

A Model for Exercise Behavior Change Regulation in Patients with Heart Disease

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Despite the known benefits of habitual exercise in patients with heart disease, less than half of these patients exercise regularly and many of those who initiate programs fail to maintain physical activity routines over the long term. The aim of this research was to examine processes related to short- and long-term regulation of exercise to gain a clearer understanding of why people might fail to maintain intended behavioral changes. We modeled intention formation and plan formulation to investigate the distinct roles of self-efficacy and motivation (self-determination) in different phases of behavior change. Our results showed self-efficacy to be more relevant to exercise intentions and motivation to exercise planning. This research provides evidence supporting the proposition that the psychological processes related to short- and long-term regulation of behavior change differ and suggests that people might fail to continue regulating intended behavior owing to a lack of self-determined motivation.

Key Words: motivation, self-determination, self-efficacy, cardiac patients, rehabilitation, health behavior

For most patients with established coronary artery disease (CAD), a program of regular exercise has a positive effect on cardiovascular mortality, exercise tolerance, coronary risk factor levels (e.g., obesity, hypertension, and elevated blood lipids), and health-related quality of life (Thompson & Lim, 2003). Despite the known benefits of regular exercise in this population, only 46% of patients with CAD are active enough to derive maximal health benefits (Reid et al., 2006). Of patients who initiate exercise-based cardiac rehabilitation programs, 25% to 50% drop out within the first 6 months and typically do not continue to be regularly active (Burke, Dunbar-Jacob, & Hill, 1997). Because health behaviors are beneficial only to the extent that they are maintained, it is important that intervention

strategies not only help people initiate changes in their behavior, but also attain a self-sustaining pattern of behavior.

Why do people *fail to maintain* intended behavioral changes? Indeed, individuals make all sorts of resolutions, but ample literature indicates that although they may initially act on their intentions, maintenance of intended actions is rarely achieved. There is a gap in the research evidence base regarding the processes through which individuals *regulate*, or *fail to regulate*, behaviors over extended periods of time and consequently in our understanding of how to intervene with individuals to help them not only initiate, but also maintain desired health behavior changes. As proposed by Rothman (Rothman, 2000; Rothman, Baldwin, & Hertel, 2004), the secret to understanding this might be that the initiation (or intention formation) and continued regulation (or plan formulation) of behavior change are governed by distinct psychological processes. To this end, important shifts in the determinants of behavior occur as one moves from initiation to maintenance of health behavior change. Specifically, Rothman and colleagues (2004) proposed that the behavior change process is made up of four distinct phases: initial response, continued response, maintenance, and habit. The *initial response* phase is defined as initial behavior change. Although this phase is a function of a person's confidence in the ability to execute the behavior and the person's motivation for change, in order to transition into the next phase, a heightened sense of self-efficacy is of prime importance. The *continued response* phase is characterized by tension between a person's ability and motivation to enact the new pattern of behavior and the obstacles that may interfere with continued enactment. Self-efficacy still plays an important role during this phase as the person strives to gain a sense of mastery over the new behavior. With the transition into the *maintenance* phase, there is an important shift in the determinants of the person's behavior. The decision to continue the behavior becomes less a function of a person's ability to perform the behavior and more a function of the motives driving sustained behavior change (i.e., perceived value of behavior). Once a person transitions into the *habit* phase, he or she has attained a self-sustaining pattern of behavior and the decision to maintain the behavior is less a function of the ability to engage in the behavior and more a function of the motivation to sustain the behavior.

The initiation of behavior is a representation of individuals' intended actions. People act on intentions if certain personal and environmental factors align, but essentially they need to be motivated and feel efficacious to carry out the intended behavior. Motivation for engaging in a behavior has traditionally been considered an important determinant of individuals' ability to initiate and maintain a pattern of behavior. Specifically, the distinction between *self-determined* (or *autonomous*) and *non-self-determined* (or *controlled*) forms of motivation has been associated with different levels of commitment to behavior change (Deci & Ryan, 1985). More autonomous forms of motivation have been shown to predict successful initiation and maintenance of behavior change (e.g., Pelletier, Fortier, Vallerand, & Briere, 2001). The distinction between different forms of motivation is based on the degree of internalization of the processes that govern the regulation of intended behavior. Autonomous self-regulation is believed to evolve through the processes of internalization, whereby external regulatory processes (i.e., those originating from and reinforced by external sources, such as incentives, pressures to act, or a significant other) are converted into internal regulatory processes (i.e., those taken

in to be governed by the sense of self and incorporated into one's existing values and actions) (Schafer, 1968). Internalization can occur to varying degrees and is reflected in autonomous regulation of behavior accordingly (Deci & Ryan, 1985). More self-determined types of motivation have been shown to facilitate the behavior change process via greater effort and persistence, whereas non-self-determined types have been found to hinder effective behavior regulation. Specifically, health behavior research has demonstrated that self-determined motivation is an important predictor of behavior maintenance and thereby leads to more desirable health outcomes (e.g., Pelletier, Dion, Slovynec D'Angelo, & Reid, 2004; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997; Williams, McGregor, Zeldman, Freedman, & Deci, 2004).

Self-efficacy reflects one's confidence in the ability to execute a behavior in a given situation (Bandura, 1986). There is substantial empirical support for the premise that people's confidence in their ability to enact a behavior positively predicts subsequent behavior and that successful enactment increases people's confidence in their behavior (Bandura, 1997). Because of this reciprocal, and therefore continuous, relationship between self-efficacy and behavior, self-efficacy is often interpreted to be a strong determinant of long-term behavior change (e.g., Maddison & Prapavessis, 2004; Schwarzer, 2001). As pointed out by Rothman et al. (2004), however, this approach to the prediction of behavior change does not take into account the degree to which perceived self-efficacy affects the decision to maintain a behavior over and above its influence on the decision to initiate the behavior. Accordingly, the reciprocity does not offer an explanation for why successfully enacted changes in behavior are not always maintained (e.g., McCauley, Glasgow, & O'Neill, 1992). Indeed, research has more consistently demonstrated self-efficacy to be a predictor of intended behavior initiation than a determinant, or even correlate, of sustained behavior change (e.g., McAuley, 1992; Salovey, Rothman, & Rodin, 1998). Some of the inconsistencies are likely due to the existence of multiple dimensions of each self-efficacy and behavioral outcome measures; certain forms of self-efficacy correspond better to the behavioral outcome of interest than other forms. In addition, the relationships appear to vary across different populations. In the general exercise literature, coping and scheduling efficacy, but not task efficacy, have been found to discriminate between levels of exercise (e.g., Rodgers & Sullivan, 2001). Barrier self-efficacy, in turn, has been linked specifically to program adherence (Rhodes, Martin, & Taunton, 2001). In both cases, the relationships were correlational. In the cardiac rehabilitation self-efficacy literature, findings have been somewhat mixed. Maddison and Prapavessis (2004) provided further evidence that barrier self-efficacy was correlated with exercise program adherence, but also that task efficacy (walking) was correlated with level of exercise (energy expenditure). In contrast, Blanchard et al. (2002) showed that one form of task efficacy (frequency) correlated with exercise frequency, whereas another form of task efficacy (duration) and barrier self-efficacy (overcoming obstacles) did not. Furthermore, in a prospective cardiac rehabilitation study, Woodgate, Brawley, and Weston (2005) demonstrated that scheduling and task (walking) self-efficacy predicted exercise program adherence at 4 weeks; barrier self-efficacy was not considered in that study. For cardiac patients, engagement in exercise may hinge on a number of very real concerns, including social, emotional, physical, and task related. Also, as noted above, assessment of patients' confidence to overcome potential barriers to exercise is important to the study of exercise adherence. Accord-

ingly, in the present investigation, where the outcome of interest was short- versus long-term regulation of exercise, which would translate to adherence for behavioral end points, we relied upon barrier self-efficacy as a determinant.

The maintenance of behavior change relies on sustained regulatory efforts to engage in an intended pattern of behavior. Rothman's (2004) model of behavior change suggests that the predictive value of self-efficacy becomes less important over time as people move from initiating to maintaining a behavior, or when the behavior requires more effort. The reasoning is that once people have established they can successfully manage their behavior, maintaining the behavior becomes less a function of their perceived ability to perform the behavior and more a function of their motives driving the behavior. Furthermore, these investigators proposed that people whose behavior reflects autonomous motivational needs may find it easier to sustain their confidence in performing the behavior. In particular, under unfavorable conditions, people may find it easier to remain committed to the behavior if their actions are motivated by their own needs and desires as opposed to the needs and desires of others (Rothman et al., 2004). Evidence for the proposition that the relationship between motivation and behavior might be mediated by self-efficacy was provided by recent research showing that perceived competence, a concept similar to self-efficacy, mediated the relation from autonomous motivation to health behavior self-management in patients with diabetes (Williams et al., 2004).

Although Rothman et al.'s (2004) descriptions of the four phases of the behavior change process demonstrate good face validity, as the investigators themselves pointed out, the conceptual value of the proposed distinctions is constrained by a lack of empirical evidence to support the premise that different phases of the behavior change are contingent on distinct sets of predictors. The purpose of the current research was to apply Rothman et al.'s (2004) thesis regarding the distinction between the processes underlying the phases of behavior change initiation (i.e., intention formation) and the processes related to maintenance, specifically planning, in the development of a model to predict short- and long-term regulation of exercise behavior among patients rehabilitating from heart disease. The main consideration in the development of this model was that not only do patients' intentions to exercise regularly need to be encouraged, but they also need to be motivated to plan for long-term maintenance of regular exercise. Traditionally, planning is posed to follow intentions; it is defined as the volitional act of specifying *when* and *where* one will enact one's intentions and how one will ensure persistence toward goals even in the face of distractions (Gollwitzer, 1999). Planning is believed to promote behavior maintenance by facilitating integration of new behaviors into one's usual routine (Gollwitzer & Brandstatter, 1997; Lippke, Ziegelmann, & Schwarzer, 2004). Specific plans for when and where behavior will be enacted have been shown to be more relevant predictors of continued behavior regulation than intentions alone; this is particularly true in the context of behaviors that are complex, such as exercise (e.g., Milne, Orbell, & Sheeran, 2002). In fact, action plans are so important to behavioral enactment that they have been found to break the strong link between past and future behavior (Orbell, Hodgkins, & Sheeran, 1997).

In agreement with Rothman's et al. (2004) analysis of the distinction between initiation and maintenance of behavior, the proposed model integrates self-efficacy and motivation to predict intentions, formed in the service of exercise behavior initiation, and action plans, formed in the service of regular exercise behavior

maintenance. Participants in our study included patients who were initiating an exercise program. Accordingly, in terms of Rothman et al.'s definition of the behavior change process, our model depicts the transition from the initial response phase into the continued response phase and furthermore into the maintenance phase. General motivation was also included in the model as a determinant of motivation within the context of exercise behavior. More specifically, our research tested the following three hypotheses: First, it was hypothesized that each self-efficacy and self-determination would have separate effects on both intentions and planning and that, when compared, self-efficacy would share a stronger relationship with intentions and self-determination a stronger relationship with planning. Second, we hypothesized that when both self-efficacy and self-determination are included in the model, the effect of self-efficacy on intentions would remain strong, but its effect on planning would be minimized, whereas the effect of self-determination on both intentions and planning would prevail. Third, self-efficacy was predicted to mediate the relationship between self-determination and intentions.

Method

Participants

A total of 200 participants who reported an interest in initiating a program of exercise as part of their cardiac rehabilitation were recruited by a study coordinator from hospital admissions and cardiac rehabilitation classes at the University of Ottawa Heart Institute, a tertiary-care cardiac center in Ottawa, Canada. Patients were eligible to participate if they were between the ages of 20 and 85 years, were proficient in English, and had documented CAD. Patients with contraindications to exercise were excluded. Approval of the study protocol was obtained from the institutional research ethics board and all participants provided written informed consent.

Design and Procedure

A cross-sectional study was conducted. A survey instrument was used to collect information on demographic, clinical, psychosocial, and cognitive variables. The outcome measures were planning of physical exercise, as defined by formulation of implementation intentions (Gollwitzer, 1999), and intentions to exercise regularly. Regular exercise was defined as "30 minutes or more of physical activity at a moderate intensity or greater (e.g., intensity of a brisk walk or faster) four or more days per week." Other measures of interest included general motivation, motivation within the context of exercise, and barrier self-efficacy.

Instruments

General Motivation. The General Self-Determination Scale (GSDS; Pelletier et al., 2003) was used to assess patients' general motivational orientation, an indication of one's tendencies to be more or less autonomous in daily interactions with the environment. The GSDS comprises six subscales, each consisting of three items, assessing each element of the self-determination continuum:

- Intrinsic motivation (e.g., "In general, I do things . . . for the pleasure of learning something new")
- Integrated regulation (e.g., ". . . because they reflect what I value most in life")
- Identified regulation (e.g., ". . . because I chose to make a commitment to what is important to me")
- Introjected regulation (e.g., ". . . because I force myself to do them")
- External regulation (e.g., ". . . in order to show others what I am capable of")
- Amotivation (e.g., ". . . even though it does not make a difference whether I do them or not")

Responses were scored on a 7-point scale, ranging from 1 (*do not agree at all*) to 7 (*completely agree*). Test-retest reliability of the GSDS has been found to range between .71 and .82, and alpha reliability coefficients for the six subscales between .73 and .90 (Pelletier et al., 2003). In the current investigation, the internal consistencies of the subscales ranged between .65 (for external regulation) and .84 (for identified and integrated regulations).

In the present research, we were interested in examining how variations in the level of general self-determination affect the level of contextual self-determination and indirectly affect other model components. For these purposes, index scores were created for each participant to represent his or her relative position on the self-determination continuum. A self-determination index (SDI) score is the weighted sum of the six subscale scores. The selection of items for each index score is random. The weight assigned is a function of the position of each subscale on the self-determination continuum: $SDI = 3(\text{amotivation item score}) + 2(\text{extrinsic item score}) + 1(\text{introjected item score}) - 1(\text{identified item score}) - 2(\text{integrated item score}) - 3(\text{intrinsic item score})$ (Blais, Sabourin, Boucher, & Vallerand, 1990). This method yields as many indicators per factor as there are items per subscale; thus, three indicators of equal weight were generated to represent the general self-determination factor. A mean SDI score was computed to describe the relative level of general self-determination for each participant. The theoretical range for the general SDI scores was -108 to +108.

Contextual Motivation in Exercise Regulation. The Physical Activity Regulation Scale (PARS) was used to assess self-determination within the context of exercise behavior. The PARS includes the four subscales (intrinsic, identified, introjected, and external regulations) of the Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997). In addition, two new subscales were added to assess the constructs of integrated regulation and amotivation. Each subscale consists of three items to assess each of the following:

- Intrinsic motivation (e.g., "I am trying to be physically active because . . . I enjoy my exercise sessions")
- Integrated regulation (e.g., ". . . healthy activity is part of my life goals")
- Identified regulation (e.g., ". . . I value the benefits of exercise")
- Introjected regulation (e.g., ". . . I feel guilty when I don't exercise")

- External regulation (e.g., "... other people say I should")
- Amotivation (e.g., "... I really don't think about being or becoming physically active")

Responses were scored on a 7-point scale, ranging from 1 (*do not agree at all*) to 7 (*completely agree*). As with the GSDS, the PARS was scored to yield SDI scores for each participant, and the mean SDI was computed for descriptive purposes. The theoretical range for the contextual SDI was -108 to +108.

Psychometric properties of the BREQ have been previously established (Wilson, Rodgers, & Fraser, 2002). In the present study, the psychometric integrity of the PARS was also examined. The alpha reliability coefficients for the six subscales of the PARS ranged from .68 (for amotivation) to .96 (for intrinsic motivation). Construct validity was supported by moderate to large correlations, in the expected direction, between the PARS subscales and various exercise attitudes (e.g., benefits associated with exercise), indices of psychological adjustment (e.g., life satisfaction) and exercise habits.

Self-Efficacy Beliefs. Self-efficacy was assessed using a 12-item Barrier Self-Efficacy Scale. Barrier self-efficacy (i.e., efficacy with respect to coping with barriers to action) is one aspect of self-efficacy that distinguishes among behavioral levels (Bandura, 1995). Items were selected from previously standardized scales that have been found to have high internal consistencies ($\alpha = .91$ to $.94$) and test-retest reliability ($r = .77$) (Bandura, 1986; Plotnikoff & Higginbotham, 2002). Each item represented a possible circumstantial barrier to exercise engagement. Participants were asked to indicate, on a 7-point scale, ranging from 1 (*not at all confident*) to 7 (*completely confident*), how confident they were that they will be able to engage in regular exercise over the next 4 weeks under a variety of circumstances. To enhance model parsimony (i.e., reduce the number of indicators of the self-efficacy construct), item parcels were formed for the analyses by grouping items together based on both their similarity in content and empirical criteria. First, for similarity in item content, items were classified according to the types of barriers into four categories: social (e.g., without support from family or friends), task related (e.g., when you become bored with the activities), emotional (e.g., when you are feeling anxious or stressed), and physical (e.g., when you feel physical discomfort when you exercise). Next, item parceling was confirmed by examining alpha coefficients to assess internal consistency between items in the same parcel. The alpha reliability coefficients for these subgroupings ranged between .86 and .92. For descriptive purposes, a mean self-efficacy score was computed for all 12 items; the internal consistency of the entire scale was .96. The theoretical range for the self-efficacy scores was 4 to 28.

Intentions to Exercise. Exercise intentions were evaluated with two items used in previous exercise research (Courneya & McAuley, 1994): (1) "I intend to exercise regularly over the next month" and (2) "I intend to exercise regularly over the next six months." Responses were scored on a 7-point scale, ranging from 1 (*do not agree at all*) to 7 (*completely agree*). In the present investigation, the correlation between the two items was .80. The theoretical range for the intention scores was 2 to 14.

Planning. Planning of exercise was assessed with two items, one asking about participants' activity routine and the other about their implementation plan. The routine item asked, "Do you tend to follow a regular exercise routine (i.e., exercise at the same time of day)?" The implementation plan item asked, "To what extent do you make specific plans (when, where, how) to be physically active?" Responses were scored on a 5-point scale, ranging from 1 (*never*) to 5 (*always*). The correlation between the two items was .83. The theoretical range for the planning scores was 2 to 10.

Data Analysis

Descriptive statistics were computed for each of the variables under study. Research hypotheses were tested with a series of structural equation modeling (SEM) analyses. The SEM analyses were conducted using EQS 6.1 (Bentler & Wu, 2004) based on the covariance matrix with estimation performed using maximum likelihood (ML) fitting function. To test the first hypothesis, pertaining to the separate effects of self-efficacy and self-determination on intentions and planning, we tested two models, one in which self-efficacy was set to predict intentions and planning and the other in which self-determination was set as the predictor. To test the second hypothesis, regarding the unique effects of self-efficacy and self-determination in the process of exercise regulation, self-efficacy and self-determination were entered into a model simultaneously to predict both intentions and planning. Self-determination was positioned as an antecedent of self-efficacy in this model. General self-determination was included as an antecedent of contextual (exercise-specific) self-determination. To test the third hypothesis, regarding the sequence in which self-efficacy and self-determination were linked in the model, the order of these two constructs was reversed so that self-determination was positioned to mediate the relationship between self-efficacy and intentions. Multiple statistical and practical criteria were used to assess overall model fit, including chi-square, degrees of freedom, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The recommended criteria for acceptability of model fit are greater than .95 for the CFI, close to .08 for SRMR, and close to .06 for RMSEA (Hu & Bentler, 1999).

Results

Participant Characteristics

Participants were predominantly male (81%), with a mean age of 64 years (range of 37 to 93 years). They were relatively well educated, with more than half of the participants having completed college and/or university, and two-thirds of them being unemployed or retired.

Descriptive Statistics

The mean SDI value for general motivation was 43.5 ($SD = 26.5$), and the SDI scores ranged from -18 to +108. For contextual motivation, the mean SDI value was 53.2 ($SD = 31.9$), and the SDI scores ranged from -45 to +108. The mean for

the barrier self-efficacy scale was 18.6 ($SD = 5.4$), and the scores ranged from 4 to 28. The mean of the two exercise intention items was 10.9 ($SD = 3.5$), and the range was 2 to 14. The mean of the two planning of exercise items was 6.3 ($SD = 2.3$), and the scores ranged from 2 to 10.

Intercorrelations for all latent constructs in the proposed model are provided in Table 1.

Table 1 Correlations Between the Latent Factors in the Model of Exercise Regulation

Factors	ECSDI	SE	INT	PL
General SDI (GSDI)	.33	.09	.03	.13
Contextual Exercise SDI (ECSDI)	1.0	.58	.54	.57
Self-Efficacy (SE)		1.0	.62	.50
Intentions (INT)			1.0	.60
Planning (PL)				1.0

Note. $N = 200$. For $r > .14$, $p < .05$. For $r > .19$, $p \leq .01$. SDI = self-determination index.

Confirmatory Factor Analysis of the PARS

Confirmatory factor analysis revealed acceptable goodness-of-fit indices: $\chi^2 = 226.91$, $df = 120$; non-normed fit index (NNFI) = .94, CFI = .96, RMSEA = .07, 90% confidence interval (CI) = .05-.08.

Testing the Hypotheses and the Model for Exercise Regulation

The lack of a longitudinal design and behavioral end point prevents confirmation of the most appropriate model for predicting exercise behavior regulation. Competing models of exercise regulation were considered to examine the sequence in which the selected variables could be linked in the processes underlying short- and long-term regulation of exercise.

First, we examined the specific roles of barrier self-efficacy and self-determination in the prediction of intentions and planning (Figures 1 and 2). In Model 1, self-efficacy was found to have a direct effect on both intentions and planning, $\chi^2 = 26.35$, $df = 17$, CFI = .99, GFI = .97, SRMR = .02, RMSEA = .05. In Model 2, self-determination also had a direct effect on both intentions and planning, $\chi^2 = 12.42$, $df = 9$, CFI = 1.0, GFI = .98, SRMR = .02, RMSEA = .04. Self-efficacy was more significantly related to intentions, whereas self-determination was more significantly related to planning. These results suggested that each of the two constructs may have a unique role in the regulatory process.

Second, we wanted to examine the distinct roles of motivation and self-efficacy in the regulatory process. We did this by testing a model that included direct paths from self-efficacy and self-determination to both intentions and planning so that the effects of self-efficacy could be compared with those of motivation (Figure 3). In Model 3, self-efficacy was positioned to mediate the relationship between self-determination and intentions. Model estimation presented an adequate fit to

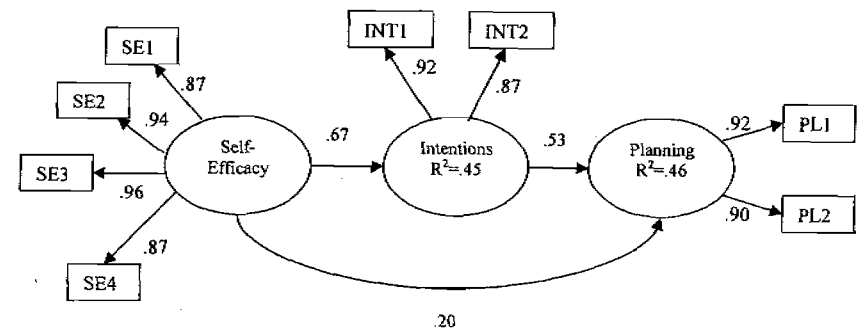


Figure 1 — Role of self-efficacy in the prediction of exercise intentions and planning (Model 1), $\chi^2 = 26.35$, $df = 17$, CFI = .99, GFI = .97, SRMR = .02, RMSEA = .05. All direct effects (beta weights) are significant at $p < .001$, with the exception of the path between self-efficacy and planning, where the beta weight is significant at $p < .01$.

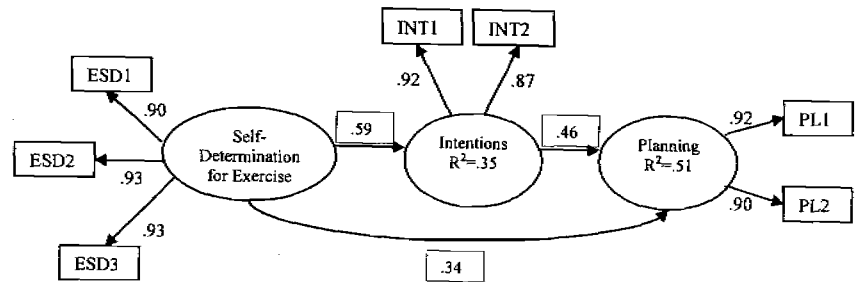


Figure 2 — Role of self-determination in the prediction of exercise intentions and planning (Model 2), $\chi^2 = 12.42$, $df = 9$, CFI = 1.0, GFI = .98, SRMR = .02, RMSEA = .04. All direct effects (beta weights) are significant at $p < .001$.

the data: $\chi^2 = 106.91$, $df = 6$, CFI = .98, GFI = .93, SRMR = .06, RMSEA = .06. Consistent with Model 2, self-determination had a significant effect on intentions and on planning, independent of the effect of self-efficacy. The effects of self-efficacy, by contrast, were influenced by the introduction of self-determination into the model; self-efficacy continued to have a significant effect on intentions, but its effect on planning became nonsignificant. These results indicated that even though self-efficacy could be linked to both intentions and planning, when variations in motivation are partialled out, the magnitude of the relationship between self-efficacy and planning is significantly reduced. This finding was in line with the theoretical premise of our investigation that self-efficacy and self-determination have different roles in the process of behavior change regulation. Accordingly, Model 3 was trimmed by removing the nonsignificant path between self-efficacy and planning. The resultant model is presented in Figure 4. As expected, dropping the nonsignificant path did not alter model fit, $\chi^2 = 107.66$, $df = 67$, CFI = .98, GFI = .93, SRMR = .06, RMSEA = .06. General motivational tendency was a strong

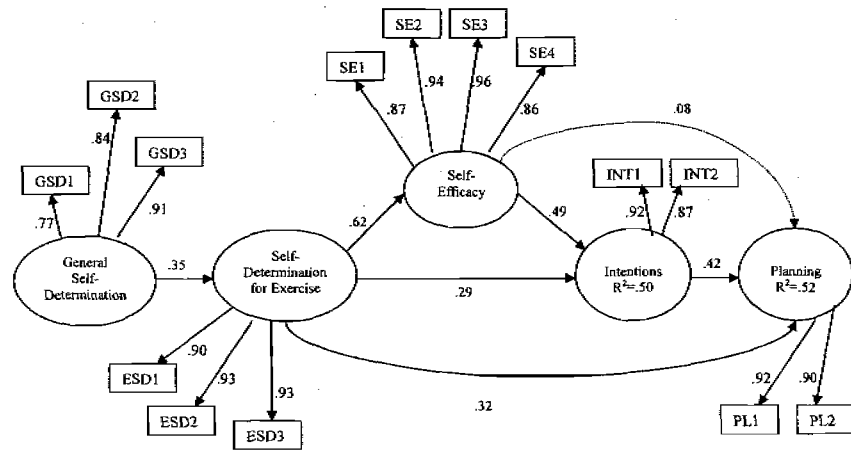


Figure 3 — Full model of exercise behavior change regulation. Roles of self-efficacy and self-determination in the prediction of exercise intentions and planning (Model 3), $\chi^2 = 106.91$, $df = 66$, CFI = .98, GFI = .93, SRMR = .06, RMSEA = .06. All direct effects (beta weights) are significant at $p < .001$.

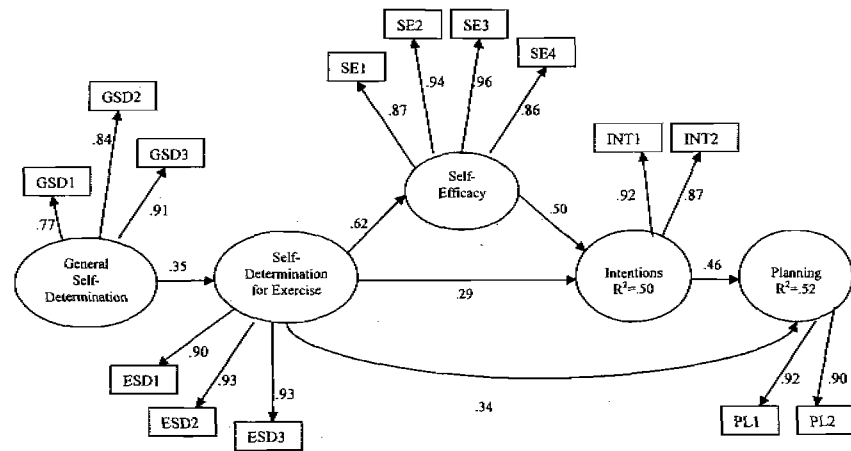


Figure 4 — Final model of exercise behavior change regulation (Model 4), $\chi^2 = 107.66$, $df = 67$, CFI = .98, GFI = .93, SRMR = .06, RMSEA = .06. All direct effects (beta weights) are significant at $p < .001$.

predictor of self-determination toward exercise. Self-determination had a large overall effect on planning of exercise ($\gamma_{total} = .61$); it had the most prominent direct effect on planning and this was mediated by self-efficacy beliefs and by intentions. Self-efficacy had the most prominent direct effect on intentions. Furthermore, the direct effect of self-determination on intentions was reduced with the introduction

Table 2 Standard Maximum Likelihood Estimates of the Direct, Indirect, and Total Effects of Causal Constructs on Endogenous Constructs of the Final Model of Exercise Regulation (Model 4)

Causal construct	Endogenous construct			
	CESD	SE	INT	PL
General SD (GSD)				
Direct effect	.35			
Indirect effect		.22	.21	.21
Total effect	.35	.22	.21	.21
Contextual Exercise SD (CESD)				
Direct effect		.62	.29	.34
Indirect effect			.31	.27
Total effect		.62	.59	.61
Self-Efficacy (SE)				
Direct effect			.50	
Indirect effect				.23
Total effect			.50	.23
Intentions (INT)				
Direct effect				.46
Indirect effect				
Total effect				.46

Note. Total effect is not always the exact sum of the direct and indirect effects as a result of rounding off to two decimal places. $N = 200$. All effects are significant at $p < .001$. SD = self-determination. PL = planning.

of self-efficacy ($\Delta\gamma = -.30$, in relation to Model 1), suggesting that, as hypothesized, self-efficacy mediated this relationship. The standardized ML estimates of all direct, indirect, and total effects for the final model are presented in Table 2.

Finally, we wanted to verify our thesis that the relationship between self-determination and intentions is mediated by self-efficacy, instead of motivation mediating the self-efficacy and intentions relationship as proposed by Bandura (1997). We did this by testing an alternative model where self-determination was specified as a mediator between self-efficacy and intentions (Model 5, Figure 5). The model fit remained unchanged: $\chi^2 = 105.81$, $df = 68$, CFI = .98, GFI = .93, SRMR = .05, RMSEA = .05. The direct effect of self-efficacy on intentions was reduced with the introduction of self-determination ($\Delta\gamma = -.17$, in relation to Model 2), suggesting that self-determination might mediate this relationship. Thus, our results provide almost equal support for the mediating role of either self-efficacy or self-determination in the model for exercise regulation.

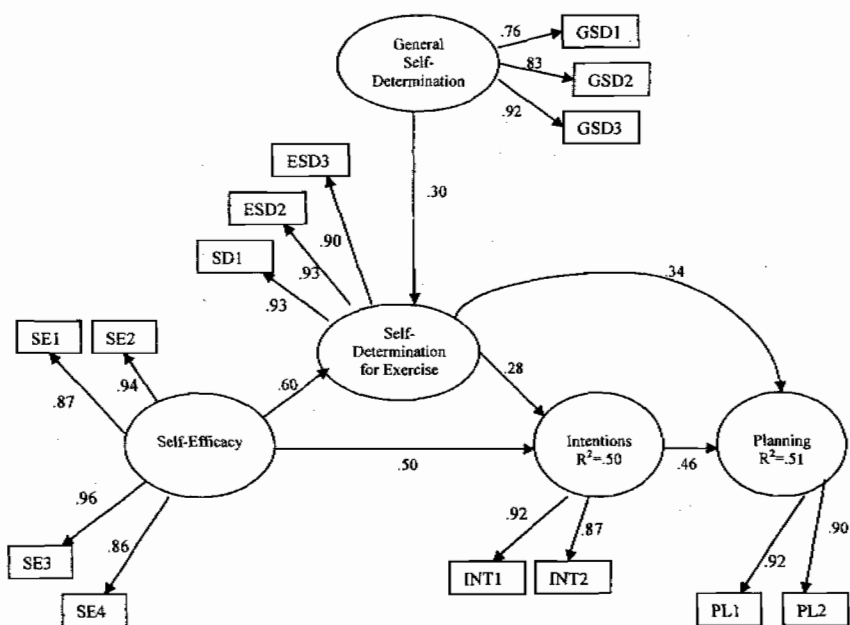


Figure 5 — Alternative model of exercise behavior change regulation where self-determination mediates the relationship between self-efficacy and intentions (Model 5), $\chi^2 = 105.81$, $df = 68$, CFI = .98, GFI = .93, SRMR = .05, RMSEA = .05. All direct effects (beta weights) are significant at $p < .001$.

Discussion

The goal of this research was to examine the psychological processes underlying cardiac rehabilitation patients' commitment to exercise behavior regulation in order to gain a clearer understanding of how people might be encouraged to continue participating in regular exercise, or conversely, why they might fail to maintain intended behavioral changes. We modeled patients' intentions to engage in regular exercise and their plans to act on these intentions to delineate the processes that might be related to short-term and long-term regulation of exercise behavior, respectively. This research was stimulated by Rothman's (2000; 2004) proposition that the psychological processes underlying behavior change initiation and maintenance differ. Of particular interest were the differential relationships of self-efficacy and self-determination to initial and ongoing regulatory efforts, as represented herein by intention formation and plan formulation. According to Rothman, both self-efficacy and motivation are important determinants of behavior change initiation, but as individuals transition into the behavior maintenance phase, self-efficacy is posed to become less important, whereas motivation becomes more important.

We took a stepwise approach and considered competing models in developing our final model for exercise behavior change. First, we examined the separate effects

of self-efficacy and self-determination on intention formation and plan formulation. Although both predictor variables were significantly related to intentions and to planning, self-efficacy had a larger effect on intentions than on planning, and self-determination had a larger effect on planning than on intentions. Next, we tested all relationships simultaneously in a larger model. Test of the larger model confirmed the relatively closer relation between self-efficacy and intentions and that between self-determination and planning. In fact, when both self-efficacy and self-determination were included in the model, the relationship between self-efficacy and planning became nonsignificant; self-determination retained its significant relationships with both intentions and planning. We then considered a competing model in which the order of self-efficacy and self-determination was reversed to test the hypothesis that self-efficacy mediates the relationship between self-determination and intention formation. Owing to the correlational design of this study, our data could not provide conclusive evidence regarding mediation effects, but, consistent with previous assertions (e.g., Rothman et al., 2004; Williams et al., 2004), the data provided some indication that self-efficacy mediates the relationship between motivation and behavior change initiation. Namely, we observed that the direct effect of self-efficacy on intentions was larger than that of self-determination, and that the introduction of the mediator reduced the effect of self-determination on intentions more so than the effect of self-efficacy on intentions. Accordingly, our final model for exercise behavior change regulation is presented in Figure 4. The model variables explained 50% of variance in intention formation, and 52% of variance in plan formulation.

The current study represents a preliminary test of Rothman et al.'s (2000; 2004) proposition that the psychological processes and associated determinants of behavior change initiation are not the same as those underlying behavioral maintenance. Specifically, our results provided support for the differential roles of self-efficacy, as defined by barriers, and motivation, as defined by self-determination, in the processes related to short- and long-term behavior change regulation. Self-efficacy was shown to be strongly related to the initial process of intention formation (short-term regulation) but not to the subsequent process of plan formulation (long-term regulation), whereas self-determination was relevant to intention formation, but even more relevant to plan formulation. This line of research is important to the field of health behavior change as it offers a logical explanation for why intended behavioral changes often fail to be maintained. Namely, people may fail to regulate behavior over the long term not so much because they lack the confidence to act, but more so because they lack the motivation to continue regulating their behavior.

The present investigation in itself is an interesting contribution to the area of exercise promotion and particularly to the design of exercise interventions aimed at increasing physical exercise in cardiac patients. The model for exercise regulation we are proposing identifies target variables through which interventions could achieve short- and long-term behavior change. Conclusions regarding behavioral implications drawn from this study, however, are limited by the lack of a behavioral outcome and the cross-sectional research design. A test of the proposed model using a longitudinal design and behavioral measures of exercise would afford more definite conclusions about the distinct roles of self-efficacy and self-determination as predictors of behavior change phases, and thereby a stronger test of Rothman's

phased model of behavior change. Moreover, the issue of mediation with respect to self-efficacy versus self-determination in the prediction of behavior initiation could be resolved. Thus, future research is needed to test the model for exercise regulation on a behavioral outcome across several time points (e.g., baseline, 3 months, and 6 months).

In conclusion, concurring with Rothman et al. (2004), we think that it is important to recognize that the initiation and the planning of maintenance of health behavior change is a phased process affected by self-efficacy and self-determination. Whereas a higher sense of self-efficacy regarding exercise behaviors furnishes individuals with the necessary competence to initiate intended behavior change, more self-determined motives for engaging in exercise behavior supply them with the drive to maintain the behavior. It is our hope that the present research has laid the foundation for the study of the distinction between two important processes, namely, the initiation and the maintenance of health behavior change.

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Manuscript submitted: May 19, 2005

Revision accepted: October 13, 2006

The Theory of Planned Behavior: Predicting Physical Activity in Mexican American Children

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Theoretically grounded research on the determinants of Mexican American children's physical activity and related psychosocial variables is scarce. Thus, the purpose of our investigation was to evaluate the ability of the theory of planned behavior (TPB) to predict Mexican American children's self-reported moderate-to-vigorous physical activity (MVPA). Children ($N = 475$, ages 9-12) completed questionnaires assessing the TPB constructs and MVPA. Multiple regression analyses provided moderate support for the ability of the TPB variables to predict MVPA as we accounted for between 8-9% of the variance in MVPA. Attitude, subjective norm, and perceived behavioral control accounted for 45% of the variance in intention. Descriptive results were encouraging because mean values indicated that most children had positive attitudes, moderately strong intentions, felt in control, and perceived support from significant others (i.e., physical education teachers) for their physical activity engagement.

Key Words: social cognitive theory, Latino, health, children, fitness

Understanding the antecedents of minority children's physical activity (PA) involvement is important. Minority children are less likely to engage in nonschool moderate-to-vigorous physical activity (MVPA) and PA in physical education classes (Gordon-Larsen, McMurray, & Popkin, 1999; Kann et al., 1996; Lindquist, Reynolds, & Goran, 1999) and are less fit (Lindquist et al. 1999) compared with Caucasian children. The value of regular PA is well established for adults and includes a reduced risk of colon and breast cancer (Friedenreich & Orenstein, 2002), as well as diabetes, high blood pressure, and heart disease (USDHHS, 1996). Concerning children, PA during childhood is thought to protect mostly against the development of cardiovascular disease, especially if children have abnormal risk factor values (Bar-Or & Rowland, 2004, pp. 129-130). In their study of over 4,000 children, Andersen and colleagues reported that rates of inactivity among Mexican American children were a particular "cause for concern" (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998, p. 942). Based on 1-mile run times, 72% of 306 Hispanic female