

Psychosocial Determinants of Stages of Change and Physical Activity Among Adults With Physical Disabilities

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A high proportion of individuals with disabilities remain physically inactive. Therefore, this study (web-based survey) investigated the relationships between the Transtheoretical Model (TTM) and physical activity among 224 adults with physical disabilities (M age = 45.4 years, SD = 10.78, females = 71%). Additionally, the most important TTM predictors of the stages of change and physical activity were examined. Standardized self-report scales of the TTM constructs and physical activity were completed. The study findings supported the theorized relationships between the TTM constructs and physical activity. The behavioral and cognitive processes of change distinguished the stages of change. These two constructs and self-efficacy mostly predicted physical activity ($R^2_{total} = .18$). The assessment methodology of the TTM constructs needs to be revisited.

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, few individuals with disabilities are regularly active. In a 1997 survey, it was reported that only 12% of the adult population with disabilities participated regularly in physical activity of moderate intensity (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 with disabilities to be physically active was recognized (Cooper et al., 1999). An approach, such as one tailored on the basis of the Transtheoretical Model (TTM), may facilitate progress in this area (Burbank & Riebe, 2002).

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The TTM is a contemporary motivational theory specifying behavior change within a stage framework. Specifically, individuals are classified into certain stages based on their readiness to change a behavior (e.g., increase or decrease of physical activity). Individuals within the same stages of change experience similar facilitators and barriers toward physical activity initiation and/or enhancement. In this way, the development of cognitive, behavioral, and emotional strategies (e.g., processes of change) directed to the individual stages of change (i.e., stage-matched programs) may facilitate the process of positive behavior change (e.g., physical activity enhancement; Blissmer & McAuley, 2002). The stages and processes of change were first used in psychotherapy in order to decrease and/or eliminate addictive behaviors (e.g., smoking cessation; Prochaska & DiClemente, 1983). In the last decade, the stages and the processes of change together with self-efficacy and decisional balance have formed the TTM in order to promote positive physical activity behavior change. The theoretical roots of self-efficacy and decisional balance are based respectively on the Social Cognitive Theory (Bandura, 1997) and the Decisional Balance Model (Janis & Mann, 1977), reinforcing the integrative (i.e., transtheoretical) nature of the TTM.

Within the physical activity domain, the most frequently studied stages of change include the precontemplation (absence of intention to be active), contemplation (intention to be active), preparation (irregularly active and intention to be regularly active), action (regularly active for less than 6 months), and maintenance stages (regularly active for more than 6 months). Self-efficacy reflects the perceived confidence to overcome physical activity barriers and maintain an active lifestyle. Self-efficacy tends to increase across the stages of change. Processes of change refer to five cognitive and five behavioral strategies that can facilitate behavior change. In Table 1, each of the 10 processes of change is reported together with a sample scale item and this study's internal consistency (i.e., Cronbach's α). People in the higher stages of change use more processes of change than individuals in the lower stages of change. Decisional balance refers to the perceived pros and cons of physical activity. When the perceived pros outweigh the perceived cons, then physical activity is most likely to be initiated and sustained (Marshall & Biddle, 2001).

Several researchers have used the TTM to develop stage-matched physical activity motivational programs among mainly people without disabilities reinforcing the positive influence of the TTM on physical activity behavior change (Cardinal, Engels, & Smouter, 2001; Cardinal & Sachs, 1995, 1996; Marcus et al., 1998). For example, Blissmer and McAuley (2002) reported that personalized stage-matched print-based materials aimed at increasing physical activity participation among college personnel are more effective on behavior change than personalized stage-mismatched materials. The need for testing the predictive contributions of the TTM constructs (i.e., behavioral and cognitive processes of change, self-efficacy, perceived pros and cons) to physical activity behavior change among individuals with physical disabilities has been recognized (Kosma, Cardinal, & Rintala, 2002). Identifying predictive relationships may facilitate the development of effective stage-matched physical activity motivational programs among the posited understudied population (Kosma et al., 2002; Rimmer & Braddock, 2002).

Researchers have recently focused on the application of the full TTM (i.e., use of *all* model constructs) to adults with disabilities. Specifically, Cardinal, Kosma, and McCubbin (2004) have used the full TTM to investigate the most important psychosocial predictors of the exercise stages of change among mainly *active* adults

with physical disabilities. In a descending order of significance, the most important predictors were the behavioral processes of change, self-efficacy, the cognitive processes of change, perceived pros, and perceived cons. In a similar study, Kosma, Cardinal, and McCubbin (2004) applied the full TTM to *inactive* adults with physical disabilities. Based on their findings, the behavioral processes of change mostly contributed to the physical activity stage of change distinction followed by the cognitive processes of change, self-efficacy, and decisional balance.

Based on the aforementioned studies, the behavioral processes of change seem to be the most important predictors of the exercise/physical activity stages of change among people with physical disabilities. The cognitive processes of change were more important to inactive individuals than active individuals, whereas self-efficacy contributed more to active individuals than to inactive participants. In both studies, the relationship between the stages of change and physical activity was not investigated. Additionally, the distribution of the participants across the stages of change was not even. Based on the statistical methodology used for prediction accuracy (i.e., direct discriminant function) *all* model variables were entered in the prediction equations simultaneously without specifying *a priori* relationships. On the contrary, in hierarchical procedures, the order of the variables entering the prediction equations is specified *a priori* based on theory and/or previous literature, depicting a reduced set of important predictors (Tabachnick & Fidell, 2001).

Therefore, the first purpose of this study was to use the full TTM in order to examine the relationships among the stages of change, the TTM predictors (i.e., processes of change, self-efficacy, and perceived pros and cons), and physical activity in both active and inactive adults with physical disabilities. In this study, physical disability is defined as a permanent congenital or acquired condition leading to mobility impairment (e.g., spinal cord injury, cerebral palsy, multiple sclerosis, muscular dystrophy, etc.; National Institute on Disability and Rehabilitation Research, 2002). It was hypothesized that overall the theorized relationships among the stages of change, the processes of change, self-efficacy, perceived pros and cons, and physical activity would apply to this population segment. Specifically, the behavioral and cognitive processes of change along with self-efficacy, perceived pros, and physical activity were expected to increase across the stages of change. On the contrary, the perceived cons were expected to decrease across the stages of change.

The second purpose of the study was to identify the most important psychosocial determinants of physical activity stages of change and physical activity behavior. Using hierarchical procedures for variable specification and analysis the behavioral processes of change were expected to be the most important predictors of both physical activity stages of change and physical activity behavior followed by the cognitive processes of change and self efficacy (unit of predictors) and perceived pros and cons (unit of predictors).

Method

Participants

The study participants represent a pool of a database that was developed in previous studies (Cardinal, Kosma, & McCubbin, 2004; Kosma et al., 2004a). Specifically, these individuals had expressed interest to participate in future research projects

related to physical activity behavior change. 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 websites (e.g., the American Association of People with Disabilities), hospitals, disability offices, and colleges. Participant recruitment was also facilitated through the Rehabilitation Research and Training Center on Health and Wellness at Oregon Health and Sciences University, Portland, Oregon.

Participant recruitment lasted 10 months and a wait-list database of about 1000 adults with physical disabilities (e.g., spinal cord injury and multiple sclerosis) was developed. Data collection for the present study was initiated one year following the development of the initial database. Participants of the wait-list database were contacted through e-mail about the purpose of the current study. However, many participants in the database did not receive the e-mail message due to problems with e-mail accounts such as accounts no longer existing, full mail boxes, and spam filters. Therefore, the exact number of participants in the database who received an e-mail message could not be determined. From individuals who received the e-mail message for data collection, 226 adults with physical disabilities provided their consent to participate and completed the survey questionnaires. Two individuals were excluded from the study because they were identified as univariate and multivariate outliers. One of them exhibited significantly higher scores in moderate, vigorous, and weight training activities than did the remainder of the participants. The second individual scored "0" in each of the perceived pro and con items of the decisional balance scale. Therefore, 224 individuals were included in the study: *M* age = 45.4 years, *SD* = 10.78, females = 159 (71%), males = 65 (29%). The distribution of the participants across disability type was as follows: spinal cord injury = 21.4%, cerebral palsy = 18.8%, multiple sclerosis = 17.9%, muscular dystrophy and arthritis = 16.5%, brain-related disorders (e.g., traumatic brain injury and stroke) = 10.7%, amputation = 3.6%, post-polio = 5.4%, spina bifida = 3%, and sensory/lung disorders = 2.7%.

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, post polio, cerebral palsy, and other locomotor disabilities). The factor analysis revealed five factors that explained 63% of the total item variance and exhibited acceptable factor loadings $\geq .40$. The five scale factors and their internal consistency values for this study are home repair, lawn and garden work ($\alpha = .58$), housework ($\alpha = .59$), vigorous sport and recreation ($\alpha = .30$), light/moderate sport and recreation ($\alpha = .43$), and occupation and transportation ($\alpha = .45$). Within each factor, Washburn and colleagues reported internal consistency values ranging from .37 to .65. The construct validity of the scale has been further supported. For example, the 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.

The final version of the PASIPD (Washburn et al., 2002) consisted of six leisure time, six household, and one work-related item. Each scale item assessed number of days and average hours/day of physical activity participation at varied intensities over the past 7 days. The scoring of the scale reflects a composite PASIPD score computed by multiplying the average hours/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. Washburn and colleagues suggested using a composite PASIPD score or scale subcategories depending on the purpose of the study (e.g., focus on overall physical activity levels vs. focus on leisure-time activity, respectively). Given the purpose of the current study, a composite PASIPD score ($\alpha = .63$) was used to assess overall physical activity levels.

Processes of Change. The five cognitive and five behavioral processes of change were assessed using a 30-item inventory created to apply to a wide range of populations (Nigg, Norman, Rossi, & Benisovich, 1999). In their developmental study, Nigg and colleagues applied the scale to 346 adults from New England. Experts in psychology, exercise science, exercisers, and nonexercisers established content validity of the scale items. The scale developers reported an acceptable fit of the two higher-order model (i.e., behavioral and cognitive processes; $\chi^2/df = 2.69$, $CFI = .88$, $AASR = .04$) with adequate factor loadings ($\geq .40$) for the 10 factors. For each factor, the internal consistency values ranged from .67 to .86. This scale has been recently used among adults with physical disabilities illustrating appropriate construct validity (i.e., expected relationships between the stages of change and processes of change; Kosma et al., 2004a). Statements are assessed using a 5-point Likert scale whereby the response options vary from 1 (*never*) to 5 (*repeatedly*). A sample scale item for each of the 10 processes of change can be viewed in Table 1. Two composite scores reflect the cognitive and behavioral processes of change as two higher-order factors. The highest score for each factor is 75 and the lowest score is 15 (cognitive processes = 15 items and behavioral processes = 15 items). Additionally, a summative score for each of the 10 processes of change is calculated with the highest score being 15 and the lowest score being 3 (3 items per process).

In the present study, the term “physical activity” was substituted for the term “exercise” that was used on the original processes of change scale (Nigg et al., 1999) in order to reflect the study’s purpose and the terminology used in the remainder of the study’s assessment scales. This substitution has been previously used among adults with physical disabilities (Kosma et al., 2004a). In this study, an acceptable internal consistency of the behavioral and cognitive processes of change was observed (see Table 1).

Self-Efficacy. A self-report 18-item multidimensional inventory was used to assess barrier self-efficacy (Benisovich, Rossi, Norman, & Nigg, 1998). The scale developers provided support for the construct validity of the instrument, whereby six different components of the self-efficacy scale were reported to predict exercise behavior: negative affect, excuse making, exercising alone, access to

Table 1 Sample Scale Item of the Behavioral and Cognitive Processes of Change and Internal Consistency of Each Scale/Sub-Scale

Process	Sample Item	Cronbach's α
<i>Cognitive</i>	—	0.83
Consciousness raising	I read articles to learn more about physical activity.	0.88
Dramatic relief	I am afraid of the results to my health if I do not do physical activity.	0.70
Environmental reevaluation	I think that regular physical activity plays a role in reducing health care costs.	0.70
Self reevaluation	I feel more confident when I do physical activity regularly.	0.90
Social liberation	I have noticed that many people know that physical activity is good for them.	0.69
<i>Behavioral</i>	—	0.88
Counter conditioning	Instead of taking a nap after work I do physical activity.	0.77
Helping relationships	I have someone who encourages me to do physical activity.	0.90
Reinforcement management	One of the rewards of regular physical activity is that it improves my mood.	0.84
Self liberation	I make commitments to do physical activity.	0.81
Stimulus control	I use my calendar to schedule my physical activity time.	0.80

equipment, resistance from others, and weather. In the present study, the term “physical activity” was substituted for the term “exercise” for terminology consistency. In the present pool of participants, the internal consistency of the scale was high ($\alpha = .91$). A sample item of the scale is “I’m confident I can participate in physical activity when I am busy.” Participants responded in each scale item using a 5-point Likert scale with values varying from 1 (*not at all confident*) to 5 (*very confident*). A composite score was calculated and used in the data analysis. The highest score of the scale is 90, whereas the lowest score is 18.

Stages of Change. Stages of change were assessed using the recommended scale of Reed, Velicer, Prochaska, Rossi, and Marcus (1997). This is a categorical scale of a 5-choice response format. In the study of Reed and colleagues, eight different algorithms were compared. As recommended by the authors, the long definition of physical activity was incorporated in this project (e.g., walking, wheeling, off-road pushing, recreational swimming and dancing daily for 30 minutes or

longer). Additionally—and as recommended by Reed and colleagues, Schumann et al. (2002), and Cardinal, Kosma, and McCubbin (2004)—both a cognitive and a behavioral element were included in the preparation stage. In particular, participants in the preparation stage were irregularly active but interested in regular physical activity participation in the near future (within 1 month). This scale has exhibited acceptable construct validity (i.e., expected relationships between the stages of change, decisional balance, and self-efficacy) in the study of Reed and colleagues as well as among adults with physical disabilities (Kosma et al., 2004a).

Decisional Balance. Decisional balance was measured using the 10-item (five pros and five cons) decisional balance scale of Plotnikoff, Blanchard, Hotz, and Rhodes (2001). This scale has been validated in a longitudinal setting among adults aged 18-65 years. Content validity of the scale was established as well as a two-week test-retest reliability ($r = .84$ and $.74$ for the pros and cons, respectively). Additionally, the scale exhibited factorial invariance across time ($CFI = .94$, $RMSEA = .07$, and $NNFI = .92$) and concurrent validity (expected relationships between self-efficacy/intention and pros/cons). This scale has also been used among adults with physical disabilities, demonstrating appropriate construct validity (expected relationships between decisional balance and the stages of change; Kosma et al., 2004a).

In the present study, the internal consistency of the pro subscale was $\alpha = .86$ and the internal consistency of the con subscale was $\alpha = .71$, indicating adequate reliability. A sample perceived pro item is “physical activity would help me have a more positive outlook” and an example of a perceived con item is “getting physical activity would cost too much money.” The responses varied from 0 (*not at all*) to 5 (*very much*).

Demographics. Gender, ethnicity, disability type, disability level, income, and age were also assessed. Participants were grouped into the following three age groups: young adults (18-35 years old), mature adults (36-55 years old), and older adults (56-73 years old). Participants reported their disability type based on the following categories: amputation, cerebral palsy, spinal cord injury, multiple sclerosis, post-polio, and/or other type of disability. Similarly, study participants reported their disability level as mild, moderate, or severe.

Procedures

Data collection lasted 5 months. Specifically, participants were informed through e-mail about the web-based survey in June 2004. They were encouraged to visit the study’s web site and read the informed consent form. Interested participants who agreed to participate in the study were automatically directed to the questionnaire web link. Three prompts about study completion were electronically sent to the participant database in order to maximize response rates. Data collection ended in October 2004.

Statistical Analyses

The Statistical Package for the Social Sciences (SPSS version 12) was used to analyze all data in the study. One-way ANOVAs and an independent-samples *t*-test

were performed to identify potential moderators of physical activity. A one-way MANOVA with Univariate F -tests was conducted to explore descriptive relationships between the constructs of the TTM and physical activity across the stages of change. A hierarchical discriminant function (HDF) analysis was performed to determine the most important TTM influential factors of stages of change and overall prediction accuracy. The probability to (variable) enter criterion was .05 and the probability to (variable) removal criterion was .10 (Tabachnick & Fidell, 2001). Lastly, a hierarchical multiple regression analysis was conducted to identify the most significant TTM predictors of physical activity behavior. Similarly, the probability to (variable) enter criterion was .05 and the probability to (variable) removal criterion was .10 (Tabachnick & Fidell).

Results

Participant Profiles

Most of the participants reported a middle-class income ($Mincome = \$49,765.79$, $SD = 40,480.84$; $n = 213$). From the study participants, 58.5% had a moderate level of disability followed by severe (27.2%) and mild (14.3%) disability conditions. Additionally, the majority of the participants were White European American (83.9%) followed by Hispanic or Latino American (4.9%), Black, African American (3.1%), Asian American (1.8%), American Indian (.9%), North African American (.4%), and Middle-Eastern American (.4%). The examined categories of ethnicity did not apply to 4.5% of the study participants.

The original stage distribution of the participants was as follows: precontemplation = 52 (23.2%), contemplation = 45 (20.1%), preparation = 39 (17.4%), action = 8 (3.6%), and maintenance = 80 (35.7%). The regularly active participants in the action and maintenance stages were combined into one stage (AC/MA = 88; 39.3%) due to the small number of participants in the action stage. In this way, the statistical analyses would not be adversely affected (Tabachnick & Fidell, 2001).

There were no significant differences between physical activity and gender, $t(222) = .13$, $p = .89$; disability level, $F(2, 221) = .26$, $p = .77$; disability type, $F(8, 215) = 1.23$, $p = .27$; nor age, $F(2, 221) = 1.1$, $p = .34$. Therefore, the demographic variables were not treated as moderators of physical activity in subsequent analyses.

Stages of Change, TTM, and Physical Activity

A one-way MANOVA was conducted to describe the relationships among the stages of change (independent variable), the TTM constructs (behavioral and cognitive processes of change, self-efficacy, and perceived pros and cons), and physical activity. A significant multivariate effect between the stages of change and the dependent variables was identified: $F(18, 651) = 7.95$, $p < .001$, $\eta^2 = .18$. The means, standard deviations, F tests, variance explained (η^2), and Tukey *post hoc* contrasts of the follow-up Univariate ANOVAs are reported on Table 2. Based on those results, the behavioral processes of change explained most of the variance ($\eta^2 = .38$), followed by the cognitive processes of change ($\eta^2 = .29$), perceived pros ($\eta^2 = .19$), physical activity ($\eta^2 = .17$), self-efficacy ($\eta^2 = .10$), and perceived cons ($\eta^2 = .07$).

Table 2 Descriptive Associations Between the Constructs of the Transtheoretical Model and Physical Activity Across the Stages of Change

Variable	Stages of Change ^a					F _{3,220}	η ²	Tukey Contrasts
	PC n = 52	CO 45	PR 39	AC/MA 88				
Behavioral Processes								
<i>M</i>	27.96	34.56	43.11	49.7		45.53**	.38	PC < CO < PR < AC/MA
<i>SD</i>	11.39	10.3	10.48	12.09				
Cognitive Processes								
<i>M</i>	39.69	48.3	54.11	55.4		29.57**	.29	PC < CO < PR PC, CO < AC/MA
<i>SD</i>	11.4	9.81	9.3	9.5				
Self-Efficacy								
<i>M</i>	49.85	50.16	53.36	60.47		8.5**	.10	PC, CO, PR < AC/MA
<i>SD</i>	14.82	13.38	13.46	14.59				
Perceived Pros								
<i>M</i>	16.66	19.53	21.49	21.99		17.27**	.19	PC < CO, PR, AC/MA CO < AC/MA
<i>SD</i>	5.8	3.97	4.25	3.78				
Perceived Cons								
<i>M</i>	9.77	11.02	9.54	7.28		5.93*	.07	PC, CO > AC/MA
<i>SD</i>	5.51	5.31	4.64	5.29				
Physical Activity								
<i>M</i>	12.35	15.37	18.36	28.84		15.34**	.17	PC, CO, PR < AC/MA
<i>SD</i>	12.78	13.36	14.04	18.14				

^a PC, Precontemplation; CO, Contemplation; PR, Preparation; AC/MA, Action/Maintenance.

** *p* < .001. * *p* = .001.

According to the Tukey *post hoc* contrasts (see Table 2), the behavioral processes of change increased across the stages of change in a linear fashion. Similarly, the cognitive processes of change increased across the stages of change in an almost linear fashion. Regularly active participants (action/maintenance stage) perceived significantly more pros and fewer cons than inactive participants (precontemplation and contemplation stages). Participants in action/maintenance exhibited significantly higher scores in self-efficacy and physical activity than those in the earlier stages of change. The absence of a statistically significant difference in physical activity between the precontemplation and preparation stages may be related to the high *SD* of the physical activity measure (see Table 2). Therefore, the effect size of physical activity levels was calculated and reached a moderate to large level ($d = .62$; Cohen, 1992).

The bivariate correlation coefficients of the tested variables are shown in Table 3. Although the relationship between the cognitive and behavioral processes of change exceeded $.70$ ($r = .77$), multicollinearity was not observed (Tolerance value range = $.33 - .83 > .1$; Variance Inflation Factor value range = $1.21 - 3.02 < 10$; Tabachnick & Fidell, 2001). Therefore, the cognitive and behavioral processes of change were used as two higher-order factors in the following prediction analyses.

Stage-of-Change Predictors

A hierarchical discriminant function (HDF) analysis was conducted to identify the most important stage-of-change predictors based on the TTM constructs (independent variables: behavioral and cognitive processes of change, self-efficacy, and perceived pros and cons). The *a priori* hypothetical order of the independent variables was as follows: behavioral processes of change, cognitive processes of change and self-efficacy (unit of predictors), and perceived pros and cons (unit of predictors).

Table 3 Correlation Matrix for the Transtheoretical Model Constructs and Physical Activity

	1	2	3	4	5	6
1. Behavioral processes	—	.77**	.56**	-.28**	.36**	.38**
2. Cognitive processes		—	.58**	-.16*	.18**	.37**
3. Pros			—	-.18**	.15*	.28**
4. Cons				—	-.24**	-.07
5. Self-efficacy					—	.25**
6. Physical activity						—

** $p = .01$. * $p = .05$.

The HDF analysis revealed one significant discriminant function (i.e., composite score of the predictors; Wilks' $\Lambda = .58$, $\chi^2 [6] = 120.08$, $p < .001$; Canonical $R = .62$). The variance accounted for in the between-group variability was 91.6% for the discriminant function. The most important predictors of the stages of change entered the equation were the behavioral ($r = .99$) and the cognitive ($r = .78$) processes of change. A meaningful relationship between each variable that enters the equation and any of the discriminant functions needs to be equal to or exceed .33 (Tabachnick & Fidell, 2001).

According to the group centroids (mean discriminant scores for each stage of change; precontemplation = -1.15 , contemplation = $-.48$, preparation = $.28$, and action/maintenance = $.80$), the predictors of the function distinguished precontemplation from preparation as well as precontemplation and contemplation from action/maintenance. After weighing for group sizes, the most accurately predicted stages were the action/maintenance (80.7%), precontemplation (67.3%), and contemplation (26.7%), whereas the least accurately predicted stage was the preparation 0.0%. The overall classification accuracy across the stages of change was 52.7%.

Physical Activity Predictors

A hierarchical multiple regression analysis was conducted to identify the most important predictors of physical activity behavior (dependent variable) based on the constructs of the TTM (order of independent variables: behavioral processes of change, cognitive processes of change and self-efficacy [unit of predictors], and perceived pros and cons [unit of predictors]). In a descending order of significance, the most important physical activity predictors were the behavioral processes of change, $Fchange(1, 222) = 36.54$, $p < .001$, $R^2change = .14$, $\beta = .38$; the cognitive processes of change, $Fchange(2, 220) = 5.13$, $p = .007$, $R^2change = .04$, $\beta = .24$; and self-efficacy, $Fchange(2, 220) = 5.13$, $p = .007$, $R^2change = .04$, $\beta = .16$. The overall variance explained by the physical activity predictors was $R^2total = .18$.

Discussion

The first purpose of this study was to examine the relationships among the stages of change, the behavioral and cognitive processes of change, self-efficacy, perceived pros and cons, and physical activity behavior in adults with physical disabilities. It was hypothesized that overall, the theorized relationships among the stages of change, the TTM predictors, and physical activity would apply to this population segment. The second purpose was to identify the most important stage-of-change and physical activity determinants on the basis of the full TTM. It was hypothesized that the behavioral processes of change would be the most important predictor followed by the cognitive processes of change and self-efficacy (unit of variables) as well as perceived pros and cons (unit of variables).

Based on the results of the one-way MANOVA, the first hypothesis was supported. Specifically, a linear pattern of associations between the behavioral processes of change and stages of change was revealed. Similarly, an almost linear increase in the use of the cognitive processes of change across the stages of change was observed. Similar findings have been reported among people with and without disabilities (Cardinal, Kosma, & McCubbin, 2004; Marshall & Biddle, 2001).

Individuals in the action/maintenance stage perceived significantly more pros and fewer cons than did those in the precontemplation and contemplation stages. A significant difference between pros and cons was first observed in the preparation stage, whereby irregular physical activity patterns were initiated. These findings indicate the positive relationship between decisional balance and physical activity behavior. Within experimental designs, examining the magnitude of change between pros and cons in association with physical activity increases has been rendered critical in understanding the mediational role of perceived pros and cons (Marshall & Biddle, 2001).

Although self-efficacy increased across the stages of change, the magnitude of change does not reflect a linear increase. Similar findings have been supported among people with and without disabilities (Cardinal, Kosma, & McCubbin, 2004; Kosma et al., 2004a; Marshall & Biddle, 2001). Participants who were regularly (action/maintenance) and irregularly active (preparation) exhibited higher physical activity levels than those who were in the inactive stages (precontemplation and contemplation). This finding suggests adding a behavioral component in the preparation stage in order to distinguish irregular physical activity patterns (i.e., preparation stage) from inactivity (e.g., precontemplation stage). Such distinction has been rendered critical by previous studies that used the same stages of change scale with only a cognitive component of the preparation stage among people without disabilities (e.g., Dannecker, Hausenblas, Connaughton, & Lovins, 2003).

Based on the hierarchical discriminant function (HDF) analysis, the second hypothesis was partially supported. Specifically, only the behavioral and cognitive processes of change distinguished the inactive stages (precontemplation and contemplation) from the action/maintenance stage as well as precontemplation from preparation. Based on these findings, active individuals may value more the importance of physical activity and seek further information about the benefits of an active lifestyle than inactive people. Additionally, active people tend to identify ways to overcome physical activity barriers (e.g., seek for social support and information about accessible physical activity facilities/equipment, reward positive behavior change, and use physical activity cues) compared to inactive individuals.

Although the importance of self-efficacy and perceived pros and cons to the exercise/physical activity stages of change among adults with physical disabilities has been previously supported (Cardinal, Kosma, & McCubbin, 2004; Kosma et al., 2004a), their stage-of-change contributions in this study were negligible. However, such a comparison is difficult due to different statistical and assessment methodologies. For example, a HDF analysis was used in this study compared with the direct discriminant function analyses used in previous studies (Cardinal, Kosma, & McCubbin, 2004; Kosma et al., 2004a). In the study of Dannecker et al. (2003), direct and hierarchical procedures were used among university students. Their findings showed that only the behavioral processes of change contributed to the stage-of-change distinction in the first function. In the second function, the cognitive processes of change and perceived pros mostly contributed to the stage-of-change differences.

According to the HDF analysis, the overall stage-of-change classification accuracy (52.7%) falls within the percentage range (50%-69.6%) reported among people with and without disabilities (Cardinal, Kosma, & McCubbin, 2004; Cardinal,

Tuominen, & Rintala, 2004; Kosma et al., 2004a). The extreme stages (i.e., action/maintenance and precontemplation) were most accurately predicted followed by the contemplation stage. Although a behavioral component was added in the preparation stage, it still remained the least accurate stage in prediction (0.0%). The prediction accuracy of the preparation stage among both people with and without disabilities tends to improve when the proportion of individuals in the preparation stage is high and/or *all* model predictors are used in the analysis (Cardinal, Kosma, & McCubbin, 2004; Cardinal & Kosma, 2004; Kosma et al., 2004a).

Based on the hierarchical multiple regression analysis, the second hypothesis was again partially supported. Specifically, the behavioral and cognitive processes of change along with self-efficacy were identified as the most important physical activity predictors. Although self-efficacy did not contribute significantly to stage-of-change prediction, its contribution to physical activity warrants further consideration. For example, in the study by Cardinal, Tuominen, and Rintala (2003), self-efficacy and the behavioral processes of change accounted for most of the variance in physical activity among U.S. and Finnish college students. As with the current study (overall variance explained = 18%), in the study of Cardinal, Tuominen, and Rintala (2003), the overall variance explained for the U.S. population was 18%.

This was a cross-sectional design and therefore prediction accuracy across time cannot be established. Longitudinal designs may capture temporal stability of the predictors. Within the 5-month period of data collection (June – October, 2004), weather conditions were not assessed to identify their potential effects on physical activity behavior. 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) hinders the examination of construct relationships between the active stages. Systematic monitoring of participant distribution across the stages of change during data collection is of paramount importance. The moderate correlation between the cognitive and behavioral processes of change, observed in this study and elsewhere (Cardinal, Kosma, & McCubbin, 2004; Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Nigg et al., 1999), may call for the examination of the processes of change as a one-factor model instead of a two-factor model.

Given the high *SD* and low-to-moderate internal consistency values of the PASIPD (reported in the current study and the study of Washburn et al., 2002), further examination of the psychometric properties of the scale is recommended. Considering additional limitations of self-report physical activity scales (e.g., societal bias, recall difficulties, and limited sensitivity), the development and validation of objective physical activity assessment techniques among people with physical disabilities appears warranted. Future studies would need to examine the associations of the TTM constructs with both self-report and objective physical activity assessments, as well as possibly more specific forms of physical activity behavior, such as resistance training (Cardinal & Kosma, 2004), among people with physical disabilities.

Although the study participants reflect an understudied population segment, the majority of the individuals were Caucasian with a middle-class income. Study participants might also have been more motivated related to physical activity behavior change than nonrespondents. One explanation for this pool of participants may be

the web-based nature of the study and the passive recruitment techniques. Future studies would need to combine different recruitment approaches (e.g., both passive and active) and data collection techniques (e.g., mail and/or interview based) in order to increase the possibility to recruit individuals of different ethnicities and socioeconomic backgrounds (Kosma, Cardinal, & McCubbin, 2004b). The combination of these findings with the unknown response rate of this study and the multiple disability categories hinders result generalization.

This is the first study to examine the full TTM and physical activity behavior among both active and inactive adults with physical disabilities. Based on the study findings, the theorized relationships between the TTM constructs and physical activity can be applied to this population segment. Additionally, only the behavioral and cognitive processes of change explained most of the variance for the stages of change and physical activity. The importance of self-efficacy on physical activity prediction was supported as well. Researchers need to study the causal relationships between the processes of change, self-efficacy, the stages of change, and physical activity through experimental designs. Examining the mediational role of the TTM predictors, scholars and practitioners can use certain motivational strategies (e.g., setting goals to commit to active lifestyles) in order to advance people with physical disabilities from the inactive to the active stages of change and increase their physical activity levels.

Behavioral scientists need to further examine the prediction contributions of the perceived pros and cons to the stages of change and physical activity as well as the importance of self-efficacy to the stages of change among people with disabilities. Revisiting and systematically examining the assessment methodology of physical activity and the TTM constructs (e.g., stage-of-change specification using perceived cons in combination with population-specific perceived barriers and testing the prediction accuracy of different barrier self-efficacy scales) within different populations may enhance the validity and accurate interpretation of study results. Additionally, the simultaneous examination of different psychosocial constructs derived from such theoretical frameworks as the TTM and the Theory of Planned Behavior may facilitate the process of positive physical activity behavior change for both people with and without disabilities (e.g., Courneya & Bobick, 2000).

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