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Exercise Motivation Predicts Differences in Exercise Intensity with a Small Versus Large Caloric "Payoff"

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Abstract The hypothesis that exercise motivation among women predicts differences in exercise intensity for a small versus a large caloric outcome was tested. A sample of 65 female participants was assigned on each of two counterbalanced days to exercise at their own pace on an exercise bike for 10 min. On one day they were assured of a large caloric payoff (burn 40 calories per 100 rotations) and on the second day they were assured of a small caloric payoff (burn 10 calories per 100 rotations). The difference in distance traveled on the bike each day was recorded and used as a measure of exercise intensity. A multiple regression analysis with subscales of exercise motivation (14 levels) as the predictor variables and exercise intensity as the criterion variable was computed. Results showed that exercise motivation subscales predicted differences in exercise intensity: social recognition and stress management motivation predicted greater exercise intensity for the easier large caloric outcome; challenge and strength and endurance motivation predicted greater exercise intensity for the more difficult small caloric outcome. Results suggest that considering "what" specifically motivates women to exercise (and not just "whether or not" they are motivated to exercise) is important and can mediate increased moderate-to-vigorous physical activity among women.

Keywords Motivation, Exercise, Calories, Exercise Intensity, Aerobic

1. Introduction

Exercise can enhance well-being and mood in general [1, 2, 3]. With regard to health, regularly engaging in moderate-to-vigorous physical activity is critical for optimal health [4], with inactivity generally linked to obesity and to increased risk of metabolic diseases [5, 6]. An alarming concern, particularly among adolescents and young adults, is that despite the deleterious health consequences of physical inactivity, estimates indicate that less than half of adolescents and young adults get the recommended 60 minutes per day of moderate-to-vigorous physical activity [7, 8, 9]. Therefore, understanding what motivates people to exercise can be beneficial to promote health.

One key factor related to the health benefits of exercise is exercise intensity, with more intense exercise associated with better weight management, lower risks for chronic diseases, such as heart failure or stroke, and improved strength and balance [10]. Factors that influence exercise intensity include features of exercising such as the enjoyment of exercising [11, 12], personal concerns for health [13], and characteristics of an individual such as their self-determination [14], and motivation [15, 16]. Motivation to exercise and motivation to exercise intensely is often intrinsic (desire to engage in exercise because it is inherently enjoyable) or extrinsic (desire to engage in exercise because of an external factor) [17], with extrinsic motivation being more commonly associated with increased exercise, particularly among college-aged students [18].

The benefits of low to moderately intensity physical activity in terms of weight loss and "burning" calories is a common message conveyed in the health media [19, 20], and evidence indicates that college students have assimilated this message [21]. Burning calories is regarded as an external factor of extrinsic motivation, and thus when college students exercise to "burn" calories or to lose weight, they are externally motivated to do so. However, while motivation to "exercise" is important, it is also important to consider how motivation is specifically related to the intensity by which young adults exercise, in part, because according to the Centers for Disease Control and Prevention, a low-intensity exercise (i.e., walking) is the most common aerobic exercise among adults [22], and exercise intensity can vary greatly among college students [13].

Motivation is a critical cognitive factor [23] related to exercise initiation and maintenance. However, while a plethora of research has investigated what motivates people to exercise in general [23, 24], there has been comparatively less work that has specifically manipulated exercise intensity-particularly in an experimental setting-to allow for a comparison of exercise intensity across the levels of

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motivation. One critical concern derived from on Brehm's Motivational Intensity Theory [25], is to identify how motivation to exercise is specifically related to the level of effort, or intensity, that an individual will mobilize. Evidence suggests that participants will work harder when performance outcomes are harder to obtain, and when such outcomes are positive, i.e., losing calories [26]. Increasing the appeal of a goal or outcome is also associated with greater effort or intensity [27].

Based on current evidence, in the present study we specifically manipulated an outcome of exercising (caloric "payoff," i.e., calories "burned") using a within-subjects design with female participants to compare participant exercise motivations to the effort, or intensity, of their exercising in each condition. Understanding how exercise motivation is related to exercise intensity is important because exercise intensity has been linked to positive health outcomes [28]. Women were observed in the present study because they are more "at risk" of failing to meet aerobic exercise guidelines [29]. Comparisons in the present study allow for an assessment of the extent to which exercise motivation mediates changes in exercise intensity to improve our understanding of how these two key factors are related among women.

2. Method

2.1. Participants

A sample of 65 undergraduate female students was recruited through university classroom visits and sign-up sheets to complete an aerobic exercise. Because women are more "at risk" of failing to meet aerobic exercise guidelines [29], and to control for sex differences, only females were observed in the present study. Participant characteristics were (M±SD) age (19.6 ± 1.0 years), weight (64.0 ± 9.6 kg), height (164.1 ± 6.9 cm), and BMI (23.7±3.8 kg/m^2). All participants passed an initial screening qualifying them to participate. Female participants were light to moderate exercisers (from 0.5 to 1.5 hours of exercise per week), and were non-smokers who were in general good health with no physical or physician/doctor diagnosed medical conditions including pregnancy, and no dietary or exercise restrictions.

2.2. Exercise Equipment

Participants cycled on a Life Fitness® 95T Inspire ™ Lifecycle Upright Stationary Bike (l × w × h: 1.5 m × 0.5 m × 1.0 m) at their own self-selected pace for 10 min. The bike has 25 resistance levels. All participants cycled at a low resistance level of 8 for the full 10 min to standardize the difficulty level of the exercise. Heart rate was recorded at two min intervals in beats per minute (bpm) using the attached wireless compatible heart rate monitoring. Also, the stationary bike had 41 exercise "programs" to choose from. Each participant in the present study cycled on the "Quick Start" program to standardize the type of exercise program, and distance traveled was recorded. Participants must pedal faster or more intensely on the stationary bike to travel farther distances on the bike in a fixed amount of time (10 min). Thus, distance traveled was used as measure of exercise intensity.

2.3. Exercise Motivation

Exercise motivation was measured using the Exercise Motivations Inventory (EMI) [30]. The EMI is divided into 14 subscales, with 51 total questions. The score for each subscale was the total score for items of a subscale, divided by the number of items for that subscale. An average score for the full inventory can also computed by adding all scores and dividing by 51 total items. Using this inventory, the 14 EMI subscales were: Stress management, revitalisation, enjoyment, challenge, social recognition, affiliation, competition, health pressures, ill-health avoidance, positive health, weight management, appearance, strength and endurance, and nimbleness.

2.4. Procedures

Participants were observed one at a time on each of two consecutive days in a university gymnasium setting between 12:00 PM and 4:00 PM EST. On each day, a participant cycled on a stationary bike for 10 min. A section of the gym was reserved for use to isolate study participants from the general gym population and avoid distractions beyond those manipulated in this study. Upon arrival to the gym, a participant was given and signed an informed consent. The university's Institutional Review Board approved all procedures.

Upon signing the informed consent on the first day, participants were asked to also complete the EMI [30] and a basic demographic survey. On each day, a participant mounted the stationary bike. On one day, the participant was told, "For this exercise, you will burn about 10 calories per 100 rotations on the bike" (a small caloric "payoff"). On another day, the participant was told, "For this exercise, you will burn about 40 calories per 100 rotations on the bike" (a large caloric "payoff"). The promise of a small and large caloric payoff was the manipulation. The order of the manipulation was counterbalanced such that for about half of participants (N = 33) a small caloric payoff was promised on Day 1 and a large caloric payoff was promised on Day 2; for the other half of participants (N = 32) the order was reversed.

Participants were asked to pedal at their own pace for 10 min after the caloric payoff was promised. For safety reasons, participants were also reassured that they could quit cycling at any time - regardless, all participants completed the 10 min of cycling. After 10 min of cycling on the bike on the first day, participants were thanked for their time and reminded to return the same time the next day. All participants in the present study returned for the second day. After 10 min of cycling on the bike on the second day, participants were debriefed, thanked for their time, and dismissed.

2.5. Data Analyses

To test for the relationship between exercise motivation and exercise intensity, a multiple regression analysis was computed with total EMI scores and the score for each EMI subscale being the predictor variables; the difference in distance traveled in miles (i.e., exercise intensity) for the small-large caloric payoff was the criterion variable. For the criterion variable, positive values indicated greater exercise intensity for the small versus large caloric payoff; negative values indicated greater exercise intensity for the large versus small caloric payoff.

To check if distance traveled (exercise intensity) was significantly different with a large versus a small caloric payoff, a planned related samples *t* test was computed with caloric payoff (small, large) as the factor, and distance traveled as the dependent variable. To check if participants showed similar exertion during exercise on each day, a two-way within-subjects analysis of variance (ANOVA) was computed with Days (small caloric payoff day, large caloric payoff day), and Time (baseline, 2, 4, 6, 8, and 10 min) as the within-subjects factors and heart rate (beats per min) as the dependent variable. All tests were conducted at a .05 level of significance.

3. Results

Of the 65 participants, total EMI scores ranged from 0.1 to 4.4 with a mean/SD score of 3.1±0.8. Table 1 depicts mean/SD scores with statistical outcomes given for coefficients assessed for each subscale. For exercise intensity, the mean/SD distance traveled in 10 min on the stationary bike was 1.93±0.50 miles on the day that the small caloric payoff was promised, and was 1.92±0.40 miles on the day that the large caloric payoff was promised.

For the regression analysis, total EMI scores were not significantly predictive of exercise intensity, p = .80. However, when the subscales for the EMI were predictor variables, a significantly predictive model was evident. The most predictive model was chosen as the model that accounted for the largest proportion of variance, and for which each subscale item was a significant predictor of exercise intensity. The most predictive model of exercise intensity included four EMI subscales, $F(4,60) = 18.44$, $p < .001$ ($R^2 = .522$). Using this most predictive model, Challenge ($\beta = .509$, $p < .001$) and Strength and Endurance ($\beta = .311$, $p = .003$) predicted significantly greater exercise intensity when a small caloric payoff was promised; Social Recognition ($\beta = -.314$, $p = .001$) and Stress Management ($\beta = -.213$, $p = .022$) predicted significantly greater exercise intensity when a large caloric payoff was promised. Interestingly, the related samples t test did not reach significance, p = .60, indicating that only when exercise motivation was considered, were differences in exercise intensity evident.

Table 1. Mean/SD scores and the statistical outcomes given of coefficients assessed for each subscale

EMI Subscale	Mean	SD	F	Sig.
Stress Management	3.38	1.26	5.56	.022*
Challenge	2.88	1.17	25.70	< .001*
Social Recognition	1.92	1.24	13.01	.001*
Strength and Endurance	3.61	1.06	9.66	.003*
Revitalisation	3.13	1.11	0.86	.357
Enjoyment	3.27	1.18	0.10	.758
Affiliation	2.27	1.26	1.13	.292
Competition	2.45	1.53	0.53	.471
Health Pressures	1.94	1.27	0.43	.516
Ill-Health Avoidance	3.56	1.17	1.23	.271
Positive Health	4.38	0.81	0.49	.485
Weight Management	3.94	0.99	0.15	.701
Appearance	3.30	1.06	1.95	.168
Nimbleness	2.84	1.22	0.05	.827

An asterisk (*) indicates $p < .05$. Any subscale without an asterisk was excluded from the most predictive model of exercise intensity. The EMI is a valid and reliable scale for determining exercise motivations, as previously shown [30].

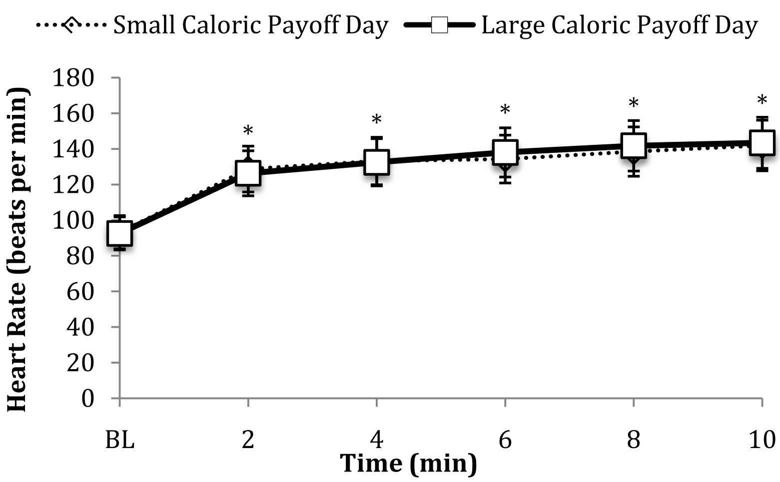

Figure 1. Mean heart rate among participants on each day of the study. An asterisk indicates significantly greater heart rate compared to baseline at $p < .01$. Error bars indicate SEM

With heart rate as the dependent variable, the within-subjects ANOVA showed a significant main effect of Time, $F(5, 320) = 222.86$, $p < .001$, $R^2 = .77$, indicating as expected that heart rate changed over the course of exercising. A significant Days × Time interaction was also evident, $F(5, 320) = 2.79$, $p = .02$, $R^2 = .04$. As shown in Figure 1, while change in heart rate was statistically similar on each day and at baseline, post hoc tests confirmed that participant heart rate was significantly greater at 2, 4, 6, 8, and 10 min compared to baseline on each day, $p < .01$ for all tests. No further significant changes were evident.

4. Discussion

The hypothesis that exercise motivation can predict differences in exercise intensity for a small versus a large caloric outcome was tested. When exercise motivation was considered as a singular construct (i.e., total EMI scores), there was no evidence that exercise motivation predicted changes in exercise intensity. However, the overall pattern of results reported here show that exercise motivation subscales did significantly predict changes in exercise intensity. The more that a participant was motivated to exercise to challenge themselves or to enhance their strength and endurance, the more intensely they exercised when the payoff was more difficult or more challenging (i.e., 10 vs. 40 calories burned per 100 pedal rotations). The more that a participant was motivated to exercise to gain social recognition or to manage their stress, the more intensely they exercised when the payoff was easier. Thus, two subscale factors predicted increased exercise motivation for a small caloric payoff and two subscale factors predicted the opposite outcome. This pattern can explain why exercise motivation (as a singular construct) did not mediate exercise intensity—because many subscales of exercise motivation "cancelled out" or mediated opposite outcomes for differences in exercise intensity.

Interestingly, the pattern of results observed here fits well with studies that evaluate why women exercise [31, 32]. Two, potentially competing predictions were tested here, and both were observed. Consistent with Brehm's Motivational Intensity Theory and related evidence [25, 26] women exercised more intensely when they thought that performance goals were harder to obtain—when they were specifically motivated by a challenge or to enhance their strength and endurance. Likewise, increasing the appeal of the goal [27] when they thought it would be easier to burn more calories (i.e., 40 calories burned per 100 rotations), increased exercise intensity among women—when they were specifically motivated to gain social recognition or to manage their stress. Thus, making the goal more challenging and making the goal easier both increased exercise intensity depending on what motivated a participant to exercise.

Importantly, the results presented here highlight the need to treat exercise motivation as a complex multi-leveled construct, and not as a singular construct. In the present study, exercise motivation, as a whole construct, did not predict differences in exercise intensity among women, partly because subscales of this measure 'cancelled out' any effects that could have been observed. Instead, the results show that getting women to exercise more intensely was mediated by "what" motivated them to exercise, and not mediated by "whether or not" they were motivated to exercise. Because women are more "at risk" than men of failing to meet aerobic exercise guidelines [29, 32] it is important to consider what motivates women to exercise intensely. The results presented here clearly show that how intensely women exercise will vary depending on what motivates them to exercise. Making considerations for "what" motivates women to exercise could therefore lead to positive outcomes in terms of maximizing physical activity and improved health among women.

One limitation in the present study is that a small sample size was observed. To address this in the present study, a within-subjects design was used, which is generally associated with greater power to detect effects [33, 34], as those reported here. A second key limitation regarding generalization of outcomes is that undergraduate women were observed in the present study. Results may therefore not be generalizable to men or to clinical samples. Future research could further examine sex differences in the relationship between motivational constructs and exercise intensity. Also, exercise intensity was the main dependent variable observed in the present study. Whether exercise motivation mediates other aspects of exercise, such as the type of exercise and likelihood to exercise cannot be determined here.

5. Conclusions

The results presented here show that how intensely women exercise will vary depending on what motivates them to exercise. Women who were motivated by a challenge or to enhance strength and endurance increased their exercise intensity with a more difficult outcome or goal. Women who were motivated to gain social recognition or to manage their stress increased their exercise intensity with an easier outcome or goal. Overall, the results suggest that making considerations for "what" motivates women to exercise intensely (such as to gain social recognition or to manage stress) is important and could lead to effective strategies aimed at motivating women to engage in moderate-to-vigorous physical activity [4].

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