activity behavior variables were correlated (Hagger et al., 2006; Ntoumanis, 2001; Sarrazin et al., 2002; Standage et al., 2003). However, after controlling for attitudes, perceived behavioral control, and subjective norms, this relationship was no longer significant. One explanation for this finding is the limited variability in autonomous motivation, as many women scored at the upper limit of this scale (i.e., ceiling effect). Another possibility is that the relationship between autonomous motivation and intentions to increase physical activity behavior is mediated by attitudes, perceived behavioral control, and subjective norms (Hagger, Chatzisarantis, & Biddle, 2002; Hagger et al., 2003, 2005, 2006) or other theoretical variables, such as perceived competence (Williams et al., 2006).

Intentions to increase physical activity were a significant predictor of physical activity behavior change. This suggests that the TPB has the potential to explain behavioral change (Courneya, 1995) and supports research demonstrating these links on a cross-sectional basis (Ntoumanis, 2001; Standage et al., 2003). These findings also support the link between intentions and physical activity and other behaviors on a temporal basis (Courneya et al., 2000, 2001; Sarrazin et al., 2002; Vallerand et al., 1997). The influence of intentions on physical activity behavior change was modest, however, and the strength of this association and amount of variance explained should be kept in mind when interpreting these findings.

Contrary to previous research in the physical activity and broader health contexts (Fortier & Kowal, in press; Frederick-Rescano, 2002; Williams, 2002), autonomous motivation was unrelated to change in physical activity behavior. Again, this is likely attributable to the suitability of the sample and, specifically, the limited variance in autonomous motivation and physical activity (i.e., ceiling effects). Given strong theoretical and

empirical support for the role of autonomous motivation in effecting positive outcomes (Deci & Ryan, 1985; Hagger & Chatzisarantis, in press; Ryan & Deci, 2000), additional research is needed to further test the relationship between autonomous forms of motivation and change in physical activity behavior.

In terms of mediating influences, because of the non-significant link between autonomous motivation and change in physical activity behavior over time, the relationship between these two variables could not be mediated by intentions to increase physical activity (Baron & Kenny, 1986). Nonetheless, results of the path analysis indicated that autonomous motivation significantly predicted intentions (Ntoumanis, 2001; Standage et al., 2003), which, in turn, significantly predicted change in physical activity behavior (Sarrazin et al., 2002). This suggests that motivation might be a determinant of intentions to increase physical activity behavior.

With regards to moderation, no interaction was observed between intentions and either autonomous motivation or controlled motivation in the prediction of physical activity behavior change over time. Although other studies have not demonstrated a moderating influence (e.g., Sarrazin et al., 2002), the present finding is discordant with past investigations supporting the interaction between intentions and motivation in physical activity settings (Chatzisarantis & Biddle, 1998; Sheeran et al., 1999). In terms of TPB and SDT mediating versus moderating influences, further longitudinal research using larger and more diverse samples and more complex data analytic procedures, such as structural equation modeling, are called for.

## **GENERAL DISCUSSION**

The overall objective of this theoretical research was to examine physical activity intentions and physical activity behavior change by integrating concepts from the TPB (Ajzen, 1991) and SDT (Deci & Ryan, 1985; Ryan & Deci, 2000) in a community based-sample of middle-aged Canadian women in two studies. This project builds on past work by integrating theoretical concepts from two important and evidence-based psycho-social theories to optimize understanding of the behavioral change process. Theory integration capitalizes on each theory's strengths, brings about more information, and thus improves the effectiveness of interventions (Nigg, Allegrante, & Ory, 2002; Noar & Zimmerman, 2005). This research also extends past work by investigating physical activity behavior change over time and targeting middle-aged women, an understudied group.

Theoretically, the overall pattern of results supported many of the relationships purported in the TPB (Ajzen, 1991). Results were mostly in agreement with past physical activity research demonstrating significant links between the three TPB variables and physical activity intentions (Chatzisarantis & Biddle, 1998; Courneya, 1995; Courneya & Friedenreich, 1999; Hagger et al., 2006; Rhodes & Courneya, 2003). The present research adds to a limited number of studies examining intentions to increase physical activity (French et al., 2005), both cross-sectionally and in a longitudinal manner.

Intentions to increase physical activity translated into behavior change over time in Study 2; however, this relationship was modest. Past studies have shown that intentions are predictive of behavior in physical activity and other settings (Chatzisarantis & Biddle,



1998; Hagger et al., 2002, 2005, 2006; Rhodes & Courneya, 2003; Vallerand et al., 1997). Our results concur with a growing number of investigations (e.g., Courneya et al., 2000, 2001; Sarrazin et al., 2002), demonstrating that intentions may play a small, but determining, role in effecting change in physical activity behavior. Some might wish to use these modest results to question the utility of the TPB in this area. We caution that this is only one study and that the active sample, which did not have much potential for change, might be partially responsible for this finding. What seems apparent is that behavior change is a complex process, and obtaining relationships of even modest strength is informative with respect to explaining why and how women increase their physical activity level (Rosnow & Rosenthal, 1989). Future research should incorporate other theoretical variables, such as different forms of self-efficacy and test complex theoretical mediational and moderational models in order to best account for the behavior change process and increase variance explained.

From the vantage point of SDT, results partially supported predictions. In Study 1, the significant association between autonomous motivation and intentions to increase physical activity concurs with previous investigations (Hagger et al., 2006; Ntoumanis, 2001; Sarrazin et al., 2002; Standage et al., 2003; Wilson & Rodgers, 2004). In providing a more stringent test of the autonomous motivation-intention relationship by employing a hierarchical regression model, findings from Study 1 highlight the unique, relative contribution of autonomous motivation to intentions beyond attitudes, perceived behavioral control, and subjective norms, and they are supportive of SDT (Deci & Ryan, 1985; Ryan & Deci, 2000). This finding was not replicated in Study 2, however, which was likely due to the limited variance in autonomous motivation. The English-speaking women in Study 2 had higher levels of autonomous motivation, perceived behavioral control, physical activity, and education, suggesting that these mixed findings might stem, at least in part, from differences between the samples.

To further examine associations among motivation, intentions, and physical activity behavior change, mediating and moderating influences were assessed in Study 2. Although autonomous motivation was related to intentions and intentions predicted physical activity change, mediation was not demonstrated due to the fact that the relationship between autonomous motivation and behavior was not significant. With regards to moderation, no interaction was observed between autonomous motivation and intentions in the prediction of physical activity behavior change. These results could be explained by the lack of suitability of sample 2. Another possibility is that the relationship between autonomous motivation and intentions is mediated by other TPB and/or SDT variables (Hagger et al., 2003, 2005, 2006; Williams et al., 2006). Given the wealth of research demonstrating that autonomous motivation (Fortier & Kowal, 2007; Williams et al., 1996, 1998, 2004, 2006) and intentions (Courneya et al., 2000, 2001; Sarrazin et al., 2002) play a key role in numerous health behaviors and health behavior change, future studies of physical activity behavior change should employ larger and more heterogeneous samples to better assess mediating versus moderating influences. Experimental and/or multiple wave longitudinal research designs would allow for optimal testing of these hypotheses.

It is likely that other psychological variables could explain how and why women changed their physical activity behavior above and beyond the TPB and SDT variables. It is also probable that factors from other ecological levels were at play. To increase our comprehension of women's physical activity behavior change and increase variance explained, future research could include socio-demographic factors, social/cultural, and environmental variables in addition to psychological factors (Speck & Harrell, 2003; Trost et al., 2002). Examining the interaction between these different levels of variables would be particularly innovative and potentially informative and also lead to theory refinement.

One of the main limitations of this research pertains to the physical activity level of study participants. The majority of women, especially in Study 2, met established population-based recommendations for regular physical activity participation (Blair et al., 2004). From a measurement perspective, there was a limit with respect to the extent to which they could have increased their physical activity behavior, despite their self-reported intentions. It would be useful in future studies to examine the relative contribution of SDT and TPB variables to physical activity behavior change among sedentary women and/or by comparing groups of inactive versus active women. It could also be helpful to include more objective measures of physical activity. In addition, the majority of women, again, mainly in Study 2, were of a relatively high socioeconomic status, limiting the extent to which the present findings could be generalized to other populations. Given the limited socioeconomic diversity in this research, an interesting avenue for future research would be to assess the purported relationships across divergent subpopulations (e.g., ethnic and socioeconomic groups). It is possible that the adaptation of some of the measures (attitudes, intentions, motivation) to the behavior change context might have affected the strength of the relationships found in the two studies. A further limitation pertains to the research design. By using a non-experimental design, what was effectively studied in the two studies was naturally occurring change in physical activity behavior. This could have further contributed to the limited amount of variability in actual physical activity increase over six months, thereby attenuating relationships among change in physical activity behavior, intentions, and motivation. Future research could benefit from using an experimental or quasi-experimental design testing an integrated TPB-SDT physical activity intervention and doing mediational and moderational analyses. Moreover, future studies could do well to study physical activity behavior change over multiple time points. This would allow for a more sophisticated analysis of change, especially using data analytic techniques such as hierarchical linear modeling.

Results of this research suggest a number of ways in which physical activity could be fostered in middle-aged women. Of the TPB variables, attitudes were most strongly and consistently associated with intentions to increase physical activity behavior which, in turn, were predictive of change in physical activity over time. Physical activity intentions could be fostered by helping women develop more positive attitudes by focusing on salient physical and mental health benefits of regular physical activity participation, by relating physical activity to their life goals, and by allowing them to experience the benefits of physical activity. Perceptions of behavioral control could be enhanced by focusing on strategies to increase physical activity levels, such as goal setting and

time-management. Subjective norms could be optimized by encouraging significant others to vocalize positive expectations regarding regular involvement in physical activity. Autonomous motivation, which was also related to intentions across studies, could be facilitated by fostering the fundamental needs for autonomy, competence, and relatedness, by encouraging significant others to act in autonomy supportive ways (e.g., providing choices and support), and by ensuring physical activity is as enjoyable as possible.

In conclusion, this research generally supported the theoretical tenets of the TPB and SDT and highlighted the role of intentions in physical activity behavior change in middle-aged women. Ideally, a more comprehensive investigation would include not only determinants of, and barriers to, physical activity behavior change but also a systematic examination of strategies that might facilitate or hinder women's ability to overcome these barriers. This could potentially shed light on strategies that are most salient to bring about an increase in physical activity levels of middle-aged women.

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