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Relations of Changes in Self-Efficacy, Exercise Attendance, Mood, and Perceived and Actual Physical Changes in Obese Women: Assessing Treatment Effects Using Tenets of Self-Efficacy Theory

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Obese and sedentary women (*N* = 76) initiated an exercise and nutrition program based on self-efficacy theory. Significant within-group improvements in body fat, waist size, and body mass index were found over 6 months. Changes in Physical Self-Concept (task self-efficacy) and Exercise Self-Efficacy (self-regulatory efficacy) scores, together, accounted for a significant portion of the variance in exercise session attendance, R^2 = .24, F = 11.67, p < .001, with both significantly contributing to the overall explained variance. Exercise attendance was significantly related to changes in Body Areas Satisfaction (β = .39) and Total Mood Disturbance (β = -.27) scores. Findings suggested a path from increased self-efficacy, to exercise attendance, to improvements in body satisfaction and overall mood. Suggestions for replication and extensions were given.

Key Words: Physical activity, mood, self-efficacy, self-image, behavior change

Physical activity is an important component of many weight loss programs and the best predictor of maintained weight loss (Miller, Koceja, & Hamilton, 1997; Pronk & Wing, 1994). Although about two-thirds of individuals report using exercise as a weight loss strategy, drop out from newly initiated regimens is high, ranging from 50 to 65% in the first 3 to 6 months (Annesi, 2003b; Dishman, 1988). Higher body mass index, weight,

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and body fat are associated with the poorest rates of attrition (Tryon, Goldberg, & Morrison, 1992). Interventions focused on improving adherence to exercise have been based on a variety of theoretical models of human behavior and have frequently been atheoretical. Effects over the last several decades have been inconsistent and disappointing (Holtzman et al., 2004; Jeffery et al., 2000; Kahn et al., 2002). A problem with achievement of systematic progress in treatment effects may be that research typically fails to evaluate interventions' effects on predictor variables that, assumedly, the treatments were designed to affect change in, based on their respective theoretical foundations (Rothman, 2004). This is in contrast with strong suggestions to incorporate analyses of possible predictors and mediators in trials of intervention effects (Baranowski, Anderson, & Carmack, 1998; Baron & Kenny, 1986).

Social cognitive theory (Bandura, 1986) and its derivative self-efficacy theory (Bandura, 1997) have been frequently cited as bases for exercise adherence interventions (Kahn et al., 2002). Social cognitive theory posits that human functioning is dependent on the reciprocal nature of personal factors (cognitive, affective, and biological events), environmental factors, and behavior (Bandura, 1986). Self-efficacy theory states that judgment of one's capabilities to organize and execute required actions are the foundation for human motivation, persistence, well-being, and personal accomplishment (Bandura, 1997). Few studies, however, have tested whether exercise was associated with variables that would have been predicted by theory. For example, if an exercise treatment based on self-efficacy theory emphasizes short-term goal progress in an effort to improve participants' sense of competence and thus increase adherence, researchers should not only assess the treatment's association with subsequent exercise behaviors, but also if perceptions of competence occurred, and whether they were associated with changes in the target behaviors. Analyses should also be sensitive to the dynamic nature of related psychological processes, and thus incorporate assessment of *changes* in corresponding variables over the course of treatment (Baranowski et al., 1998).

A 6-month exercise adherence intervention, based largely on the self-efficacy theory components of self-regulatory efficacy, or one's perceived ability to utilize internal resources to persevere (i.e., self-management and self-regulatory skills), and task self-efficacy, or self-appraisal of one's physical abilities to carry out the task at-hand, was tested (Annesi, 2003b; Annesi & Unruh, 2004; also see McAuley, Peña, & Jerome, 2001 for discussion on self-efficacy components). The intervention consisted of one-on-one meetings with a trained exercise leader, and administration of a protocol guided by a computer program. In an effort to induce perceptions of competence with exercise, manageable amounts were suggested incorporating preferred physical activities. Analyses of changes in feeling states from before to after exercise were used to assess acceptability of durations and intensities. Additionally, training in an array of self-management and self-regulatory skills (e.g., goal setting, relapse prevention, cognitive restructuring, stimulus control, dissociation, and self-reward) was incorporated. A behavioral contract was administered, and methods for self-monitoring and obtaining progress feedback through use of the computer program were incorporated.

The protocol was intended to induce feelings of progress, mastery, and physical competence in participants, and enable idiosyncratic barriers to exercise to be effectively dealt with. Testing in fitness and wellness settings in the United States and Europe demonstrated significant reductions in dropout of one-third to one-half that of typical exercise counseling (Griffin, 1998), and significant improvements in exercise session attendance, physiological factors, and mental health factors (Annesi, 2000, 2003b). Additional findings suggested that progressive improvements in mood (e.g., depression, tension, fatigue) were associated with adherence (Annesi, 2004), and only moderate frequencies and durations appeared to be required to induce significant changes (Annesi, 2003a; Moses, Steptoe, Mathews, & Edwards, 1989). Although significant reductions in weight, body fat, and waist circumference were found, perceptions of bodily changes and health risks corresponded only weakly to the actual changes in the formerly sedentary women participants (Annesi, 2000, 2006a; Ben-Shlomo & Short, 1986). It was proposed that participants might have *perceived* positive outcomes due to effects of enhanced feelings of mastery over their own health behaviors; however, this was not directly tested. The protocol had also not been tested with exclusively obese samples, or with a nutrition component. Because little was known about variables associated with or mediating the effects of the intervention on exercise behaviors, and whether changes on those factors are consistent with predictions based on self-efficacy theory, the present field investigation was conducted.

Based on principles of self-efficacy theory, and consistent with the previously described treatment results, it was thought that the present intervention would be associated with improvements in perceptions of one's physical abilities to complete exercise (i.e., task self-efficacy), self-management competencies related to completing exercise (i.e., self-regulatory efficacy), satisfaction with one's body, overall negative mood, and actual physiological changes. Based on self-efficacy theory, however, it was unclear whether changes in exercise-related self-efficacy would be expected to be directly related to changes in body satisfaction and overall mood (Model 1), possibly with exercise session attendance being a mediator (Model 2), or whether improvements in self-efficacy would be associated with higher exercise session attendance which, in turn, would predict changes in body satisfaction and mood (Model 3). It was also unclear whether the proposed models should account for components of self-efficacy (i.e., self-regulatory efficacy and task self-efficacy) separately or together.

Thus, the present field investigation was conducted to test direct, mediated, and path relationships in self-efficacy, exercise behavior, body satisfaction, and mood, extrapolated from self-efficacy theory and represented within the above three models. Analyses incorporated both changes in measures of components of self-efficacy independently, and combined with one another. Also tested were relations of body satisfaction with actual physical changes in one's body. To assess possible mediation, methods described by Baron and Kenny (1986) were used. It was hoped that findings would clarify possible bases of treatment effects, shape the direction of further theoretical and intervention research, and enable refinement of intervention components that may promote reductions in the modifiable health risk of physical inactivity and its associated pathologies.

Method

Participants

Women volunteered to be a part of this research by responding to advertisements in local newspapers. Inclusion criteria consisted of (a) minimum age of 21 years, (b) being obese (body mass index; BMI [kg/m^2] 30 to 45), (c) no regular exercise (more than one session/week) undertaken within the previous year, and (d) reporting a goal of weight loss. Individuals with selected physical pathologies were also excluded. Written confirmation of adequate physical health to participate was required from a medical professional. Institutional review board approval was received, and informed consent was obtained from all participants.

Participants agreed to complete required physiological and psychological assessments, record exercise electronically during the 6-month duration of the study, and participate in a group-based nutritional intervention program for weight management. Women with complete data sets at baseline (95% of those who originally volunteered) were retained. In six cases, participants who terminated exercise during the initial 2 months of the investigation could not be reached for assessments at Month 6. To minimize biasing of results by excluding them, and consistent with recent suggestions (Gadbury, Coffey, & Allison, 2003), their scores at baseline were imputed for subsequent analyses (i.e., last observation carried forward method). Thus, a modified intent-to-treat design was incorporated. The sample size was 76 with an age range of 23 to 59 years (M = 45.4, SD = 10.1). BMI was 30.0 to 44.7 (M = 36.6, SD = 4.3). Ethnic group make-up was 58% White, 37% African-American, and 5% of other races. Eighty-four percent were in the lower-middle to middle classes.

Measures

Consistent with previous research (Annesi, 2006b, 2007), the Exercise Self-Efficacy Scale (Marcus, Selby, Niaura, & Rossi, 1992) was used to measure exercise barriers self-efficacy, or confidence in using internal resources to overcome common barriers to completing regular exercise (i.e., self-regulatory efficacy). The scale required responses to five items which began with the stem, "I am confident I can participate in regular exercise when:" (e.g., "I am in a bad mood," "It is raining or snowing," "I feel I don't have the time"), anchored by 1 (*not at all confident*) and 7 (*very confident*). Items were based on previous research (e.g., Sallis, Pinski, Patterson, & Nader, 1988) indicating that areas of negative affect, resisting relapse, and making time for exercise are correlates of maintaining regular physical activity. Internal consistencies were .82 and .76, and test-retest reliability over 2 weeks was .90 (McAuley & Mihalko, 1998). Score totals significantly discriminated between participants in different stages of readiness to exercise (Marcus et al., 1992).

Consistent with previous research (Annesi, 2006b, 2007), the Physical Self-Concept Scale of the Tennessee Self-Concept Scale (Fitts & Warren, 1996) was used to measure feelings of adequacy regarding the physical self (i.e., task self-efficacy). The scale required responses to 14 items based on item clusters of identity (e.g., "I have a healthy body"), satisfaction (e.g., "I am neither too fat nor too thin"), and behavior (e.g., "I am not good at games and sports") anchored by 1 (*always false*) and 5 (*always true*). This scale is, however, unidimensional and only a total score is recorded. The internal consistency was .83, and test-retest reliability over 1 to 2 weeks was .79 (Fitts & Warren, 1996). Significant correlations with the Psychasthenia scale of the Minnesota Multiphasic Personality Inventory, the Nash Body Image Scale, and the Body Shape Questionnaire suggested concurrent validity in women (Fitts & Warren, 1996; Popkess-Vawter & Banks, 1992).

The Body Areas Satisfaction Scale of the Multidimensional Body-Self Relations Questionnaire (Cash, 1994) evaluated satisfaction with specific aspects of the body (e.g., lower torso [buttocks, hips, thighs, legs], mid torso [waist, stomach], weight). It required responses to five items anchored by 1 (*very dissatisfied*) and 5 (*very satisfied*). For females, the internal consistency was .73, and test-retest reliability was .74 (Cash, 1994).

Total Mood Disturbance is an aggregate measure of negative mood derived by summing the Profile of Mood States - Short Form (McNair, Lorr, & Droppleman, 1992) scales of Tension, Fatigue, Depression, Confusion, and Anger, and subtracting Vigor. Respondents rate how much specific feelings were felt over the past week on 30 items (e.g., Tense, Sad, Worn out) anchored by 0 (*not at all*) and 4 (*extremely*). Internal consistency was .84 to .95, and test-retest reliability at 3 weeks averaged .69. The factor structure has been consistent across normal and psychiatric patients. Concurrent validity was demonstrated through contrasts with other valid measures such as the Manifest Anxiety Scale, the Beck Depression Inventory, and the Minnesota Multiphasic Personality Inventory-2 (see McNair et al., 1992, pp. 13-15, for a review of validation research).

A recently calibrated scale and tape measure were used to assess waist circumference and BMI. Body fat percentage was assessed using skinfold calipers at three sites (abdomen, ilium, and tricep) and applying the Jackson-Pollock equation (see Golding, 2000).

Measurement of attendance of exercise sessions followed from previous research (e.g., Annesi, 2003; Martin et al., 1984). Because participants were assigned three cardiovascular exercise sessions per week, attendance percentage was the ratio of sessions attended divided by the "ideal" number of sessions or 72 (24 weeks x 3 sessions per week). To protect against high numbers of exercise sessions completed in a single week (typically soon after program initiation) distorting the measurement of attendance over the length of the study, more than three sessions completed in a week was coded "3." Sessions completed were based on data collected from participants' logging of exercise completed into a computer kiosk at an experimental facility or through the Internet. Acceptability of this method was indicated through significant correlations (*r*s = .42 to .55) between reported exercise session attendance and changes in cardiorespiratory function (e.g., $VO_{2\ max}$, blood pressure, resting heart rate) (Annesi, 2000).

Change scores on all measures were calculated by subtracting the baseline score from the score at Month 6.

Procedure

Participants were given access to YMCA wellness centers. Testing of the physiological and psychological factors was at baseline and at Month 6. A series of six, 1-hour meetings with a trained wellness staff member, spaced across 6 months, were provided each treatment group participant. These one-on-one meetings included an orientation to available exercise apparatus (e.g., treadmills, stationary bicycles) and administration of a cognitive-behavioral treatment protocol designed to support maintenance of exercise. Goal setting and progress feedback, and other cognitive-behavioral methods such as contracting, stimulus control, cognitive restructuring, and dissociation from exercise-induced discomfort were presented (see Annesi, 2003, or contact the first author for a more complete written description of the treatment used).

Although specific modalities used in exercise plans (e.g., type of cardiovascular machines, incorporation of outdoor walking/running) were based on each participant's preference, three exercise sessions per week were assigned. The cardiovascular exercise progressed from a minimum of 20 minutes to a maximum of 30 minutes per session at a Rate of Perceived Exertion (Borg, 1998) of 13 to 14 (estimated 60 to 70% $VO_{2\ max}$). Exercise sessions could be completed both inside and outside of the exercise facilities provided. Computerized kiosks were provided within wellness centers to record exercise completed. The Internet, which participants reported having easy access to, was also available as a method for recording exercise. Graphic summaries of exercise completed could be reviewed any time at the kiosks or over the Internet.

Participants were also provided six, 1-hour nutrition information sessions over the initial 3 months. These were taught by registered dietitians in a group format of approximately 15 participants, and were based on a standardized protocol (see Kaiser Permanente Health Education Services, 2002, or contact the first author for a more complete written description of the treatment used). A corresponding workbook with homework assignments was provided to all participants. Examples of curriculum components were: (a) understanding calories, carbohydrates, protein, and fats; (b) using the food pyramid for number of servings and portion control; (c) developing a plan for low-fat, low-sugar snacking; and (d) menu planning.

Results

Statistical significance was set at $\alpha = .05$ (two-tailed). As was suggested for preliminary research such as this, which is driven by *a priori* theory, no adjustments were made for multiple tests (see Perneger, 1998). Analyses indicated a sufficient sample size to detect a moderate effect at the minimum recommended statistical power of .80 (Cohen, 1992). Change scores over 6 months in the psychological factors of Exercise Self-Efficacy, Physical Self-Concept, Body Areas Satisfaction, and Total Mood Disturbance; and the physiological factors of percent body fat, waist circumference, and BMI; are summarized in Table 1. Exercise session attendance ranged from 21 to 100% (M = 68.33%, SD = 21.07). Change scores in variables to be utilized in each of the three proposed predictive models, and exercise session attendance, were tested for normality of distribution. In each case, there was less than 2 standard errors of skewness (< .55) and 2 standard errors of kurtosis (< 1.09) which indicated an approximately normal distribution, and enabled subsequent planned analyses.

Table 1
Changes in Scores on Psychological and Physiological Factors Over 6 Months

	Baseline		Month 6		Paired differences (Change scores)			$t(75)$	p	d
	M	*SD*	*M*	*SD*	M_{diff}	SE_{diff}	95%Confidence Interval			
Psychological factor										
Exercise Self-Efficacy	16.89	4.12	17.74	3.40	0.84	.39	0.06, 1.63	2.13	.036	.21
Physical Self-Concept	37.01	5.40	38.34	3.88	1.33	.57	0.18, 2.48	2.31	.024	.25
Body Areas Satisfaction	9.76	1.92	12.39	2.08	1.32	.57	2.15, 3.12	10.81	<.001	1.37
Total Mood Disturbance	12.53	11.15	3.18	13.06	-9.34	1.99	-13.30, -5.38	-4.70	<.001	-.84
Physiological factor										
Percent body fat	39.10	3.76	34.76	5.61	-4.34	.56	-5.45, -3.23	-7.81	<.001	-1.15
Waist circum. (cm)	104.88	9.23	99.92	9.19	-4.95	.78	-6.52, -3.40	-6.33	<.001	-.54
BMI	36.64	4.32	34.51	4.24	-2.13	.29	-2.72, -1.54	-7.22	<.001	-.49

Note. M_{diff} = Mean of difference scores; SE_{diff} = standard error of difference scores; *d* = Cohen's measure of effect size.

Because a significant relationship between changes over 6 months in Body Areas Satisfaction scores, and changes in scores of Exercise Self-Efficacy, Physical Self-Concept, and both entered simultaneously into a multiple regression equation, was not found (see Table 2), the possibility of changes in self-efficacy *directly* affecting changes in body satisfaction was discounted.

Table 2
Results of Simultaneous Linear Multiple Regression Analyses for Prediction of Changes in Body Areas Satisfaction Scale Scores (Model 1)

	β	*R*	R^2	*F*(2, 73)	*p*
		.208	.043	1.65	.199
Δ Exercise Self-Efficacy	.160				.343
Δ Physical Self-Concept	.110				.170

Note. The delta symbol (Δ) indicates change in scores from baseline to Month 6.

Because relations of changes in self-efficacy factors and body satisfaction did not reach statistical significance, further analyses to determine if exercise attendance fulfilled the established criteria as a mediator was unnecessary (see Barron & Kenny, 1986, p. 1177). Similarly, because a significant relationship between changes in Total Mood Disturbance scores, and score changes in Exercise Self-Efficacy, Physical Self-Concept, and both entered into a multiple regression equation, was not found (see Table 3), the possibility of changes in self-efficacy *directly* affecting changes in overall mood was discounted. Thus, proposed Model 1 and Model 2 were discounted.
Note. The delta symbol (Δ) indicates change in scores from baseline to Month 6.

Table 3
Results of Simultaneous Linear Multiple Regression Analyses for prediction of Changes in Total Mood Disturbance Scores (Model 1)

	β	*R*	R^2	*F*(2, 73)	*p*
		-.237	.056	2.18	.120
Δ Exercise Self-Efficacy	-.075				.518
Δ Physical Self-Concept	-.215				.066

Note. The delta symbol (Δ) indicates change in scores from baseline to Month 6.

Linear multiple regression analyses with simultaneous entry of predictor variables indicated that a significant portion of the variance in exercise session attendance was accounted for by score changes over 6 months in the self-efficacy factors of Exercise Self-Efficacy and Physical Self-Concept, $R = .492$, $R^2 = .242$, $F(2, 73) = 11.67$, $p < .001$. Changes in both Exercise Self-Efficacy ($\beta = .304$, $p = .004$) and Physical Self-Concept ($\beta = .344$, $p = .001$) scores made significant, unique contributions to the overall explained variance in exercise attendance. Exercise attendance percentage was significantly related to changes in scores in both Body Areas Satisfaction ($\beta = .387$, $p = .001$) and Total Mood Disturbance ($\beta = -.273$, $p = .017$). Thus, proposed Model 3 was accepted. A path representation is given in Figure 1.

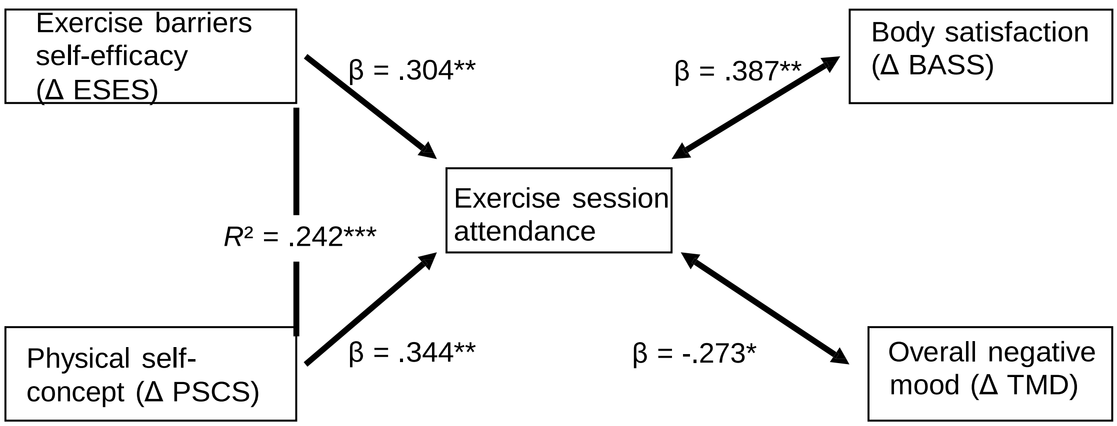

Figure 1. Path representation of proposed relationships of changes in self-efficacy variables, exercise session attendance, body areas satisfaction, and mood disturbance changes (Model 3).

ESES = Exercise Self-Efficacy Scale. PSCS = Physical Self-Concept Scale of the Tennessee Self-Concept Scale. BASS = Body Areas Satisfaction Scale of the Multidimensional Body-Self Relations Questionnaire. TMD = Total Mood Disturbance scale of the Profile of Mood States - Short Form. The delta symbol (Δ) indicates change in scores from baseline to Month 6.
$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

When changes in waist circumference, percent body fat, and BMI were simultaneously entered into a multiple regression equation as proxy of *actual* physiological changes, 33% of the variance in *perceived* bodily changes (changes in Body Areas Satisfaction Scale scores) was accounted for, $R = .575$, $R^2 = .331$, $F(3, 68) = 11.21$, $p < .001$.

Discussion

The present research assessed relations of changes in theoretically derived components of self-efficacy, and exercise session attendance, changes in body satisfaction, and changes in overall mood in a group of obese women initiating a supported exercise and nutritional weight management program. Significant within-group improvements in physical self-concept, exercise barriers self-efficacy, body satisfaction, and overall mood over 6 months were suggested, although this should be interpreted with caution due to a control condition not being employed. Additionally, significant within-group improvements in body fat, waist circumference, and BMI were found. Exercise session attendance was similar to research using the present intervention with adults who were not specifically identified as obese (Annesi, 2003b).

Of the three models extrapolated from self-efficacy theory, only Model 3 demonstrated the predicted relations. Model 1 failed to detect significant direct relations between measures of self-efficacy and both body areas satisfaction and overall mood. Because this relationship was a prerequisite for testing whether exercise session attendance was a mediator, Model 2 was also discounted. It should be noted, however, that all proposed relations in these two models were in the predicted direction, but lacked sufficient strength to reach statistical significance. In support of Model 3, results suggested that a significant portion of the variance in exercise session attendance was accounted for by entry of changes in Physical Self-Concept Scale and Exercise Self-Efficacy Scale scores into a multiple regression equation. Both predictor variables demonstrated unique, significant contributions to the overall explained variance. Thus, when participants improved their perceptions of both their physical abilities (i.e., task self-efficacy), and ability to overcome barriers to exercise (i.e., self-regulatory efficacy), they tended to maintain their assigned exercise regimens better. Exercise attendance was, in turn, significantly associated with both improved mental health (i.e., reduced mood disturbance) and perceived physical improvements (i.e., improved satisfaction with one's body).

Although physiological explanations of the exercise-mental health relationship have been offered (see Morgan, 1997, for a review), self-efficacy theory again appeared supported through a demonstrated association of accomplishment of a difficult task (maintaining an exercise regimen) and improved mood. The proposed reciprocal relationship based on improved mood being associated with exercise, and thus its frequency being increased, also was supported. Similar perceptual mechanisms conceptually linked to accomplishment of regular exercise may have promoted increased satisfaction with one's body. Perceptions of an improved body, reciprocally, may have advanced regular exercise because of an assumed association by participants. Again, elements of self-efficacy theory were supported. It should be noted, however, that directionality of exercise with perceived bodily improvements and improved mood could not be directly evaluated here.

Results supported previous findings suggesting that relations of perceived physical changes and actual bodily changes have limited correspondence (Annesi, 2000, 2006a; Ben-Shlomo & Short, 1986). Although this may have been related to aspects of the intervention itself (e.g., an emphasis on perceived competence), it is likely that self-evaluations will typically be affected, to a considerable extent, by perceptual (as opposed to actual) changes. This may have implications for treatment design through incorporation of an initial focus on enhancing *perceptions* of incremental progress, over *measured* physiological changes (which is common practice).

Although findings supported and extended previous research on self-efficacy and exercise behavior in adults (e.g., McAuley, 1992; Oman & King, 1998; Trost, Owen, Bauman, Sallis, & Brown, 2002), replication with different samples will be required to increase confidence in findings and more comprehensively test self-efficacy theory. A control group should be utilized to better deal with potential confounds in treatment effects such as expectation and demand characteristics (Ojanen, 1994). It is also not known how different treatment protocols and amounts of exercise assigned may affect results. Possibly inclusion of additional predictor variables that may be affected by treatment may increase the explained variance in attendance in a manner meaningful for development of interventions. Of course, they too would need to be driven by a priori theory. Although experimental control may have been somewhat compromised in the present field design, it is not recommended that replication be conducted under laboratory conditions because of possible adverse effects on generalizability of findings for practical settings.

As research such as this is replicated and extended, it is hoped that a comprehensive model of exercise, changes in psychological and self-perception factors, and weight loss emerges. As summarized by Baker and Brownell (2000), such relationships are not presently well understood. Because weight loss interventions are increasingly concerned with maintaining weight which is lost (Cooper, Fairburn, & Hawker, 2003), and regular physical activity is the best predictor of sustaining weight loss (Miller, Koceja, & Hamilton, 1997; Pronk & Wing, 1994), continued study of relations of variables related to treatment effects is warranted.

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