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Psychology of Sport and Exercise 6 (2005) 629–641

Psychology

OF SPORT AND EXERCISE

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## The transtheoretical model and exercise adherence: examining construct associations in later stages of change

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Received 29 April 2004; accepted 6 January 2005

Available online 30 March 2005

### Abstract

*Objective:* Over 40% of Americans are sedentary and of those beginning an exercise program, 50% will drop out within 6 months. The Transtheoretical Model (TTM) is commonly used to describe exercise behavior and develop interventions for the initiation of exercise behavior. Less is known, however, about maintenance of exercise behavior and the construct associations for the action, maintenance, and termination stages of change. Thus, the purpose of this study was to examine which of the TTM constructs (i.e. decisional balance, processes of change, barriers-efficacy, and temptation) best distinguishes between the action, maintenance, and termination stages of change for men and women.

*Methods:* Questionnaires measuring each of the TTM constructs were collected from 330 men ( $M$  age = 27.14 years) and 380 women ( $M$  age = 24.80 years). Data were examined for sex differences and subsequently, two forward logistic regressions were conducted for each sex such that the dependent variables for the regressions were action/maintenance and maintenance/termination.

*Results:* Compared to men, women reported significantly less barriers-efficacy ( $p = .04$ ), greater pros of exercise ( $p = .004$ ), and greater use of behavioral ( $p = .001$ ) and experiential ( $p < .001$ ) processes of change. For the men, affect temptation was the only significant correlate of action/maintenance ( $p = .02$ ), while barriers efficacy ( $p = .001$ ), environmental evaluation ( $p = .02$ ), and affect temptation ( $p = .03$ ) were associated with maintenance/termination. For the women, environmental reevaluation ( $p = .02$ ) and social liberation ( $p = .05$ ) were associated with action/maintenance, while barriers-efficacy ( $p = .003$ ) was the only construct correlated with maintenance/termination.

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*Conclusions:* Stage and gender specific considerations are warranted when designing stage-matched exercise interventions for long-term maintenance of exercise behavior.

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*Keywords:* Transtheoretical model; Exercise; Physical activity; Stages of change; Sex differences; Gender differences

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Regular physical activity contributes positively to physical and psychological health (United States Department of Health and Human Services (USDHHS), 1996, 1999, 2000). Despite the efforts of government, public, and private organizations to increase physical activity levels, over 40% of American adults are sedentary (National Center for Health Statistics (NCHS), 1995, USDHHS, 1996). This has led health-care professionals and researchers to develop exercise interventions based on theoretical models of behavior change in an attempt to increase physical activity levels (e.g. Marcus, Banspach, Lefebvre, Rossi, Carleton, & Abrams, 1992). One model that has been applied to exercise behavior with success is the Transtheoretical Model (TTM; Prochaska & DiClemente, 1982, 1983). Although this model was developed for the cessation of a negative behavior (i.e. smoking), the TTM has also been applied to the acquisition of and adherence to positive behaviors such as exercise (e.g. Marcus, Banspach, et al., 1992; Marcus, Eaton, Rossi, & Harlow, 1994; Marcus, Rossi, Selby, Niauri, & Abrams, 1992; Nigg & Courneya, 1998).

Although the TTM consists of the following constructs: stages of change, self-efficacy, temptation, decisional balance, and processes of change, it is the stages of change construct that has received the most research attention (Reed, Velicer, Prochaska, Rossi, & Marcus, 1997). The stages of change hypothesize that individuals move cyclically through the following six stages with periods of progression and relapse: precontemplation, contemplation, preparation, action, maintenance, and termination. The *Precontemplation* stage is when an individual does not intend to exercise regularly within the next six months. *Contemplation* is the stage in which an individual intends to exercise regularly within the next 6 months. When individuals seriously consider exercising regularly within the next month, or have begun exercise, but the exercise is not consistent, they are in the *preparation* stage. The *action* stage is when an individual is exercising regularly and is characterized by overt, measurable changes within the past six months. When these changes in exercise behavior continue for six or more consecutive months, a person is classified into the *maintenance* stage. Finally, individuals are said to be in the *termination* stage when they have maintained their exercise behavior for more than 5 years and have 0% temptation to engage in the undesired behavior and 100% self-efficacy to engage in the desired behavior (Prochaska & Velicer, 1997).

The TTM also poses that the following constructs are used to move between the stages: self-efficacy, temptation, decisional balance, and the processes of change. Self-efficacy is the situation-specific confidence to overcome a high-risk circumstance without relapse into an unhealthy habit (Bandura, 1977, 1986, 1992). Meta-analyses have shown that self-efficacy for exercise increases with each stage of change, but does so in a nonlinear pattern (Marshall & Biddle, 2001). More specifically, moderate effects were observed from precontemplation to contemplation, small to moderate effects from contemplation to preparation, moderate from preparation to action, and moderate to large effects from action to maintenance.

Temptation is the intensity of urges to engage in a specific habit in the midst of a difficult situation (Prochaska & Velicer, 1997). Temptation varies inversely with self-efficacy across the stages of change, such that temptation is highest in the earlier stages and lowest in the later stages with equal levels of

temptation and self-efficacy in the preparation or action stages (Hausenblas, Nigg, Dannecker, Symons, Ellis, & Fallon, 2001; Prochaska & Velicer, 1997). Research investigating the role of temptation across the stages of change for exercise is limited and has been predominantly used in research focusing on the later stages of change (Fallon & Hausenblas, 2001, 2004). Each of the studies indicate, however, a decrease in both affect and competing demands temptation in transition from action to maintenance (Hausenblas et al., 2001) and from maintenance to termination (Fallon & Hausenblas, 2001, 2004).

Decisional balance reflects the weighing of the pros and the cons of engaging in a healthy behavior (Marcus, Rakowski, & Rossi, 1992; Prochaska & Velicer, 1997), and is important for early stage progression (Nigg & Courneya, 1998; Prochaska & Velicer, 1997). Specifically for exercise, Marshall and Biddle (2001) showed an increase in perceived benefits of exercise for every forward stage transition, with the most robust change in transition from precontemplation to contemplation, and other stage transitions characterized by small effects. For perceived disadvantages of exercise, results depicted a decrease across the stages, with the largest decline in cons was evident in the transition from precontemplation to contemplation, and the smallest decline from action to maintenance.

Finally, the processes of change consist of five experiential and five behavioral processes that people use to progress through the stages of change. The experiential processes of change consist of consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation. *Consciousness raising* is when an individual seeks new information and gains understanding and feedback about exercise or sedentary lifestyle. *Dramatic relief* is affective aspects of change, often involving intense emotional experiences related to exercise or sedentary lifestyle. *Self-reevaluation* is emotional and cognitive appraisal of values by the individual regarding exercise. *Environmental reevaluation* is consideration and assessment by the individual of how exercise or sedentary lifestyle affects their physical and social environments. *Social liberation* is the awareness, availability, and acceptance of alternative, physically active lifestyles in society. The behavioral processes of change include counterconditioning, helping relationships, reinforcement management, self-liberation, and stimulus control. *Counterconditioning* is the substitution of physical activity for sedentary behaviors. *Helping relationships* involve trusting, accepting, and using the support of caring others during attempts to begin exercise. *Reinforcement management* is changing the contingencies that control or maintain the sedentary lifestyle. *Self-liberation* is the individual's choice and commitment to change, and includes the belief that one can change. *Stimulus control* is maintaining control of situations and other causes that trigger sedentary behavior.

Recent literature reviews of the TTM and the processes of change have indicated that self-liberation and counterconditioning have been associated with the early stages of change (i.e. precontemplation, contemplation, and preparation; Marshall & Biddle, 2001). With regard to later stages of change, counterconditioning has consistently been reported as having a large effect from action to maintenance (Marshall & Biddle, 2001; Rosen, 2000), while consciousness raising, reinforcement management, helping relationships, social liberation, environmental reevaluation, and self-reevaluation have moderate effects from action to maintenance (Rosen, 2000).

Only recently has attention been turned to the possible effects of moderating variables within the TTM (Marshall & Biddle, 2001). Most important to this study is previous documentation of sex differences for TTM constructs, such that compared to men, women report significantly more pros for exercise (Fallon & Hausenblas, 2004; O'Hea, Wood, & Brantley, 2003) and greater use of behavioral and experiential processes of change (Fallon & Hausenblas, 2004). Thus, for research using the TTM for exercise behavior, it is important to consider the moderating role of sex.

Also pertinent to this study is the lack of research examining construct associations for adjacent stages of change. If acquisition and adherence to exercise is a stage-by-stage progression, there is great need for examining the variables associated with adjacent stage transition. Furthermore, if most people beginning an exercise program drop out within the first 6 months (Dishman, 1988), it is important to investigate the TTM constructs associated with exercise adherence by examining the action, maintenance, and termination stages of change. Understanding which of the TTM constructs is important for these adjacent stage transitions can help practitioners target intervention content in an effort to increase long-term exercise adherence. Thus, the purpose of this study is to examine the association among the TTM constructs (i.e. decisional balance, processes of change, barriers-efficacy, and temptation to not exercise) and the adjacent stages of change (i.e. action, maintenance, and termination) for men and women.

Congruent with previous research, sex differences were predicted for decisional balance and processes of change. Compared to the men, the women were hypothesized to report greater pros for exercise (Fallon & Hausenblas, 2004; O'Hea et al., 2003) and report greater use of experiential and behavioral processes of change (Fallon & Hausenblas, 2004). No significant sex differences were hypothesized for barriers efficacy (Fallon & Hausenblas, 2001, 2004; Oman & King, 1998), cons, or temptation to not exercise (Fallon & Hausenblas, 2001, 2004).

For the associations among the TTM constructs and stage of change, self-efficacy (Marshall & Biddle, 2001), experiential and behavioral processes of change (Marshall & Biddle, 2001; Rosen, 2000), and temptation (Fallon & Hausenblas, 2001, 2004; Hausenblas et al., 2001) were expected to be statistically reliable in distinguishing between action and maintenance and maintenance and termination. Pros and cons were expected to explain lesser amounts of variance in the stage groups, if any (Marshall & Biddle, 2001).

Because experiential and behavioral processes of change were expected to distinguish between stage groups, hypotheses were developed for the individual processes of change. Specifically, counterconditioning was expected to be the strongest factor in distinguishing between the action, maintenance, and termination stages (Marshall & Biddle, 2001; Rosen, 2000). Consciousness raising, reinforcement management, helping relationships, social liberation, environmental reevaluation, and self-reevaluation were also expected to be significantly associated with stage of change (Marshall & Biddle, 2001; Rosen, 2000). Because past research has found little association between the remaining processes of change and later stages of change, they were not expected to be valuable in distinguishing between the later stages of change.

## Method

### *Participants*

Participants ( $N=710$ ) were undergraduate students and adults (age range = 18–72 years) from north central Florida. On average, the men ( $n=330$ ;  $M$  age = 27.14 years ( $SD=11.93$ )) were 1.80 m tall ( $SD=.07$ ), weighed 80.83 kg ( $SD=12.89$ ), and had a BMI of 24.98 ( $SD=3.42$ ). In comparison, the women ( $n=380$ ;  $M$  age = 24.80 years ( $SD=9.30$ )) were 1.66 m tall ( $SD=.07$ ), weighed 61.01 kg ( $SD=9.89$ ), and had a BMI of 22.24 ( $SD=3.27$ ).

## Measures

### *Stages of exercise change questionnaire*

Stage of change for exercise behavior was assessed using a modified version of the Stages of Exercise Change Questionnaire (Reed et al., 1997). The original staging measure consists of five items that represent the first five SOC (i.e. precontemplation, contemplation, preparation, action, and maintenance). However, for the purposes of this study, the item ‘Yes, I have been exercising for more than five years’ was added to the staging algorithm to represent the termination stage. The original version of the exercise-staging measure is a valid and reliable staging method for adults (Reed et al., 1997). To establish face validity for the staging algorithm used in this study, five exercise science professionals reviewed the staging algorithm for readability and clarity.

### *Barriers-efficacy scale*

Barriers-efficacy was measured with the 12-item Barriers-efficacy Scale (McAuley & Mihalko, 1998), which assesses participant’s perceived ability to exercise five times per week in the face of barriers (e.g. bad weather, lack of interest/boredom, pain and discomfort, exercising alone). On a 0–100% scale, participants rated their degree of confidence that they could exercise in the event that barrier circumstances were to occur (0% = no confidence at all, 50% = somewhat confident, 100% = completely confident). This scale has excellent psychometric properties (McAuley & Mihalko, 1998), and in this study the internal consistency was good ( $\alpha = .89$ ).

### *Temptation to not exercise questionnaire*

The temptation to not exercise questionnaire (Hausenblas et al., 2001) consists of 10 items that measure the intensity of temptations to not exercise, and contains the following two subscales: competing demands (e.g. lack of time, too busy) and affect (e.g. anger, stress, satisfaction). Participants rate their temptation to not exercise for a variety of situations on a 0–100% scale (0% = not tempted at all, 50% = somewhat tempted, 100% = extremely tempted). Greater amounts of temptation to not exercise are indicated by a higher score. This questionnaire has adequate psychometric properties (Hausenblas et al., 2001). In this study, the internal consistency values were .86 and .82 for the affect and competing demands subscales, respectively.

### *Decisional balance questionnaire*

The 16-item decisional balance questionnaire (Marcus et al., 1992) uses a 5-point Likert scale ranging from not at all important (1) to extremely important (5) to assess an individual’s attitudes towards exercise. An example of a pro item is ‘Regular exercise would help me relieve tension or stress.’ An example of a con item is ‘I would have less time for my family and friends if I exercised regularly.’ For each subscale, higher scores indicate greater beliefs for the pros and cons associated with exercise. This measure has adequate psychometric properties, and the internal consistency values for this study for the pros ( $\alpha = .92$ ) and the cons ( $\alpha = .75$ ) were adequate.

### *Processes of change questionnaire*

The processes of change questionnaire (Nigg, Burbank, Padula, Dufresne, Rossi, & Velicer et al., 1999) is a 30-item measure that uses a 5-point Likert scale (1 = never and 5 = repeatedly) to assess the five experiential and five behavioral activities individuals use to modify their exercise behavior.

Higher scores on this questionnaire indicate greater use of the processes of change. This measure has adequate psychometric properties (Nigg et al., 1999). Internal consistency values for the experiential processes ( $\alpha = .88$ ) and behavioral processes ( $\alpha = .86$ ) were good for this study. For the individual processes of change, the internal consistency values ranged from poor to good. Specifically, the scores were as follows: self-liberation ( $\alpha = .55$ ), dramatic relief ( $\alpha = .64$ ), stimulus control ( $\alpha = .64$ ), environmental reevaluation ( $\alpha = .73$ ), social liberation ( $\alpha = .74$ ), reinforcement management ( $\alpha = .77$ ), counterconditioning ( $\alpha = .77$ ), self reevaluation ( $\alpha = .83$ ), consciousness raising ( $\alpha = .84$ ), and helping relationships ( $\alpha = .85$ ).

### *Body composition*

Self-reported height and weight measurements were used to compute BMI (weight(kg)/(height(m<sup>2</sup>)). Although BMI has a  $\pm 5\%$  error rate in estimating body composition (American College of Sports Medicine, 2000), it has a moderately high correlation with body composition ( $r \geq .69$ ; Morrow, Jackson, Disch, & Mood, 1995), and it is an adequate estimate of body composition in epidemiological studies (Kuczmarski, Carroll, Flegal, & Troiano, 1997).

### *Procedure*

The university's internal review board approved the study before data collection began. All potential participants were told that participation was anonymous (no name required) and voluntary. If they agreed to participate, participants were asked to read and sign an informed consent before completing the questionnaires. The questionnaire packet took approximately 20 min to complete. Participants enrolled in the university were provided extra course credit for completing the questionnaires. Individuals not enrolled in the university received no compensation for their participation.

### *Data analysis*

First, we investigated the presence of sex differences for each of the TTM constructs (Fallon & Hausenblas, 2004). If significant sex differences emerged for any of the constructs, the logistic regressions were separated by sex. Second, because research has shown that some of the TTM constructs are curvilinear across the stages (Prochaska, Velicer, Rossi, Goldstein, Marcus, & Rakowski et al., 1994), logistic regressions were conducted with the following dependent variables: action/maintenance and maintenance/termination. Although the TTM states that decisional balance is calculated by subtracting cons from pros, the subscales are often analyzed separately because it is not known whether it is better to raise the pros, reduce the cons, or both (Marshall & Biddle, 2001; Prochaska et al., 1994). Thus, in these analyses, decisional balance was separated into pros and cons for behavior change. Because the temptation to not exercise scale was only recently developed (Hausenblas et al., 2001), and has been used in few studies, the affect and competing demands subscales were separated for these analyses to determine which of the subscales is most associated with stage transition. Finally, with regard to the processes of change, early research indicated that the experiential processes of change were associated with earlier stages of change and behavioral processes of change were associated with later stages of change (Nigg & Courneya, 1998), and thus, the subscales were often analyzed separately. More recently, researchers have suggested that these higher order constructs may not be worth preserving in the physical activity domain (Marshall & Biddle, 2001). As a methodological consideration, however,



including the 10 individual processes of change would compromise the statistical power in this study by bringing the total number of independent variables to 15 in each logistic regression. Thus, the following independent variables were included in each logistic regression: (a) barriers efficacy, (b) pros, (c) cons, (d) experiential processes of change, (e) behavioral processes of change, (f) affect temptation, and (g) competing demands temptation. In the event that experiential or behavioral processes of change were significantly associated with stage transition, a follow-up logistic regression was conducted investigating the 10 individual processes of change and their association with stage of change.

## Results

### Examination of sex differences

Means and standard deviations for the TTM constructs are located in Table 1. A one-way ANOVA for sex was conducted for barriers-efficacy. Results revealed that the men reported greater barriers-efficacy for exercise ( $F(1, 676) = 4.22, p = .04$ ) compared to the women. Because the temptation, decisional balance, and processes of change measures each have two subscales, a one-way MANOVA was conducted for sex for each measure. For temptation, results indicated no significant difference for sex

Table 1  
Means and standard deviations for the men and women for each of the TTM constructs

Construct	Action		Maintenance		Termination	
	Men <i>n</i> = 44 (13.3%) <i>M</i> (SD)	Women <i>n</i> = 102 (26.8%) <i>M</i> (SD)	Men <i>n</i> = 120 (36.4%) <i>M</i> (SD)	Women <i>n</i> = 126 (33.2%) <i>M</i> (SD)	Men <i>n</i> = 166 (50.3%) <i>M</i> (SD)	Women <i>n</i> = 152 (40.0%) <i>M</i> (SD)
Barriers-efficacy	48.79 (15.50)	47.41 (16.62)	54.37 (17.75)	55.66 (18.29)	65.72 (18.24)	62.87 (16.99)
Decisional balance						
Pros	38.56 (6.31)	37.92 (9.45)	36.29 (9.10)	39.86 (9.83)	37.86 (10.59)	40.38 (9.83)
Cons	14.51 (3.31)	14.67 (4.37)	13.43 (5.47)	13.45 (4.63)	12.92 (5.66)	12.24 (4.76)
Temptation						
Affect	37.57 (23.80)	34.18 (23.22)	28.27 (22.25)	34.74 (26.40)	28.46 (28.44)	29.22 (29.00)
Competing demands	54.20 (21.61)	54.59 (26.04)	52.94 (20.09)	50.87 (25.05)	48.96 (21.95)	49.35 (22.69)
Processes of change						
Experiential	3.09 (.56)	3.24 (.59)	3.21 (.62)	3.59 (.63)	3.57 (.61)	3.80 (.59)
Consciousness Raising	2.56 (.89)	2.57 (1.00)	2.71 (.97)	3.02 (1.04)	3.00 (1.06)	3.36 (1.01)
Dramatic relief	2.78 (.87)	3.00 (.84)	2.97 (.83)	3.23 (.88)	3.32 (.87)	3.49 (.84)
Environmental reevaluation	2.52 (.92)	2.61 (.97)	2.68 (1.00)	3.11 (1.03)	3.11 (1.06)	3.19 (1.06)
Self reevaluation	4.01 (.66)	4.28 (.68)	3.99 (.78)	4.49 (.73)	4.36 (.74)	4.64 (.61)
Social liberation	3.67 (.69)	3.81 (.75)	3.76 (.79)	4.11 (.74)	4.10 (.73)	4.34 (.65)
Behavioral	2.99 (.52)	3.25 (.56)	3.16 (.64)	3.51 (.59)	3.34 (.61)	3.77 (.57)
Reinforcement management	3.55 (.73)	3.85 (.86)	3.66 (.83)	4.15 (.80)	4.08 (.73)	4.48 (.63)
Self-liberation	3.27 (.73)	3.75 (.72)	3.36 (.72)	3.77 (.68)	3.47 (.77)	3.88 (.72)
Helping relationships	2.90 (1.00)	2.98 (1.04)	2.93 (1.07)	3.16 (1.08)	3.04 (1.12)	3.34 (1.14)
Stimulus control	2.52 (.90)	2.91 (.85)	2.86 (.98)	3.40 (.90)	2.89 (.97)	3.64 (.88)
Counter conditioning	2.69 (.75)	2.75 (.83)	2.97 (.94)	3.13 (.89)	3.26 (.87)	3.57 (.85)

(Wilk's Lambda = .99,  $F(2, 701) = .99$ ,  $p = .37$ ,  $\eta^2 = .003$ ). For decisional balance, results indicated a significant difference for sex (Wilk's Lambda = .99,  $F(2, 673) = 4.19$ ,  $p = .02$ ,  $\eta^2 = .01$ ), such that the women reported greater pros of exercise ( $F(1, 674) = 8.34$ ,  $p = .004$ ,  $\eta^2 = .01$ ) compared to the men. No significant sex difference emerged for the cons of exercise ( $F(1, 674) = .01$ ,  $p = .91$ ,  $\eta^2 < .001$ ). Finally, a significant sex difference emerged for the processes of change (Wilk's Lambda = .93,  $F(2, 667) = 23.86$ ,  $p < .001$ ,  $\eta^2 = .07$ ), such that the women reported greater use of behavioral processes ( $F(1, 668) = 17.61$ ,  $p < .001$ ,  $\eta^2 = .07$ ) and experiential processes ( $F(1, 668) = 6.77$ ,  $p < .001$ ,  $\eta^2 = .02$ ) compared to the men. The stage distributions for males and females are presented in Table 1. Most participants were in the termination stage of change and sex was not associated with stage of change ( $\chi^2(5) = 7.56$ ,  $p = .18$ ).

### Predicting stages of change for the men

For the men, two forward logistic regressions were conducted to determine which independent variables (affect temptation, competing demands temptation, barriers-efficacy, pros, cons, experiential and behavioral processes of change) were associated with stage of change (action/maintenance, and maintenance/termination). Results for action/maintenance revealed an overall model of one factor (affect temptation) associated with stage of change that was statistically reliable in distinguishing between action and maintenance ( $-2 \text{ Log Likelihood} = 164.16$ ;  $\chi^2(1) = 5.93$ ,  $p = .02$ ; Wald (1) = 5.84,  $p = .02$ ; see Table 2). The model correctly classified 73.5% of the cases.

Results for maintenance/termination revealed the overall model of three predictors (barriers efficacy, experiential processes of change, and affect temptation) that were statistically reliable in distinguishing between maintenance and termination ( $-2 \text{ Log Likelihood} = 306.97$ ;  $\chi^2(3) = 25.72$ ,  $p < .001$ ; see Table 2). The model correctly classified 63.6% of the cases. Wald statistics indicated that barriers efficacy ( $p = .001$ ) held the strongest association with stage of change, followed by experiential processes of change [ $p = .02$ ] and affect temptation [ $p = .03$ ].

Table 2  
Results for initial and follow-up logistic regressions

Stage of change	Construct	B	SE	Wald	df	Significance	exp (B)
<i>Men</i>							
Action/maintenance							
	Affect temptation	.02	.008	5.84	1	.02	.98
Maintenance/termination							
	Barriers efficacy	.03	.009	10.42	1	.001	1.03
	Experiential processes of change	.56	.24	5.49	1	.02	1.76
	Environmental reevaluation	.32	.13	5.86	1	.02	1.37
	Affect temptation	.01	.006	4.49	1	.03	1.01
<i>Women</i>							
Action/maintenance							
	Experiential processes of change	1.02	.25	16.83	1	<.001	2.77
	Environmental reevaluation	.36	.15	5.75	1	.02	1.44
	Social liberation	.41	.21	3.90	1	.05	1.50
Maintenance/termination							
	Barriers efficacy	.02	.008	9.13	1	.003	1.02



Because the experiential processes of change were found to explain significant amounts of variance the maintenance/termination regression, a follow-up logistic regression was conducted. Specifically, barriers efficacy was entered into block 1, the five experiential processes of change were entered into block 2, and affect temptation was entered into block 3. Results indicated that environmental reevaluation ( $p = .02$ ) was the only process of change that explained significant amounts of variance in the maintenance/termination stages of change (see Table 2).

### *Predicting stages of change for the women*

Similar to statistical analyses for the men, two forward logistic regressions were conducted for the women to determine which independent variables (temptation, barriers-efficacy, decisional balance, and processes of change) were significantly associated with stage of change (action/maintenance, and maintenance/termination; see Table 2).

Results indicated that experiential processes were the only predictor that was statistically reliable in distinguishing between action and maintenance ( $-2$  Log Likelihood = 264.02,  $\chi^2(1) = 19.20$ ,  $p < .001$ ) by correctly classifying 68.0% of the cases. Because experiential processes were significantly associated with stage of change, a follow-up logistic regression was conducted using the five experiential processes of change as independent variables. Results indicated that environmental reevaluation ( $p = .02$ ) held the strongest association with stage of change, followed by social liberation ( $p = .05$ ). These processes of change explained 62.5% of the variance in action/maintenance stages of change (see Table 2).

Results for maintenance/termination revealed that one variable (barriers-efficacy) was statistically reliable in distinguishing between maintenance and termination ( $-2$  Log Likelihood = 325.05;  $\chi^2(3) = 9.62$ ,  $p = .002$ ). The model correctly classified 57.0% of the cases.

## **Discussion**

The TTM has often been used to describe the acquisition and maintenance of an exercise regimen. Limited research exists, however, investigating the TTM constructs and moderator variables (i.e. sex) associated with stage transition, especially for long-term maintenance. Furthermore, because 50% of sedentary individuals beginning an exercise program drop out within 6 months (Dishman, 1988), there is need for investigating the later stages of change. Thus, this study augments TTM research by (1) including all 5 TTM constructs, (2) examining TTM construct associations among later adjacent stages of change, and (3) investigating sex as a moderating variable of the TTM.

For the moderating effect of sex, we hypothesized that women would report more pros of exercise, and greater use of experiential and behavioral processes of change, while no sex differences would exist for cons, barriers efficacy, or temptation to not exercise. Results were consistent with hypotheses such that women reported greater use of experiential and behavioral processes of change, greater pros for exercise, and no differences between men and women were observed for cons of exercise or temptation to not exercise. Contrary to our hypotheses, however, men reported greater barriers-efficacy for exercise compared to women. Although higher self-efficacy has not previously been reported for men, it is important to note that research examining sex differences within the TTM is limited. Furthermore, men report greater amounts of physical activity compared to women

(USDHHS, 1996, 2000), and because self-efficacy is often considered to be the most important predictor of exercise behavior (Bandura, 1997; McAuley & Courneya, 1993; McAuley, Jerome, Elavasky, Marquez, & Ramsey, 2003; McAuley & Mihalko, 1998) it is plausible that men would also report higher self-efficacy for exercise.

With regard to the associations among the TTM constructs and adjacent stages of change, results for the men in the action/maintenance stages revealed that affect temptation was the only TTM construct associated with stage membership such that decreases in affect temptation distinguished between action and maintenance in 73.5% of the cases. Results for the men in maintenance/termination stages of change revealed that increases in barriers-efficacy, experiential processes of change, and affect temptation were able to distinguish stage membership in 63.6% of the cases. Follow-up analyses revealed that environmental reevaluation was the only experiential process of change associated with the maintenance and termination stages. Thus, it appears that continuing to increase confidence to overcome barriers, assessing the consequences of their behaviors on others (i.e. believing that family and friends will benefit from their increased longevity and quality of life), and coping with negative affect are important considerations for those men who maintain their exercise for long periods of time.

For the women, the experiential processes of change were the only TTM construct able to distinguish between those in the action/maintenance stages of change in 68.0% of the cases. Further analyses revealed that increases in environmental reevaluation and social liberation were most important for distinguishing between action and maintenance stages. With regard to stage membership in maintenance/termination stages, increases in barriers-efficacy classified 57.0% of the cases. Thus, to maintain exercise for more than 6 months, it is important for women to focus on the belief that family and friends will benefit from their exercise through increased longevity and quality of life, and be aware of the various ways they can be physically active in their community. To maintain exercise behavior for more than 5 years, it is important for women to focus on their confidence to overcome the daily barriers to their exercise regimen.

Consistent with our hypotheses, the pros and cons of decisional balance were not effective in distinguishing between the later stages of change. This is consistent with previous research indicating that decisional balance is important for the earlier stages of change (Marshall & Biddle, 2001; Nigg & Courneya, 1998; Prochaska & Velicer, 1997). Contrary to our hypotheses, competing demands temptation and behavioral processes of change were not significantly correlated with the later stages of change. One possible explanation is that those people who are able to reach the later stages of change for exercise may have fewer social, familial, and professional demands, thus leaving more time for exercise in their daily schedules and reducing the need for behavioral strategies. Similarly, those people who are successful in reaching the later stages of change may be more proficient in reducing competing demands through efficient time management capabilities compared to those in lower stages of change. There is a large amount of research documenting that finding time for exercise is difficult amid the many daily responsibilities people carry in today's society and is often cited as a reason for not exercising (King, Castro, Wilcox, Eyler, Sallis, & Brownson, 2000; Sallis & Owen, 1998). Another explanation is statistical in nature. The behavioral processes tend to increase in use up to the action stage and then remain level, indicating that maintaining exercise requires continual use of these processes. This, however, makes the interstage variability of the behavioral processes small within the later stages (action/maintenance/termination), diminishing any chances at finding statistical differences. With this interpretation, a non significant result would confirm the theory for the later stages of change.

Although we were able to improve upon previous research by using all five TTM constructs to investigate the correlates of the action, maintenance, and termination stages, there are three limitations to this study that warrant discussion. First, this was a cross-sectional study and therefore, we are unable to confirm whether the individuals moved forward, backward, or remained in the same stage over time. More importantly, without longitudinal research, we can not make causal inferences to determine which of the TTM constructs is most valuable in upward stage transition or which is most predictive of relapse. Longitudinal studies using the TTM to investigate exercise maintenance are warranted. Second, the voluntary nature of this study may have resulted in a more motivated subset of the population. Proactive random sampling is recommended to overcome this limitation in future research.

Third, measurement errors often result from self-report measures (Sallis & Owen, 1998). For example, participants may unintentionally misreport retrospective information such as number of months or years of exercise, exercise frequency, duration, and intensity. Furthermore, because people who are physically active are often attributed with positive social characteristics (Langlios, Kalakanis, Rubenstein, Larson, Hallam, & Smoot et al., 2000; Martin, Sinden, & Fleming, 2000), participants' responses are subject to self-presentation bias. Therefore, future research should verify self-report data by using prospective and longitudinal designs and incorporating objective physiological measures of health such as body composition (i.e. caliper measurements, hydrostatic weighing) and physical fitness testing (i.e. maximal oxygen uptake, 1 repetition maximum).

In conclusion, this study's purpose was to determine which constructs of the TTM were associated with later adjacent stages of change for men and women. This study confirms research indicating that significant sex differences exist within the TTM constructs (Fallon & Hausenblas, 2001, 2004; O'Hea et al., 2003). More importantly, however, this study shows that sex is an important moderator variable that must be considered when developing and implementing behavior change strategies. With regard to construct associations for adjacent stages of change, our study shows the importance of increasing self-efficacy to overcome daily barriers to exercise for long-term exercise adherence for both men and women. Strategies for increasing barriers-efficacy may include interventions for time management strategies and developing coping strategies for anticipated events that may interfere with exercise plans. Environmental reevaluation is also important for long-term exercise adherence, but appears to be more important for women in the maintenance stage, and men in the termination stage. Interventions using environmental reevaluation should focus on the identification and assessment of changes that have occurred (or may occur) in their physical and social environment (e.g. relationships with family and friends, household expenses, short and long term health, quality of life). For men in maintenance and termination, it is important for interventions to focus on the reduction of temptation to not exercise resulting from affective states (i.e. lazy, angry, high stress). For women in maintenance, it is important for interventions to focus on social liberation, such that women are encouraged to evaluate their choice to become active and their commitment to their behavior change.

In the future, longitudinal research is needed to ultimately determine the ability of the TTM to predict forward stage transitions. It is important that the research includes all five TTM constructs and all six stages of change. To date, research examining the role of temptation in exercise behavior is limited, as is research examining the termination stage of change. Additionally, longitudinal research may be able to identify precursors or symptoms of relapse, such that interventions may be initiated to prevent relapse. In summary, the results of our study indicate that stage and gender specific considerations are warranted when designing stage-matched exercise interventions for long-term maintenance of exercise behavior.

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