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Psychology of Sport and Exercise 9 (2008) 559–575

Psychology

OF SPORT AND EXERCISE

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The *why* and the *how* of goal pursuit: Self-determination, goal process cognition, and participation in physical exercise

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Received 17 August 2006; received in revised form 18 July 2007; accepted 25 July 2007

Available online 7 August 2007

Abstract

Objectives: To examine goal process cognition as a mediator of the relationship between self-determined motivational ratings and strenuous exercise participation.

Design: Cross-Sectional Survey.

Methods: University students ($N = 535$) identified their most important exercise goal and rated this goal according to the nine goal process dimensions of the Goal Systems Assessment Battery (GSAB; [Karoly, P., & Ruehlman, L.S. (1995). Goal cognition and its clinical implications: Development and validation of four motivational assessment instruments. *Assessment*, 2, 113–129]), an instrument derived from Ford's [Ford, D.H. (1987). *Humans as self-constructing living systems: A developmental perspective on behavior and personality*. Hillsdale, NJ: Erlbaum] control systems model of self-regulation. Additionally, students completed measures of self-determination for exercise and leisure-time exercise participation. A multiple mediator model was tested using the Preacher and Hayes [Preacher, K. J., & Hayes, A. F. (2007a). Asymptotic and resampling strategies for assessing and comparing indirect effects in simple and multiple mediator models. Manuscript submitted for publication; Preacher, K. J., & Hayes, A. F. (2007b). SPSS and SAS macros for estimating and comparing indirect effects in multiple mediator models. Retrieved February 9, 2007, from <http://www.comm.ohio-state.edu/ahayes/SPSS%20programs/indirect.htm>] bootstrapping procedure.

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Results: The effect of self-determination for exercise on strenuous leisure-time exercise was fully mediated. Self-determination did not exert a significant direct effect and 72% of its total effect on strenuous exercise was indirect via the goal processes of self-monitoring, planning, and positive arousal for exercise goals.

Conclusions: Findings support the utility of goal process cognition as a means of understanding how self-determination influences strenuous exercise behavior.

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Keywords: Control systems theory; Goals; Multiple mediation; Self-determination

Introduction

Health behavior change has proven to be extremely difficult to accomplish, and the adoption and maintenance of leisure-time exercise has emerged as a particularly daunting task for the average individual. Although many people voice a desire to more frequently engage in exercise activities (Norcross, Mrykalo, & Blagys, 2002), few are able to successfully adhere to the exercise regimens that they initially adopt (Dishman, 1994). This is unfortunate because regular physical activity is associated with a range of beneficial health outcomes such as prevention of cardiovascular disease and obesity (Dietz, 2004; US Department of Health and Human Services, 2000). In light of the so-called “obesity epidemic” in the United States (Flegal, Carroll, Ogden, & Johnson, 2002) and the disappointing results of many programmatic efforts to increase exercise adoption and adherence (Baranowski, Anderson, & Carmack, 1998), some researchers have called for a broadening of theoretical approaches and the inclusion of theory-derived mediating variables in the domain of exercise (Baronowski et al., 1998; Bauman, Sallis, Dzewaltowski, & Owen, 2002; Masse, Dassa, Gauvin, Giles-Corti, & Motl, 2002).

Despite the call for integration, achieving a synthesis of constructs from the diverse theoretical frameworks applied to the study of exercise remains a significant challenge. Karoly (1999) proposed that the complex system of goals and self-regulatory skills articulated by numerous investigators over the past 25 years (cf. Austin & Vancouver, 1996; Bandura, 1986; Carver & Scheier, 1998; Karoly, 1993; Mischel & Shoda, 1995) might enable researchers to study motivationally relevant constructs across diverse but interconnected analytic levels (e.g., traits, motives, situations, etc.). The present research was designed to assess the utility of a *self-regulatory process perspective* as a means of enriching the capability of our theoretical frameworks for understanding exercise participation. Specifically, we sought to address the utility of goal process cognition to explain the link between perceptions of self-determination and exercise participation. In this manner, the present research addresses whether goal cognition can help to explicate how self-determination exerts its influence on exercise behavior.

Researchers using constructs derived from *self-determination theory* (e.g., Deci & Ryan, 2000) has consistently accounted for significant (and meaningful) variance in exercise behavior (Edmunds, Ntoumanis, & Duda, 2006; Li, 1999; Vallerand, 1997; Wilson, Rodgers, Blanchard, & Gessell, 2003). By contrast, goal-centered self-regulatory theory has been sparingly applied to the study of exercise. Thus, the present research holds the promise of combining an established theoretical paradigm with an emergent approach, allowing for a more nuanced understanding of the human motivational system in the context of exercise strivings.

Self-determination, self-regulation, and physical exercise

Self-Determination Theory (SDT) emphasizes need fulfillment as a primary determinant of psychological well-being and successful goal pursuit (Deci & Ryan, 2000), with needs being defined as “innate experiential requirements for thriving that are common to all persons” (Sheldon, 2007, p. 362). SDT presumes people to be “naturally inclined” toward pursuing goals that meet or match their innate needs and to “internalize” the regulation of important if inherently uninteresting activities (such as learning to do long division or maintaining a dietary or exercise regimen). Individuals tend to differ, however, in their degree of internalization, varying along a continuum that reflects autonomous motivation at one end (*intrinsic, integrated and identified* regulation) and controlled motivation at the other (with its *external and introjected* forms). Alternatively, control theory-based self-regulatory theorists focus upon action, decision-making, and individual differences in adjustment and psychological disorder (e.g., Bandura, 1986; Baumeister, Heatherton, & Tice, 1994; Cantor, 1990; Dweck & Leggett, 1988; Ford, 1987; Karoly, 1999; Mischel & Shoda, 1995). They propose that goal pursuit takes place in the context of a multi-component, transactional system (including goals or standards, feedback mechanisms, energizing or arousal functions, and the like). Within this model, persons are seen as varying in the development of and accessibility to the system’s key mediating cognitive-affective components. Although SDT and cybernetic self-regulatory models are not inherently at odds with each other, each adopts a different core focus for explaining motivation and its dysfunctions. Essentially, SDT is concerned with understanding the contents of people’s goals (the *what*) and the reasons *why* individuals pursue a given goal (for autonomous or controlled reasons). By contrast, the primary emphasis of regulatory/control system models resides in the *processes*, or the *how* of goal pursuit (see Deci & Ryan, 2000 for a similar analysis).

Importantly, not all self-regulatory models are alike. The work of Carver and Scheier (1998) and their colleagues is built upon a cybernetic (engineering inspired) conception that was first articulated, in psychological terms, by Powers (1973). People, like complex self-governing machines, act in order to make their current perceptions correspond as closely as possible with their desires (goals, standards, or reference levels). This perceptual control is achieved by detecting errors whose impact upon system functioning is fed back to a central, coordinating element. Within this perspective, goals are viewed as hierarchically organized, task-specific reference values and behavior is always goal-directed and feedback controlled. Karoly’s (1999) conception, although consistent with the cybernetic, control theory view, has also been influenced by the social learning tradition (e.g., Bandura, 1986; Kanfer & Karoly, 1972) and the integrative work of Ford (1987) who has articulated a general “living systems” model of human self-directedness. Central to Karoly’s (1999) model is the role of thinking that is directed toward the process of working toward a goal (termed *goal process representation* or *goal cognition*). The present research makes use of an assessment instrument (the Goal Systems Assessment Battery [GSAB], Karoly & Ruehlman, 1995) designed to gauge the action schema or mental map underlying the individual’s pursuit of valued goals (see below for more detail on the GSAB).

SDT has proven quite successful in explaining exercise-related outcomes. Within this framework, if an individual appraises a goal or activity in an autonomous, non-controlling fashion, he or she will tend to display a myriad of positive outcomes such as increased engagement in the activity in the absence of rewards (Deci & Ryan, 2000). Humans are also hypothesized to

possess three innate psychological needs: the need for competence, for autonomy, and for relatedness. Importantly, individuals' attributions concerning any given goal/activity's contribution to the fulfillment of these needs will result in different types of regulation or motivation. SDT research has demonstrated that the location of an individual's goal or activity-related appraisals along a continuum of internalization can influence behavioral outcomes such as participation in exercise (Li, 1999; Oman & McAuley, 1993; Williams, Grow, Freedman, Ryan, & Deci, 1996) as well as the affective outcomes attendant to exercise participation (Lutz, Lochbaum, & Turnbow, 2003; Ryan, Frederick, Lipes, Rubio, & Sheldon, 1997).

It should be noted, however, that some research findings in exercise settings have revealed that less than fully self-determined regulatory styles (i.e., integrated and/or identified regulation) are better predictors of exercise when compared against fully self-determined forms of intrinsic motivation (Wilson et al., 2003). Such findings are not necessarily contradictory to SDT because, as Ryan (1995) has noted, situational factors can moderate the impact of self-determined vs. non-self-determined regulatory styles on behavioral outcomes. Given that exercise is not inherently enjoyable for most people, and is prompted by both external pressures, such as media campaigns and interpersonal influence, and by internal goads such as health concerns or guilt, it makes sense that there would be some ambiguity as to exactly which regulatory process would best predict exercise participation. Nevertheless, it is *generally* the case that those who report that they exercise for more fully internalized or autonomous reasons tend to engage in more frequent exercise and enjoy it more than those who exercise in reaction to external pressures. Thus, the underlying reason or reasons *why* one pursues exercise can be an important predictor of motivation and motivational outcomes.

In contrast to SDT, perspectives emphasizing goal processes have been applied sparingly to the study of exercise participation (cf. Karoly et al., 2005; Oaten & Cheng, 2006). Yet, because feedback-centered regulatory models depict a diverse set of potentially modifiable factors that may influence the movement of an individual toward desired goals, such frameworks merit further study in the exercise domain.

Self-regulation by definition requires the articulation of goals (or desired end states) and pathways to goal attainment. Goals serve broadly to specify the system's trajectory, or what Ford (1987) calls the *directive* function (incorporating such components as goal value and self-efficacy). Once an end-state is identified, a *regulatory* function (incorporating, among other things, social comparison and self-monitoring) operates to bring the present state into alignment with the goal. Should the regulatory function detect a discrepancy between a goal and the present situation, a *control* function (involving such mechanisms as planning, self-criticism, and self-reward) is called into service to achieve the needed course corrective actions that will move the individual closer to goal attainment. All of these interconnected functions require energy or arousal, and therefore an *arousal* function (with the potential for both positive and negative valence) is postulated. All the aforementioned functions are influenced by the operation of an *information-collection* function that provides input (feedback) to the system from the environment. Thus, although regulatory/control models do not specifically address the *why* of the goal construction by means of an internal–external locus of origin concept, it remains the case that goals, their environmental supports, their hierarchical organization, and their varied modes of pursuit are central to the core operation of self-regulating systems (Dweck, 1996; Ford, 1987; Karoly, 1999; Miller & Brickman, 2004; Toates, 2006).

Goal process representation

To obtain a picture of the regulatory system in action, ratings of process cognition relevant to goal strivings need to be obtained. *Goal process representation* is defined as thinking not about the goal itself (i.e., what it is or *why* we are pursuing it), but about the journey toward the goal (e.g., Working on this goal makes me feel happy; I am aware of my day-to-day behavior as I work on this goal, etc.; Karoly, 1999, p. 273). Because such ratings of goal process are reflective of the human regulatory control system in action, they should play a key role in helping to determine the success of exercise goal striving. Further, they may serve to mediate the relation between perceptions of self-determination and exercise participation. In effect, we propose that an individual's appraisals regarding why they are pursuing exercise goals as measured along the SDT internal–external locus of causality continuum reveals only a portion of the total self-regulatory picture, and that peoples' self-appraisals regarding degree of internalization/self-determination will exert their effects on exercise participation through *goal process representation*—that is, thoughts about the striving process itself (Karoly, 1999).

It should be noted that our hypothesis is not entirely unique. Hagger, Chatzisarantis, and Harris (2006a, 2006b) found that the relationship between relative autonomy for dieting and exercise behaviors and intention for exercise was mediated by constructs derived from the Theory of Planned Behavior (TPB)—namely attitude, perceived behavioral control, and intentions. As Chatzisarantis, Hagger, Biddle, and Karageorghis (2002) note, Deci and Ryan (1980) have postulated that intrinsic motivation is an energizing function to aid cognitive processing in the service of decision making. Accordingly, those individuals who exhibit greater degrees of self-determination will be predisposed to engage in greater evaluation of attitudes, normative and control beliefs, and intentions. While Hagger and colleagues (Chatzisarantis et al., 2002; Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger, Chatzisarantis, & Biddle, 2002; Hagger et al., 2006a, 2006b) have tended to focus on TPB-derived measures of cognition, we propose that control theory measures of goal process cognition offer an appealing alternative set of cognitive mediators of the motivation–behavior relationship.

In a recent study focusing on health behaviors selected by undergraduates (e.g., exercise, nutrition, alcohol consumption), Okun and Karoly (2007) found that participants with partner-set goals had less adaptive goal cognitions and were less likely to report positive health behavior change than participants with self-set or joint-set goals. Furthermore, three aspects of goal processes—self-efficacy, commitment, and social support—mediated the relation between type of goal setting and perceptions of health behavior change. In light of the fact that the distinction between self-set, joint-set, and partner-set goals is somewhat analogous to SDT's concern with degrees of autonomous versus controlled motivation, Okun and Karoly's (2007) findings suggest that goal process cognition may be an effective means by which to understand how strength of self-determination affects progress on exercise goal pursuits.

To date, only one study has examined goal process cognition with an exclusive focus on exercise. In this study, Karoly and colleagues (2005) examined the regulatory goal process cognitions of regular and irregular exercisers in reference to their top exercise goal and the goal that most interfered with exercise. Results revealed that irregular exercisers rated interfering goals as more valued, planned for, and monitored than exercise goals. Also, irregular exercisers indicated that they engaged in more goal social comparison and self-reward vis-à-vis their

interfering goals than their exercise goals. For regular exercisers, however, ratings did not differ between interfering goals and exercise goals. This suggests that regular exercisers are investing more of their self-regulatory resources in their exercise goals, whereas irregular exercisers are allocating such goals less self-regulatory attention than their interfering goals. This implies that goal process cognition, believed to reflect the processes of ongoing self-regulatory functions, plays an important role in the success of one's exercise goal pursuits. Taken together, results of Okun and Karoly (2007) and Karoly and colleagues (2005) suggest that goal process cognition might allow researchers to understand the processes by which self-determined motivation exerts its effects on exercise behavior.

Research questions

Our primary research question was “Does goal process cognition mediate the relation between strength of self-determination for exercise and strenuous leisure-time exercise participation?” We hypothesized that the relation between self-determination and strenuous leisure-time exercise would be mediated either partially or fully by goal process appraisals. As a follow-up research question, we also sought to determine *which* dimensions of goal process cognition serve as the key mediators, thus allowing a more meaningful understanding of *how* greater levels of self-determined motivation result in more frequent exercise engagement.

Method

Participants

Participants for the present study were 535 students enrolled in introductory psychology classes at a large southwestern state university in the US. These students, in exchange for class credit, volunteered to complete a goal identification sheet, and questionnaires to assess goal process appraisals and self-determined motivation for exercise. Of these participants, 323 (60.4%) were female, 146 (27.3%) were male, and 66 (12.3%) did not indicate their sex. Three-hundred forty (63.6%) were Caucasian, 38 (7.1%) were Hispanic, 25 (4.7%) were Asian, 22 (4.1%) were African American, 45 (8.5%) were of other descent or a combination of the above, and 65 (12.1%) did not list their ethnicity. The age of participants ranged from 17 to 37 with a mean of 20.06 (SD = 1.90). Mean Body Mass Index equaled 22.70 (SD = 3.18) and was somewhat higher for males ($M = 24.27$, $SD = 3.48$) than for females ($M = 22.14$, $SD = 2.89$).

Instruments

As part of a larger study concerning goal pursuit, students who agreed to participate were asked to complete survey measures pertaining to their goals in several life domains, motivation for exercise, and leisure-time exercise participation. For the present investigation, only ratings considering exercise goals were considered.

Exercise Motivation Scale (EMS)

The EMS was developed specifically to assess self-determined motivational orientations in exercise as opposed to sport settings, and has demonstrated adequate levels of internal consistency and test–retest reliability ($r = .78-.88$) (Li, 1999). Li (1999) provided evidence for this scale's validity, which has received additional support in a study examining affective responses to exercise bouts (Lutz et al., 2003).

The EMS presents 31 potential reasons (e.g., “To satisfy people who want me to exercise”) or lack of reasons (e.g., “I can't understand why I am doing this”) for participating in exercise. Ratings of the level of agreement with each reason for exercising are made on a scale ranging from 1 “strongly disagree” to 6 “strongly agree.” In order of most to least self-determined, the eight regulatory dimensions assessed by this measure (and sample items/reasons) are: (a) intrinsic motivation to learn (e.g., “For the satisfaction it gives me to increase my knowledge about this activity”), (b) intrinsic motivation to accomplish things (e.g., “For the pleasure of mastering this activity”), (c) intrinsic motivation to experience sensations (e.g., “For the enjoyment that comes from how good it feels to do the activity”), (d) integrated regulation (e.g., “Because it is consistent with what I value”), (e) identified regulation (e.g., “Because I think exercise contributes to my health”), (f) introjected regulation (e.g., “Because I would feel guilty if I did not take the time to do it”), (g) external regulation (e.g., “Because I feel pressure from others to participate”), and (h) amotivation (e.g., “It is not clear to me anymore”). To quantify degree of self-determination, the Self-Determination Index (SDI; Vallerand, 1997) was computed. This index was computed by multiplying amotivation by -3 , external regulation by -2 , introjected regulation by -1 , identified regulation by 1 , integrated regulation by 2 , and the mean of intrinsic motivation to learn, to accomplish things, and to experience sensations by 3 . The mean of all of these adjusted values constituted the SDI. Vallerand (1997) describes a similar procedure to compute a measure of participants' relative level of self-determined motivation such that positive scores reflect self-determined motivation and negative scores indicate non-self-determined motivation.

Goal process appraisal: GSAB

The GSAB (Karoly & Ruehlman, 1995) is a 36-item scale that assesses four process domains or functions of a self-regulating system: (a) the directive function including value (e.g., “this goal is worthwhile”) and self-efficacy (e.g., “I have what it takes to reach this goal”) subscales, (b) the regulatory function including social comparison (e.g., “I evaluate my progress toward this goal in comparison to how well other people are doing in pursuing it”) and self-monitoring (e.g., “I keep track of my overall progress toward this goal”) subscales, (c) the control function including planning (e.g., “I try not to let other goals interfere with this goal”), self-reward (e.g., “I reward myself for working hard on this goal”), and self-criticism (e.g., “I tend to criticize myself when I'm not making progress toward this goal”) subscales, and (d) the arousal function including positive (e.g., “This goal is a source of pleasure for me”) and negative (e.g., “Thinking about this goal gives me an uneasy feeling”) arousal subscales. Ratings for each item are made using a scale ranging from 0 (not at all true for me) to 4 (describes me very well). Each subscale score was created by using the mean for all items comprising it; thus, all subscales had a range of scores of between 0 and 4. Previous research has demonstrated that the GSAB possesses adequate reliability, validity, and consistent factor structure (Karoly & Ruehlman, 1995; Karoly et al., 2005; Lecci, Karoly, Ruehlman, & Lanyon, 1996).

Leisure-Time Exercise Questionnaire (LTEQ)

The LTEQ was developed by Godin and Shephard in 1985 as a means to assess participants' typical exercise participation and was used in the present investigation. In previous research, the LTEQ has shown adequate test–retest reliability ($r_s = .62-.81$: Godin & Shephard, 1985; Sallis, Buono, Roby, Micale, & Nelson, 1993) and has shown concurrent validity with other measures of exercise participation ($r = .32-.61$: Miller, Freedson, & Kline, 1994; Sallis et al., 1993). On this measure, participants were asked, “Considering a typical 7-day period (a week), how many times on average do you do the following kinds of exercise for *more than 15 min* during your *free time*?” Typical weekly frequencies of exercise are reported for light, moderate, and strenuous exercise, respectively.

Although a total score can be created for the LTEQ (Godin & Shephard, 1985), Okun and colleagues (2003) found that motivational variables exert a stronger effect on frequency of strenuous as opposed to moderate and light exercise. Because this finding is also corroborated by other studies using the LTEQ (Godin & Shephard, 1985) as well as other measures of exercise behavior (Sallis & Saelens, 2000), in the present study, we used frequency of strenuous exercise as our dependent variable. Using procedures adopted by Okun, Karoly, & Lutz (2002), Okun et al. (2003), strenuous exercise frequency was rated on a 9-point scale ranging from 0—“never” to 8—“8 times or more a week.” It is acknowledged that assessing frequency of exercise using a 9-point scale may slightly underestimate the mean, and reduce the variance of, exercise scores because it was not possible to respond with frequencies greater than eight times per week. Nonetheless, examination of the distribution of strenuous exercise scores revealed that only 13 (2.4%) participants responded to this item indicating a score of 8 (skewness = .56, kurtosis = $-.39$). Thus, the truncation of the range on this variable is likely to have minimal consequences.

Procedures

Participants were told that they would be asked to complete a series of questionnaires that assessed goals and exercise behaviors. As part of a larger study concerning health and personal goals, participants identified their two most important goals in the domains of exercise, academic, social, and work/family. However, for the present research ratings for only the most important exercise goal were considered and participants were told to keep this goal in mind while completing the GSAB. Additionally, participants completed the EMS and LTEQ.

Data analysis

To examine the proposed mediation model, we employed Preacher and Hayes's (2007a) bootstrapping procedure to extrapolate estimates of direct and indirect effects. While Baron & Kenny's (1986) 4-step test of mediation is used frequently in the psychological literature, this procedure has been criticized on the grounds that it does not (a) test whether the indirect effect is different from zero, (b) have adequate power to detect indirect effects, or (c) examine multiple mediators simultaneously (Preacher & Hayes, 2007a). Preacher and Hayes' strategy employs the use of bootstrapping, a non-parametric re-sampling procedure, to estimate the size of indirect effects using adjusted percentile (asymmetrical) confidence intervals. This procedure is particularly advantageous when applied to the case of multiple mediation, as it is important

not only to determine whether an indirect effect exists, but which mediators contribute meaningfully to that effect. Bootstrapping allows estimation of individual indirect effects and contrasts amongst indirect effects without potential problems due to collinearity that may be a problem in path analysis (Preacher & Hayes, 2007a).

This analysis was performed using SPSS 14.0 with Preacher and Hayes' INDIRECT.SPS macro (Preacher & Hayes, 2007b). Ninety-five percent confidence intervals were employed and 1000 bootstrapping re-samples were run. Confidence intervals were adjusted for bias and contrasts between all significant indirect effects were tested. For these analyses, a list-wise deletion of missing data was employed ($N = 505$).

Results

Descriptive statistics

Participants tended to exhibit more self-determined as opposed to non-self-determined motivation for exercise as demonstrated by a positive mean score on the SDI ($M = 2.0$, $SD = 1.2$). Participants were relatively active, engaging in an average of 2.71 ($SD = 2.06$) bouts of strenuous exercise per week. Additionally, participants generally appeared to value their exercise goals and be efficacious in their ability to attain these goals, exhibiting mean values greater than 3.0 (out of maximum score of 4.0) for these goal process subscales (see Table 1). Intercorrelations among the main study variables are presented in Table 1. Consistent with previous research (Károly & Ruchlman, 1995), correlations among GSAB subscales were positive and generally of a moderate magnitude. The SDI and GSAB subscale scores were generally positively and moderately correlated, though there were a few exceptions. Notably, social comparison and self-criticism exhibited non-significant correlations with the SDI and negative arousal exhibited a

Table 1
Means, standard deviations, coefficient alphas, and correlations among study variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Strenuous exercise/Wk											
2. Self-Determination Index	.27**										
3. Value	.29**	.39**	.88								
4. Efficacy	.20**	.34**	.35**	.83							
5. Social comparison	.14**	.03	.23**	.01	.86						
6. Self-monitoring	.38**	.37**	.55**	.40**	.40**	.65					
7. Planning	.41**	.37**	.58**	.36**	.30**	.70**	.80				
8. Self-criticism	.10*	-.04	.32**	-.02	.51**	.36**	.28**	.89			
9. Self-reward	.21**	.24**	.40**	.23**	.31**	.60**	.48**	.31**	.90		
10. Positive arousal	.37**	.48**	.61**	.39**	.22**	.64**	.62**	.19**	.55**	.89	
11. Negative arousal	.00	-.16**	.19**	-.17**	.47**	.20**	.18**	.56**	.13**	.02	.74
<i>M</i>	2.71	2.00	3.27	3.35	1.55	2.40	2.30	1.87	2.12	2.63	1.06
<i>SD</i>	2.06	1.20	.77	.64	1.10	.72	.90	1.13	1.04	.94	.89

Note: Coefficient alphas are on the diagonal. Listwise $N = 505$; * $P < .05$, ** $P < .01$.

significant, inverse correlation with the SDI. Finally, with the exception of negative arousal, all of the GSAB subscales and the SDI were significantly and positively correlated with strenuous exercise frequency (see Table 1).

Multiple mediator model

The results obtained from using Preacher and Hayes' (2007a) bootstrapping procedure are summarized in Table 2 and Fig. 1. The total effect of self-determination (SDI) on frequency of strenuous exercise (.47) was significant, $t = 6.36$, $SE = .07$, $p < .0001$. However, the direct effect of self-determination on strenuous exercise (.13) was not significant, $t = 1.61$, $p > .10$. The path coefficients, standard errors, and p -values for the multiple mediator model are displayed in Fig. 1.

As Fig. 1 shows, self-determination for exercise was related to all dimensions of goal process cognition with the exceptions of social comparison and self-criticism. Self-determination was positively associated with value, efficacy, self-monitoring, planning, self-reward, and positive arousal for their top exercise goal. Also, there was a significant negative relation between self-determination and negative arousal. Among the goal process cognition variables, self-monitoring, planning, and positive affect exhibited significant direct effects on frequency of strenuous exercise.

Of the nine indirect effects, three were significant. The effect of self-determination on frequency of strenuous exercise was mediated by self-monitoring (indirect effect = .12), planning (indirect effect = .14), and positive affect (indirect effect = .10). The pair-wise contrasts among these

Table 2
Indirect effects of self-determination index on strenuous exercise through proposed mediators

	Bootstrap effect	Normal effect	Normal theory tests ^a			Bias corrected and accelerated C.I.'s	
			SE	Z	P	Lower	Upper
Total effect	.34	.34	.05	6.21	<.0001	.23	.45
Value	.00	.00	.04	.06	.9559	-.08	.07
Efficacy	-.01	-.01	.03	-.53	.5934	-.07	.04
Social comparison	.00	.00	.00	.42	.6771	-.003	.02
Self-monitoring	.12	.12	.04	2.63	.0086	.03	.21
Planning	.14	.14	.04	3.45	.0006	.05	.23
Self-criticism	.00	.00	.00	-.11	.9121	-.02	.01
Self-reward	-.04	-.04	.02	-1.68	.0934	-.10	.01
Positive arousal	.10	.10	.05	1.99	.0471	.003	.21
Negative arousal	.02	.02	.02	1.35	.1756	-.01	.06
Contrasts for indirect effects							
Self-monitoring vs. planning	-.03	-.03	.07	-.41	.6852	-.16	.12
Self-monitoring vs. positive arousal	.01	.01	.07	.16	.8765	-.12	.16
Planning vs. positive arousal	.04	.04	.07	.55	.5855	-.10	.19

^aNormal theory results are reported with bootstrap generated confidence intervals. There were no appreciable differences between normal theory results and bootstrap results for any of the indirect effects or contrasts. Significant ($p < .05$) effects indicated using bold text.

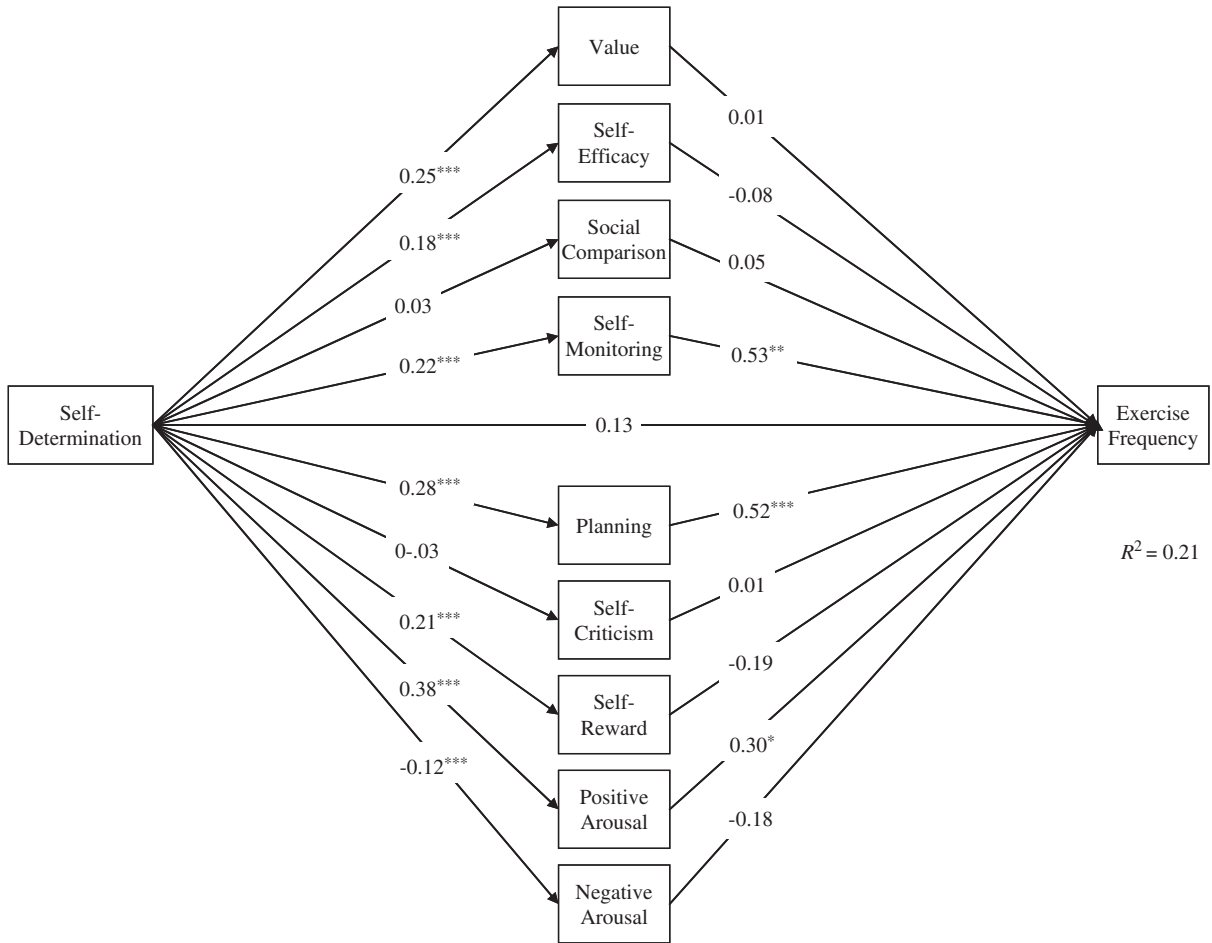


Fig. 1. Coefficients representing effects of Self-Determination Index on goal process mediators and strenuous exercise. * $P < .05$, ** $P < .01$, *** $P < .001$.

indirect effects were non-significant, indicating that the magnitude of these effects is comparable. Overall, the multiple mediator model was significant, $F(10, 494) = 13.13, p < .0001$, accounting for 21% of the variance in strenuous exercise ($Adj. R^2 = .19$).

Discussion

Prior research has generally demonstrated that individuals with higher levels of self-determined motivation engage in greater amounts of leisure-time physical activity than those with less self-determined motivation (Chatzisarantis & Biddle, 1998; Frederick & Ryan, 1993; Oman & McAuley, 1993; Ryan et al., 1997). In the present research, we simplified the relation between self-determined regulatory styles and behavioral outcomes in the exercise domain by using the SDI, a continuous measure of the predisposition toward self-determination, as opposed to the

eight EMS subscales. Yet, when we compared the amount of variance in strenuous exercise explained by the eight EMS subscales versus the SDI scale alone, only a small advantage accrued to using the subscales ($R^2 = .11$ versus $.07$ for the SDI). Given that our primary interest was to examine goal process as a mediator of self-determination for exercise, it seemed preferable in terms of parsimony to use one (the SDI) as opposed to eight (the EMS subscales) exogenous variables in conjunction with the set of nine mediating variables.

Self-determination and goal process cognition

Relatively little attention has been paid in the SDT literature to exploring how differential levels of self-determined motivation exert their influences on behavior. Of research conducted to examine this issue, the majority has examined a small set of possible mediators derived from the TPB (e.g., Chatzisarantis et al., 2002; Hagger et al., 2002, 2005, 2006a, 2006b). Certainly, SDT theorists have sought to demonstrate that self-determined or autonomous motivational styles generally exert positive influences on behavior because such styles arise from the fulfillment of basic needs. Yet, because self-regulatory system models assume that relatively invariant intra-psychoic features such as motives and traits operate in the service of goal attainment, it was deemed reasonable to probe further and ask whether *goal process cognitions* link self-determination tendencies to the self-reported frequency of strenuous exercise. Deci and Ryan (2000), the primary developers of SDT, have stated that self-regulatory control models are useful for understanding the nature of the processes of goal-related strivings and may serve as a means for integrating and comparing constructs across motivational domains.

How do the findings of the present research bear upon our integrative objectives? First, the observed correlations between the SDI and the GSAB ratings of goal process cognition are clearly congruent with the SDT perspective in that perceptions of self-determination for exercise varied positively with patterns of goal cognition. Only the GSAB-derived measures of social comparison and self-criticism were not related to the SDI in our model. Among the goal process variables, three contributed to the prediction of frequency of strenuous exercise—planning, self-monitoring, and positive arousal. Second, one of the most intriguing findings of the present study was that the effect of self-determination for exercise on strenuous leisure-time exercise was fully mediated. Self-determination did not exert a significant direct effect and 72% of its total effect on strenuous exercise was indirect via the goal processes of self-monitoring, planning, and positive arousal for exercise goals. These self-regulatory skills deserve greater attention in future research in the exercise domain.

Research examining other difficult self-regulatory challenges (e.g., weight loss through dietary restraint) likewise supports the role of consistent self-monitoring (Boutelle & Kirschenbaum, 1998). As viewed within the behavior modification tradition, self-monitoring is believed to impact action in at least two ways (Karoly, 2005). First, self-monitoring serves an informational or record-keeping function, providing persons pursuing a change goal with the opportunity to systematically track their to-be-altered performance. Second, self-monitoring has been shown to be therapeutic or change inducing when individuals engaged in self-recording become more mindful of the undesirable or desirable aspects of the monitored actions, and subsequently undertake the initial steps toward habit change.

Goal planning likewise was found to mediate the relation between self-determination motives and exercise frequency in the present study. This finding may be better understood in light of Sniehotta, Scholz, and Schwarzer's (2005) demonstration that planning serves as an important mediator between intention and action. Many of the extant social cognitive theoretical models of change (e.g., Health Belief Model, TPB) when directed toward the exercise domain have predicted intent to exercise more effectively than exercise behavior (Godin & Kok, 1996). Perhaps the missing element in these models is goal planning. Similarly, although self-determined forms of motivation may support one's intention to exercise, it may be necessary to engage in regulatory action (i.e., planning) to bridge the gap to action. In support of the importance of planning for successful exercise goal pursuit, Milne, Orbell, and Sheeran (2002) found that participants who formed "implementation intentions" (see Gollwitzer, 1993) consisting of plans for when and where they would exercise exhibited greater levels of exercise participation than those who did not form such intentions. The present research raises the possibility that self-determined motivation may enhance goal-related planning processes leading to increased exercise participation. In a series of studies, researchers have focused on a small set of possible mediators derived from the TPB (e.g., Chatzisarantis et al., 2002; Hagger et al., 2002, 2005, 2006a, 2006b). Our findings support Chatzisarantis and colleagues' (2002) proposition that self-determination has a positive influence upon deliberative processing of cognitive elements such as planning. It would be interesting to examine if planning (and other goal process constructs) moderate the relationship between intent and exercise behavior, perhaps combining models tested by Hagger and colleagues (2006a, 2006b) and our own. For example, the relationship between intent to exercise and exercise behavior may be stronger among individuals who generate implemental intentions, create barrier-related contingency plans, and develop exercise schedules relative to those who do none of these things.

With regard to the impact of arousal, self-regulatory/control systems theory and research highlight the process whereby "error signals" generated by the comparison of current outcomes against goals or standards yields an affective response. Positive arousal is the expected response when goal progress occurs at a relatively high rate (Carver & Scheier, 1998) or simply when one perceives progress toward goal realization (Lazarus, 1991). More importantly for our purposes, the link between positive affect and persistent action has been widely investigated, with the general conclusion being that positive affect facilitates approach to distant goals, maintains long-term commitment or goal engagement, and, at least at moderate levels, facilitates cognitive processing (Carver & Scheier, 1998; Ciompi & Panksepp, 2005).

Self-monitoring, planning, and positive arousal thus constitute a triad of targets for interventions designed to increase the frequency of strenuous exercise by college age individuals who attribute to themselves varying degrees of self-determination. Future research should examine the combination of various strategies aimed to increase self-determined motivations for exercise in conjunction with a variety of self-regulatory strategies such as self-monitoring, providing feedback, or developing implementation intentions. Perhaps focusing on both the why and the how of exercise engagement will be more effective than focusing solely on either one.

Limitations

Although the present research provides a snapshot of the means by which self-determined motivation and goal process cognition influence exercise behavior, it should be acknowledged that

several salient limitations apply. First, as is true for much of the literature in this area, the present study relied upon a correlational design that does not permit definitive statements regarding causal direction. Second, the current gold standards for physical activity/exercise measurement (Montoye, 2000) include a 7-day recall format (Sallis et al., 1985) or the use of accelerometers (Freedson & Miller, 2000). Although we readily acknowledge the limitations of using a simple self-report measure of exercise (with its potential for poor recall, social desirability, or poor understanding of terms such as exercise or physical activity; cf. Sallis & Saelens, 2000), such global self-report measures of exercise have previously been shown to have good reliability and validity (Ainsworth, Montoye, & Leon, 1994), particularly when examining exercise of a more strenuous nature (Sallis & Saelens, 2000). Third, the generalizability of our findings may be limited in that the present sample consisted of a relatively homogeneous group of young, healthy, and moderately active university students. However, it should be noted that college students are considered to be an at-risk population with respect many health behaviors including lack of exercise (Leslie et al., 1999; Sands, Archer, & Puleo, 1998).

Despite these limitations, the present research aptly demonstrated the feasibility of combining self-regulatory and goal cognition with SDT constructs, and holds the promise of broadening researchers' theoretical armamentarium in the domain of exercise participation. Future research should employ longitudinal designs and attempt to manipulate participants' self-determined regulatory styles and/or goal process cognitions to examine resultant effects on exercise behaviors. Such experimentation may have the promise to allow insight as to the causal nature of the relations among self-determination, goal cognition, and frequency of exercise behavior. Additionally, such research may inform the design of interventions by exercise professionals in their attempts to increase exercise participation.

Acknowledgments

We would like to thank the anonymous reviewers' for their thoughtful and constructive contributions to this work.

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