

# To See or Not to See: Effects of Exercising in Mirrored Environments on Sedentary Women's Feeling States and Self-Efficacy

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Effects of a mirrored exercise environment and body image concerns on changes in exercise-induced feeling states and self-efficacy were examined among 58 sedentary women (mean age = 20.7 years). Participants performed a 20-min bout of exercise in front of either a mirrored or a nonmirrored wall. Feeling states and self-efficacy were measured pre- and postexercise. Multilevel linear modeling indicated that regardless of their level of body image concern, women in the mirrored condition felt worse after exercising than women in the unmirrored condition. There were no effects of the environment or body image on self-efficacy. Results are consistent with predictions of objective self-awareness theory and have implications for promoting exercise among sedentary women.

*Key words:* physical activity, affect, body image, environmental effects

A growing body of research focuses on understanding the determinants of physical activity and developing interventions to promote physical activity among the largely sedentary populations of industrialized nations (U.S. Department of Health and Human Services [USDHHS], 1996). In an effort to bridge the gap between research and practice, organizations such as the American College of Sports Medicine (ACSM) formulate guidelines to help interventionists adopt state-of-the-art practices for promoting more active lifestyles. One such guideline suggests that all exercise classrooms “should have mirrors on at least two of [their] four walls” (ACSM, 1997, p. 9.G22). Although these guidelines may aid exercisers in improving their form and maximizing the physical benefits of workouts, it is possible that the presence of mirrors has some negative effects. Specifically, preliminary studies indicate that the psychological benefits that are typically associated with acute bouts of exercise—that is, an increase in positive mood and a decrease in negative mood (Gauvin, Spence, & Anderson, 1999) and an increased sense of self-efficacy (McAuley & Blissmer, 2000)—may not be experienced when the exercise is performed in front of a mirror (Focht & Hausenblas, in press; Katula, McAuley, Mihalko, & Bane, 1998). The purpose of this study was to further examine the effect of exercising in front of a mirror on feeling state and self-efficacy changes in a sample of sedentary young women.

## Extant Empirical Research

To our knowledge, there are three published studies in which researchers have examined the effects of exercising in front of a mirror in moderating the effects of exercise on psychological changes. In the first study (Katula et al., 1998), exercise self-efficacy levels in mirrored versus unmirrored exercise settings were compared using a sample of moderately active men and women. In the mirrored condition only, women's self-efficacy was significantly lower than men's, and body image concerns predicted self-efficacy. The authors suggested that women's self-focus was increased by the presence of the mirror, which in turn led to increased body image concerns that were instrumental in decreasing self-efficacy. Conversely, Katula and McAuley's (2001) follow-up study of highly active women revealed that a bout of exercise performed in front of a mirror actually increased self-efficacy. Perhaps for this sample of highly experienced exercisers, seeing themselves use proper technique increased their feelings of mastery and, ultimately, exercise self-efficacy.

In the third study (Focht & Hausenblas, in press), researchers examined the effects of exercise performed in a public, mirrored setting and a private, unmirrored setting on exercise-induced feeling states. Participants were low-active women with high social physique anxiety. While exercising, the women experienced negative changes in some feeling states, but only in the public mirrored condition. Unfortunately, the mirrored exercise condition was conducted in a public gym facility, so it is impossible to determine whether the observed effects were due to perceived social evaluative threat (due to the presence of others), increased self-awareness (due to the presence of the mirror), or some combination of these factors. Nonetheless, when considered along with Katula et al.'s (1998) findings, these results suggest that if exercise is performed in a mirrored environment, women who are highly concerned about their physical appearance may not incur the

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positive psychological benefits that are typically associated with exercise.

### Related Theorization

The negative effects of mirrors have been demonstrated in other contexts within the framework of objective self-awareness theory (Duval & Wicklund, 1972). This theory posits that any stimulus that causes focus on the self, such as the presence of a mirror, can lead to a state of increased self-awareness. This state is characterized by a greater awareness of internal sensations and the elicitation of a self-evaluation process whereby individuals compare themselves with standards or ideals that are salient in the situation. When the self-evaluation process results in a perceived discrepancy between the actual and the ideal self, negative self-evaluations and negative affect will occur. In support of this theory, numerous studies have shown that gazing at oneself in a mirror increases self-focus and can lead to increased negative mood, particularly among women (for a meta-analytic review, see Fejfar & Hoyle, 2000).

### The Present Study

It was predicted that women who exercised in front of a mirror would experience a negative change in feeling states after exercising whereas those who exercised without a mirror would experience a positive change. Given that previous studies have produced mixed findings for the effects of mirrors on exercise self-efficacy, self-efficacy was also included as a study variable. In addition, in the present study we explored the moderating effects of body image concerns on affective responses to exercising. On the basis of the tenets of objective self-awareness theory, women who are prone to negatively evaluate their physiques (i.e., those with a poor body image) should experience negative self-evaluations and a concomitant increase in negative affect while watching themselves exercise in front of a mirror. Accordingly, we predicted that following exercise in front of a mirror, women with high body image concerns would experience a greater increase in negative affect than those with low or no body image concerns.

Women were studied because they typically report greater sensitivity to mirrored environments than do men (Fejfar & Hoyle, 2000). Sedentary women were sampled because the discordance between their actual selves and the ideal, exercising self (a self that would be salient in this situation) might make them particularly prone to negative self-evaluations while exercising in front of a mirror. Thus, the women most susceptible to the potential negative effects of mirrors during exercise should be those who are inactive. Furthermore, from a health promotion perspective, given that the majority of North American women are not sufficiently active to derive health benefits (USDHHS, 1996), it would be useful to know if fitness environments adorned with mirrors actually make women feel worse after exercising instead of better. An answer to this question could have implications for designing interventions to increase physical activity participation among this population.

### Method

#### Participants

Sedentary women were recruited from a university community by means of posters, university Web site notices, and in-class announcements. *Sed-*

*entary* was defined as participation in less than one moderate or strenuous 15-min bout of leisure-time physical activity in a typical 1-week period over the previous year. Of the 59 women recruited, 58 completed the experiment (1 canceled the second experimental session due to illness and moved away before being rescheduled). The sample was predominantly White-Caucasian (34%) and Asian (48%). There were no significant differences between the Asian and non-Asian participants on any of the study variables. Other characteristics of the women who completed the study are presented in Table 1.

#### Study Design

The study adopted a 2 (exercise environment: with mirror vs. without mirror)  $\times$  2 (time: pretreatment vs. posttreatment) mixed factorial design.

#### Measures

**Screening questionnaires.** Participants were identified as sedentary on the basis of their scores on the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985). This four-item instrument assessed strenuous, moderate, and mild leisure-time exercise over a typical 1-week period in the past year. An in-house health questionnaire was used to screen participants for any health problems that may preclude them from exercising.

**Body image.** Body image concerns were assessed by three scales that were subsequently combined. Consistent with related studies (Focht & Hausenblas, in press; Katula et al., 1998), the nine-item Social Physique Anxiety Scale (SPAS; Martin, Rejeski, Leary, McAuley, & Bane, 1997) was used to assess self-presentational aspects of body image. Participants indicated how well each item described them on a scale ranging from 1 (*not at all characteristic*) to 5 (*extremely characteristic*). Cognitive and affective aspects of body image were assessed using the Body Area Satisfaction subscale (BAS) of the Multidimensional Body-Self Relations Questionnaire (Cash, Winstead, & Janda, 1986) and the Physical Appearance Trait Anxiety scale (PATAS; Reed, Thompson, Brannick, & Sacco, 1991), respectively. The BAS assessed level of satisfaction with nine aspects of the body using a scale ranging from 1 (*very dissatisfied*) to 5 (*very satisfied*). The PATAS assessed how anxious participants generally felt about the appearance of 16 parts of their bodies such as the thighs, buttocks, and waist on a scale ranging from 0 (*not all anxious*) to 4 (*extremely anxious*). Internal consistencies of the different scales in the

Table 1  
Characteristics of the Study Sample

Demographic characteristic	Condition					
	Mirror (n = 28)			No mirror (n = 30)		
	%	M	SD	%	M	SD
Smoke	7.10			6.74		
Student	78.64			73.37		
Age		20.86	1.65		20.60	1.57
Body mass index		23.35	3.76		24.23	6.19
Bouts of strenuous activity per week		0.11	0.31		0.17	0.46
Bouts of moderate activity per week		0.29	0.46		0.20	0.61
Bouts of mild activity per week		0.98	1.48		0.70	1.75

*Note.* The conditions did not differ as a function of any of the above characteristics ( $ps > .05$ ).

present sample were high, with Cronbach alpha values of .76, .92, and .88, respectively. Given that scale intercorrelations were generally high ( $\sim .60$ ) and that there is no obvious rationale for choosing one scale over the others as an index of body image concern, we created a factor score ( $M = 0$ ,  $SD = 1$ ) using principal-components analysis to differentiate participants with high versus low body image concerns. This first component accounted for 78.9% of the variance in scores.

**Feeling states.** Feeling states were assessed using the Exercise-Induced Feeling Inventory (EFI; Gauvin & Rejeski, 1993) and the Physical Appearance State Anxiety scale (PASAS; Reed et al., 1991). The 12-item EFI assessed the degree to which respondents experienced four distinct feeling states related to exercise: revitalization, tranquility, positive engagement, and physical exhaustion. Participants indicated the extent to which each EFI item (e.g., "calm," "worn-out") described their current feeling state (0 = *do not feel*, 4 = *feel very strongly*). Internal consistencies for the EFI subscales ranged from .82 to .89 at baseline and from .85 to .91 postexercise. The PASAS was virtually identical to the PATAS described above, except that it instructed participants to indicate how anxious they felt right now (rather than generally) about the appearance of specific parts of their bodies. The scale's internal consistency (alpha) was .90 at baseline and .95 postexercise.

**Self-efficacy.** Self-efficacy was assessed by a nine-item measure that required participants to indicate their degree of confidence in their ability to successfully ride a stationary bike for incremental 5-min intervals (5–45 min) at a moderate pace without stopping. Participants' responses could range from 0% (*not at all confident*) to 100% (*highly confident*). Total strength of self-efficacy was calculated as the average of all the items. The internal consistency of this scale (alpha) was .95 at baseline and .93 postexercise.

**Anthropometric measures.** Body mass index was calculated as the ratio of actual weight (in kilograms) to height (in meters, squared) as assessed by the researcher, using a standardized, mechanical scale (Physician 4025 Mechanical Balance Beam Scale, Healthometer, Boca Raton, FL).

## Procedure

Volunteers were screened for eligibility via telephone by administering the GLTEQ and health screening questionnaire. Eligible women were then scheduled to attend two experimental sessions spaced approximately 1 week apart. They were informed that they would perform a 20-min bout of moderate intensity exercise during the second session. All sessions were conducted individually (i.e., with only 1 participant in the lab at a time) and by the same researcher (Mary E. Jung), who was aware of the study purpose but not the explicit study hypotheses.

**Session 1.** Participants completed an informed-consent form and the body image measures. They were instructed to wear loose-fitting shorts, a T-shirt, and running shoes at the next session. After participants left the lab, they were randomly assigned to either the condition with the mirror or the without the mirror.

**Session 2.** Participants were seated in an area of the laboratory that was partitioned from the main section of the lab where the exercise bout would be performed. Participants completed the feeling state measures (EFI and PASAS) and the exercise self-efficacy scale. The order of presentation of these questionnaires was systematically rotated to prevent order-of-presentation effects.

Next, participants left the partitioned area and were shown a stationary bicycle (Monark Ergometer Model 818E, Monark Exercise AB, Vansbro, Sweden). In the mirrored condition, the bike was centered in front of a bank of mirrors, 8 ft high  $\times$  10 ft wide (2.44 m high  $\times$  3.05 m wide), that covered the entire front wall of the laboratory from floor to ceiling. In the condition without a mirror, a set of floor-length, dark blue curtains was

drawn across the mirrored wall such that the mirrors were completely hidden from view. The bike was centered in front of this curtained wall.

All participants were then guided through both a quadriceps and a gastrocnemius stretch by the researcher. After the bike seat height was adjusted for the participant's comfort, participants were instructed to perform a light warm-up by pedaling at their preferred cadence with the bicycle wheel's tension dial set at 0. After 5 min, the researcher increased the workout intensity by increasing tension on the bicycle wheel. Intensity was increased to a workload that the participant identified as moderate. Level of intensity was defined using the 11-point Borg (1982) Rating of Perceived Exertion Scale (RPE), which ranges from 0 (*nothing at all*) to 10 (*very, very heavy*). Participants were told that they were to exercise at a moderate level of intensity (RPE = 4–5) throughout the experimental session. The appropriateness of the intensity level was checked at the 10-, 15-, and 20-min marks of the exercise session by presenting participants with a copy of the RPE chart and asking them to provide an RPE. The researcher then adjusted the tension accordingly. When she was not adjusting the workload, the researcher sat silently in a chair behind the participant and read a book. She deliberately avoided watching the exerciser so as to minimize any effect that her presence might have on the participant.

After 20 min of exercise, the researcher reduced the bike tension to 0 and instructed the participant to perform a 5-min cooldown by pedaling at an easy cadence. Next, the participant was given a drink of water and then returned to the partitioned area for 5 min of quiet rest. Once 5 min had elapsed, the researcher administered a second set of feeling state and self-efficacy measures. The order of presentation of these measures was systematically rotated. After the participant completed all questionnaires, she was led into another room where she was asked to remove her shoes and step onto a scale for measurement of both height and weight. Each participant was given the choice of standing facing toward or away from the scale numbers. Last, participants were debriefed, paid \$15, and thanked for their time and effort.

## Data Analysis Strategy

A couple of challenges arose when we were crafting a data analysis strategy. First, we were confronted with the problem of how to deal with baseline differences in the outcome variables. In a previous study (Gauvin, Rejeski, & Reboussin, 2000), we observed that baseline feeling states varied tremendously across individuals and can best be conceptualized as random rather than fixed effects. Furthermore, several studies (e.g., Blanchard, Rodgers, Courneya, & Spence, 2002; Gauvin et al., 2000) have shown that baseline feeling states moderate the change in exercise-induced feeling states with people having the worst baseline profiles gaining the greatest benefits postexercise.

A second challenge emerged from our interest in simultaneously examining the impact of the environmental manipulation and the influence of body image on changes in feeling states due to exercise while taking into account randomly varying baseline feeling states. Although analysis of covariance strategies offer a potential tool for addressing these issues, heterogeneity of slopes disqualifies their use. Accordingly, we used multilevel modeling (Bryk & Raudenbush, 1992) for our data analysis. In particular, we applied the multivariate normal models approach (Bryk, Raudenbush, & Congdon, 2000), which allowed us to relax the assumption of fixed effects at baseline by using a random effect at baseline and to test the significance of the effects using models with unrestricted variance-covariance structure, homogeneous Level 1 variance, and heterogeneous Level 1 variance. The effects in this model were identical for the baseline and change terms and included a dummy variable contrasting the conditions with (1) and without (0) a mirror, the composite body image concerns

Table 2

*Fixed Effects Revealed by Multilevel Modeling Procedure for Positive Engagement, Revitalization, and Tranquility*

Effect	Positive engagement		Revitalization		Tranquility	
	$\gamma$	SE	$\gamma$	SE	$\gamma$	SE
Intercept ( $\gamma_{00}$ )	5.84***	0.43	3.68***	0.52	7.11***	0.50
Condition ( $\gamma_{01}$ )	0.40	0.62	-0.42	0.75	0.00	0.72
Body image ( $\gamma_{02}$ )	-0.55	0.36	-0.81	0.44	-0.57	0.42
Body Image $\times$ Condition ( $\gamma_{03}$ )	-0.05	0.71	1.13	0.86	0.58	0.83
Time ( $\gamma_{10}$ )	0.77	0.43	3.12***	0.60	0.86	0.53
Condition $\times$ Time ( $\gamma_{11}$ )	-1.69**	0.61	-1.73*	0.87	-1.62*	0.77
Body Image $\times$ Time ( $\gamma_{12}$ )	-0.03	0.36	0.84	0.51	0.37	0.45
Body Image $\times$ Condition $\times$ Time ( $\gamma_{13}$ )	0.46	0.71	-0.92	1.00	-0.75	0.88

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

variable, and an interaction term that was the product of the dummy variable and body image concerns.<sup>1</sup>

### Results

Using the multilevel modeling procedure previously described, we observed that fixed effects were similar across differing variance-covariance structures. We therefore chose to report the results for the most parsimonious model (fewest number of parameters), the homogeneous Level 1 variance. Results for each of the four EFI subscales are presented next, followed by results for the PASAS and self-efficacy scores. All results appear in Tables 2 and 3. Illustrations of the significant effects are presented in Figure 1.

For the EFI positive engagement subscale, baseline scores did not differ between the two exercise conditions (i.e., with vs. without the mirror) and did not differ as a function of body image concern or as a function of the Exercise Condition  $\times$  Body Image Concern interaction. As for changes from pre- to postexercise, levels of positive engagement did not change significantly overall. However, as predicted, there was a significant Condition  $\times$  Time interaction ( $\gamma_{11} = -1.69$ ,  $p = .006$ ). Overall, exercise in the condition without the mirror had no effect on positive engagement, whereas exercise in the condition with the mirror decreased positive engagement. Optional hypothesis testing showed that postexercise positive engagement was significantly lower in the mirror condition in comparison with the no-mirror condition. Contrary to our hypothesis, body image concern did not moderate the effects of the experimental manipulation.

For the EFI revitalization subscale, baseline scores did not differ between the exercise conditions or as a function of body image concern or the Exercise Condition  $\times$  Body Image Concern interaction. With respect to changes from pre- to postexercise, there was a significant main effect for time, indicating a significant overall increase in revitalization ( $\gamma_{10} = 3.12$ ,  $p < .001$ ). Furthermore, a significant Condition  $\times$  Time interaction ( $\gamma_{11} = -1.73$ ,  $p = .046$ ) revealed differences in the pattern of revitalization changes between the two conditions. Women in the mirrored condition experienced an improvement in revitalization that was only half the magnitude of the improvement experienced by women in the unmirrored condition. Contrary to our hypothesis, body image concern did not moderate the effects of the experimental manipulation.

For tranquility, the pattern of findings was very similar to that observed for positive engagement. At baseline, tranquility scores were similar across exercise conditions and levels of body image concern, and the Exercise Condition  $\times$  Body Image Concern interaction was not significant. Overall, there was no significant change in tranquility from pre- to postexercise. However, as predicted, the Condition  $\times$  Time interaction was significant ( $\gamma_{11} = -1.62$ ,  $p = .035$ ), reflecting a significantly different pattern of change in tranquility across the two exercise conditions. Specifically, women in the mirrored condition tended to experience a decrease in tranquility whereas those in the unmirrored condition experienced an increase. Contrary to our hypothesis, body image concern did not moderate the effects of the exercise condition.

For physical exhaustion, at baseline, there were effects for body image concern ( $\gamma_{02} = 0.87$ ,  $p = .036$ ), but not for condition or for the Body Image Concern  $\times$  Condition interaction. The main effect of body image concern indicated that those women with greater

<sup>1</sup> Power and sample size calculations in multilevel modeling are complicated by the presence of an intraclass correlation and the inclusion of random effects. There is general consensus that more simulation studies are required prior to making firm statements regarding the manner in which to calculate power (Kreft & De Leeuw, 1998; Snijders & Bosker, 1999). However, Snijders and Bosker (1999) mentioned that

sample size at the highest level is usually the most restrictive element in the design. . . . Requirements on the sample size at the highest level, for a hierarchical linear model with  $q$  explanatory variables at this level, are at least as stringent as requirements on the sample size in a single level design with  $q$  explanatory variables. (p. 140)

Had we analyzed the data with fixed-effects models (i.e., single-level design), sample size could have been determined a priori using Green's (1991) estimation procedures for regression-type analyses. On the basis of results from studies of women's affect (Scheier & Carver, 1977, Study 3) and exercise self-efficacy (Katula et al., 1998) following exposure to a mirror, a medium-sized effect ( $d = 0.50$ ) would be anticipated for the experimental manipulation. Given the number of main effects and interactions to be tested in our analyses, Green's conventions would indicate that a sample of 59 would be needed to detect medium-sized effects with a alpha of .05 and power of .80. This would lead us to the conclusion that a sample size of 58 would provide for sufficient power to test our hypotheses. We therefore feel comfortable that this study is sufficiently powered to detect medium effect sizes.

Table 3  
Fixed Effects Revealed by Multilevel Modeling Procedure for Physical Exhaustion, Self-Efficacy, and Physical Appearance State Anxiety

Effect	Physical exhaustion		Self-efficacy		Appearance state anxiety	
	$\gamma$	SE	$\gamma$	SE	$\gamma$	SE
Intercept ( $\gamma_{00}$ )	4.12***	0.48	64.18***	3.50	13.55***	1.02
Condition ( $\gamma_{01}$ )	-0.44	0.69	-1.71	5.04	1.41	1.46
Body image ( $\gamma_{02}$ )	0.87*	0.40	-3.52	2.95	5.79***	0.86
Body Image $\times$ Condition ( $\gamma_{03}$ )	1.39	0.79	2.10	5.79	5.47**	1.68
Time ( $\gamma_{10}$ )	-1.58**	0.51	14.63***	3.58	-0.29	0.66
Condition $\times$ Time ( $\gamma_{11}$ )	2.01**	0.73	3.20	5.15	1.33	0.95
Body Image $\times$ Time ( $\gamma_{12}$ )	-1.27**	0.43	3.93	3.02	1.79**	0.56
Body Image $\times$ Condition $\times$ Time ( $\gamma_{13}$ )	0.99	0.84	-10.29	5.92	-1.86	1.09

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

concerns reported greater physical exhaustion than those with lesser body image concerns. When change from pre- to postexercise was examined, there was a significant main effect for time, showing an overall decrease in physical exhaustion postexercise

( $\gamma_{10} = -1.58, p = .002$ ). Yet, as predicted, a significant Condition  $\times$  Time interaction indicated that women in the mirrored exercise experienced a significantly different pattern of change in exhaustion than those in the no-mirror condition ( $\gamma_{11} = 2.01, p =$

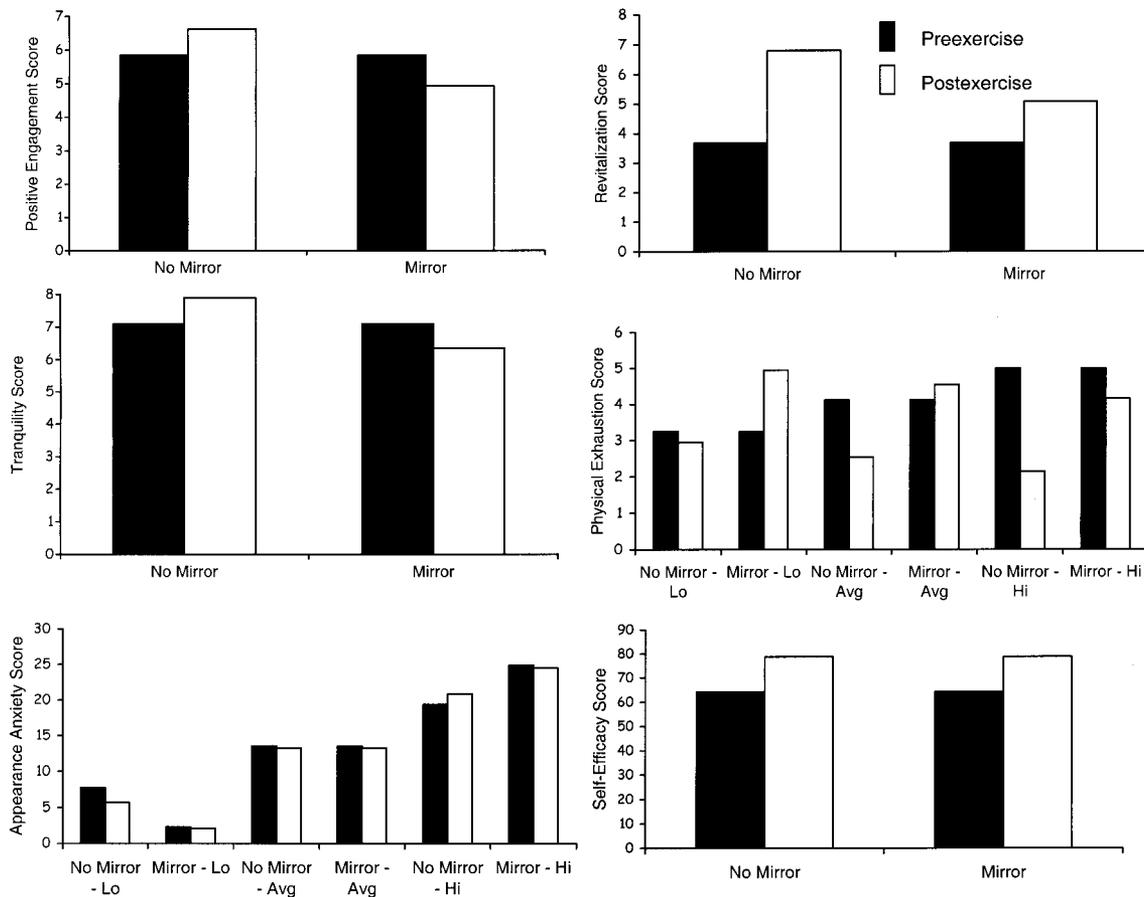


Figure 1. Preexercise and postexercise predicted values for positive engagement (top left), revitalization (top right), tranquility (middle left), and self-efficacy (bottom right) scores as a function of the exercise environment, and preexercise and postexercise predicted values for physical exhaustion (middle right) and physical appearance state anxiety (bottom left) scores as a function of the exercise environment and body image concerns. Only significant effects are shown. Lo = a lower level of body image concern; Avg = an average level of body image concern; Hi = a higher level of body image concern.

.007). Specifically, hypothesis tests showed that overall, women in the mirrored condition experienced virtually no change in physical exhaustion, whereas those in the unmirrored condition experienced a significant decrease. Although body image concerns did not moderate the effects of the mirror over time (i.e., there was no significant three-way interaction), there was a significant interaction between body image concerns and time (i.e., there was a significant two-way interaction,  $\gamma_{12} = -1.27, p = .004$ ). Hypothesis tests revealed that regardless of exercise condition, women with greater body image concerns experienced a greater decrease in physical exhaustion from pre- to postexercise than women with lesser body image concerns.

For the measure of physical appearance state anxiety, we observed a different pattern of results. At baseline, there was a significant effect for body image concerns ( $\gamma_{02} = 5.79, p < .001$ ) and a Body Image  $\times$  Exercise Condition interaction ( $\gamma_{03} = 5.47, p = .002$ ). As one might expect, women with the greatest body image concerns experienced the greatest levels of physical appearance anxiety at baseline. In addition, even though participants had not yet been exposed to the mirror, women with the greatest body image concerns reported higher baseline levels of appearance anxiety in the mirrored than the unmirrored condition. There were no baseline differences in appearance anxiety between the two exercise conditions for women with lower levels of body image concern. There was no main effect for time, indicating no reductions in physical appearance anxiety from pre- to postexercise for women in either exercise condition. Contrary to expectation, body image did not moderate the effects of the exercise condition from pre- to postexercise. An unexpected Body Image  $\times$  Time interaction ( $\gamma_{12} = 1.79, p = .002$ ) indicated that women with greater body image concerns experienced increases in physical appearance anxiety from pre- to postexercise, regardless of their exercise condition.

Finally, for self-efficacy, at baseline we observed no differences across exercise conditions or levels of body image concern at baseline and no Condition  $\times$  Body Image Concern interaction. There was a significant effect for time, indicating that all participants experienced an increase in self-efficacy from pre- to postexercise ( $\gamma_{10} = 14.63, p < .001$ ). However, these changes in self-efficacy were not moderated by exercise condition or body image concern.

## Discussion

The primary purpose of this experiment was to study the effects of exercising in front of a mirror on sedentary women's feeling states and exercise self-efficacy. A secondary purpose was to examine whether body image concerns moderated the effects of exercise performed in a mirrored environment. In general, the results indicated that consistent with our experimental hypotheses, exercise performed in front of a mirror had a negative effect on participants' feeling states. Contrary to our hypothesis, however, changes in self-efficacy were unrelated to the exercise environment, and body image did not moderate the effects of the environment on changes to either feeling states or self-efficacy. Taken together, these findings have possible implications for understanding factors that might deter sedentary women from starting an exercise program and for the development of strategies to promote physical activity among this population.

Our study demonstrated that women in the unmirrored environment did not experience any change in positive engagement or tranquility, but they did experience some mildly positive changes in other feeling states—a decrease in physical exhaustion and a large increase in revitalization. These results are consistent with findings that inactive women may not derive all of the mood-enhancing benefits of an exercise bout that are typically reported by women who are regularly active (Gauvin, Rejeski, Norris, & Lutes, 1997; Rejeski, Gauvin, Hobson, & Norris, 1995). In contrast, women in the mirrored exercise condition experienced primarily negative outcomes—a decrease in positive engagement, a tendency toward decreased tranquility, no change in physical exhaustion, and only a small increase in revitalization. This finding has relevance for understanding barriers to exercise program initiation among this population. If a bout of exercise leaves a sedentary woman feeling worse than before she worked out, it will be difficult to convince her to establish a regular exercise program. Our data highlight a practical need to identify environments wherein sedentary women are most likely to feel good following exercise (e.g., settings that do not contain any mirrors). Sedentary women could then be encouraged to try exercising in these settings.

The detrimental effects of exercising in front of a mirror are consistent with other laboratory studies that have tested objective self-awareness theory (Duval & Wicklund, 1972) and have found that women often report feeling worse after exposure to a mirror (e.g., Scheier & Carver, 1977; Sedikides, 1992). Our results expand the tenets of this theory by suggesting that the presence of mirrors does not just affect feeling states while one is at rest but that it can also affect feeling states that are induced by a bout of exercise.

No support was obtained for the hypothesis that body image would moderate the effects of the exercise environment on feeling states. The mirrored exercise environment negatively affected women with both weak and strong body image concerns. It should be noted, however, that our sample size was sufficiently large to detect only medium-sized effects for body image. It is possible that with a more powerful design, smaller effects for body image could be detected.

Body image concerns had significant effects on changes in exhaustion and physical appearance state anxiety. With regard to physical exhaustion, overall, women with greater body image concerns reported greater decreases in exhaustion postexercise than those with lesser concerns. As women with high body image concerns had the highest baseline exhaustion scores, it is probably not surprising that they showed the greatest exercise-related change in exhaustion. Previous research indicates that the people who derive the greatest mood-enhancing benefits of exercise are those who feel the worst prior to exercising (Gauvin et al., 2000). It is unclear, however, why body image concerns were positively related to baseline levels of exhaustion. Possibly, given that women with a poor body image tend to experience greater dysphoria in their daily lives than those with a healthy body image (Denniston, Roth, & Gilroy, 1992), higher baseline exhaustion scores may simply reflect a proclivity for greater negative affect.

With regard to the effects of body image on changes in physical appearance state anxiety, it is disconcerting that women with greater body image concerns experienced a postexercise increase in appearance anxiety. As an exercise bout has been shown to

increase body awareness (Koltyn, Raglin, O'Connor, & Morgan, 1995), it is possible that among women with body image concerns, the exercise bout made them more aware of their bodies and served to exacerbate their body image concerns. Further research is needed to explore the effects of acute exercise on appearance state anxiety and other aspects of body image among sedentary women.

With regard to exercise self-efficacy, increases were observed regardless of where the exercise was performed or the participant's body image. These findings are in stark opposition to those of Katula and McAuley (2001), who found that highly active women experienced an increase in exercise self-efficacy only if they exercised in front of a mirror. We propose that these discrepancies are due to differences in the usual activity levels of the women who participated in Katula and McAuley's study versus our study. Presumably, for all of the sedentary women in the present experiment, a 20-min bout of moderate-intensity exercise acted as a powerful source of mastery information that increased their efficacy beliefs. Indeed, when sedentary individuals engage in moderate activity, any information is likely to enhance their exercise efficacy beliefs, which tend to be relatively low. However, for highly active individuals—such as those in Katula and McAuley's study—a similar bout of activity is unlikely to provide new mastery information. Exercise performed in front of mirrors, however, may provide experienced exercisers with new, useful mastery information about their form, physical appearance, displayed exertion, and so on. Such information may be efficacy enhancing and could, potentially, influence feeling states. Further research is needed to determine the extent to which exercise experience moderates the effects of mirrored exercise environments on self-efficacy. Parenthetically, it is interesting that although changes in self-efficacy have been shown to mediate changes in exercise-induced feeling states (McAuley, Talbot, & Martinez, 1999), an increase in self-efficacy among women in the mirrored exercise condition did not translate into improved feeling states. Perhaps the presence of mirrors also moderates the effects of self-efficacy on feeling states.

### Future Directions and Implications

Given that the current data were collected in a laboratory environment where people's affective responses to exercise may be somewhat different than their responses in naturalistic exercise settings (e.g., Katula et al., 1998; McAuley, Mihalko, & Bane, 1996), we encourage the replication of our study in real-world exercise environments using participants drawn from beyond the university community. We also encourage replications involving other types of exercise activities to determine whether exercise type influences the effects of a mirrored environment (e.g., perhaps even inexperienced exercisers would be inclined to use a mirror as a source of performance feedback information for activities such as weight training). Future research is also needed to determine the mechanisms by which the mirror may influence exercise-induced affect—in particular, the mediating role of increased self-awareness (cf. objective self-awareness theory). If increased self-awareness does indeed mediate exercise-induced affect, then other factors that increase self-awareness, such as the presence of others (Carver & Scheier, 1978), might also represent aspects of the exercise environment that could influence exercise-induced affect or exacerbate the effects of mirrors.

In summary, our findings suggest that mirrored exercise environments may not just prevent sedentary women from deriving the mood-enhancing benefits of exercise but may actually cause mood decrements. This raises the possibility that mirrored fitness facilities are a deterrent to exercise participation among sedentary women. Certainly if a woman leaves the gym feeling even worse than when she arrived, she will not be particularly motivated to continue exercising in the future. As such, the recommended practice of placing mirrors in exercise centers may need to be reconsidered, especially in centers that are trying to attract exercise initiates.

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