Journal of Sport & Exercise Psychology, 2007, *29,* 21-38

The Mediating Role of Intention and Stages of Change in Physical Activity Among Adults with Physical Disabilities: An Integrative Framework

Maria Kosma,[1] Rebecca Ellis,[1] Bradley J. Cardinal,[2] Jeremy J. Bauer,[2] and Jeffrey A. McCubbin[2]
[1]Louisiana State University and [2]Oregon State University

The study's purpose was to identify the mediating role of intention and the stages of change (SOC) in physical activity (PA) over a 6-month period using two models (Theory of Planned Behavior [TPB] and TPB/SOC). Participants were 143 adults with physical disabilities (70.68% response rate; *M* age = 46.03). The TPB constructs, SOC (time 1), and PA (time 2) were assessed using standardized self-report questionnaires. Based on path analyses, attitude had the highest effect on intention and SOC followed by perceived behavioral control within both well-fit models. The variance in PA explained by the first (TPB) and second (TPB/SOC) models was 16% and 28% respectively. In the just identified model of TPB/SOC, the direct effect of SOC on physical activity remained strong ($\gamma_{soc \cdot pa}$ = .45) and SOC approached full mediation through attitude. Health promotion interventions need to include both intention and behavior elements (SOC) reinforcing increased PA value and barrier elimination.

Key Words: theory of planned behavior, transtheoretical model, prospective design, Web-based study

National health and governmental agencies have reached consensus that physical activity promotion is a public health priority (United States Department of Health and Human Services, [USDHHS], 2000). However, 56% of adults with physical disabilities do not participate in any leisure-time physical activity compared with 36% of adults without disabilities (USDHHS, 2000). Living a mainly inactive lifestyle may lead to secondary health conditions, such as coronary heart disease, hypertension, obesity, Type II diabetes, osteoporosis, and decreased functioning in activities of daily living (Heath & Fentem, 1997; Rimmer & Braddock, 2002). In a consensus paper, the importance of determining factors that motivate individuals

Kosma and Ellis are with the Department of Kinesiology, Louisiana State University, Baton Rouge, LA 70803; Cardinal, Bauer, and McCubbin are with the College of Health and Human Sciences, Department of Nutrition and Exercise Sciences, Oregon State University, Corvallis, OR 97331.

with disabilities to be physically active was recognized (Cooper et al., 1999). Using an integrative framework whereby constructs of the Theory of Planned Behavior (TPB) are integrated with the transtheoretical model may facilitate progress in this area (Kosma, Ellis Gardner, Cardinal, Bauer, & McCubbin, 2006; Rosen, 2000).

Based on the TPB (Ajzen, 1991), the major determinant of physical activity behavior is intention. Intention is influenced by attitude, subjective norm, and perceived behavioral control (PBC). Attitude, subjective norm, and PBC are hypothesized to affect physical activity behavior indirectly through intention. Perceived behavioral control is also stipulated to directly affect behavior (shown later in Figure 2). Intention reflects one's motivation and willingness to be active. Attitude refers to the perceived consequences (positive or negative) of physical activity participation and the perceived value of these consequences. Subjective norm reflects the perceived social pressure from significant others to engage in an active lifestyle and motivation to comply with their beliefs. Lastly, PBC reflects both perceived ease and difficulty to be active (self-efficacy) and perceived control (e.g., capacity to overcome barriers) of the behavior. Therefore, the basic hypotheses of the TPB are that people will intend to perform a behavior when they possess favorable attitudes, subjective norm, and strong PBC, and they will perform the behavior when they possess strong intentions and PBC (Ajzen, 1991).

The transtheoretical model is an integrative framework whereby the stages of change (SOC), processes of change (behavioral and cognitive strategies to be active), self-efficacy, and decisional balance influence physical activity behavior (Prochaska & Velicer, 1997). Decisional balance (perceived pros and cons of physical activity) and self-efficacy have been hypothesized to be similar to attitude and PBC of the TPB, respectively (Ajzen, 1991; Courneya, Nigg, & Estabrooks, 1998). A major dimension of the transtheoretical model is the SOC, which reflects both intention and behavior (Marcus, Eaton, Rossi, & Harlow, 1994; Nigg, 2005). Examining both behavior and intention may increase the predictive strength of physical activity determinants (Rosen, 2000).

Based on the SOC, physical activity behavior change unfolds over time. Specifically, individuals can be classified within five SOC based on their intention toward physical activity and physical activity behavior. Individuals in the precontemplation stage are not active and they do not intend to be active in the near future. Contemplators represent inactive individuals who intend to be active within the next 6 months. In preparation, people are irregularly active and they intend to be regularly active within 1 month. Individuals in the action stage are regularly active for less than 6 months, whereas people in maintenance are regularly active for more than 6 months. The major advantage of the SOC reflects the development and implementation of physical activity motivational programs tailored to one's stage of physical activity intention and behavior (stage-matched programs; Cardinal & Sachs, 1996).

Overall, the predictive strength of the TPB for physical activity among mainly individuals without disabilities has been supported. Specifically, in two recent meta-analyses (Downs & Hausenblas, 2005; Hagger, Chatzisarantis, & Biddle, 2002), the most important predictor of physical activity was intention and the most important predictors of intention were attitude and PBC. Two recent studies have examined the application of the TPB to physical activity among adults with spinal cord injuries (Latimer & Martin Ginis, 2005; Latimer, Martin Ginis, & Craven, 2004). Based on the latter cross-sectional study (Latimer et al., 2004), only PBC was a significant predictor of intention and physical activity of moderate intensity among adults with tetraplegia. One possible explanation of the low construct validity of the TPB, as described by the study authors, was the use of indirect assessment methods for attitude (behavioral beliefs) and subjective norm (control beliefs). The authors indicate that two additional reasons for the weak construct relationships may be related to the exercise measure used as well as the limited correspondence of exercise description between the questionnaire items and the exercise measure. According to the 1-week prospective study (Latimer & Martin Ginis, 2005), intention was the most important predictor of leisure-time physical activity and intention was predicted by attitude, subjective norm, and PBC.

It has been reported that stage-matched physical activity motivational materials are more effective for physical activity behavior change than stage-mismatched motivational materials among college personnel (Blissmer & McAuley, 2002). Recently, the application of the SOC to physical activity behavior change among people with physical disabilities has been supported. Specifically, the behavioral and cognitive processes of change along with self-efficacy, perceived pros, and physical activity tend to increase across the SOC. Perceived cons tend to decrease across the SOC among both active and inactive adults with physical disabilities (Cardinal, Kosma, & McCubbin, 2004; Kosma, Cardinal, & McCubbin, 2004a; Kosma et al., 2006). Within an experimental design, a 1-month Web-based physical activity motivational program was responsible for producing positive SOC differences between pretest and posttest among inactive adults with physical disabilities. Therefore, SOC may serve as an important mediator of physical activity behavior change among people with disabilities (Kosma, Cardinal, & McCubbin, 2005).

Three criteria need to be met to support mediator effects (Figure 1). First, the independent variable needs to exhibit a significant effect on the mediator (path a). Secondly, the mediator needs to be a strong predictor of the dependent (outcome) variable (path b). Lastly, when the effects of paths a and b are controlled, "a previously significant relationship between the independent and the dependent variable is no longer significant, with the strongest demonstration of mediation occurring when path c is zero" (Baron & Kenny, 1986, p. 1176). Within the last equation (3rd mediator criterion), the indirect effect of the independent variable on the dependent variable via the mediator needs to be calculated to confirm the predictive strength of the mediator (Baron & Kenny, 1986).

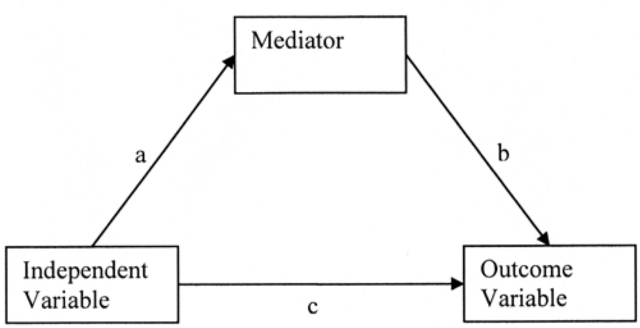

Figure 1 — Mediation Model (Baron & Kenny, 1986).

It has been further stipulated that SOC mediate the relationship between TPB and transtheoretical model constructs and physical activity (Courneya et al., 1998, and Marcus et al., 1994, respectively). However, only in the study of Marcus and colleagues (1994) was SOC tested as the sole mediator between perceived pros, cons, self-efficacy, and physical activity behavior within a work site setting of mainly active employees. In this cross-sectional and 6-month prospective study, structural equation modeling was used to analyze the study data. In the study by Courneya and colleagues (1998), multiple regression analyses were used to test the predictive strength of intention and SOC on exercise over a 3-year period. In multiple regression analyses, mediator and outcome effects cannot be tested simultaneously (Kline, 1998). Prospective research designs (e.g., use of psychosocial constructs to predict future behavior) that examine simultaneously the effects of the predictors (e.g., path analysis over multiple regression analyses) are recommended to accurately identify temporal predictive strength (Carron, Hausenblas, & Estabrooks, 2003; Jöreskog & Sörbom, 2001; Kline, 1998).

In the study by Courneya et al. (1998), both intention and SOC were used as mediators between the TPB independent variables (attitude, subjective norm, and PBC) and current as well as future (3-year) exercise behavior among mainly active older adults. Using both SOC (intention and behavior) and intention as mediators of physical activity may lead to inaccurate parameter estimates (e.g., attenuation or increase of predictive strength; Kline, 1998). In their study, there was also a lack of time frame correspondence between the TPB construct terminology and behavior assessment.

In both aforementioned studies, although the SOC was conceptualized as an ordinal variable, it was used as a continuous variable in the statistical analyses. This may lead to decreased accuracy of parameter estimates (Jöreskog & Sörbom, 1993a, 1993b). Additionally, the necessary mediator criteria were not tested (Figure 1). No studies have integrated the SOC with TPB constructs to test the mediating role of SOC in future physical activity among people with disabilities. Identifying the predictive strength of the SOC as a mediator of behavior change may facilitate the development and delivery of stage-matched physical activity motivational programs among adults with physical disabilities.

Therefore, the purpose of this study was to examine simultaneously (i.e., use of path analysis) the mediating role of intention and SOC in future physical activity behavior (6-month prospective study) among adults with physical disabilities using two models. In the first model, the application of the TPB to physical activity behavior change for the posited populace was examined (Figure 2). In the second model, SOC was integrated with the TPB independent variables (attitude, subjective norm, and PBC; integrative framework) and served as the sole mediator of physical activity behavior change (Figure 3).

Based on the theoretical frameworks of TPB and SOC and the literature review, the following hypotheses were formed for the first model (TPB). First, it was hypothesized that intention would be the strongest predictor of future physical activity followed by PBC. Secondly, the most important predictors of intention were hypothesized to be attitude and PBC. Within the second model (TPB/SOC), it was hypothesized that SOC would be the most important predictor of behavior. Attitude and PBC were expected to be the strongest predictors of SOC. Lastly, SOC (integration of intention and behavior) was expected to be a stronger predictor of physical activity behavior than intention.

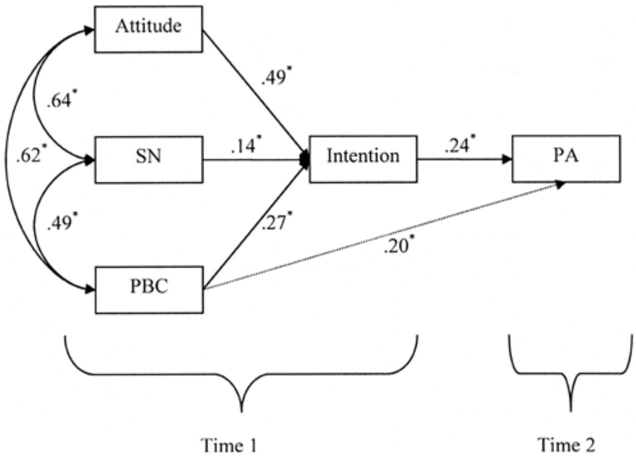

Figure 2 — The conceptual model of TPB (Ajzen, 1991).

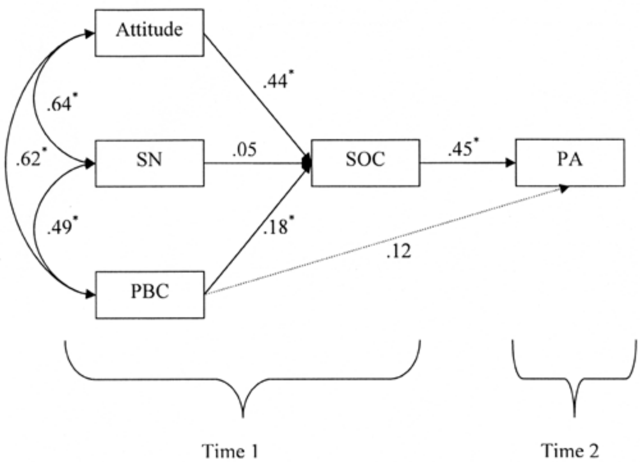

Figure 3 — An integrative framework of TPB and SOC.

Method

Design

This study was a 6-month Web-based prospective design, and an appropriate institutional review board approved the project. Participants completed standardized self-report questionnaires assessing attitude, subjective norm, PBC, intention, and SOC in the first cycle of data collection (February 2005). In the second cycle of data collection (August 2005), they completed a standardized self-report scale about their physical activity behavior levels. Physical activity was defined as the accumulation of at least 30 min of daily activity (e.g., walking, off-road pushing, cycling, dancing, tennis) at moderate or higher intensity (Pate et al., 1995).

Participants

In the first cycle of data collection, 225 people completed the study's informed consent form, demographic information, and questionnaires (all completed online). However, two individuals were identified as univariate and multivariate outliers and they were excluded from the study (n = 223). These individuals represent a pool of participants from a database that was developed in previous studies (Cardinal et al., 2004; Kosma et al., 2004a). The main recruitment method for the database was the development and distribution of a study flyer to several sites across the United States such as rehabilitation centers, disability association Web sites, hospitals, disability offices, and colleges.

Participant recruitment lasted 10 months and a wait list database of about 1,000 adults with physical disabilities (e.g., spinal cord injury and multiple sclerosis) was developed. Data collection for the first cycle was initiated 1 year following the development of the initial database. Participants of the wait-list database were contacted through email about the purpose of the current study. However, many participants in the database did not receive the email message due to problems with email accounts such as accounts no longer existing, full mailboxes, and spam filters. Therefore, the study's recruitment rate could not be determined (Kosma et al., 2006).

In the second cycle of data collection, an email message was distributed to the study participants (n = 223) directing them to the Web page of the second assessment. About 15 individuals did not receive the email message because of problems with email accounts (e.g., change of email address). From the 208 individuals who received the email message, 147 people completed both the first and second cycles of data collection (147/208 = 70.68% response rate). Four univariate and multivariate outliers were identified and excluded from the study. Therefore, the final sample size comprised 143 individuals (M age = 46.03, SD = ±10.79, age range = 18–73). Within 2 weeks following the first and second cycles of data collection, three study reminders were electronically distributed to participants to increase retention rate.

Several steps were taken to screen for disability type. Specifically, the study's disability type (i.e., physical disability) was specified in the study flyer and informed consent form during participant recruitment and data collection. Additionally, participants had the opportunity to report any other (e.g., cognitive) disability type in the demographics section of the questionnaires. Only individuals with physical disabilities were included in the study. Lastly, education level was also assessed to ensure accurate completion of the survey questionnaires.

Measures

Physical Activity. Physical activity was measured using the 13-item self-report Physical Activity Scale for Individuals with Physical Disabilities ([PASIPD]; Washburn, Zhu, McAuley, Frogley, & Figoni, 2002). The developers of the scale validated the instrument among 372 adults with physical disabilities (i.e., spinal cord injury, postpolio, cerebral palsy, and other locomotor disabilities). The PASIPD consists of six leisure time (e.g., wheeling, walking, swimming), six household (e.g., gardening, washing dishes), and one work-related item. Each scale item assessed number of days and average hours per day of physical activity participation at varied intensities over the past 7 days. Washburn and colleagues reported that participants who rated themselves as physically active and of "excellent/very good" health exhibited significantly higher PASIPD scores than those who rated themselves as inactive and of "good" or "fair/poor" health, supporting the construct validity of the scale. The scoring of the scale reflects a composite PASIPD score computed by multiplying the average hours per day by a metabolic equivalent (MET) value based on activity intensity. For example, the MET value multiplier for moderate sport and recreational activities is 4.0, whereas the MET value multiplier for strenuous sport and recreational activities is 8.0. Mathematically, the maximum composite score of the scale is 199.5 MET-hours/day. In this study, the internal consistency of the PASIPD scale was $\alpha = .72$. Total daily physical activity hours over the past week ($\alpha = .75$) were also calculated to test the accuracy of the scale MET values.

Stages of Change. Stages of change were assessed using the recommended scale of Reed, Velicer, Prochaska, Rossi, and Marcus (1997). This is an ordinal scale of a 5-choice response format. In the study of Reed and colleagues, eight algorithms were compared. As recommended by the authors, the long definition of physical activity was incorporated in this project. In particular, participants were asked if they accumulated at least 30 min of daily activity at moderate or higher intensity. Overall, the presented list of activity types matched with the activity types of the PASIPD (e.g., walking, wheeling, off-road pushing, swimming, dancing, cycling, and tennis). Additionally—and as recommended by Reed and colleagues, Schumann et al. (2002), and Kosma et al. (2006)—both a cognitive and a behavioral element were included in the preparation stage. In particular, participants in the preparation stage were irregularly active but they were planning to be regularly active within 1 month. This algorithm has exhibited acceptable construct validity (i.e., expected relationships between the stages of change, transtheoretical model constructs, and physical activity) in the study of Reed and colleagues, as well as among adults with physical disabilities (Kosma et al., 2006).

Intention. Intention was assessed on a 7-point Likert scale using two items: a) I intend to participate in regular physical activity over the next 6 months (1 = *strongly disagree,* 7 = *strongly agree*) and b) I intend to participate in regular physical activity over the next 6 months (1 = *not at all,* 3 = *some of the time,* 5 = *most of the time,* 7 = *all of the time;* Courneya, Blanchard, & Laing, 2001). A mean score was used to analyze the study data and the internal consistency of intention was $\alpha = .90$.

Attitude. The statement "participating in regular physical activity over the next 6 months will be" was rated on a 7-point Likert scale (1–7) to assess attitude. Eight adjective pairs (i.e., *boring–interesting, unpleasant–pleasant, unenjoyable–enjoyable, stressful–relaxing, useless–useful, harmful–beneficial, foolish–wise, bad–good;* Ajzen & Fishbein, 1980) anchored the ends of the scales. A mean score was used to analyze the study data, and the internal consistency of attitude was $\alpha = .89$.

Subjective Norm. The following three items were rated on a 7-point scale (1 = *strongly disagree,* 7 = *strongly agree*) to measure subjective norm: a) most people who are important to me think I should participate in regular physical activity over the next 6 months, b) most people who are important to me approve of me participating in regular physical activity over the next 6 months, and c) most people who are important to me support me participating in regular physical activity over the next 6 months (Courneya et al., 2001). A mean score was used to analyze the study data and the internal consistency of subjective norm was $\alpha = .96$.

Perceived Behavioral Control. Three items rated on a 7-point Likert scale measured PBC. The items were a) if I wanted to, I could easily participate in regular physical activity over the next 6 months (1 = *strongly disagree,* 7 = *strongly agree*), b) how much control do you have over participating in regular physical activity over the next 6 months? (1 = *very little control,* 7 = *complete control*), and c) for me to participate in regular physical activity over the next 6 months will be (1 = *extremely difficult,* 7 = *extremely easy;* Courneya et al., 2001). Internal consistency for the three-item scale was .83 and a mean score was used to analyze the study data.

Analyses

Using the Statistical Package for the Social Sciences (SPSS 14), Pearson correlations of the continuous (at least interval level) study variables and descriptive statistics were performed. A MANOVA was conducted to determine potential differences in physical activity determinants and physical activity behavior across disability type. A chi-square analysis was also used to analyze the relation between SOC and disability type.

A path analysis was conducted to identify the direct effects of the independent variables (attitude, subjective norm, and PBC) on the dependent variable (physical activity). Two additional path analyses (over identified models) were conducted to examine if the first two mediator criteria were met (Figure 1). Lastly, two path analyses were performed using just identified models (equal numbers of parameters and observations) to test the third mediator criterion. Maximum likelihood parameter estimation was used to analyze the study data of the TPB model. Diagonally weighted least squares (DWLS) parameter estimation was used to analyze the data of the integrative framework (TPB/SOC). Considering the ordinal level of the SOC scale and the medium sample size, DWLS is a recommended parameter estimation procedure (Flora & Curran, 2004; Jöreskog & Sörbom, 2001; Muthén, 1993). LISREL 8 was used to run the path analyses.

Path analysis belongs to the structural equation modeling family tree and reflects the structural (or path) model of the hybrid model (i.e., path and measurement models). It represents an advanced technique to simultaneously test for mediator and outcome effects (Kline, 1998). In this study, a single observed measure (e.g., mean score) was used for each theoretical variable and thus latent variables were not tested (as in a hybrid model). Considering the study conceptualization and purpose, the way data were treated, and the size of the study sample, path analysis reflects an appropriate statistical technique to analyze the study data (Kline, 1998).

Results

Participant Profile and Descriptive Data

Table 1 represents the demographic profile and SOC distribution of the participants during the first and second cycles of data collection as well as among the survey noncompleters. As can be observed, there were no significant differences in the participants' profile between the survey completers ($n = 143$) and noncompleters

Table 1 Participant Profile

Variable	Cycle 1 (*n* = 223)	Cycle 2 (*n* = 143)	Noncompleters (*n* = 80)	*p*
Disability type				.20
Spinal Cord Injury	21.5 (48)	22.4 (32)	20 (16)	
Cerebral palsy	18.8 (42)	15.4 (22)	25 (20)	
Multiple Sclerosis	17.9 (40)	15.4 (22)	22.5 (18)	
Muscle/joint disorders[a]	16.1 (36)	18.9 (27)	11.3 (9)	
Brain-related disorders[b]	10.8 (24)	10.5 (15)	11.3 (9)	
Postpolio	5.4 (12)	7.7 (11)	1.3 (1)	
Amputation	3.6 (8)	4.2 (6)	2.5 (2)	
Spina bifida	3.1 (7)	3.5 (5)	2.5 (2)	
Sensory and lung disorders	2.7 (6)	2.1 (3)	3.8 (3)	
Education				.63
Formal school (<high school)	.9 (2)	.7 (1)	1.3 (1)	
High school	4.9 (11)	5.6 (8)	3.8 (3)	
Some college (no degree)	21.5 (48)	18.9 (27)	26.3 (21)	
College graduate	43.5 (97)	43.4 (62)	43.8 (35)	
Graduate degree	29.1 (65)	31.5 (45)	25 (20)	
Ethnicity				.24
White	83.9 (187)	84.6 (121)	82.5 (66)	
Latino American	4.9 (11)	4.2 (6)	6.3 (5)	
African American	3.1 (7)	4.2 (6)	1.3 (1)	
Asian American	1.8 (4)	2.8 (4)	.00 (0)	
American Indian	.9 (2)	.7 (1)	1.3 (1)	
North African American	.4 (1)	.00 (0)	1.3 (1)	
Middle Eastern American	.4 (1)	.7 (1)	.00 (0)	
n/a	4.5 (10)	2.8 (4)	7.5 (6)	
Gender				.92
Female	70.9 (158)	70.6 (101)	71.3 (57)	
Male	29.1 (65)	29.4 (42)	28.8 (23)	
Stages of Change				.75
Precontemplation	23.3 (52)	23.8 (34)	22.5 (18)	
Contemplation	20.2 (45)	18.9 (27)	22.5 (18)	
Preparation	17.5 (39)	16.8 (24)	18.8 (15)	
Action	3.1 (7)	4.2 (6)	1.3 (1)	
Maintenance	35.9 (80)	36.4 (52)	35 (28)	

Note. Numbers outside parentheses represent percentage scores (%) within the first and second cycles of data collection as well as among the survey noncompleters. Numbers in parentheses represent frequencies within each group.

[a]Muscular dystrophy and arthritis.

[b]Traumatic brain injury and stroke.

(n = 80). Additionally, the profile of the survey completers was representative of the profile of the total sample at cycle 1 (n = 223). Study participants (n = 143) exhibited a variety of physical disabilities with the most prevalent categories being spinal cord injury (22.4%), muscle/joint disorders (18.9%), cerebral palsy, and multiple sclerosis (15.4% each). Additionally, the majority of the participants were female, White European-American, well-educated, and they had a middle-class income (M = \$47,607, SD = ±\$32,751, median = \$35,000, n = 135). They were almost equally distributed across the SOC except for the action stage, in which only six individuals were classified. Therefore, the action and maintenance active stages were combined into one stage (AC/MA; n = 58) to decrease potential adverse effects on the statistical analyses (Tabachnick & Fidell, 2001).

Table 2 represents Pearson correlations, means, and standard deviations of the continuous study variables. Most of the construct relationships were moderate to high except for the relationship between physical activity (MET-hours per day and hours per day) and subjective norm. The moderate-to-high relationships between the mediator (intention) and the independent variables (attitude, subjective norm, and PBC) reinforce the importance to report indirect effects of the independent variables on physical activity via intention in the third mediator criterion (just identified model). In this way, the unique contribution of each independent variable can be estimated (Baron & Kenny, 1986). Overall, study participants had positive beliefs about physical activity and they engaged in some forms of physical activity (see M and SD in Table 2).

Table 2 Pearson Correlations, Means, and *SD* of Continuous Study Variables

	1	2	3	4	5	6	*M*[a]	*SD*
1. Physical activity (MET-hr/day)	—	.87**	.37**	.35**	.20*	.35**	20.2	18.78
2. Physical activity (hr/day)		—	.37**	.33**	.16	.37**	10.85	6.54
3. Intention			—	.74**	.58**	.64**	4.64	1.85
4. Attitude				—	.63**	.62**	5.1	1.24
5. Subjective norm					—	.49**	5.1	1.87
6. Perceived behavioral control						—	4.4	1.73

[a]Physical activity (MET-hr/day) range: .00–90.88; physical activity (hr/day) range: .00–36; intention, attitude, subjective norm, and perceived behavioral control range: 1–7.

$^{**}p$ = .01, $^{*}p$ = .05.

Based on the MANOVA, there was no significant difference in physical activity determinants and physical activity behavior across the different types of disability, $F(48, 804) = .91$, $p = .64$. The mean ranges for each dependent variable across disability type was as follows: intention = 4.08–6.3, attitude = 4.66–6.58, subjective norm = 4.33–6.15, PBC = 3.6–5.3, physical activity = 15.62–23.54 MET-hr/day (11.84 and 26.85 MET-hr/day for multiple sclerosis and cerebral palsy, respectively). Considering the high SD in the MET values, total average hours of daily physical activity over the past 7 days were also calculated in relation to disability type. The mean range of physical activity across disability type was 8.45–12.2 hr/day. The relation between the SOC and disability type was also examined. The chi-square analysis revealed no differences between the SOC and disability type, $\chi^2(24, N = 143) = 20.45$, $p = .67$.

Mediating Role of Intention in Physical Activity

Attitude had the highest significant direct effect on physical activity (MET-hours/day) ($\gamma_{attitude \cdot pa} = .25$) followed by PBC ($\gamma_{pbc \cdot pa} = .23$). Subjective norm did not have a significant direct effect on physical activity ($\gamma_{sn \cdot pa} = -.08$). Figure 2 shows the path diagram and standardized path coefficients of the over identified model for TPB. Coefficients associated with single-headed straight arrows are standardized regression weights that indicate the effect of one variable on another, whereas those associated with double-headed curved arrows represent correlations between variables. All path coefficients were statistically significant at $p \leq .05$, although subjective norm had a small effect on intention ($\gamma_{sn \cdot intention} = .14$). Attitude had the highest effect on intention ($\gamma_{attitude \cdot intention} = .49$) followed by PBC ($\gamma_{pbc \cdot intention} = .27$). The overall variance in intention and physical activity explained by the model was 62% and 16%, respectively.

Based on the goodness-of-fit statistics (i.e., indices of fit), the sample covariance matrix exhibited a strong fit to the hypothesized model. Specifically, the χ^2 statistic provides a statistical test of the goodness of fit of the sample covariance matrix to the population (hypothesized) model. A statistically significant value indicates misfit. In this study, $\chi^2(2, N = 143) = 1.94$ ($p = .38$), indicating a well-fit model (Tabachnick & Fidell, 2001). The root mean square error of approximation (RMSEA) quantifies the amount of error when estimating the population covariance matrix (hypothesized model) from the sample covariance matrix (observed/data model). Values less than .05 indicate a good fit (MacCallum, Browne, & Sugawara, 1996). In this model, RMSEA = .00 representing a strong fit. The goodness-of-fit index (GFI) is an indicator of the amount of variance/covariance explained by the sample model. For this index, values can range between 0 and 1, with values greater than .90 indicating a good fit (Byrne, 1998). In this study, the value of GFI was .99, indicating a strong fit.

When the unique contribution of intention to physical activity was controlled (just identified model), the direct effects of the independent variables on physical activity were not significant ($\gamma_{attitude \cdot pa} = .16$; $\gamma_{sn \cdot pa} = -.11$; $\gamma_{pbc \cdot pa} = .18$). However, these small-to-moderate effects were not close to zero and thus full mediation was not supported (Baron & Kenny, 1986). Additionally, the nonsignificant effect of intention on physical activity ($\gamma_{intention \cdot pa} = .20$) was lower than the significant effect of intention on physical activity in the overidentified model ($\gamma_{intention \cdot pa} = .24$). Lastly, the indirect effects of the independent variables on physical activity via intention were small and nonsignificant ($\gamma_{attitude \cdot intention \cdot pa} = .10$; $\gamma_{sn \cdot intention \cdot pa} = .03$; $\gamma_{pbc \cdot intention \cdot pa} = .05$). Based on these data, the mediating role of intention on physical activity is partially supported.

Mediating Role of SOC in Physical Activity

Figure 3 represents the path diagram and standardized path coefficients of the over identified model for the integrative framework (TPB/SOC). All path coefficients were statistically significant at $p \leq .05$, except for the effect of subjective norm on SOC and the effect of PBC on physical activity (MET-hours per day). Attitude had the highest effect on SOC ($\gamma_{attitude \cdot soc} = .44$) followed by PBC ($\gamma_{pbc \cdot soc} = .18$). The overall variance on SOC and physical activity explained by the model was 36% and 28%, respectively. Based on the goodness-of-fit statistics, the sample data exhibited a strong fit to the hypothesized model, $\chi^2(2, N = 143) = 1.13$, $p = .57$; RMSEA = .00; GFI = 1.0).

When the unique contribution of SOC to physical activity was controlled (just identified model), the direct effects of the independent variables on physical activity were not significant ($\gamma_{attitude \cdot pa} = .06$; $\gamma_{sn \cdot pa} = -.10$; $\gamma_{pbc \cdot pa} = .15$). The direct effect of SOC on physical activity remained strong ($\gamma_{soc \cdot pa} = .45$). Attitude approached a moderate indirect effect on physical activity via SOC ($\gamma_{attitude \cdot soc \cdot pa} = .20$). The indirect effects of subjective norm and PBC on physical activity through SOC were small and nonsignificant ($\gamma_{sn \cdot soc \cdot pa} = .02$; $\gamma_{pbc \cdot soc \cdot pa} = .08$). Based on these data, the mediating role of SOC on physical activity has been partially supported within an integrative framework. Full mediation was approached through attitude (almost zero direct effect).

Discussion

The purpose of this study was to simultaneously (path analysis) examine the mediating role of intention and SOC in physical activity behavior change over a 6-month period. Two models were tested: a) the TPB model whereby intention served as the mediator between attitude, subjective norm, and PBC and future physical activity, and b) an integrative framework whereby SOC served as the mediator between attitude, subjective norm, and PBC and future physical activity.

Both hypothesized models had a strong fit to the study data. Based on the findings of the first model (TPB), the study hypotheses were supported. In particular, intention was the most important predictor of physical activity followed by PBC. In addition, attitude and PBC mostly predicted intention (Hagger et al., 2002). The overall variance in physical activity (16%) explained by the study's model and elsewhere (Latimer & Martin Ginis, 2005) was lower than the amount of variance in physical activity (27.41%) accounted for by the TPB constructs in the meta-analysis of Hagger, Chatzisarantis, and Biddle (2002). A reason for this difference may relate to the measurement of physical activity in the current study. Specifically, the terminology of physical activity for the TPB constructs and SOC reflected "accumulation of at least 30 min of daily physical activity of moderate or higher intensity." However, some of the PASIPD items reflect such types of activities as household and work-related activity that may reflect light intensity. Based on the nature of the PASIPD, different intensities of physical activities could not be tested separately.

Another reason for the low-to-moderate variance explained in physical activity by the TPB model may relate to the time frame of past behavior assessed through the PASIPD (i.e., physical activity behavior over the past week may not reflect habitual activity). Additionally, a high *SD* was observed in the PASIPD scores (Table 2) that might have led to decreased predictive strength. This finding reinforces the need for the development and validation of objective physical activity scales for the posited populace.

The study models were also tested using total average hours of daily physical activity over the past week as an outcome variable (data not shown) to test the accuracy of the MET values. Based on the path analyses (physical activity = hours per day), the findings were almost the same as the results reported in this study (physical activity = MET-hours per day). For example, the overall variance in intention and physical activity (hours per day) explained by the TPB model was 62% and 17%, respectively. The overall variance in SOC and physical activity (hours per day) explained by the TPB/SOC model was 36% and 26%, respectively. Therefore, an accurate estimation of physical activity behavior (i.e., type, frequency, duration, and intensity) for the posited populace may be captured by using the scale's MET values. Further refinement of the MET values may still be necessary.

The overall variance in intention explained by the study's model (62%) and elsewhere (60%; Latimer & Martin Ginis, 2005) was significantly higher than the amount of variance in intention (37% and 44.5%) reported in the studies of Courneya et al. (1998) and Hagger et al. (2002), respectively. This finding provides support for the first mediator criterion and reinforces one of the study's strength (i.e., terminology correspondence of the time frame between the TPB independent variables [attitude, subjective norm, and PBC] and intention).

The hypotheses in the second model (integrative framework) were supported as well. As expected, SOC was a stronger predictor of future physical activity behavior ($\gamma_{soc \cdot pa}$ = .45) than intention ($\gamma_{intention \cdot pa}$ = .24). A similar finding was reported in the prospective study (1 to 3 months) of Rosen (2000) whereby baseline early SOC (precontemplation–contemplation vs. preparation–semi-preparation) accounted for 15.4% of the variance on future exercise behavior, whereas intention accounted for 4.6% of the variance on behavior. The important predictive role of SOC to future physical activity behavior has also been supported in the study of Marcus, Eaton, Rossi, and Harlow (1994; $\gamma_{soc \cdot pa}$ = .43).

On the contrary, in the prospective data of Courneya, Nigg, and Estabrooks (1998) baseline SOC did not significantly predict future exercise behavior (beta weight was not reported). This finding may relate to the type of modeling used. Specifically, intention and SOC (intention and behavior) were both used as mediators of exercise behavior. In this case, the effect of SOC on future exercise behavior might have been attenuated (Kline, 1998). The variance explained in behavior by the present model (28%) is compatible with the variance explained in behavior in the studies of Marcus and colleagues (1994; 28% for prospective data) and Courneya and colleagues (1998; 29% for prospective data).

According to the findings of the second model, the most important predictor of SOC was attitude followed by PBC. The inclusion of the SOC in the TPB constructs might have attenuated the predictive strength of PBC on SOC and behavior, as well as the predictive strength of subjective norm on SOC. Similar findings have been reported elsewhere (Hagger et al., 2002) whereby the inclusion of past behavior in the TPB constructs attenuated the relationships between intention-behavior, attitude-intention, and self-efficacy-behavior. Stages of change incorporates both intention and behavior elements. As noted by Hagger and colleagues (2002), past behavior needs to be taken into consideration to identify the unique contributions of TPB constructs to future behavior. Therefore, incorporating both intention and behavior elements (e.g., SOC) in the TPB may increase prediction accuracy. Subjective norm has generally exhibited small and/or insignificant effects on physical activity behavior (Downs & Hausenblas, 2005; Hagger et al., 2002). The predictive strength of social influences may increase when social support substitutes for subjective norm (Courneya, Plotnikoff, Hotz, & Birkett, 2000).

The stronger mediator effect of SOC over intention was further supported in the third criterion of mediation (just identified model). Specifically, the direct effects of the independent variables (attitude, subjective norm, and PBC) on physical activity did not attenuate the strong effect of SOC on behavior. Additionally, the indirect effect of attitude on physical activity through SOC approached full mediation ($\gamma_{attitude \cdot pa} = .06$). However, in the just identified model of TPB the direct effects of the independent variables on the dependent variable were small to moderate and attenuated the direct effect of intention on physical activity ($\gamma_{intention \cdot pa} = .20$). In both models, the indirect effects of subjective norm and PBC on physical activity were small and insignificant; therefore, full mediation was not supported (Baron & Kenny, 1986).

Although participants were almost evenly distributed across the stages of change, few people were classified in the action stage. The combination of the action and maintenance stages into one stage (action/maintenance) may influence the predictive strength of SOC. Systematic monitoring of participant distribution across the SOC during data collection is of paramount importance. In this study, the SOC algorithm (Reed et al., 1997) reflects a valid assessment instrument that has been previously used among people with physical disabilities (e.g., Kosma et al., 2006). However, the terminology used to describe the early SOC (i.e., thinking or planning to be active) may not directly reflect intention. Additionally, it has been critiqued that intention may not be directly assessed in the later SOC (i.e., action and maintenance). Therefore, future studies need to focus on the development and use of SOC instruments that reflect both intention and behavior within each stage to increase the predictive validity of SOC (Godin, Lambert, Owen, Nolin, & Prud'homme, 2004). The congruence between intention and behavior also needs to be taken into consideration. For example, an individual who is irregularly active may exhibit positive or negative intention toward future physical activity participation (Ouellette & Wood, 1998). The current SOC measure possesses another inherent limitation. Specifically, not all stages are associated with the same criteria (i.e., people in precontemplation and contemplation want to become active, whereas people in preparation, action, and maintenance are becoming regularly active). Although this has been common in the exercise area (Marcus et al., 1994), future stage applications should incorporate the same target criteria across all stages (e.g., regular physical activity participation).

Although the study participants reflect an understudied population segment, the majority were Caucasian and well-educated, and had a middle-class income. Study participants might also have been more motivated in the area of physical activity behavior change compared to nonrespondents. One explanation for this pool of participants may be the Web-based nature of the study and the passive recruitment techniques. Future studies need to combine different recruitment approaches (e.g., both passive and active) and data collection techniques (e.g., mail and/or interview based) to increase the recruitment of individuals of different ethnicities and socioeconomic backgrounds (Kosma, Cardinal, & McCubbin, 2004b). The combination of these findings with the unknown recruitment rate of this study and the multiple disability categories hinders result generalization.

Although several steps were taken to ensure accurate completion of the survey questionnaires (e.g., screening or disability type), it is important to identify such instruments as the Mini-Mental State Examination (MMSE–interview format; Folstein, Folstein, & McHugh, 1975) that directly assess cognitive impairment. In this way, response accuracy may increase. There is evidence to suggest that cognitive impairment as measured by the MMSE is influenced greatly by education level (Crum, Anthony, Bassett, & Folstein, 1993). As can be observed in Table 1, all the participants had at least some form of high school education level and most of them (~94%) had some form of college level education or higher. Therefore, the impact of cognitive impairment on the responses to the current survey is most likely minimal because of the steps taken to ensure response accuracy and exclude individuals with cognitive disabilities, and because the current sample was well-educated (≥12 years).

Although path analysis has several advantages over traditional statistical techniques (e.g., multiple regression), replication of the current study using large sample sizes and a hybrid model (i.e., combination of path and measurement models) is warranted. Future studies also need to examine potential moderator effects of demographic variables (e.g., disability type, onset, level, gender, socioeconomic status) between physical activity determinants and physical activity behavior using techniques outlined by Baron and Kenny (1986).

This is the first prospective study to use an integrative framework and advanced statistical methodology to simultaneously examine the mediating role of intention and SOC in physical activity behavior change over a 6-month period. Based on the study findings, both models fit the sample data well. The SOC was the strongest predictor of future physical activity behavior reinforcing the development and use of SOC instruments that incorporate both intention and behavior within each stage. Attitude was the strongest predictor of intention in both models followed by PBC. Therefore, health promotion practitioners and researchers need to focus on the development and implementation of physical activity motivational programs that incorporate both intention and behavior elements and reinforce the value of positive consequences of physical activity (e.g., increased physical, psychological, and social aspects of quality of life). Additionally, strategies to increase PBC (e.g., identify ways to overcome perceived barriers) are of paramount importance. Future examination of the predictive strength of social support over subjective norm is warranted. Using theory-based integrative frameworks (e.g., replication of the Marcus et al. [1994] study including processes of change) may lead to the identification of effective strategies to increase positive physical activity behavior change among people with disabilities.

Acknowledgments

For their assistance with participant recruitment, the authors would like to thank the staff of the Rehabilitation Research and Training Center on Health and Wellness, Oregon Health and Sciences University, Portland, OR. Sincere appreciation is also expressed to the funding agents for this project: a) National Institute on Disability and Rehabilitation Research (Grant No. H133B990019), United States Department of Education, and b) International Trade and Development Graduate Fellowship, Nippon Foundation, Oregon University System.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Engelwood Cliffs, NJ: Prentice-Hall.

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

Blissmer, B., & McAuley, E. (2002). Testing the requirements of stages of physical activity among adults: The comparative effectiveness of stage-matched, mismatched, standard care, and control interventions. *Annals of Behavioral Medicine, 24*, 181-189.

Byrne, B.M. (1998). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Cardinal, B.J., Kosma, M., & McCubbin, J.A. (2004). Factors influencing the exercise behavior of adults with physical disabilities. *Medicine and Science in Sports and Exercise, 36*, 868-875.

Cardinal, B.J., & Sachs, M.L. (1996). Effects of mail-mediated, stage-matched exercise behavior change strategies on female adults' leisure-time exercise behavior. *Journal of Sports Medicine and Physical Fitness, 36*, 100-107.

Carron, A.V., Hausenblas, H.A., & Estabrooks, P.A. (2003). *The psychology of physical activity*. New York, NY: The McGraw-Hill Companies.

Cooper, R.A., Quatrano, L.A., Axelson, P.W., Harlan, W., Stineman, M., Franklin, B., et al. (1999). Research on physical activity and health among people with disabilities: A consensus statement. *Journal of Rehabilitation Research and Development, 36*, 142-154.

Courneya, K.S., Blanchard, C.M., & Laing, D.M. (2001). Exercise adherence in breast cancer survivors training for a dragon boat race competition: A preliminary investigation. *Psycho-Oncology, 10*, 444-452.

Courneya, K.S., Nigg, C.R., & Estabrooks, P.A. (1998). Relationships among the theory of planned behavior, stages of change, and exercise behavior in older persons over a three year period. *Psychology and Health, 13*, 355-367.

Courneya, K.S., Plotnikoff, R.C., Hotz, S.B., & Birkett, N.J. (2000). Social support and the theory of planned behavior in the exercise domain. *American Journal of Health Behavior, 24*, 300-308.

Crum, R.M., Anthony, J.C., Bassett, S.S., & Folstein, M.F. (1993). Population-based norms for the Mini-Mental State Examination by age and educational level. *Journal of the American Medical Association, 269*, 2386-2391.

Downs, D.S., & Hausenblas, H.A. (2005). The theories of reasoned action and planned behavior applied to exercise: A meta-analytic update. *Journal of Physical Activity and Health, 2*, 76-97.

Flora, D.B., & Curran, P.J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods, 9*, 466-491.

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). Mini-Mental State. A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*, 189-198.

Godin, G., Lambert, L.D., Owen, N., Nolin, B., & Prud'homme, D. (2004). Stages of motivational readiness for physical activity: A comparison of different algorithms of classification. *British Journal of Health Psychology, 9*, 253-267.

Hagger, M.S., Chatzisarantis, N.L.D., & Biddle, S.J.H. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24*, 3-32.

Heath, G.W., & Fentem, P.H. (1997). Physical activity among persons with disabilities: A public health perspective. *Exercise and Sport Sciences Reviews, 25*, 195-234.

Jöreskog, K, & Sörbom, D. (1993a). *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Chicago, IL: Scientific Software International.
Jöreskog, K., & Sörbom, D. (1993b). *PRELIS 2: User's reference guide*. Chicago, IL: Scientific Software International.
Jöreskog, K., & Sörbom, D. (2001). *LISREL 8: User's reference guide*. Lincolnwood, IL: Scientific Software International.
Kline, R.B. (1998). *Principles and practices of structural equation modeling*. New York, NY: The Guilford Press.
Kosma, M., Cardinal, B.J., & McCubbin, J.A. (2004a). Predictors of physical activity stage of change among adults with physical disabilities. *American Journal of Health Promotion, 19*, 114-117.
Kosma, M., Cardinal, B.J., & McCubbin, J.A. (2004b). Recruitment techniques among understudied populations and their implications for physical activity promotion. *Quest, 56,* 413-420.
Kosma, M., Cardinal, B.J., & McCubbin, J.A. (2005). A pilot study of a web-based physical activity motivational program for adults with physical disabilities. *Disability and Rehabilitation: An International Multidisciplinary Journal*, *27*, 1435-1442.
Kosma, M., Ellis Gardner, R., Cardinal, B.J., Bauer, J.J., & McCubbin, J.A. (2006). Psychosocial determinants of stages of change and physical activity among adults with physical disabilities. *Adapted Physical Activity Quarterly, 23*, 49-64.
Latimer, A.E., & Martin Ginis, K.A. (2005). The theory of planned behavior in prediction of leisure time physical activity among individuals with spinal cord injury. *Rehabilitation Psychology, 50*, 389-396.
Latimer, A.E., Martin Ginis, K.A., & Craven, B.C. (2004). Psychosocial predictors and exercise intentions and behavior among individuals with spinal cord injury. *Adapted Physical Activity Quarterly, 21*, 71-85.
MacCallum, R.C., Browne, M.W., & Sugawara, H.M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130-149.
Marcus, B.H., Eaton, C.A., Rossi, J.S., & Harlow, L.L. (1994). Self-efficacy, decision-making, and stages of change: An integrative model of physical exercise. *Journal of Applied Social Psychology, 24*, 489-508.
Muthén, B. (1993). Goodness of fit with categorical and other non normal variables. In K.A. Bollen, & J.S. Long (Eds.), *Testing structural equation models* (pp. 205-234). Newbury Park, CA: Sage.
Nigg, C.R. (2005). There is more to stages of exercise than just exercise. *Exercise and Sport Sciences Reviews*, *33*, 32-35.
Ouellette, J.A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychological Bulletin, 124*, 54-74.
Pate, R.R., Pratt, M., Blair, S.N., Haskell, W.L., Macera, C.A., Bouchard, C., et al. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273*, 402-407.
Prochaska, J.O., & Velicer, W.F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*, 38-48.
Reed, G.R., Velicer, W.F., Prochaska, J.O., Rossi, J.S., & Marcus, B.H. (1997). What makes a good staging algorithm: Examples from regular exercise. *American Journal of Health Promotion, 12*, 57-66.
Rimmer, J.H., & Braddock, D. (2002). Health promotion for people with physical, cognitive, and sensory disabilities: An emerging national priority. *American Journal of Health Promotion, 16*, 220-224.

Rosen, C.S. (2000). Integrating stage and continuum models to explain processing of exercise messages and exercise initiation among sedentary college students. *Health Psychology, 19*, 172-180.

Schumann, A., Nigg, C.R., Rossi, J.S., Jordan, P.J., Norman, G.J., Garber, C.E., et al. (2002). Construct validity of the stages of change of exercise adoption for different intensities of physical activity in four samples of differing age groups. *American Journal of Health Promotion, 16*, 280-287.

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

U.S. Department of Health and Human Services. (2000). Physical activity and fitness. In Healthy People 2010 (2nd ed.). *With understanding and improving health and objectives for improving health* (Vols. 1-2), Washington, DC: U.S. Government Printing Office.

Washburn, R.A., Zhu, W., McAuley, E., Frogley, M., & Figoni, S.F. (2002). The physical activity scale for individuals with physical disabilities: Development and evaluation. *Archives of Physical Medicine and Rehabilitation, 83*, 193-200.

Manuscript submitted: March 15, 2006
Revision accepted: September 1, 2006