DEVELOPMENT OF THE EXERCISE AND STATE BODY IMAGE MODEL

DEVELOPMENT OF THE EXERCISE AND STATE BODY IMAGE MODEL: EXAMINING CHANGES IN SELF-EFFICACY, PHYSICAL SELF-PERCEPTIONS, AND AFFECT AS MECHANISMS BY WHICH ACUTE EXERCISE IMPROVES STATE BODY IMAGE

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A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment of the

Requirements for the Degree Master of Science

MASTER OF SCIENCE (2015) McMaster University
(Kinesiology) Hamilton, Ontario

TITLE: Development of the exercise and state body image model: Examining changes in self-efficacy, physical self-perceptions, and affect as mechanisms by which acute exercise improves state body image

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NUMBER OF PAGES: ix, 108

ABSTRACT

The primary purpose of this study was to determine if changes in physical self-efficacy, physical self-perceptions, and affect (including enjoyment) are mechanisms by which a single bout of exercise improves state body image. A secondary purpose was to identify how long exercise-related improvements in state body image are sustained post-exercise. Sixty women with body image dissatisfaction were randomized to either an exercise or control condition. Participants in the exercise condition completed a 30 minute moderate-to-vigorous intensity workout on a stationary bike. Women in the control condition read for the same duration. Before and immediately, 10-minutes and 20-minutes after (post-0, post-10, post-20) the exercise/control manipulations, participants completed measures of state body image, aerobic self-efficacy, physical self-perceptions and affect (including enjoyment). PROCESS macro was used to test mediation models, and a repeated measures mixed ANCOVA, followed by a univariate ANCOVA was used to test how long state body image improvements were sustained.

There was a significant indirect effect of increases in strength self-perceptions on state body image improvements from pre- to post-0 (95% C.I. =.07 - .52, κ^2=.16, ab_{ps}=.31), post-10 (95% C.I.=.05 - .50, κ^2=.16, ab_{ps}=.30) and post-20 minutes (95% C.I. = .10 - .55, κ^2 =.16, ab_{ps} =.33), as well as a significant indirect effect of decreases in tiredness (i.e., increases in the energetic arousal dimension) on state body image improvements from pre- to post-10 (95% C.I. =.22 – 1.14, κ^2=.30, ab_{ps}=.77). Exercise-related state body image improvements were sustained 20 minutes after exercise.

The present findings suggest that a bout of exercise improves state body image through increases in strength self-perceptions and energetic arousal and these effects lasted up to 20 minutes. This is the first study to design and empirically test a model to account for the effects of exercise on state body image, and provides important theoretical and practical implications.

ACKNOWLEDGEMENTS

I would like to begin by thanking my supervisor, Dr. Kathleen Martin Ginis. When I reflect on my skill-set and research knowledge when I began my Master's, I can see that I have made great improvements. You have worked to help me identify areas to improve upon and strengths to develop further. I appreciate that you always challenged me to be a better researcher than yesterday. In working with you I have also developed a great appreciation for the research process and the beneficial implications it can have on the community. Thank you for the opportunity to work with you – it has been a privilege. The insights you have helped me to acquire will remain with me in any career path I pursue.

I would like to acknowledge my thesis advisory committee: Dr. Steven Bray, Dr. Jennifer Heisz and Dr. Marie-Josée Perrier. I have greatly valued your input and contributions throughout this process. I sincerely thank you for your guidance, support and encouragement throughout the past two years.

I would like to thank my labmates: Jenn, Matt, Jess, Jasmin, Robert, Hanna, Ilana, Denver, Jeff, Jeni, and Paul. I appreciate how willing each of you have been in helping me throughout the past two years. Whether it was answering questions or providing moral support, it was very helpful and I appreciated it greatly. Beyond the academic setting, I feel so fortunate to have spent time with a great group of people. From program events to traveling for conferences you have all helped create great memories that I will always fondly remember.

I would also like to thank the undergraduate students that helped me with my project: Claire, Jen, and Khadijah. Whether it was your volunteering efforts in the lab or handing out posters at the front of DBAC for hours on end, I really appreciate the time, effort and enthusiasm you contributed to the project.

Thank you to Rebecca, Glenna, and Doris for all of your administrative support and always making the admin office a pleasant place to visit, and to Dam for your technical support. I would also like to extend a thank you to all of the other faculty and students in the program that have helped me in some way, shape or form. The Kinesiology Department is a very close-knit, welcoming community and that greatly contributed to my experience as being a positive one.

Further, I would like to acknowledge the Harry Lyman Hooker Senior Fellowship and the Joseph Armand Bombardier Canada Graduate Scholarship provided by the Social Sciences and Humanities Research Council of Canada for supporting me and this research.

Last but certainly not least, I would like to extend a sincere thank you to my family and friends. You have been by my side through the ups and downs in my life and that didn't stop in my Master's. I couldn't be more grateful to have you all in my life. The love and support you have shown me has not only kept me motivated through the tough times, but have also encouraged me to treasure the times of triumph. I know that none of this would have been possible without your support. For that I thank you deeply.

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LIST OF ABBREVIATIONS

AD ACL	Activation deactivation adjective check list
AE	Appearance evaluation
ANOVA	analysis of variance
ANCOVA	Analysis of covariance
BASS	Body areas satisfaction scale
BDS	Body dissatisfaction scale
BISS	Body image states scale
BMI	Body mass index
bpm	Beats per minute
DMS	Drive for Muscularity Scale
EA	Energetic arousal
EDE-Q	Eating disorder examination questionnaire
EXSEM	Exercise and self-esteem model
HR	Heart rate
MBSRQ	Multidimensional body self-relation questionnaire
MQ	Mood questionnaire
PACES	Physical Activity Enjoyment Scale
PANAS	Positive and negative affect scale
PAR-Q	Physical Activity Readiness Questionnaire
PSDQ	Physical self-description questionnaire
REI	Reasons for exercise inventory
RPE	ratings of perceived exertion
SPAS	Social physique anxiety subscale
SPSS	Statistical Package for the Social Sciences
TA	Tense arousal

DECLARATION OF ACADEMIC ACHIEVEMENT

L.E. Salci's role:

- Author of ethics application at McMaster University
- Created study design and measure selection
- Responsible for participant recruitment
- Lead investigator responsible for preparation of lab settings, materials, and scripts
- Responsible for data collection, input, analysis and interpretation
- Supervised placement students who assisted with data collection

Role of co-authors:

- KMG assisted LES with obtaining ethics approval at McMaster University
- KMG assisted LES with study design and measurement selection
- KMG obtained study funding
- KMG assisted LES with interpretation of the data
- SB, JH, MJP provided input on study design and data analysis

Introduction

In today's society, there is a large emphasis placed on outward physical appearance and altering it to meet the ideal criteria dictated by mass media. There is a well-established market catering to the general population's body image obsession including magazines, talk shows and commercials that promote products or lifestyle changes to enhance one's appearance. The annual revenue of the American weight-loss industry, consisting of diet drugs, weight-loss surgeries and diet books, was $20 billion in May 2012 (ABC News Staff, 2012). Eighty-five percent of these consumers were women. The supply and demand of the weight-loss market emphasizes the importance society places on body image.

Body image is defined as "the multifaceted psychological experience of embodiment, especially but not exclusively one's physical appearance" (Cash, 2004). It encompasses how people think, feel, see, and act toward their own bodies. Body image has been described as an enduring trait, and is consistent in varying situations (trait body image), although more recent findings have found that body image has transitory characteristics, which allow it to also be studied as a state variable (state body image; Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004; Tiggemann, 2001). State body image has been receiving greater attention from the scientific community as more suitable state measures have been established for research and clinical settings (Cash, Fleming, Alindogan, Steadman, & Whitehead, 2002).

In a 2006 *Nutrition Journal* survey of female college students, 58% felt pressure to be a certain weight, and of that group 83% dieted for weight loss. Among those that dieted, 44% were of normal weight (Eating Disorders Statistics, 2011). The focus of body image research has traditionally been on women and this may be due to the fact that they have reported to be less satisfied with their bodies in comparison to men (e.g., Demarest & Allen, 2000; Martin Ginis et al. 2005). As well, body image dissatisfaction is related to eating disorders, which are more likely to develop in women than men (Follette, Heffner, & Pearson, 2010). These findings emphasize the dissatisfaction young women have with their appearance and their obsession to change the way they look. It is important to address the body image dissatisfaction women in our culture face, as poor body image can have harmful implications for other aspects of an individual's health. Poor body image has been found to negatively impact self-esteem (Davison & McCabe, 2005), increase the risk for depression and anxiety (Lichtenberger, Martin Ginis, MacKenzie, & McCartney, 2003) and cause eating disorders (Polivy & Herman, 2002). Due to the severe implications that body image dissatisfaction can have on mental health, it is necessary to further investigate body image-enhancing strategies. Exercise has received attention as a viable option for improving body image dissatisfaction.

There have been three published meta-analyses examining the effects of exercise interventions on trait body image (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007). A range of 35 to 121 studies were

included across the three meta-analyses and the effect sizes ranged from small (0.29) to medium (0.47) and were all statistically significant. It is important to consider these smaller effect sizes in light of the variability between the studies analyzed across the meta-analyses. The methodology, including the type of exercise, the definition of body image and the measurements used all differed between studies. These inconsistencies can directly affect the average effect size calculated. Nonetheless, all the meta-analyses arrived at the same overall finding: exercise has positive, significant effects on trait body image.

Specifically, research has investigated the effects of exercise on both trait and state body image in two separate study samples: regular exercisers and sedentary individuals. The most effective type of exercise for improving trait and state body image remains unclear. As well, the mechanisms of change by which exercise improves trait and state body image are not fully understood. The literature on trait body image will be reviewed first, followed by state body image.

Trait Body Image

There has been considerable research examining the relationship between change in trait body image and actual physical changes. Some aerobic-training studies have found that changes in trait body image are related to changes in body composition (McAuley, Bane, Mihalko, 1995; McAuley, Bane, Rudolph, & Lox, 1995; Taylor & Fox, 2005), whereas other studies have found no significant associations between changes in trait body image and changes in body composition (Anderson, Murphy, Murtagh, Nevill, 2006) and aerobic fitness

(Ben-Shlomo & Short, 1986; Taylor & Fox, 2005). Furthermore, a strength-training study found that trait body image change is related to changes in body composition but not strength (Shaw, Ebbeck, & Snow, 2000). Studies examining a combination of strength and aerobic training found that trait body image change was correlated with changes in body composition (McAuley, Blissmer, Katula, Duncan, Mihalko, 2000), aerobic fitness (McAuley, Marquez, Jerome, Blissmer & Katula, 2002) and strength (Tucker & Mortell, 1993), while other studies found that trait body image change was unrelated to changes in body composition (Annesi, 2000; Lindwall & Lindgren, 2005; McAuley et al., 2002; Ransdell, Detling, Taylor, Reel, & Shultz, 2004), aerobic fitness (Lindwall & Lindgren, 2005; McAuley et al., 2000; Ransdell et al., 2004) and strength and flexibility (Ransdell et al., 2004). Due to the inconsistent findings among the studies examining the relationship between actual physical changes and trait body image change, it has been suggested that there is a psychological process taking place that is driving trait body image change. That is, actual fitness changes may not be as important as an individual's interpretation of that change (e.g., Martin Ginis, Bassett, Conlin, 2012). Hence, a focus has been placed on understanding the relative roles of physical self-perceptions and physical changes in explaining exercise-related trait body image change, particularly among sedentary samples.

A study investigating correlates of trait body image change found that self-reported physical changes as well as actual physical changes were correlated with trait body image change (Martin Ginis, Eng, Arbour, Hartman, & Phillips, 2005).

Twenty-eight sedentary men and 16 sedentary women were involved in a 12 week, 5-day/week full-body progressive resistance training program. Participants completed the Body Areas Satisfaction Scale (BASS) of the Multidimensional Body-Self Relations Questionnaire (MBSRQ; Brown, Cash, & Mikulka, 1990), Social Physique Anxiety Scale (SPAS; Martin, Rejeski, Leary, McAuley, & Bane, 1997) and Drive for Muscularity Scale (DMS; McCreary & Sasse, 2000) to assess trait body image as well as self-reported assessments and actual measurements of body fat, muscularity and strength before and after the exercise intervention. Results revealed that women had improvements in trait body image, which were correlated with self-reported physical changes as well as actual improvements in anthropometric measurements**.** The correlation between changes in trait body image and self-reported physical changes (perceived fatness) was medium sized (r = 0.62), and was larger than the correlation between changes in body image and actual measurements (percentage of body fat), which was small (r = -0.23). A subsequent study (Martin Ginis, McEwan, Josse, & Phillips, 2012) confirmed that changes in anthropometric measures played less of a role in trait body image change than perceived changes.

Martin Ginis et al. (2012) examined variables related to trait body image change and found that perceived physical changes to the body were more important in predicting trait body image than actual physical changes to the body. A single group of 88 overweight and obese women participated in a 16 week diet and exercise weight-loss intervention. The study utilized a repeated measures

design with measurements taken at baseline, 8 weeks and 16 weeks. The Body Areas Satisfaction Scale (BASS) and Appearance Evaluation (AE) subscale, which are both subscales of the Multidimensional Body-Self Relations Questionnaire (MBSRQ; Cash, Winstead, & Janda, 1986), were used to assess the cognitive and subjective satisfaction dimensions of trait body image, while the affective dimension of trait body image was assessed by the Social Physique Anxiety Scale (SPAS; Hart, Leary, & Rejeski, 1989). Perceived physical changes were measured using three 6-item subscales of the Physical Self-Description Questionnaire (PSDQ; Marsh, Richards, Johnson, Roche, & Tremayne, 1994): the body fat subscale, the body strength subscale and body endurance subscale. Actual physical changes were measured by Dual-Energy X-ray Absorptiometry scans to assess body composition, a modified Astrand Submaximal Fitness Test Protocol was used to assess aerobic fitness and participants' one repetition maximum for selected exercises was used to assess muscular strength. Self-efficacy was assessed by participants indicating their confidence on a scale from 0 to 100 to complete specific aerobic and strength training tasks without stopping. Hierarchical regressions were used to examine the relative contribution of physical self-efficacy and perceived physical changes in predicting trait body image change beyond actual physical changes. There were some differences in the pattern of predictors of trait body image change at different time points, so Martin Ginis et al. (2012) suggested that actual physical changes, self-efficacy changes and perceived physical changes all be examined when studying

mechanisms of exercise-related trait body image change. Nevertheless, perceived physical changes consistently accounted for the most explained variance in trait body image change and improved perceptions of body fat appeared to be the most important predictor.

A study by Martin Ginis, Strong, Arent, Bray and Bassett-Gunter (2014) examined the effects of an 8 week aerobic versus strength training program on trait body image changes and its association with changes in fitness, perceived fitness and exercise self-efficacy. Forty college-aged women with body image disturbance, who were relatively inactive, were randomized to an aerobic condition (30 min on elliptical moderate and heavy intensity) or strength training condition (30 minutes of resistance and free weight exercises at moderate and heavy intensity). In line with Martin Ginis et al. (2012), the SPAS (Hart, Leary, & Rejeski, 1989), BASS and AE subscales of the MBSRQ (Cash, Winstead, & Janda, 1986) were used to assess the affective, cognitive and subjective satisfaction dimensions of body image, respectively. Three attributes of physical fitness were assessed: body composition (measured by body mass index), aerobic fitness (measured by the Astrand Rhyming Submaximal Fitness Test) and muscular strength (measured by a 10 rep maximum test). Also consistent with Martin Ginis et al. (2012), perceived fitness was assessed by the body fat subscale, the body strength subscale and body endurance subscale of the Physical Self-Description Questionnaire (PSDQ; Marsh, Richards, Johnson, Roche, & Tremayne, 1994). Lastly, participants' physical self-efficacy was assessed using a

scale similar to that used by Martin Ginis et al. (2012). Aerobic and strength training brought about significant improvements in trait body image, although aerobic training led to significantly greater improvements for the affective dimension of trait body image than did strength training. Furthermore, for both conditions, body image changes were significantly correlated with changes in perceptions of body fat and aerobic endurance and aerobic self-efficacy. Changes in physical measurements were not found to be significantly correlated with trait body image change. Martin Ginis, Strong et al. (2014) suggested that an appropriately powered study be conducted to test for perceptions of body fat and aerobic endurance and aerobic self-efficacy (not physical measurements) as mediators by which exercise improves trait body image.

There has also been research examining other possible mechanisms by which exercise improves trait body image among regular exercisers. One mechanism in particular that has been explored is self-efficacy. McAuley et al. (2002) also found that changes in self-efficacy were related to reductions in social physique anxiety among a sedentary study sample who participated in either a 6-month exercise program for aerobic or stretching/ strengthening training. Furthermore, McAuley et al. (1995) found that changes in walking self-efficacy predicted change in social physique anxiety among sedentary, middle-aged men and women who participated in a moderate-intensity walking program for 20 weeks. As well, completion of a 6 month strength/ flexibility or walking program at moderate intensity brought about improvements in physical self-efficacy which predicted

change in body attractiveness (McAuley et al., 2000). Further, Martin Ginis, Strong et al. (2014) found that increases in aerobic self-efficacy were correlated with improvements in appearance evaluation and social physique anxiety, regardless of strength or aerobic training. However, a study by Martin Ginis et al. (2012), examined the relative effects of changes in physical self-perceptions and changes in self-efficacy as predictors of change in trait body image. Hierarchical regression models revealed that changes in physical self-perceptions were more consistent than changes in self-efficacy in predicting trait body image change. Therefore, although changes in self-efficacy may be involved in explaining trait body image change, it does not appear to have as great of an influence on trait body image change as do changes in physical self-perceptions.

Furthermore, exercise enjoyment may also be positively correlated with trait body image change (Tucker & Mortell, 1993; Martin Ginis & Bassett, 2011). Those who enjoy exercise may push themselves harder in comparison to those who do not enjoy exercise, and therefore yield greater improvements in actual and perceived fitness changes and self-efficacy. As well, those who find exercise enjoyable may have greater improvements in affect, which may lead to more positive feelings about one's body. Therefore, it may be important to examine exercise enjoyment along with the other potential exercise-related mediating factors of trait body image change.

Overall, previous research (among sedentary samples) reveals that exercise-related changes in physical self-perceptions are more important than actual

physical changes in predicting trait body image changes (Martin Ginis et al., 2005; Martin Ginis et al., 2012) and it is worthwhile to explore this relationship further while also considering additional factors, such as self-efficacy (McAuley et al., 2002) and exercise enjoyment (Martin Ginis & Bassett, 2011).

State Body Image

The effect of acute exercise on state body image has been studied among women who are sedentary and among those who exercise regularly. For sedentary women, acute exercise bouts have been found to increase physical appearance anxiety (Martin Ginis, Jung & Gauvin, 2003). For women who exercise regularly, several studies have shown that a single bout of exercise for as little as 30 minutes can improve state body image (Martin Ginis & Bassett, 2012), however, the mechanisms to explain these changes are unknown (Martin Ginis & Bassett, 2012). Emerging research suggests that improvements in affect may play a role.

A study by LePage and Crowther (2010) examined the immediate effects of exercise on state body image dissatisfaction and affect and how it was related to exercise motivations. Sixty-one female undergraduates who exercised at least 3 times per week were categorized as having high or low trait body dissatisfaction as assessed by the Appearance subscale of the State Self-Esteem Scale (SSES; Heatherton & Polivy, 1991), which was administered with adapted instructions to serve as a trait measure of body image. State body image was assessed by the Appearance subscale of the SSES, affect was assessed by the Positive and Negative Affect Scale – Expanded Form (PANAS-X; Watson & Clark, 1994) and

exercise motivations were assessed by the Reasons for Exercise Inventory (REI; Silberstein, Striegel-Moore et al., 1988; Silberstein, Mishkind, Striegel-Moore, & Timko, 1989). Measurements were completed by participants in their naturalistic environment randomly throughout the day and immediately after exercise on a day-to-day basis using ecological momentary assessment, whereby individuals reported on their emotions, attitudes and behaviors as they occurred during the day. It was found that all women experienced less state body dissatisfaction and negative affect and more positive affect following exercise compared to the random time points throughout the day. Overall, exercise had positive effects on affect and state body dissatisfaction for high frequency exercisers. It is important to note, however, that this was a field study. Thus, an unlimited number of factors could have introduced variance into the results. For example, there was no set exercise duration or intensity prescribed to participants, so affect and state body image could be influenced differently from pre to post-exercise depending on the specific duration and intensity that each participant engaged in (Reed & Ones, 2006). As well, affect and state body image were not assessed immediately prior to exercise. Thus, the relationship between the change in affect and change in state body image was not examined.

A study conducted by Vocks, Hechler, Rohrig, and Legenbauer (2009) also examined a sample of regular exercisers to determine the effects of exercise on mood and state body image. The study sample consisted of 65 female members of a fitness club who trained at least 3 hours per week and the initial degree of trait

body image disturbance was assessed by the eating disorder examination questionnaire (EDE-Q, Fairburn & Beglin, 1994; Tuschen-Caffier, Pook, & Hilbert, 2005), the drive for thinness and body dissatisfaction subscales of the eating disorder inventory-2 (EDI-2; Garner, 1997; Paul & Thiel, 2005). The study used a repeated measures cross-over design so participants were randomized to one of two groups to perform both the experimental and control conditions. The experimental condition consisted of a stationary bike workout while the control condition consisted of participants reading a newspaper. Questionnaires were completed prior to and post each treatment. The Body Image States Scale (BISS; Cash, Fleming, Alindogan, Steadman, & Whitehead, 2002) was used to assess state body image and a photo distortion technique was used to assess the perceptual dimension of state body image, whereby participants adjusted pictures of their body to represent what they thought they looked like and these images were compared to what they actually looked like. Mood was assessed using the 'elation-depression' scale from the Mood Questionnaire (MQ; Eid, Steyer, & Schwenkmezger, 1996). The perceptual measure of body image indicated that participants in the experimental group perceived their bodies as feeling slimmer post-exercise compared to pre-exercise. Also, discontent with one's own body decreased and positive mood increased from pre to post-exercise. Participants in the control group had an increased perception of their body girth, an increased discontent with their own body and mood did not significantly change. Thus, exercise was related to improvements in mood and state body image for women

who regularly exercise, although the relationship between change in mood and change in state body image was not tested.

A study by Niven, Rendell and Chisholm (2008) examined the effects of 72 hours of exercise abstinence on affect and state body dissatisfaction. Fifty-eight women who exercised at least four times a week were randomized to either the experimental condition, where they were told not to exercise for 72 hours, or the control condition, where they could continue with their regular exercise routines. All participants completed the UWIST-Mood Adjective Checklist (UMACL; Matthews, Jones, & Chamberlain, 1990) consisting of tense arousal (i.e., tense/ calm), energetic arousal (i.e., vigour/ tired) and hedonic tone (i.e., pleasure/ displeasure) and the Body Dissatisfaction Scale (BDS) from the Eating Disorder Inventory (Garner, Olmstead, & Polivy, 1983) prior to the randomization and after the 72 hour period. Both times these scales were completed, participants reported on their state body image and affect based on the previous 4 days. Compared to the control group (i.e., exercise), participants in the experimental group (i.e., exercise abstinence) significantly increased their scores from pre to post-intervention for body image dissatisfaction and tense arousal and significantly decreased their scores on the hedonic tone and energetic arousal. Although insignificant, there were small correlations between change in body dissatisfaction and change in tense arousal ($r = 0.15$; $p > 0.05$), energetic arousal ($r = -0.18$; $p > 0.05$) and hedonic tone ($r = -0.25$; $p = 0.05$). Although not statistically significant, these correlations indicate that a small relationship exists

between changes in state body image and change in affect in uncontrolled naturalistic settings.

In summation, previous research has shown that exercise improves state body image for women who regularly exercise. However, the mechanisms of change are unclear (Martin Ginis & Bassett, 2012). Previous research has yet to examine the relationship between exercise-related changes in physical self-perceptions and changes in state body image among women who regularly exercise, although changes in physical self-perceptions have been found to be significant in predicting changes in trait body image among sedentary women (Martin Ginis et al., 2005; Martin Ginis et al., 2012). Change in self-efficacy has been found to be a correlate of trait body image change, however, it is not as relevant as physical self-perceptions (Martin Ginis et al., 2012). As well, there has been little research examining the relationship between exercise-related changes in affect and changes in state body image, although a small correlation has been identified (Niven et al, 2008) and studies suggest a bout of exercise can elicit improvements in both outcomes (LePage & Crowther, 2010; Vocks et al., 2009). Therefore, the current study will serve to extend previous research and will further investigate those mechanisms that may be the most relevant in explaining state body image change for regular exercisers.

Regular exercisers are the focus of this experiment because acute exercise has been found to improve state body image for women who exercise regularly (Martin Ginis & Bassett, 2012), while it has been found to increase body image

concerns for sedentary women (Martin Ginis, Jung & Gauvin, 2003). However, the duration that these positive effects on state body image last post-exercise have not been examined for regular exercisers (Martin Ginis, Bassett, 2012). As affect may be a mediator of exercise-related changes in state body image and some of the affect dimensions (i.e., energy) have remained elevated up to post-20 minutes (Ekkekakis, Hall, & Petruzzello, 2008; Hall, Ekkekakis, & Petruzzello, 2002; Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000), it would suggest that exercise-related state body image improvements may also be sustained for this duration. Thus, despite the uncertainty in how long exercise-related improvements in state body image may last for regular exercisers, they are an ideal group for studying the effects of exercise on state body image, and the underlying mechanisms.

To date, there are no models to guide research on exercise and body image (Martin Ginis, Bassett-Gunter, & Conlin, 2012), so the Exercise and Self-Esteem Model (EXSEM) has been used (Martin Ginis et al., 2012; Martin Ginis, Strong, et al., 2014). This model explains how chronic exercise can lead to improvements in global self-esteem and the constructs are organized in a hierarchical fashion to explain how these changes occur, with body image change functioning as one mechanism (Sonstroem & Morgan, 1989). Each construct in the model is influenced by the construct that precedes it. The model begins at the top with chronic exercise (see Figure 1). According to the model, chronic exercise directly influences the most distal determinant of global self-esteem, which is change in physical measures, such as changes in body composition. Changes in physical

measures then influence changes in physical self-efficacy (i.e., one's confidence to perform specific physical tasks). The changes one experiences in physical self-efficacy will then impact changes in one's physical competence, which is operationalized as perceived physical changes (Sonstroem, Speliotis, & Fava, 1992). Perceived physical changes are an individual's evaluation of changes in his/her physical fitness, such as his/her stamina to run a race. Perceived physical changes can then influence change in global self-esteem (i.e., a person's overall evaluation of his/her worth) directly or indirectly through changes in physical acceptance (i.e., operationalized as one's satisfaction with their body appearance; Sonstroem et al., 1992). See Figure 1 for the Exercise and Self-Esteem Model (Sonstroem & Morgan, 1989).

Although the EXSEM was designed to explain how exercise leads to changes in global self-esteem, this model has been successfully applied to research examining how exercise leads to changes in trait body image (Martin Ginis et al., 2012; Martin Ginis, Strong, et al., 2014). All of the constructs of the EXSEM (i.e., exercise-related changes in physical fitness, physical self-efficacy and physical perceptions) have been shown to be correlated with changes in the cognitive, affective and satisfaction dimensions of trait body image (Martin Ginis et al., 2012). The model can be used to understand how acute exercise-related changes in the constructs preceding body image, influence body image change. Figure 2 shows a model we are proposing to explain how acute exercise affects state body image. This model is a revised version of the EXSEM. Global self-esteem has

been removed from this proposed model since state body image change is our primary outcome of interest. Further, although Sonstroem and Morgan (1989) postulate that self-efficacy change predicts changes in physical self-perceptions, this causal, temporal relationship has not been tested in the exercise and body image context. As such, in the proposed model, changes in self-efficacy and physical self-perceptions have been conceptualized as concurrent mediators (See Figure 2).

Additionally, there is literature suggesting change in affect might play a role in exercise-related state body image change (LePage et al., 2010; Niven et al., 2008; Vocks et al., 2009) so change in affect has been included in the model. Affect has been added into the model alongside self-efficacy and physical self-perceptions (see Figure 2) as there is currently not enough evidence to speculate on the temporal ordering of these constructs. In the context of exercise, McAuley, Talbot and Martinez (1999) found that manipulations of self-efficacy were associated with changes in affect. However, while self-efficacy beliefs can affect the nature and intensity of emotional experiences, affective experiences can also influence one's self-efficacy (Bandura, 1997). To our knowledge, the relationship between affect and physical self-perceptions has not yet been examined. See Figure 2 for the exercise and state body image model with the addition of the change in affect construct.

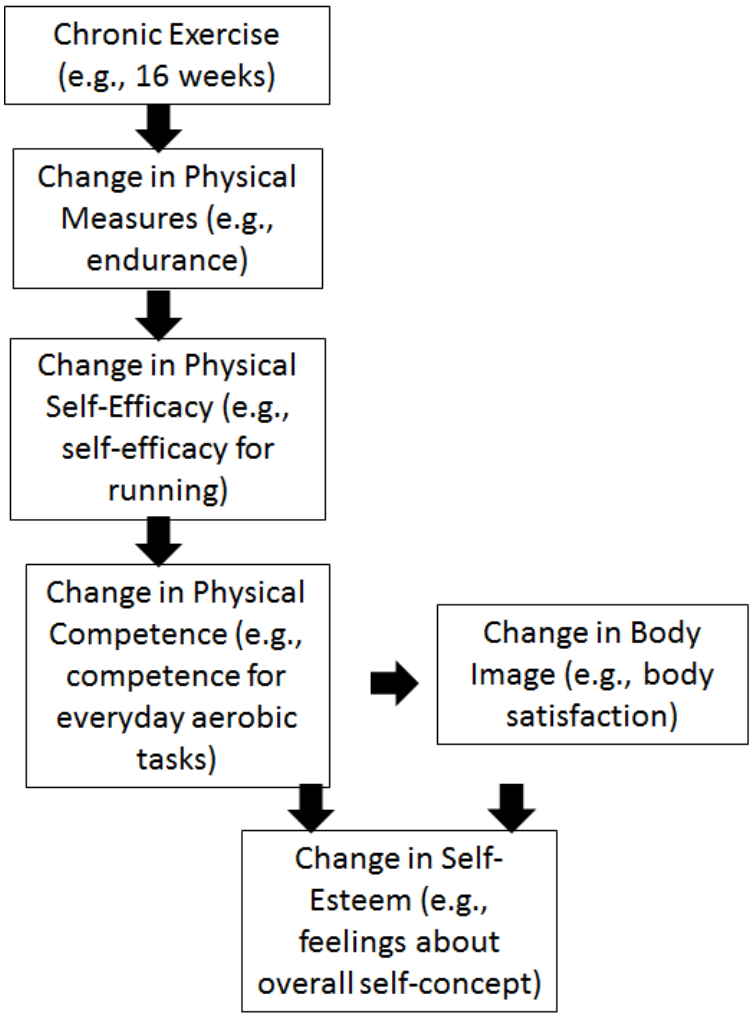

Figure 1: Diagram of the Exercise and Self-Esteem Model (Sonstroem & Morgan, 1989).

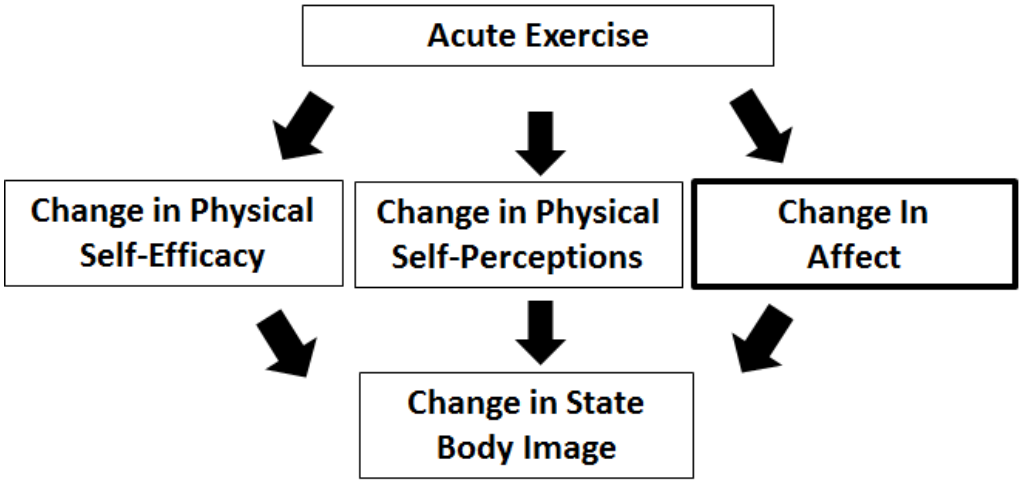

Figure 2: The proposed exercise and state body image model (i.e., the EXSEM with the addition of the 'change in affect' construct and the 'change in self-esteem' construct removed).

Purpose of the Present Study

Using the proposed exercise and state body image model as a guiding framework, the primary purpose of this study was to determine if acute exercise-related changes in physical self-efficacy, physical self-perceptions, and affect (including enjoyment) are mechanisms by which a single bout of aerobic exercise improves state body image in women who regularly exercise. A secondary purpose was to identify how long exercise-related improvements in state body image are sustained post-exercise, relative to a control condition.

Hypotheses

First, it was hypothesized that exercise-related changes in state body image would be mediated by changes in physical self-perceptions (Martin Ginis et al.,

2012) and affect (LePage et al., 2010; Niven et al., 2008; Vocks et al., 2009), but not by changes in aerobic self-efficacy (Martin Ginis et al., 2012). Secondly, it was hypothesized that state body image would be greater in the exercise condition in comparison to the control condition immediately after exercise (post-0) and throughout recovery (post-10 and -20; Ekkekakis, Hall, & Petruzzello, 2008; Hall, Ekkekakis, & Petruzzello, 2002; Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000).

Method

Participants

Participants were recruited through advertisements posted and handed out on the McMaster University Campus. The advertisements provided contact information for interested participants to learn more about participating in the study. Informed consent was obtained from all participants. Participants were routinely active, university-aged women because exercise interventions have been found to positively influence body image among this demographic (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Martin Ginis & Bassett, 2012; Martin Ginis, Jung & Gauvin, 2003). Participants were required to meet the following inclusion criteria: 17 – 23 years old, normal BMI range of 18.5 – 24.9 kg/m^2 (Campbell & Hausenblas, 2009; Canadian Society for Exercise Physiology, 2013), indication on the Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985) of performing moderate physical activity $\geq$ 3 days per week over the past year. Rodgers and Gauvin (1998) found that there are differences between

non-regular exercisers and regular exercisers (as defined by exercising $\leq$ 2 and $\geq$3 days per week, respectively) on how they think about exercise, so it is appropriate to define "regular exercisers" in this way. Also, participants must have had trait body image disturbance as defined as scoring $\leq$ 3.5 on the Body Areas Satisfaction Subscale (BASS) of the Multidimensional Body-Self Relations Questionnaire (MBSRQ; Brown, Cash, & Mikulka, 1990), and $\geq$ 27 on the Social Physique Anxiety Scale (SPAS; Martin, Rejeski, Leary, McAuley, & Bane, 1997). Participants also had to have passed the Physical Activity Readiness Questionnaire (PAR-Q; Physical Activity Readiness Questionnaire, 2002). These criteria have effectively been used to screen participants for body image concerns in previous exercise studies (Martin Ginis, Strong, et al., 2014).

Exclusion criteria were established to limit biases in participants' responses. Clinical levels of anxiety (Stice & Whitenton, 2002) or depression (Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006) have been suggested to be causes of body image disturbance. As well, individuals with an eating disorder report greater body dissatisfaction compared to the general population (Cash & Deagle, 1997). Further, individuals with mood disorders have greater negative baseline emotion, compared to those without clinical symptoms (Campbell-Sills, Barlow, Brown, & Hofmann, 2006). Thus, participants were excluded if they had been diagnosed with any of the following: anxiety, depression, eating disorders, and/or mood disorders. Participants were also excluded if they had contraindications to

exercise based on the Physical Activity Readiness Questionnaire (PAR-Q; Physical Activity Readiness Questionnaire, 2002).

According to Frtiz and McKinnon (2007), a required sample size to achieve statistical significance in a test for mediation using the PROCESS procedure can be determined based on the effect sizes of the alpha and beta pathways of the mediation model. There were no studies of the acute effects of exercise on physical self-perceptions to draw on for a sample size calculation. Thus, the effect sizes from the affect literature were used for the power calculation. A meta-analysis by Reed and Ones (2006) found an effect size of 0.47 for the relationship between exercise and affect, which is considered the alpha pathway in the mediational model. Niven et al. (2008) found a correlation (r = -0.25) for the relationship between changes in hedonic tone (pleasure/displeasure) and changes in body dissatisfaction, which represents the beta pathway in the mediation model. The positive value of this correlation was used since body satisfaction, not body dissatisfaction, was assessed in this study. Thus, for sample size calculation purposes, the effect size of the beta pathway in the mediation model was set at 0.25. According to Fritz and McKinnon (2007), based on these effect sizes, the sample size required for a bias-corrected bootstrap mediation test with a power of 0.8 is 116.

After data from 58 participants were collected (i.e., 50% of the estimated sample size) an interim analysis was conducted. Our rationale for this analysis was that the effect size used for the beta value of the power calculation was from a

correlational study, which is an inherently weaker design with fewer controls than the randomized controlled experimental design utilized in the present study. Recognizing that the power calculation was likely conservative, and an N of 116 could result in an over-powered design, the interim analysis was undertaken. These interim analyses revealed significant changes in the constructs in the exercise condition compared to the control condition, as well as significant indirect effects for physical self-perceptions and affect on exercise-related state body image change. Since there was support for our hypotheses, recruitment was terminated at n = 58 and the remaining booked participants completed their lab visits (n = 2). The conservative power calculation provides a likely explanation for why significant results were obtained at the interim analysis.

Design

A two-condition, between-subjects, randomized controlled design was used. The two conditions were an experimental (exercise) condition and a control (quiet rest) condition.

Measures

State Body Image. State body image was measured using the 6-item Body Image States Scale (BISS; Cash, Fleming, Alindogan, Steadman & Whitehead, 2002). This questionnaire is a measure of individuals' situational evaluation and affect about their physical appearance. Specifically, items assess overall physical appearance, body shape and size, weight, attractiveness, current feelings about one's looks compared to usual feelings and one's appearance

compared to the average person's looks. Participants rated their agreement with each item on a 9-point scale. Higher scores on the 9-point scale indicated more favorable body image states. BISS was scored as the mean of the six items after reverse scoring three items (2,4, and 6). In a prior study, this scale was used to assess state body image among regular exercisers and had an internal consistency of $\alpha = 0.85$ (Vocks et al., 2009). In the present study, internal consistency at all four study measurement points was: $\alpha = 0.58, 0.72, 0.79, 0.77$.

Affect. The Activation Deactivation Adjective Check List (AD ACL; Thayer, 1989) was used to measure changes in participants' affect before and after the experimental and control condition. As there have been a limited number of studies examining the relationship between affect and state body image, it was best to keep the investigation broad by assessing the global domain of affect as opposed to distinct-states (Ekkekakis, 2012). This was done using a two-dimensional model of affect (Ekkekakis, 2012). AD ACL was chosen as the affect measure as it consists of a more complete operationalization than an alternate two-dimensional scale, the Positive and Negative affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; Ekkekakis, 2012). The AD ACL consists of two bipolar dimensions: Energetic Arousal (EA) and Tense Arousal (TA). EA extends from high-activation pleasant affect (labeled 'Energy' containing 5 items) to low activation unpleasant affect (labeled 'Tiredness' containing 5 items). TA extends from high activation unpleasant affect (labeled 'Tension' containing 5 items) to low activation pleasant affect (labeled 'Calmness' containing 5 items).

In total there are 20 items and participants were asked to rate how they felt at that moment based on Likert-type scale ranging from 1 (not at all) to 5 (extremely) (Thayer, 1986). Two items were reverse scored. The four dimensions - energy, tiredness, tension and calmness - were scored individually. Each dimension was scored as the mean of the five items pertaining to that dimension. Ekkekakis, Hall and Petruzzello (2005) found that the AD ACL is a satisfactory measure to assess changes in affect in response to physical activity. Internal consistency at all four study measurement points was: Energy: $\alpha = 0.81, 0.93, 0.84, 0.88$; Tiredness: $\alpha = 0.77, 0.93, 0.90, 0.89$; Tension: $\alpha = 0.75, 0.62, 0.53, 0.70$; Calmness: $\alpha = 0.51, 0.78, 0.72, 0.77$.

Exercise Enjoyment. Exercise enjoyment was assessed by the Physical Activity Enjoyment Scale (PACES), which was created to assess exercise enjoyment among college-aged students (Kendzierski & DeCarlo, 1991). The original PACES has 18 items, although some of these items have been found to detect the antecedents/ consequences of enjoyment (e.g., "it made me depressed") and not enjoyment of the activity itself (Raedeke, 2007). Thus, a modified version including 8 items that solely assess enjoyment of the activity (e.g., "I enjoyed it", "I felt interested") was used (Raedeke, 2007). This modified version was strongly correlated with the complete scale ($r = 0.94$; Raedeke, 2007). As this scale was completed post-exercise in the present study, the wording of each item was changed from present tense (i.e., "enjoy") to past tense (i.e., "enjoyed"). Participants rated their agreement with each item on a 7-point bipolar scale.

PACES was scored as the sum of the items after reverse scoring four items (1,4, 5, and 7). This scale showed acceptable internal consistency when administered in the present study ($\alpha = 0.92$).

Physical Self-Perceptions. Physical self-perceptions were measured using four 6-item subscales of the Physical Self-Description Questionnaire (PSDQ; Marsh, Richards, Johnson, Roche, & Tremayne, 1994): the Body Fat subscale measured perceived fatness, the Body Strength subscale measured perceived muscular strength, the Appearance subscale measured perceived appearance, and the Body Endurance subscale measured perceived aerobic endurance. These scales have shown to have good validity and reliability among the present study sample of interest: college-aged women (e.g., Marsh et al., 1994). Participants rated how well each item describes them on a scale from 1 (false) to 6 (true). After reverse scoring the negatively worded items (Body fat subscale 6 items, Appearance subscale 2 items, Strength subscale 1 item), scale scores were computed by averaging the responses to items on each subscale. Higher scores on the 6-point scale indicated more favourable perceptions of body fat, strength, appearance and endurance. These scales showed acceptable internal consistency at all four study measurement points (Body fatness: $\alpha = 0.85, 0.91, 0.94, 0.93$; Appearance: $\alpha = 0.85, 0.84, 0.87, 0.84$; Strength: $\alpha = 0.92, 0.93, 0.94, 0.93$; Endurance: $\alpha = 0.90, 0.93, 0.95, 0.95$).

Aerobic Self-Efficacy. Aerobic self-efficacy was assessed by measuring participants' confidence to perform activities requiring aerobic endurance.

Participants indicated their confidence to cycle on a bike for 10, 20, 30, 40, 50 and 60 minutes without stopping on a scale ranging from 0 (not at all) to 100 (completely). A mean value was calculated across the six different levels of activity. A higher score indicated greater aerobic self-efficacy. This assessment of aerobic self-efficacy was used by Martin Ginis et al. (2012) and had an internal consistency of $\geq$ 0.94. This scale showed acceptable internal consistency at all four study measurement points (α = 0.93, 0.91, 0.93, 0.93).

Covariates

Body Mass Index. Body mass index was assessed by body mass index (BMI). Height and weight were measured using a tape measure and a standard scale and by calculating kilograms/meters^2. The BMI cut-offs indicating a healthy BMI were based on the guidelines provided by the Canadian Society for Exercise Physiology (Canadian Society for Exercise Physiology, 2013).

Demographics. Race, age and socioeconomic status were collected through self-report as these variables have been found to influence body image (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Miller et al., 2000; Paeratakul, White, Williamson, Ryan & Bray, 2002).

Manipulation Checks

Heart Rate. Heart rate was monitored only for participants in the exercise condition by using a Polar Heart Rate monitor (HR monitor, Polar S625X). Participants' heart rate was recorded at 2.5 minutes into the warm-up, 1.5 minutes into the cool-down and every 5 minutes during the exercise bout.

Perceived Exertion. To ensure participants perceived themselves to be exercising at a moderate-to-vigorous intensity, perceived exertion was assessed by Borg's Rating of Perceived Exertion scale (RPE; Borg, 1982). Participants were presented with a scale ranging from 6 (no exertion at all) to 20 (maximal exertion). Participants were asked to indicate a number to represent their perceived exertion according to the scale at 2.5 minutes into the warm-up, 1.5 minutes into the cool-down and every 5 minutes during the exercise bout. A rating between 13 – 15 denotes moderate-to-vigorous intensity exercise (Canadian Society for Exercise Physiology, 2013).

Procedure

The university's Research Ethics Board approved the research protocol. Interested participants contacted the researcher by email and were screened via an online survey to determine if they met the inclusion/ exclusion criteria. Eligible participants were scheduled for a lab visit and at that time were instructed to not exercise on the day of the visit, and to wear baggy sweat pants and a t-shirt to the experimental session. These protocols were followed to avoid capturing any exercise induced affect changes not elicited by the study and to avoid any attire-related body image concerns.

Upon arrival at the lab, participants provided consent and completed the PAR-Q for a second time (completed initially during email screening). All participants then put the heart rate monitor on in private. Prior to the exercise/control manipulations, participants sat at a computer and completed a demographics

questionnaire. Participants then completed the BISS, aerobic self-efficacy scale, AD ACL, and the four subscales of the PSDQ. Participants were then randomized by an online randomizer to complete either the exercise or control condition. At that point, participants were then provided with instructions on the condition they were to complete.

Throughout the lab visit, the researcher followed a script to ensure each participant followed the same protocol. Only one researcher was present in the lab and she wore a baggy lab coat throughout the entirety of the lab visit. Also, during the experimental and control testing sessions, the researcher organized paperwork/ worked on a computer in the lab facing away from participants to deliberately avoid watching them. Participants in both conditions received no verbal encouragement from the researcher. Lastly, no men were present in the room throughout the entire lab visit. These protocols were followed to minimize the effects of the researcher's presence and physique on participants and to limit extraneous factors that could influence the variables being examined.

Exercise Manipulation

Previous meta-analyses examining the effects of exercise on body image have revealed that exercise intensity significantly moderates the effects of exercise on body image (Hausenblas & Fallon, 2006; Reel et al., 2007). Specifically, moderate (effect sizes between d = .31 to .36) and vigorous (effect sizes between d = .33 to .58) intensities have the greatest effects on body image improvements in comparison to mild intensity (effect sizes between -.04 to .06; Hausenblas &

Fallon, 2006; Reel et al., 2007). In an acute exercise study that compared participants in an exercise condition to those in a reading condition, women who completed a cycling exercise at a moderate-to-vigorous intensity (65% - 85% maximum heart rate) had significantly greater improvements in state body image compared to women in the control condition (Vocks et al., 2009). As such, to bring about optimal state body image change, a moderate-to-vigorous intensity was chosen for this exercise protocol (65% – 85% maximum heart rate; RPE 13 to 15; Canadian Society for Exercise Physiology, 2014). The age-predicted maximal heart rate equation (220 – age) was used to determine participants' maximum heart rate. Heart rate monitors (Polar 650X) were used to corroborate exercise participants' rated perceived exertion, to ensure they were exercising at a moderate intensity (Fallon & Hausenblaus, 2005).

Consistent with Vocks et al.'s study (2009), participants in the present study completed an aerobic bout on a stationary cycle ergometer (Lode Corival, Groningen, the Netherlands). This type of exercise was suitable as previous meta-analyses examining the effects of exercise on body image have not produced conclusive evidence as to whether aerobic, strength training or a combination of both is superior to the others in improving body image (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007). Furthermore, as meta-analyses have not found exercise duration to significantly moderate exercise-related body image change (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007), we determined the optimal exercise duration by looking

at meta analyses that examined the durations associated with the greatest changes in the mediator variables. To the best of our knowledge, there are no meta-analyses that reported the exercise durations that bring about the greatest improvements in physical self-perceptions or physical self-efficacy. As such, the exercise duration was determined based on the effect size from a meta-analysis outlining the effects of exercise on affect (Reed & Ones, 2006). Based on Reed and Ones' meta-analysis (2006), participants had the greatest exercise-related improvements in affect when they engaged in 30 to 35 minutes of exercise (excluding warm-up and cool down; effect size = 0.57). Thus, based on all of these considerations, the exercise bout in the present study was a 30 minute moderate-to-vigorous intensity aerobic workout on a stationary cycle ergometer, along with a 5 minute warm-up and 3 minute cool down for a total of 38 minutes of activity.

Control Manipulation

The control condition manipulation consisted of participants sitting in a comfortable chair in the lab reading magazines (e.g., National Geographic) for the same duration that the experimental condition lasted, 38 minutes. Reading magazines was chosen as the control activity because it is not physical activity, provides distraction, and has been shown to bring about differing effects than exercise in a randomized controlled study comparing state body image between an exercise and control condition (Vocks et al., 2009). Magazines were chosen by the researcher that were unrelated to diet, fitness, health and appearance and any

pictures of models were excluded to avoid triggering body image concerns or dissatisfaction among participants (cf. Vocks et al., 2009).

After the exercise/control manipulations, participants sat at a computer and completed the BISS as well as the aerobic self-efficacy scale, AD ACL, and the four subscales of the PSDQ at post-0, post-10 and post-20, while PACES was only measured at post-0. In the time between completing the measures, all participants sat in a chair for quiet rest. Data for state body image and the mediator variables were collected at multiple time points post-condition in case there was a need to test the alternate mediation model (e.g., change in state body image mediates exercise-related affect changes). The order that the measures were presented was systematically rotated at each time point to control for temporal order and carry over effects. After all questionnaires had been completed, the participant removed the heart rate monitor in private. She was then asked to remove her shoes and step on a scale. Height and weight were measured by the researcher to calculate BMI. Lastly, participants were debriefed regarding the study and given a $20 gift card to reimburse them for their time and participation in the study. See Appendix A, Figure A for an overview of the study procedure.

Data Analysis

Analyses were conducted using SPSS v. 19 (IBM SPSS Predictive Analytics, Chicago IL). All statistical tests were two-tailed, set at a significance level of $p < 0.05$. As BMI has been found to be correlated with change in body image (Campbell & Hausenblas, 2009), it was statistically controlled for and

added as a covariate in ANCOVAs for state body image and physical self-perceptions. Independent samples t-tests and chi squared tests were conducted on the remaining demographic variables to determine if any of these variables needed to be controlled for in the analyses. Preliminary analyses were then conducted to determine if exercise brought about changes, compared to the control group, in the proposed mediators: physical self-perceptions, affect, and aerobic self-efficacy. A mixed between-within repeated measures 2 (experimental vs. control) x 2 (pre, post 0) ANCOVA was conducted on the four subscales of the PSDQ, aerobic self-efficacy scores and the AD ACL scores to determine if a significant condition X time interaction existed. BMI was included as a covariate in the analysis on physical self-perceptions. An independent samples t-test was used to determine if enjoyment was greater for participants in the exercise condition compared to the control condition. To determine if exercise brought about positive changes in state body image, and to determine how long these improvements lasted, relative to the control group, a mixed between-within repeated measures 2 (experimental vs control) x 4 (pre, post-0, post-10, post-20) ANCOVA was conducted on the BISS scores to test for a significant condition x time interaction. BMI was included as a covariate. Post-hoc univariate ANCOVAs were used to determine if differences existed in BISS scores at post-10 and post-20 between exercise and control conditions, which subsequently tested the secondary hypothesis.

Mediation analyses were computed using model 4 within the PROCESS software macro (Hayes, 2013). The test of mediation proceeded in several steps.

First, separate models were computed to explain change in state body image from baseline to post-0, by testing each mediating construct separately. Specifically, aerobic self-efficacy was tested as a mediator, then the physical self-perception measures were tested in a separate model, and lastly, affect measures (including enjoyment) were tested in a third model. Second, variables that were significant mediators were entered all together in another model to determine the significance of the indirect effect of these variables when entered together. Third, the above steps were repeated using change in state body image from pre- to post-10 as the outcome measure. Fourth, the steps were repeated to explain change in state body image from pre- to post-20. In all of the models, the tested mediators were changes in the measures from pre to post-0. Our rationale for testing this change as the mediator is that post-0 is most proximal to the completion of exercise and might therefore most accurately capture exercise-related changes.

Consistent with recommendations by Hayes and Scharkow (2013), bias-corrected bootstrap procedures utilizing 1000 simulations were computed for each mediation model. Ninety-five percent confidence intervals were calculated and used to determine the significance of the indirect (mediation) effect. BMI was included as a covariate in each multiple mediator model. The partially standardized indirect effects were reported and represent the number of standard deviations that state body image will change due to exercise, compared to control, via the mediator variable (Hayes, 2013). Kappa squared (κ^2) values were also reported and represent the proportion of the maximum possible effect that was

accounted for by the mediator in each model and meets all of the requirements of an effect size as outlined by Preacher and Kelley (2011). As this effect size has not been generalized to multiple mediation models, PROCESS software macro can only calculate this statistical value for a single mediator model with no covariates. Hence, those mediators with significant indirect effects were entered separately in a mediation model without any covariate (i.e., BMI) to obtain κ^2.

Results

Participant Characteristics

Of the 254 participants that expressed interest in partaking in the study, 75 (29.5%) met all of the eligibility criteria. All 75 participants were women, between ages 17-23, self-reported regular exercisers ($\geq$ 3 days per week), within a self-reported normal BMI range (18.5 – 24.9 kg/m^2), had not been diagnosed with clinical anxiety, depression, mood or eating disorders, and had body image disturbance as assessed by the BASS ($\leq$3.5) and SPAS ($\geq$27). Four participants dropped out of the study prior to their lab visit and six could not be reached after four attempts via email. The remaining 65 participants were randomized and completed the exercise (n=31) or control (n=34) condition manipulation. Five participants' data were subsequently removed due to the following ineligibility reasons: fraudulent information was provided regarding body image dissatisfaction during screening (n = 1); participants' self-reported BMI met the eligibility criteria, however, their objective measures taken at lab visit deemed they were not eligible (n = 4). This resulted in 30 participants remaining in each

condition for data analysis. Figure 3 presents a flowchart of participants through the study.

Independent samples t-tests and chi squared tests revealed no significant differences between the exercise and control conditions on the demographic variables (age, BMI, mild, moderate and strenuous intensities of physical activity, race, socioeconomic status) or trait body image variables (BASS, SPAS; all *p*s > .35). Table 1 presents participants' demographic characteristics.

Table 2 presents the means and standard deviations for the state body image measure (BISS), and measures of the psychological mechanisms (physical self-perceptions of body fat, appearance, strength and endurance of the PSDQ; energy, tiredness, tension and calmness of the AD ACL and enjoyment; aerobic self-efficacy) for the exercise and control conditions at pre and post-0 assessments (as well as post-10 and post-20 for state body image).

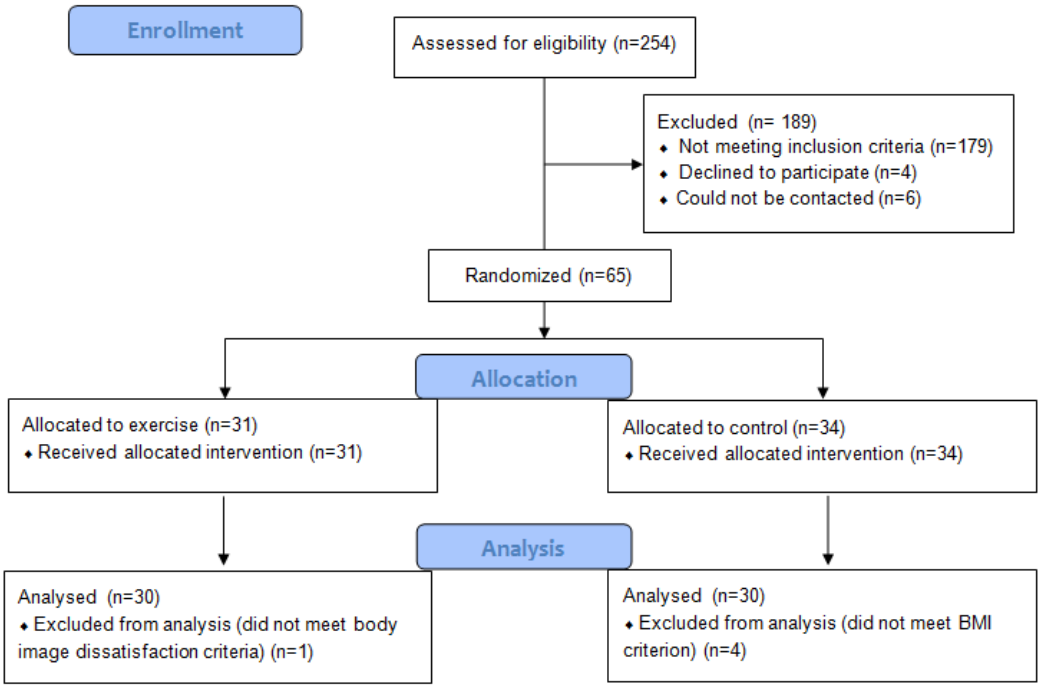

Figure 3: Flow of participants through the study.

Table 1

Demographic characteristics of participants included in the analyses

Demographic Measure	Exercise Condition (n=30)	Control Condition (n=30)
Age (years)	19.40 (1.28)	19.73 (1.46)
Body Mass Index (kg/m^2)	22.05 (1.55)	21.70 (1.63)
Days/ week exercise		
Strenuous intensity	2.92 (1.27)	2.90 (1.65)
Moderate intensity	3.82 (1.70)	3.73 (1.59)
Mild intensity	3.98 (2.55)	4.12 (2.15)
Total days per week	4.25 (1.57)	4.35 (1.35)
Race		
Caucasian	63.3%	56.7%
Asian	16.7%	30.0%
Other	20%	13.3%
Family's Socioeconomic status		
1^{st} Quintile ($16,000 to $28,000)	13.3%	6.7%
2^{nd} Quintile ($28,000 to $38,500)	13.3%	13.3%
3^{rd} Quintile ($38,500 to $50,600)	16.7%	30%
4^{th} Quintile ($50,600 to $85,500)	46.7%	30%
5^{th} Quintile ($85,500 +)	10.0%	20%
Trait Measures		
Body Areas Satisfaction Subscale	2.84 (.40)	2.84 (.47)
Social Physique Anxiety Scale	31.83 (3.82)	32.57 (4.25)

Note. Values in parentheses are standard deviations. Quintiles are based on Canada's 2010 after tax income ranges (http://www.statcan.gc.ca/).

Table 2

Means, standard deviations and significance tests for state body image and mechanism measures

	Exercise (n=30)				Control (n=30)				F (df = 1, 58)[a]		
Measure	Pre	Post 0	Post 10	Post 20	Pre	Post 0	Post 10	Post 20	Time	Condition	Time x Condition
State body image	4.81 (.81)	5.20[b] (1.08)	5.21[b] (1.07)	5.04 (1.03)	5.20 (.88)	4.77 (.91)	4.89 (1.13)	4.81 (1.09)	.85	.52	7.25**
Psychological Mechanisms											
Aerobic Self-efficacy	80.97 (15.20)	88.65 (10.10)	--	--	80.20 (15.69)	78.62 (15.97)	--	--	5.76*	2.37	13.30**
Physical self-perceptions											
Body Fat	3.87 (.86)	4.12 (1.04)	--	--	4.25 (1.09)	4.19 (1.29)	--	--	1.13	.31	4.34*
Appearance	4.14 (.79)	4.26 (.82)	--	--	3.89 (.68)	3.74 (.61)	--	--	.19	3.73	10.90*
Body Strength	3.71 (1.02)	4.13 (1.03)	--	--	3.88 (1.07)	3.77 (1.07)	--	--	.89	.003	14.43**
Body Endurance	3.28 (1.11)	3.96 (1.19)	--	--	3.66 (1.27)	3.61 (1.34)	--	--	.87	.10	10.07**

Affect											
Energy	2.82	3.40			2.71	1.51			13.72**	53.64**	105.37**
	(.67)	(.57)	--	--	(.73)	(.51)	--	--			
Tiredness	2.80	2.01			2.73	3.73			.74	30.93**	89.13**
	(.58)	(.66)	--	--	(.69)	(.75)	--	--			
Tension	1.85	1.90			1.85	1.39			5.65*	5.20*	8.49*
	(.48)	(.57)	--	--	(.72)	(.36)	--	--			
Calmness	2.96	2.39			3.05	3.56			.16	24.10**	42.08**
	(.50)	(.71)	--	--	(.57)	(.57)	--	--			
Enjoyment		35.67				23.63					
	--	(7.66)	--	--	--	(9.84)	--	--	--	5.28**[c]	--

Note. Values in parentheses are standard deviations; $p \leq .05$; ** $p \leq .001$

[a] Degrees of freedom differed for repeated measures mixed ANCOVAs on physical self-perception s (1, 57) and state body image (2.53, 144.37) as BMI was included as a covariate and Huynh-feldt corrections were made (state body image only). [b] Post-hoc one-way ANCOVAs, controlling for the baseline BISS score and BMI, showed these BISS scores were significantly greater for the exercise condition compared to the control condition with Bonferroni correction, $p < .02$. [c] t value from an independent samples t-test.

Manipulation check

Heart rate. Participants' mean heart rates were 152.86, 159.93, 161.18, 161, 71, 161.21 and 159.32 beats per minute (bpm) at 5, 10, 15, 20, 25, and 30 minutes during the exercise bout. As well, participants' mean heart rate was 108.23 bpm and 137.86 bpm at 2.5 minutes into the warm-up and 1.5 minutes into the cool-down, respectively. This data suggests that the manipulation was successful, such that participants were exercising at a moderate-to-vigorous intensity.

Perceived Exertion. Participants' mean perceived exertion was 13.15, 14.27, 14.29, 14.52, 14.42, and 13.45 at 5, 10 5, 10, 15, 20, 25, and 30 minutes during the exercise bout. As well, participants' mean perceived exertion was 7.58 and 8.94 at 2.5 and 1.5 minutes during their warm-up and cool-down, respectively. This data suggests that the manipulation was successful, such that participants perceived themselves to be exercising at a moderate-to-vigorous intensity.

Preliminary analyses

Data were screened for entry errors and outliers, and there were no missing data (Glass & Hopkins, 1996). All outliers were replaced with values that were one unit above the next highest score in the data set (Field, 2009). Homogeneity of variance was assessed by Levene's Test for Equality of Variances. When Levene's test was significant, Hartley's F_{max} was used to confirm the assumption was met. Sphericity was tested using Mauchly's Test of Sphericity for state body image only because there were more than 2 time-point

assessments. As the variances were significantly different, the degrees of freedom were corrected using Huynh-feldt, as the estimated epsilon was greater than .75 (Field, 2009). Level of significance was set a priori at $p < .05$. Table 2 summarizes the ANOVA findings.

State Body Image. A 2 (condition: exercise or control) x 4 (time: pre, post-0, post-10, post-20) repeated measures mixed ANCOVA was conducted on state body image scores. There was no significant main effect of time, F (2.53, 144.37) = .85, p= .45, or condition, F (1, 57) = .42, p =.52. The covariate, BMI, was not significant, F (1, 57) = .03, p =.88. As predicted, there was a significant condition x time interaction, F (2.53, 144.37) =7.25, p <.001. Post-hoc one-way ANCOVAs, controlling for the baseline BISS score and BMI, showed BISS scores were significantly greater for the exercise condition compared to the control condition at post-0, F (1, 56) = 12.28, p = .001, d = .44; post-10, F (1, 56) = 7.39, p = .01 d = .27; and at post-20, F(1, 56) = 5.12, p = .03, d = .24. These findings support the secondary hypothesis.

Aerobic self-efficacy. A 2 (condition: exercise or control) x 2 (time: pre, post-0) repeated measures mixed ANOVA was conducted on aerobic self-efficacy scores. There was a significant main effect for time, F (1, 58) = 5.76, p = .02, but not for condition, F (1, 58) = 2.37, p = .13. As predicted, there was a significant condition x time interaction, F (1, 58) = 13.30, p= .001, such that the exercise condition had a greater increase in aerobic self-efficacy than the control condition.

Energy. A 2 (condition: exercise or control) x 2 (time: pre, post-0) repeated measures mixed ANOVA was conducted on energy scores. There was a significant main effect for time, F (1, 58) = 13.72, p = .001 and condition, F(1, 58) = 53.64, p < .001. As expected, main effects were superseded by a significant condition x time interaction, F(1, 58) = 105.37, p < .001, such that the exercise condition had a greater increase in energy than the control condition.

Tiredness. A 2 (condition: exercise or control) x 2 (time: pre, post-0) repeated measures mixed ANOVA was conducted on tiredness scores. There was no significant main effect for time, F (1, 58) = .74, p = .39, but there was for condition, F (1, 58) = 30.93, p < .001. As predicted, there was a significant condition x time interaction, F (1, 58) = 89.13, p < .001, such that the exercise condition had a greater decrease in tiredness than the control condition.

Tension. A 2 (condition: exercise or control) x 2 (time: pre, post-0) repeated measures mixed ANOVA was conducted on tension scores. There was a significant main effect for time, F (1, 58) = 5.65, p = .02, and condition, F (1, 58) = 5.20, p = .03. As predicted, there was a significant condition x time interaction, F (1, 58) = 8.49, p = .01, such that the exercise condition had a greater increase in tension than the control condition.

Calmness. A 2 (condition: exercise or control) x 2 (time: pre, post-0) repeated measures mixed ANOVA was conducted on calmness scores. There was no significant main effect for time, F (1, 58) = .16, p = .69, but there was for condition, F (1, 58) =24.10, p < .001. As expected, there was a significant

condition x time interaction, F (1, 58) = 42.08, p < .001, such that the exercise condition had a greater decrease in calmness than the control condition.

Enjoyment. An independent samples t-test was conducted to compare enjoyment scores for participants in the exercise and control conditions. As expected, participants in the exercise condition reported greater enjoyment (M = 35.67, SD = 7.66) versus the control condition (M = 23.63, SD = 9.84); t (54.71) = 5.28, p = < .001 (two tailed).

Perceived endurance. A 2 (condition: exercise or control) x 2 (time: pre, post-0) mixed ANCOVA was conducted on perceived endurance scores. There was no significant main effect of time, F (1, 57) = .87, p = .35, or condition, F (1, 57) = .10, p = .75. The covariate, BMI, was significant, F (1, 57) = 6.21, p = .02. As predicted, there was a significant condition x time interaction, F (1, 57) = 10.07, p = .002, such that the exercise condition had a greater increase in perceived endurance than the control condition.

Perceived strength. A 2 (condition: exercise or control) x 2 (time: pre, post-0) mixed ANCOVA was conducted on perceived strength scores. There was no significant main effect of time, F (1, 57) = .02, p = .89 or condition, F (1, 57) = .003, p = .96. The covariate, BMI, was significant, F (1, 57) = 9.78, p = .003. As predicted, there was a significant condition x time interaction, F (1, 57) = 14.43, p < .001, such that the exercise condition had a greater increase in perceived strength than the control condition.

Perceived appearance. A 2 (condition: exercise or control) x 2 (time: pre, post-0) mixed ANCOVA was conducted on perceived appearance scores. There was no significant main effect of time, F (1, 57) = .19, p = .66, or condition, F (1, 57) = 3.73, p = .06. The covariate, BMI, was not significant, F (1, 57) = 1.62, p = .21. As expected, there was a significant condition x time interaction, F (1, 57) = 10.90, p = .002, such that the exercise condition had a greater increase in perceived appearance than the control condition.

Body fatness. A 2 (condition: exercise or control) x 2 (time: pre, post-0) mixed ANCOVA was conducted on perceived body fatness scores. There was no significant main effect of time, F (1, 57) = 1.13, p = .29 or condition, F (1, 57) = .31, p = .58. The covariate, BMI, was significant, F (1, 57) = 10.37, p = .002. As anticipated, there was a significant condition x time interaction, F (1, 57) = 4.34, p = .04, such that the exercise condition had a greater increase in perceived body fatness than the control condition.

Main Analyses

Results of the mediation analyses, including 95% confidence intervals, kappa squared values, and partially standardized indirect effects for the significant mediators, are reported in Table 3. All tested models are presented in Appendix A, Figure B.

In the mediation model explaining changes in state body image from pre- to post-0, changes in strength self-perceptions emerged as the only significant mediator in the first step of our analyses. Change in strength self-perceptions was

subsequently entered on its own in the model in the second step of our analyses (95% C.I. = .07 - .52, κ^2 =.16, ab_{ps}=.31).

In the mediation model explaining changes in state body image from pre- to post-10, increases in strength self-perceptions as well as decreases in tiredness had significant indirect effects in the first step of the analysis. Both change in strength self-perceptions (95% C.I. = .05 - .50, κ^2 =.16, ab_{ps} =.30) and tiredness (95% C.I. = .22 – 1.14, κ^2 = .30, ab_{ps}= .77) remained significant when entered together in a mediation model in the second step of the analysis.

Lastly, in the mediation model explaining changes in state body image from pre- to post-20, changes in strength emerged as the only significant mediator. Change in strength self-perceptions was subsequently entered on its own in the model in the second step of our analyses (95% C.I. = .10 - .55, κ^2 =.16, ab_{ps} =.33).

Overall, the results indicate that exercise improves state body image through a significant indirect (mediation) effect of changes in strength self-perceptions (pre to post-0) in the mediation model explaining state body image change from pre- to post-0, post-10 and post-20 minutes, as well as through an indirect effect of changes in tiredness (pre to post-0) in the mediation model explaining state body image change from pre- to post-10 (Figure 4).

Table 3

Indirect (mediation) effects of change in self-efficacy, physical self-perceptions, and affect on the exercise and change in state body image relationship between pre-exercise and post-0, post-10 and post-20 minutes.

	Change in BISS								
	Post-0			Post-10			Post-20		
	95% C.I.	κ^2	ab_{ps}	95% C.I.	κ^2	ab_{ps}	95% C.I.	κ^2	ab_{ps}
Step 1 Models									
Self-efficacy	-.002, .39			-.01, .44			-.06, .40		
Affect									
Energy	-.08, 1.29			-.32, .92			-.41, 1.18		
Tired	-.46, .83			.03, 1.38			-.13, 1.42		
Calm	-.46, .38			-.67, .14			-.63, .22		
Tension	-.27, .13			-.21, .19			-.23, .20		
Enjoyment	-.19, .37			-.35, .22			-.55, .12		
Physical self-perceptions									
Body fatness	-.05, .23			-.07, .24			-.05, .29		
Appearance	-.17, .23			-.38, .11			-.42, .10		
Endurance	-.49, .12			-.30, .24			-.47, .12		
Strength	.06, .77			.04, .68			.10, .75		
Step 2 Models									
Strength	.07, .52	.16 (.05, .29)	.31 (.08, .58)	.05, .50	.16 (.04, .28)	.30 (.05, .56)	.10, .55	.16 (.06, .27)	.33 (.12, .55)
Tiredness	--	--	--	.22, 1.14	.30 (.12, .47)	.77 (.24, 1.30)	--	--	--

Note. BISS = Body Image States Scale, C.I = confidence interval, κ^2 = kappa squared, ab_{ps} = partially standardized indirect effect. All psychological mediator variables were included in mediation models as change scores (post-0 – pre). κ^2 values were only reported for mediators that were significant within their group of psychological mechanisms (i.e., variables in the Tested Model). Values in brackets represent 95% confidence intervals for effect sizes.

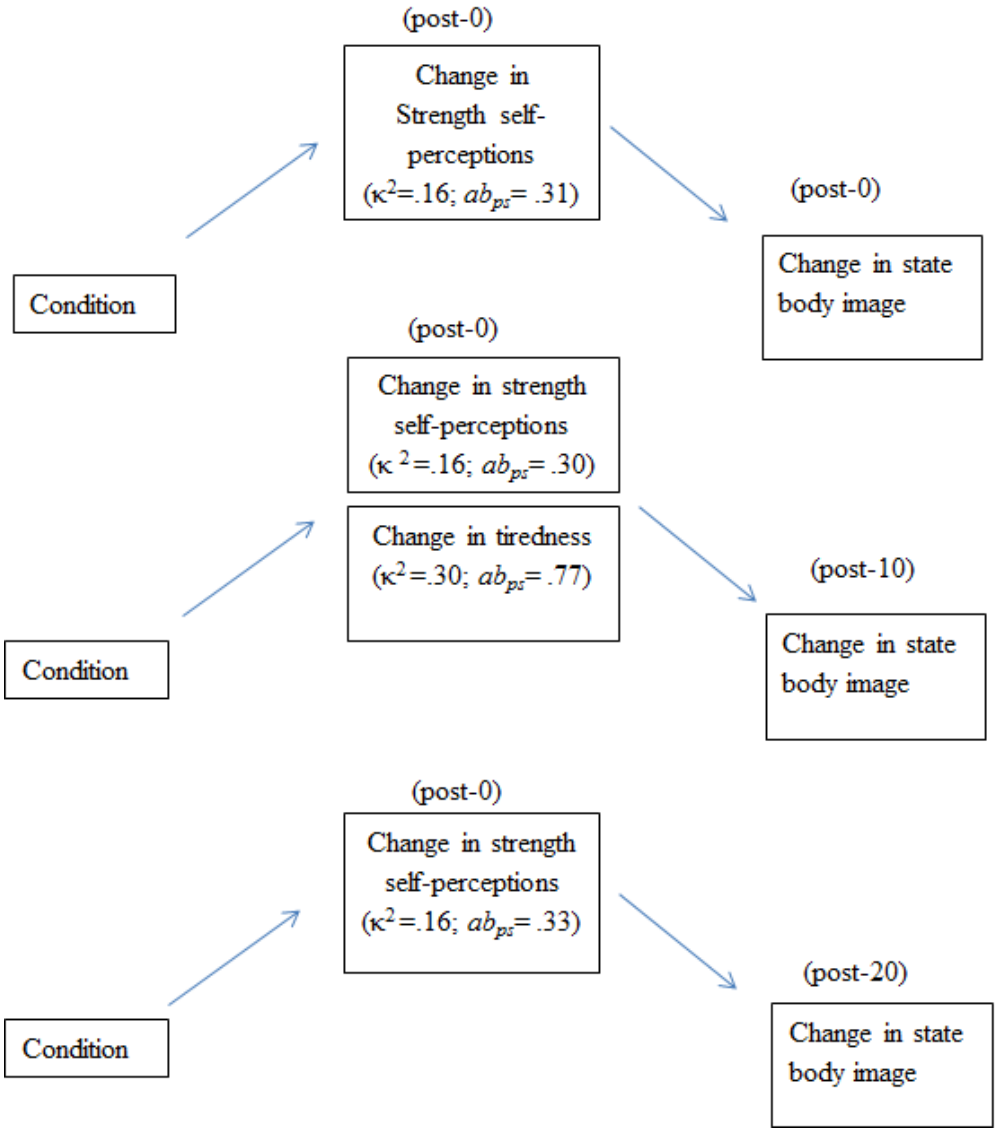

Figure 4: Summary of tests of models from Step 2 of the analyses. Indirect (mediation) effects of changes in strength self-perceptions and tiredness on state body image change between pre- and post-0, post-10 and post-20 minutes.

Discussion

As predicted, women with body image dissatisfaction who engaged in one bout of exercise on a stationary bike for 30 minutes at moderate-to-vigorous intensity, experienced significantly greater changes in state body image than those who sat and read in control. They also had significantly greater increases in aerobic self-efficacy, physical self-perceptions, affect, and had greater enjoyment in comparison to women in the control condition. In support of the secondary hypothesis, the positive effects of exercise on state body image were sustained 20 minutes post-exercise, relative to the control condition. In partial support of the hypothesis, the exercise-related changes in state body image from before to 0, 10 and 20 minutes after exercise were mediated by measures of physical self-perceptions and affect (from before to 10 minutes after exercise only), and not by changes in aerobic self-efficacy. Each of these findings will be discussed in turn.

Effects of acute exercise on state body image

Women in the exercise condition had significantly greater changes from before to immediately after exercise in state body image, in comparison to the control condition. This finding supports previous research which found that regular exercisers experienced increases on measures of state body image from before to immediately after an acute bout of exercise in comparison to a control group (Vocks et al., 2009). This finding also supports the overall effect that exercise exerts on state body image, according to the exercise and state body image model proposed for this study.

The positive effects that exercise had on state body image were sustained through 20 minutes after exercise relative to the control condition. This finding supports the secondary hypothesis and is novel as no study has yet examined how long exercise-related improvements in state body image last post-exercise (Martin Ginis & Basset, 2011). Our finding suggests that the "boost" exercise can have on state body image is sustained 20 minutes after exercise. Future research should assess state body image beyond 20 minutes after exercise to further explore how long state body image change lasts post-exercise.

Mechanisms underlying body image change

Women in the exercise condition had significantly greater changes from before to immediately after exercise in aerobic self-efficacy compared to women in the control condition. This builds upon previous research which found that physically active participants experienced greater changes in aerobic self-efficacy from before to immediately after an acute exercise bout compared to less active participants (Rudolph & McAuley, 1995).

However, exercise-related improvements in state body image were not mediated by changes in aerobic self-efficacy. Although change in physical self-efficacy emerged as a significant correlate of body image change in previous studies (Martin Ginis, Strong, et al., 2014; McAuley, Bane, Mihalko, 1995; McAuley et al., 2000; McAuley et al., 2002), the predictive power of physical self-efficacy change on body image change in regression models was inconsistent and was superseded by changes in physical self-perceptions (Martin Ginis, et al.,

2012). The present findings confirm and build upon this previous research as mediational analyses revealed that change in self-efficacy was not a mediator of state body image change while change in physical self-perception of strength was.

Due to the specificity of aerobic self-efficacy (i.e., belief in one's capabilities to cycle 50 minutes), it may not influence changes in the more general construct of state body image. As well, it may be that women's beliefs about what they *could* perform (i.e., self-efficacy beliefs) are not important in contributing to improved body image in the *present* moment, while perceptions about what the individual thinks about themselves (i.e., physical self-perceptions) are important. Our findings, taken together with previous research (Martin Ginis, Strong, et al., 2014; Martin Ginis et al., 2012; McAuley, Bane, Mihalko, 1995; McAuley et al., 2000; McAuley et al., 2002; Williams & Cash, 2001) suggest that improvements in women's beliefs about their aerobic capabilities may occur in conjunction with improved state body image change, however, change in physical self-efficacy is not important in determining these state body image changes. This evidence supports our decision to exclude physical self-efficacy from our proposed exercise and state body image model.

Women in the exercise condition had significantly greater increases in energy from before to immediately after exercise, and significantly greater decreases in tiredness, in comparison to women in the control condition. This finding supports previous research which found that regular exercisers experienced greater increases in energy and decreases in tiredness from before to

immediately after an acute bout of exercise in comparison to a control group (Reed & Ones, 2006; Van Lunduyt et al., 2000).

Change in affect, specifically a decrease in tiredness, was a significant mediator of exercise-related changes in state body image at 10 minutes after exercise. This is the first study to attempt to examine the causal relationship between affect and state body image, but the hypothesis was driven by previous research that revealed a correlation between affect and body image (Niven et al., 2008). Conceptually, it would be expected that shifting towards a more positive valence (i.e., decrease in tiredness) could improve women's thoughts and feelings about their bodies, as positive affective states are directly related to an improved psychological state (Diener, & Biswas-Diener, 2005). An increase in positive valence could be linked to the affective dimension of state body image, which was measured by the BISS, causing women to have improved feelings, specifically about their body appearance. Fox (2000a, 2000b) has suggested that exercise enhances body image by improving mood and self-regard, via eliciting a psychophysiological mechanism. Although Fox's suggestion was not rooted in empirical testing, the present results offer support for his proposed mechanism. However, reductions in tiredness did not mediate exercise-related changes in state body image in the models at 0 and 20 minutes after exercise, so the support for reduced tiredness as a mediator is limited.

It is important to emphasize, however, that previous research has only found a correlation, not causation, between affect and body image in an exercise

context (Niven et al., 2008). A correlation does not provide any information on the direction of causality between two variables. The present study proposed that changes in affect could mediate exercise-related changes in body image, however, the alternate model may also be plausible in that exercise-related changes in body image could lead to changes in affect. This alternate model was tested for all four affect variables in a post-hoc analysis (see Appendix B), and we found that change in state body image significantly mediated exercise-related changes in energy in all three models.

It is interesting that increases in energy and decreases in tiredness both emerged as significant variables in the tested models. According to Thayer's (1989) circumplex model of affect, an increase in the energetic arousal dimension is comprised of a decrease in tiredness and an increase in energy. Therefore, it is plausible that exercise may change state body image through changes in the energetic arousal dimension of affect.

Our findings, taken together with Fox's suggested psychophysiological mechanism of body image improvement (2000a, 2000b) suggest that affect and state body image may interact through reciprocal causation (Marsh & Craven, 2006; Morano et al., 2011). Indeed, researchers have suggested that body dissatisfaction and mood may have a reciprocal relationship (Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006; Haedt-Matt, Zalta, Forbush, & Keel, 2012). Therefore, exercise may increase both affect (i.e., energetic arousal) and state body image simultaneously. Overall, the present findings do not provide

conclusive evidence of the casual direction between changes in the energetic arousal dimension of affect and state body image, but do suggest change in one is linked with change in the other. Further investigation is needed to identify the direction of the relationship between these constructs to develop a better understanding of its role within the exercise and state body image model.

A decrease in tiredness may have emerged as a mediator only in the model at 10 minutes after exercise, possibly due to the effects of multicollinearity. All four dimensions of affect were included as mediators in each mediation model to reduce any epiphenomenal associations (Hayes, 2013). However, there could have been redundancy between each affect variable since they are each different combinations of the same two scales – activation and valence. For example, an increase in pleasant activation (i.e., energy) was strongly associated with a decrease in unpleasant unactivation (i.e., tiredness; supplemental analysis revealed $r = -.77$) and an increase in unpleasant activation (i.e., calmness; $r = -.66$). Multicollinearity increases sampling variance, which can increase the width of confidence intervals, thereby deeming a mediator as non-significant even though it may have a significant effect (Hayes, 2013). Conversely, testing mediators in a simple mediation model could be dangerous as it could create spurious effects or epiphenomenal associations by not statistically controlling for other variables in a model (Hayes, 2013). Multicollinearity presents an inevitable drawback to multiple mediation and may explain why decreases in tiredness were revealed as a significant mediator in only one model.

Women in the exercise condition had significant increases in tension and decreases in calmness from before to immediately after exercise in comparison to women in the control condition. This supports previous research which found that regular exercisers experienced increases in tension and decreases in calmness from before to immediately after an acute bout of exercise in comparison to a control group (Van Lunduyt et al., 2000). Changes in tension and calmness did not mediate the exercise-related improvements in state body image. It was expected that women would feel better about their bodies by experiencing a shift towards positive valence. Increases in tension are a result of increases in unpleasant valence (i.e., tension; Russell, 1980). Post-exercise, women had increases in tension, hence it would not be logical for this increase in unpleasant valence to cause positive changes in state body image and our findings support this. Furthermore, calmness is due to an increase in pleasantness (Russell, 1980). However, women experienced decreases in calmness post-exercise suggesting they instead experienced decreases in pleasant valence. Decreases in calmness would not be expected to influence state body image changes, which our findings also support. Thus, there is strong evidence to suggest that increases in unpleasant valence/ decreases in pleasant valence may not play a role in mediating exercise-related changes in state body image.

With regard to enjoyment as a dimension of affect, exercisers enjoyed stationary cycling significantly more than participants enjoyed reading, which builds upon previous research that found women who regularly exercise enjoy an

acute bout of aerobic exercise lasting 30 minutes (Raedeke, 2007). Enjoyment was not revealed to be a significant mediator of the exercise and state body image relationship. Previous research suggested that enjoyment may play a role in state body image improvements (Tucker & Mortell, 1993; Martin Ginis & Bassett, 2011). It was suggested that those who enjoy exercise may exert more effort and therefore reap greater psychological benefits. However, there is limited evidence to support this idea. Our findings suggest that although an exercise activity may be enjoyable for regular exercisers it does not necessarily make women feel better about their bodies. Hence, our findings do not support enjoyment as a dimension of affect that mediates exercise within the exercise and state body image model.

Women in the exercise condition had significantly greater changes from before to immediately after exercise in self-perceptions of strength, endurance, appearance and body fatness, in comparison to women in the control condition. To the best of our knowledge, this is the first study to assess changes in physical self-perceptions within the context of acute exercise. Women with body image dissatisfaction who regularly exercise have been shown to exercise both for appearance/weight and health/fitness reasons (LePage & Crowther, 2009). Therefore, women in the present study likely valued the expected health and appearance benefits of exercise. Perhaps knowing that they did something that was good for them (i.e., benefited health, appearance) contributed to an improved physical self-concept. As well, the exercise activity could have brought these

women's physical attributes into a positive focus, thereby improving their physical self-perceptions.

Changes in strength self-perceptions consistently mediated exercise-related changes in state body image across all three time points. Although no study has previously examined this mediated relationship, research has shown that changes in strength self-perceptions were related to and predicted trait body image change among obese and sedentary women who participated in long-term exercise training programs (Martin Ginis et al., 2005; Martin Ginis et al., 2012). Building upon this past research, the present findings suggest that only one exercise bout is needed for improvements in strength self-perceptions to enhance state body image among women with a healthy BMI. Perceiving improved strength capabilities could create feelings of accomplishment and empowerment. This could stimulate improved "internal dialogue" (Cash, 2002) about the body, which could in turn improve state body image. It has also been suggested that exercise shifts the focus of attention from appearance to physical functioning (e.g., Martin Ginis et al. 2012; Martin Ginis et al. 2005). For example, a woman may initially think of her legs as "fat". But, upon exercising, she may come to see them as strong, and it could be that this shift in thinking results in a more positive evaluation of one's body. Hence, the present evidence supports the role of change in physical self-perceptions within the proposed exercise and state body image model, but with respect to changes in strength self-perceptions in particular.

Changes in perceptions of aerobic endurance did not mediate exercise-related improvements in state body image. Although perceptions of endurance have been shown to be correlated to body image change, they did not predict changes in trait body image in previous exercise training studies (Martin Ginis et al., 2012; Martin Ginis, Strong et al., 2014). The physical self-perception of endurance is defined by Marsh (1996) as one's perceptions of "being able to run a long way without stopping, not tiring easily when exercising hard" (Marsh, 1996, pp. 114). As such, many of Marsh's PSDQ-endurance items assessed women's perceptions of their endurance to run as opposed to bicycle, which is the activity women actually performed in the study. The subscale may not have been sensitive to changes in how women felt about their cycling-related endurance. Another possibility is that changes in endurance self-perceptions may not have been large enough to influence how women thought about their bodies. As they were regular exercisers, participants might have already been aware of their physical endurance competencies, hence there was no new information to change the way they thought and felt about their bodies. Without improved perceptions of physical capabilities, there may be no stimulus for positive "internal dialogue" (Cash, 2002) about one's body to, in turn, improve body image.

It is also possible that physical self-perceptions of endurance may not have emerged as a significant mediator due to multicollinearity. All the physical self-perception variables were entered into the model together, as opposed to separately, to limit the chance of an epiphenomenal association and spurious

effects (Hayes, 2013). However, the association between change in physical self-perceptions of endurance and strength were highly correlated (supplemental analysis, r = .76). Thus, the indirect effects of physical endurance could perhaps be significant, yet its large association with strength self-perceptions could be increasing sampling variance, thereby increasing the confidence interval and deeming it insignificant (Hayes, 2013). As mentioned previously, multicollinearity presents a drawback when testing related mediators together in a mediation model. Hence, there is unclear evidence as to the role of aerobic endurance within the exercise and state body image model. Future research should investigate the indirect effects of endurance self-perceptions on exercise-related state body image change further.

Exercise-related improvements in body image did not occur through an indirect effect of changes in physical self-perceptions of body fatness. Previous studies have shown that change in body fatness was correlated to, and predicted, trait body image change for women participating in exercise programs for eight weeks or more (Martin Ginis et al, 2005; Martin Ginis et al., 2012; Martin Ginis, Strong et al., 2014). However, unlike women in the present study, women in the previous studies were obese and sedentary when they began the exercise programs. The women in the present study were all self-reported regular exercisers within a normal BMI range. Although their body composition was unknown, it was likely they had relatively less body fat than their obese counterparts and, therefore, were less concerned about losing body fat than obese women (Kruger, Galuska, Serdula,

Jones, 2004). As they self-reported to have been exercising regularly (≥ 3 days per week) for the past year, it could be that any drastic changes in perceptions of their body fatness would have already happened, especially if they were out-of-shape when they began exercising regularly (Martin Ginis & Bassett, 2011). As their training progressed, they may have become accustomed to these changes, which could explain why perceptions of body fat change does not inform body image change after one exercise bout. Thus, it is likely that women within the normal BMI range experience exercise-related state body image changes via mechanisms other than changes in physical self-perceptions of body fatness.

Changes in physical self-perceptions of appearance did not mediate exercise-related improvements in state body image. This is the first study to examine the influence of exercise-related changes in physical self-perceptions of appearance on state body image change. This construct is defined as "being good looking, having a nice face" (Marsh, 1996, pp. 114). Hence, it is likely that the PSDQ items assessing appearance self-perceptions captured women's perceptions of their face, hair, etc. Women's perceptions of their face may not relate to how women think and feel about the appearance of their body, specifically with regards to weight, body size and shape. Hence, changes in perceptions of appearance are not likely to mediate exercise-related changes in body image, yet these findings require replication as there has been limited research.

In summary, the findings from the present study help to clarify and refine the proposed exercise and state body image model to explain how exercise

improves state body image. An acute bout of cycling at an intensity that elevates heart rate and is perceived to be hard (RPE of 13, 14) can initiate change in psychological mechanisms that lead to improved state body image. Of the physical self-perceptions tested, changes in strength self-perceptions emerged as a significant mediator. These improved self-perceptions may positively transform the way women think and feel about the functionality of their body and therefore improve their overall thoughts and feelings about their body. Furthermore, reductions in tiredness mediated the exercise-state body image change relationship; however, there was also post hoc evidence that change in state body image mediated the effects of exercise on feelings of energy. Hence, our findings suggest that affect and body image may have a reciprocal relationship, which could support Fox's (2000a, 2000b) suggestion that exercise elicits a psychophysiological mechanism that brings about an overall positive psychological state including improved body image. Lastly, there was no support for aerobic self-efficacy as a mediator of exercise-related improvements in state body image. Women's beliefs about their capabilities to perform a specific task are unlikely to influence their overall thoughts and feelings about their bodies. Based on these findings, the proposed exercise and state body image model to explain how exercise improves state body image has been revised and is shown in Figure 5.

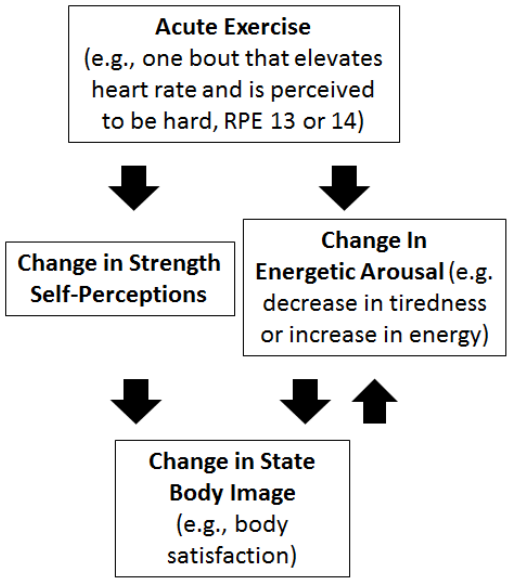

Figure 5: Proposed exercise and state body image model based on the findings of the present study.

Study Implications

These findings have important theoretical and practical implications. First, the present findings provide support for an empirically tested exercise and state body image model to explain acute exercise-related improvements in state body image change. The exercise and body image literature has been lacking a theory to guide research and interventions (e.g., Martin Ginis, Bassett, Conlin, 2012). Although there has been extensive research on the various correlates of exercise-related body image change, no published study has used mediation to test potential mechanisms of change. To our knowledge, this is the first study to develop and test a model that explains how acute exercise improves state body

image. This model provides researchers with a preliminary framework to build upon and further develop.

In a practical setting, these findings provide program developers with key mechanisms to target when creating exercise interventions for women with body image dissatisfaction. Our findings suggest that targeting women's strength self-perceptions and energetic arousal (e.g., feelings of tiredness) are important to improving body image. As such, interventionists should determine the type, duration and intensity of exercise that brings about the greatest changes in strength self-perceptions and energetic arousal for each individual. Beyond the exercise prescription, women could include additional elements into their exercise bout that could enhance their energetic arousal, such as listening to motivational music (Elliott, Carr, & Orme, 2005).

Further, encouraging women during an exercise bout to focus more on their strength perceptions, as opposed to drawing women's attention to other aspects of their physical self-concept (i.e., body fatness, appearance) or their physiological changes, could be pertinent to improving state body image. For example, an exercise trainer could say to women "think about how powerful your arms are", as opposed to "think about how hard your heart is pumping" or "think about how much fat your are burning". Encouraging women to think about what they are accomplishing in the exercise bout with respect to their physical strength could be paramount to driving state body image change. Hence, acute exercise

sessions should target and enhance strength self-perceptions and energetic arousal to help bring about optimal improvements in women's state body image.

Study Strengths

This study provides unique contributions to the exercise and body image literature in several ways. To our knowledge, this is the first study to examine mechanisms underlying the effects of acute exercise on state body image change using mediational analyses. A study testing the mechanisms involved in exercise-related state body image improvements has repeatedly been identified in the exercise and body image literature as an essential next step to establishing a theory to understand how exercise improves body image (e.g., Martin Ginis, Bassett-Gunter, Conlin, 2012; Martin Ginis, McEwan, Bassett, 2013). Additionally, there has previously not been an investigation of change in body image in relation to change in physical self-perceptions, self-efficacy, and affect all together in one study. Finally, prior to this study, no research had investigated how long exercise-related improvements in state body image were sustained (Martin Ginis & Bassett, 2011).

The present study utilized a rigorous methodology to limit confounding effects on mediator and outcome variables. To reduce the possibility of participants' state body image being influenced by social comparison or social physique anxiety, specific procedures were followed: only one investigator was present throughout the lab visit, the investigator wore a lab coat, and deliberately avoided watching the participants during the exercise/ control manipulation;

participants put on the heart rate monitor in private; and no men were present in the laboratory during testing. Other variables that have been identified to moderate scores on measures of body image (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Miller et al., 2000; Paeratakul et al., 2002) were controlled for in the study design, such as including women only who were within a restricted age range (17 – 23) and normal BMI range. As well, race and socioeconomic status data were collected, although these variables were not related participants' state body image differently between the experimental and control conditions, so these variables were not included in the analyses. Lastly, individuals with clinically diagnosed levels of anxiety, depression, mood and/or eating disorders were excluded from participating as these clinical diagnoses could have biased affect and/or state body image responses (Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Cash & Deagle, 1997; Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006; Stice & Whitenton, 2002).

A randomized controlled experimental design was used to examine the effects of an exercise condition compared to a control condition. As a similar rigorous methodology was followed for both the experimental and control conditions, the only experiential difference between both groups was the exercise and reading manipulation. Hence, there is strong evidence to suggest that differences in outcome measures between these groups are solely due to the manipulations. Further, to minimize the influence of external factors on the exercise activity, all participants were instructed not to exercise prior to their lab

visit and confirmed meeting this expectation upon arrival to the lab. This could have limited capturing any exercise induced affect changes not elicited by the study (Hausenblaus & Fallon, 2005). As well, participants did not receive any verbal encouragement throughout the manipulation, nor did they listen to music as it has been shown to influence affect during an exercise bout at a moderate-to-vigorous intensity (Elliott, Carr, & Orme, 2005).

The mediation analyses were conducted using statistical procedures that have been identified as the most statistically and logically sound (Hayes, 2013). Previously, the causal steps approach, as outlined by Baron and Kenny (1987), was the most commonly used in studies statistically testing mediation. Yet, there are several flaws to this method which are addressed by the statistical methods used by the PROCESS macro. Furthermore, change scores were used in the mediation analyses which allow the results to be interpreted after taking participants' baseline scores into consideration. Lastly, the majority of mediation models tested the mediators and outcome variables in chronological order (i.e., the mediators preceded the outcome variable). Testing the majority of mediation models in this manner provides stronger evidence that the mediator does exert an indirect effect on exercise-related state body image improvements compared to those models that included mediators and outcomes variables measured at the same time-point (Hayes, 2013).

Study Limitations

Despite these strengths, there are limitations to the present study. As there were many inclusion/exclusion criteria placed upon the study sample, the generalizability of the results are limited to young women with body image dissatisfaction who exercise regularly. The effect of an acute bout of exercise on state body image affects overweight women differently than it does women with a healthy weight (Martin Ginis & Bassett, 2012; Martin Ginis, Jung & Gauvin, 2003). As well, the internalized ideal for men differs from that of women (McCabe & Ricciardelli, 2004) so their body image may be affected differently by the specific exercise manipulation employed in the present study. Furthermore, the exercise condition also took place within a controlled lab so there may be extraneous factors in a naturalistic setting that could bring about different results. Yet, examining the effects of an acute exercise bout on state body image using the well-controlled protocols of the present study was necessary as this is the first essential step needed to develop a theory to understand how exercise improves body image.

Due to the self-report nature of the measures, there is the possibility of self-report bias. Many of the survey items were assessing participants' thoughts and feelings about themselves. Hence, participants may have responded to surveys based on what they thought would be viewed favourably by the experimenters. Although these biases are often inevitable in measuring these constructs, participants were encouraged at the start of their lab visit to answer as honestly as possible in completing all surveys and were reminded that all

information would be kept confidential. These methods should have decreased such biases.

Many confounders were considered and taken into consideration, yet, there are other variables that were not measured that could have also affected the mediator and outcome variables. Cash's (2002) cognitive-behavioural model of body image states that personality may also play a role in affecting body image. There is evidence to suggest that gender role orientation, as opposed to biological sex, may moderate the influence of exercise on trait body image (Martin Ginis, Bassett, & Conlin, 2012) so it could influence state body image as well. For example, someone may identify more with stereotypical masculine traits (e.g., assertive) or feminine traits (e.g., gentle) as opposed to their biological sex. In turn, the influence of exercise on body image may be moderated by how well the type of exercise contributes to the ideal of that individual's gender role orientation instead of their biological sex. As well, personality can also affect the pleasantness one experiences in general (Diener, & Biswas-Diener, 2005) and ultimately could influence the effects of an acute exercise bout on affect. Hence, personality could potentially moderate the effects of exercise on state body image and affect and should be included as a moderator in future studies.

Although all the scales in the present study have been extensively used in the exercise literature and have shown acceptable reliability, the Body Image States Scale and AD ACL Calmness subscale at baseline, as well as the AD ACL Tension subscale at immediately after the manipulations had Cronbach's alphas

below 0.7. A low alpha presents a concern as to whether participants' scores accurately reflected the scores for the construct that was expected to be measured (Streiner, Norman, & Cairney, 2014). However, Cash et al. (2002) found that the reliability of the BISS was lower when participants were in a neutral state, such as at baseline of the present study. This was likely due to there being less variability for the fifth item, which assessed a comparison of current feelings to usual feelings. Although the Cronbach's alpha for the baseline BISS was lower than conventionally accepted levels, it is still considered acceptable by body image researchers (T. F. Cash, personal communication, February 20, 2015). Furthermore, despite the relatively low reliability of the AD ACL calm and tension subscales, participants' calmness and tension scores changed in response to exercise as they have been shown to in previous studies that assessed affect using the AD ACL with acceptable reliabilities (Ekkekakis, Hall, & Petruzzello, 2008; Hall, Ekkekakis, & Petruzzello, 2002; Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000). Since participants' tension and calmness scores changed as expected, there is good evidence to suggest that the low Cronbach's alphas in the present study do not pose detrimental concerns.

The control condition employed in the present study brought about decreases in participants' state body image. This phenomenon was also shown to occur for participants in a similar control condition in the study by Vocks et al. (2009). This begs the question as to whether the reading control condition truly met its purpose of serving as a neutral condition to bring about no changes in the

outcome measure. Niven et al. (2008) have shown that when regular exercisers were asked to abstain from exercise for three days, their body image satisfaction decreased. Future research should further investigate if these effects take place after an acute bout of exercise. It may be that women who regularly exercise feel greater body dissatisfaction when they are asked to sit/read, but were wanting to exercise. A control condition that may bring about no change in state body image could be mild intensity exercise as it has been shown to have no effect on body image (d = -.04; Hausenblas & Fallon, 2006). Future research should explore this option further as it could be a better suited control condition for this population.

When assessing more than one psychological state through self-report from one respondent, the issue of common method variance arises. Podsakoff and Organ (1986) suggest that when assessing psychological states from the same source, "any defect in that source contaminates both measures, presumably in the same fashion and same direction." As all of the variables assessed changed in the positive direction for participants in the exercise condition, it is possible that women's improved psychological state influenced their ratings on all of the study measures. This raises the issue as to whether or not the variables are truly related or if they appear to be related through common method variance. According to Podsakoff and Organ (1986), other self-report psychological measures assessed by these women in their positive psychological state could also change in the same direction. Hence, it could be worthwhile in future studies to include a questionnaire assessing women's thoughts, feelings and perceptions of other items

unrelated to their bodies that would be unexpected to change after exercise (e.g., a piece of furniture) to determine the role common method variance may play in the relationships between the variables in the present study.

Future Directions

Further investigation should be conducted to determine the role of affect within the proposed exercise and state body image model. A better understanding of the role of affect on exercise-related state body image change needs to be established before it can be targeted in exercise interventions to improve body image. Further, future research should investigate if this proposed exercise and state body image model applies to chronic exercise, and explaining changes in trait body image. Also, as both aerobic and strength training and a combination of both have been found to bring about improvements in body image (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007), it would be worthwhile to determine if strength training and a combination of strength and aerobic training also improve state body image via similar indirect effects.

Additionally, overweight and sedentary women's state body image is affected by an acute exercise bout differently than it affects healthy weight women (Martin Ginis & Bassett, 2012; Martin Ginis, Jung & Gauvin, 2003). It could be worthwhile to examine the mechanisms from the proposed exercise and state body image model among an overweight, sedentary population to understand why an acute exercise bout decreases state body image. In addition, as mentioned previously, men's ideal body image differs from that of women's (McCabe &

Ricciardelli, 2004). As the ideal body image for men is to appear muscular, a study specific to men involving an acute bout of strength training may be warranted to determine the mechanisms involved in acute exercise-related state body image improvements.

In addition, it would be important to examine the lasting effects of exercise-related improvements in state body image in a naturalistic setting. It could more accurately mimic women's post-exercise behaviours/ settings and it would be worthwhile to examine state body image in the presence of other extraneous factors that were not captured in the present study (i.e., social comparison) that could also influence women's state body image.

Conclusion

In conclusion, this is the first study to empirically test an exercise and state body image model to understand the mechanisms underlying exercise-related state body image improvements. Overall, our results suggest that among women with a normal BMI who regularly exercise and have body image dissatisfaction, an acute bout of exercise can improve state body image through increased strength self-perceptions and energetic arousal (i.e., decreases in tiredness). Improvements in state body image may also mediate increases in exercise-related energetic arousal (i.e., increases in energy). These findings are invaluable to establishing a theory to explain the effects of exercise on body image change and in developing interventions to maximize body image improvements among those with body image dissatisfaction.

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APPENDIX A: SUPPLEMENTARY FIGURE

Figure A

Figure B

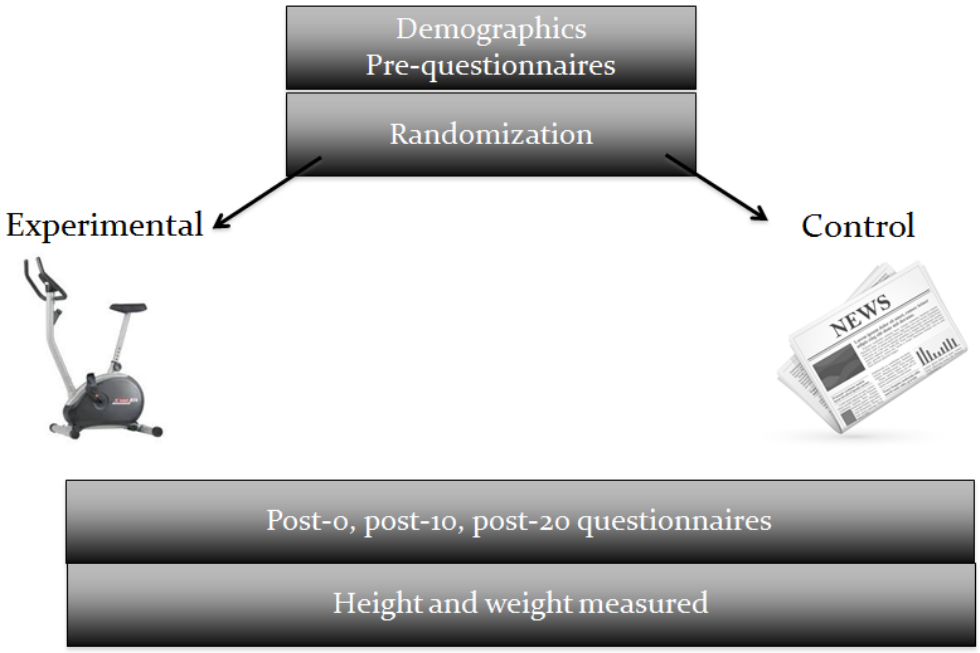


Figure A. Outline of study protocol.

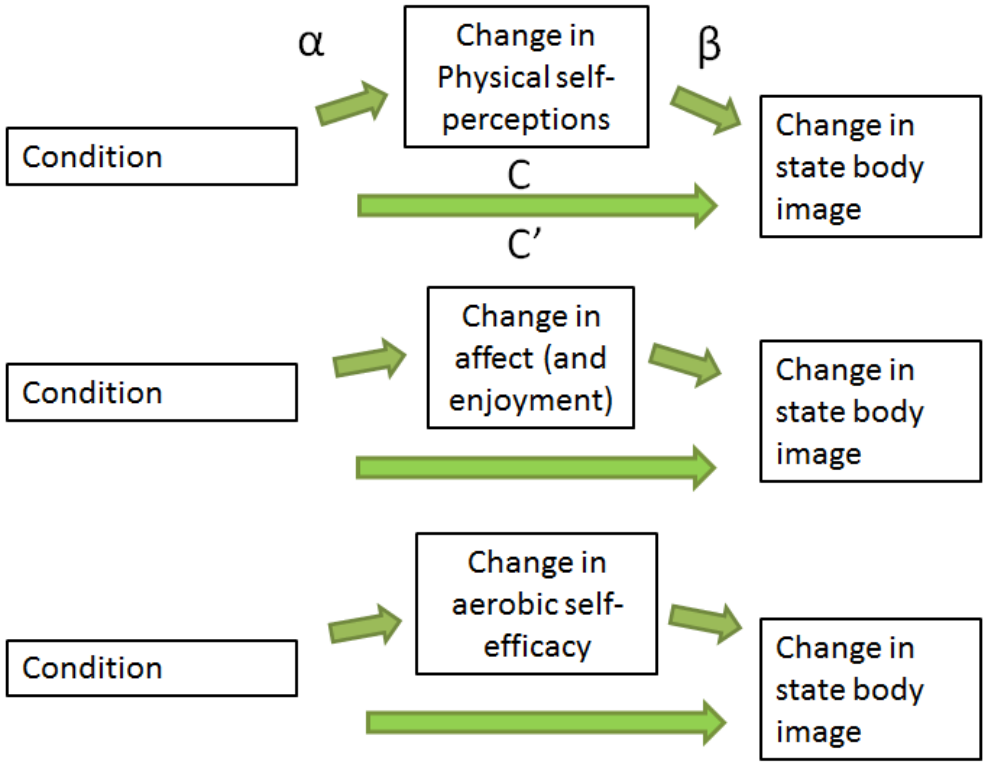
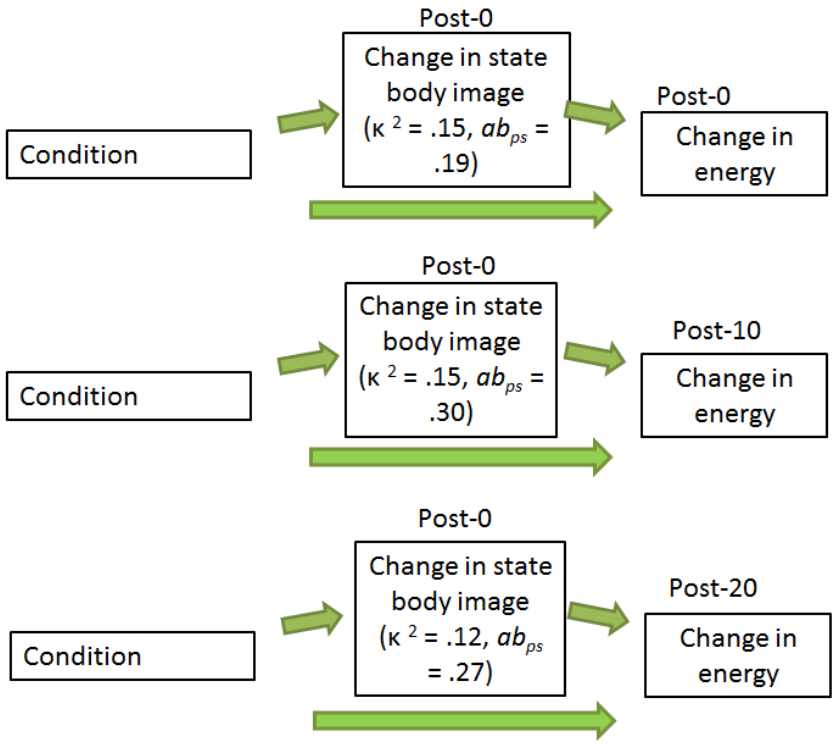


Figure B: Mediational pathways tested in this present study (controlling for BMI) among women who exercise regularly and have body image disturbance. The above models were tested for change in state body image from pre to post-0, post-10 and post-20.

APPENDIX B: POST-HOC ANALYSES

Post-hoc Findings

Based on the inconsistent indirect effects of tiredness, post-hoc analyses were conducted to test the alternate mediation model including affect and state body image (i.e., change in state body image mediates exercise-related changes in affect). The indirect effects of change in state body image (pre to post-0) on exercise-related changes in affect were tested at all three time-points. Changes in state body image emerged as a significant mediator in the mediation models explaining changes in energy from pre- to post-0 (95% C.I. = .05 - .42, κ^2 = .15, ab_{ps} = .19), post-10 (95% C.I. = .06 - .45, κ^2 = .15, ab_{ps} = .30) and post-20 (95% C.I. = .06 - .48, κ^2 = .12, ab_{ps} = .27). The findings are presented below.



APPENDIX C: STUDY MATERIALS

Letter of Information & Consent Form
Body Areas Satisfaction Scale
Social Physique Anxiety Scale
Godin Leisure Time Exercise Questionnaire
Physical Activity Readiness Questionnaire
Demographic Questionnaire
Body Image State Scale
Physical Self-Description Questionnaire
Aerobic Self-efficacy scale
Activation Deactivation Adjective Check List
Physical Activity Enjoyment Scale
Ratings of Perceived Exertion Scale
Exercise/control condition script
Recruitment Poster

PARTICIPANT LETTER OF INFORMATION / CONSENT FORM

A Study of/about Understanding how exercise and rest influences thoughts and feelings.

Investigators: Lauren Salci and **Dr. Kathleen Martin Ginis**

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Purpose of the Study
The purpose of this study is to explore how exercise and rest influence thoughts and feelings.

Procedures involved in the Research
This study will take approximately 1.5 hours total to complete including one lab visit. The lab visit will consist of completing a demographics questionnaire (e.g., to report your age, race) and either a 30 minute moderate-intensity workout on a stationary bike (excluding warm up and cool down), or sitting quietly and reading a newspaper. You will be asked to complete surveys to assess mood, physical self-perceptions and body image.

Potential Harms, Risks or Discomforts:
You might find some of the questions about yourself and your physical activity to be uncomfortable. You may also have concerns about how others will react to your questionnaire responses. The steps we are taking to maintain your confidentiality are described below. You can skip any question you wish and still remain in the study. The potential physical risks and discomforts associated with the exercise testing can include fatigue, nausea, abnormal blood pressure, and irregular heart rhythm and in rare cases, heart attack and stroke. To minimize these potential risks, your health and fitness information will be evaluated prior to any physical tests and you will be monitored during testing. If you feel physically

uncomfortable or dizzy when exercising you should inform the experimenter and immediately stop exercising. We will seek medical assistance if necessary.

Potential Benefits

Your participation will contribute to developing a better understanding of how exercise and rest effects thoughts and feelings. We would also be happy to provide you with the results of your fitness test if you would like to see them.

Payment or Reimbursement

You can earn up to a total of $20 in the form of gift cards for Starbucks or Tim Horton's (your choice). If you withdraw before the end of the first visit, no reimbursement can be given.

Confidentiality

Any information that is obtained during this study and that can be identified with you will remain confidential and will be disclosed only with your permission. The questionnaires are completely private and will be kept on a password protected computer for a period of five years after which they will be destroyed. Only the researchers will have access to this information. Your identity will never be revealed in any reports of this study.

Participation and Withdrawal

If you volunteer for this study, you can withdraw at any time during the testing sessions, or after by emailing salcile@mcmaster.ca. You may also refuse to answer any questions you don't want to answer while remaining in the study. In cases of withdrawal, any data you have provided will be destroyed, unless you indicate otherwise.

Information about the Study Results

I expect to have this study completed approximately by February 2015. If you would like a brief summary of the results, please provide your email here:_____

_____

Questions about the Study

If you have questions or require more information about the study itself, please contact me at salcile@mcmaster.ca.

This study has been reviewed by the McMaster University Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

McMaster Research Ethics Secretariat
Telephone: (905) 525-9140 ext. 23142

c/o Research Office for Administrative Development and Support

E-mail: ethicsoffice@mcmaster.ca

CONSENT

I have read the information presented in the information letter about a study being conducted by Lauren Salci of McMaster University. I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested. I understand that if I agree to participate in this study, I may withdraw from the study at any time. I have been given a copy of this form. I agree to participate in the study. By consenting I have not waived any rights to legal recourse in the event of research-related harm.

_____

Name of Participant

_____

Signature of Participant Date

Signature of investigator:

_____

Name

_____

Signature Date

BODY AREAS SATISFACTION SCALE

For the next items use a 1 to 5 scale to indicate how dissatisfied or satisfied you are with each of the following areas or aspects of your body:

1=Very Dissatisfied 2 = Mostly Dissatisfied 3= Neither Satisfied Nor Dissatisfied
4 = Mostly Satisfied 5 = Definitely Satisfied

_____ 1. Face (facial features, complexion)
_____ 2. Hair (color, thickness, texture)
_____ 3. Lower torso (buttocks, hips, thighs, legs)
_____ 4. Mid torso (waist, stomach)
_____ 5. Upper torso (chest or breasts, shoulders, arms)
_____ 6. Muscle tone
_____ 7. Weight
_____ 8. Height
_____ 9. Overall appearance

SOCIAL PHYSIQUE ANXIETY SCALE

Instructions: Read each of the following statements carefully and indicate the degree to which the statement is characteristic or true of you, according to the following scale.

	1: Not at all Characteristic	2: Slightly Characteristic	3:Moderately Characteristic	4: Quite Characteristic	5: Extremely Characteristic
1. I wish I wasn't so uptight about my physique/figure.	☐	☐	☐	☐	☐
2. There are times when I am bothered by thoughts that other people are evaluating my weight or muscular development negatively.	☐	☐	☐	☐	☐
3. Unattractive features of my physique/figure make me nervous in certain social settings.	☐	☐	☐	☐	☐
4. In the presence of others, I feel apprehensive about my physique/figure.	☐	☐	☐	☐	☐
5. I am comfortable with how fit my body appears to others.	☐	☐	☐	☐	☐
6. It would make me uncomfortable to know others were evaluating my physique/figure.	☐	☐	☐	☐	☐
7. When it comes to displaying my physique/figure to others, I am a shy person.	☐	☐	☐	☐	☐
8. I usually feel relaxed when it is obvious that others are looking at my physique/figure.	☐	☐	☐	☐	☐
9. When in a bathing suit, I often feel nervous about the shape of my body.	☐	☐	☐	☐	☐

GODIN LEISURE TIME EXERCISE QUESTIONNAIRE

Over the past year, how many times **a week** have you done the following kinds of exercise for 30 minutes or more during your **free time**?

Times per week

1. STRENUOUS EXERCISE (your heart beats rapidly): _____
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, skating)

2. MODERATE EXERCISE (not exhausting): _____
(e.g., fast walking, weight-training, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing)

3. MILD EXERCISE (minimal effort): _____
(e.g., yoga, archery, fishing, bowling, horseshoes, golf, snow-mobiling, easy walking)

4. How many days per week do you consistently exercise? _____

PHYSICAL ACTIVITY READINESS QUESTIONNAIRE

Please answer yes or no to the following questions:

1. Do you have a medical condition that requires you to avoid strenuous exercise?

2. Has your doctor ever said that you have a **heart condition** and that you should only do physical activity recommended by a doctor?

3. Do you feel **pain in your chest** when you do physical activity?

4. In the past month, have you had **chest pain** when you were not doing physical activity?

5. Do you lose balance because of **dizziness or do you lose consciousness**?

6. Do you have a **bone or joint problem** (for example, back, knee or hip) that could be made worse by a change in your physical activity?

7. Is your doctor currently prescribing **drugs** (for example, water pills) for your **blood pressure** or heart condition?

8. Do you know of any other reason why you should not do physical activity?

9. Have you been diagnosed with
    a. clinical levels of anxiety?

    b. clinical depression?

    c. any mood disorders?

    d. Eating disorders?

DEMOGRAPHIC QUESTIONNAIRE

1. Age:_____ years

2. What is your cultural background? (please check the box that applies to you):

□ Caucasian □ African-Canadian □ Asian □ Arab/West Asian □ Aboriginal

Other:_____

3. What is your family's total household income?: (please check the one that applies to you)

- Under $10,000
- $10,000 - $19,999
- $20,000 – $29,999
- $30,000- $39,999
- $40,000 - $49,999
- $50,000 - $59,999
- $60,000 - $69,999
- $70,000 - $79,999
- $80,000 - $89,999
- $90,000 - $99,999
- $100,000 - $124,999
- $125,000 – 149,999
- $150,000 or more

To be completed by investigator:

Height:_____ Weight:_____ BMI:_____

BODY IMAGE STATES SCALE (BISS)

For each of the items below, check the circle beside the one statement that best describes how you feel RIGHT NOW AT THIS VERY MOMENT. Read the items carefully to be sure the statement you choose accurately and honestly describes how you feel right now.

1. Right now I feel . . .
   - ☐ ***Extremely dissatisfied*** with my physical appearance
   - ☐ ***Mostly dissatisfied*** with my physical appearance
   - ☐ ***Moderately dissatisfied*** with my physical appearance
   - ☐ ***Slightly dissatisfied*** with my physical appearance
   - ☐ ***Neither dissatisfied nor satisfied*** with my physical appearance
   - ☐ ***Slightly satisfied*** with my physical appearance
   - ☐ ***Moderately satisfied*** with my physical appearance
   - ☐ ***Mostly satisfied*** with my physical appearance
   - ☐ ***Extremely satisfied*** with my physical appearance

2. Right now I feel . . .
   - ☐ ***Extremely satisfied*** with my body size and shape
   - ☐ ***Mostly satisfied*** with my body size and shape
   - ☐ ***Moderately satisfied*** with my body size and shape
   - ☐ ***Slightly satisfied*** with my body size and shape
   - ☐ ***Neither dissatisfied nor satisfied*** with my body size and shape
   - ☐ ***Slightly dissatisfied*** with my body size and shape
   - ☐ ***Moderately dissatisfied*** with my body size and shape
   - ☐ ***Mostly dissatisfied*** with my body size and shape
   - ☐ ***Extremely dissatisfied*** with my body size and shape

3. Right now I feel . . .
   - ☐ ***Extremely dissatisfied*** with my weight
   - ☐ ***Mostly dissatisfied*** with my weight
   - ☐ ***Moderately dissatisfied*** with my weight
   - ☐ ***Slightly dissatisfied*** with my weight
   - ☐ ***Neither dissatisfied nor satisfied*** with my weight
   - ☐ ***Slightly satisfied*** with my weight
   - ☐ ***Moderately satisfied*** with my weight
   - ☐ ***Mostly satisfied*** with my weight
   - ☐ ***Extremely satisfied*** with my weight

4. Right now I feel . . .
   - ☐ ***Extremely*** physically ***attractive***
   - ☐ ***Very*** physically ***attractive***
   - ☐ ***Moderately*** physically ***attractive***
   - ☐ ***Slightly*** physically ***attractive***
   - ☐ ***Neither attractive nor unattractive***
   - ☐ ***Slightly*** physically ***unattractive***
   - ☐ ***Moderately*** physically ***unattractive***
   - ☐ ***Very*** physically ***unattractive***
   - ☐ ***Extremely*** physically ***unattractive***

5. Right now I feel . . .
   - ☐ ***A great deal worse*** about my looks than I usually feel
   - ☐ ***Much worse*** about my looks than I usually feel
   - ☐ ***Somewhat worse*** about my looks than I usually feel
   - ☐ ***Just slightly worse*** about my looks than I usually feel
   - ☐ ***About the same*** about my looks as usual
   - ☐ ***Just slightly better*** about my looks than I usually feel
   - ☐ ***Somewhat better*** about my looks than I usually feel
   - ☐ ***Much better*** about my looks than I usually feel
   - ☐ ***A great deal better*** about my looks than I usually feel

6. Right now I feel that I look . . .
   - ☐ ***A great deal better*** than the average person looks
   - ☐ ***Much better*** than the average person looks
   - ☐ ***Somewhat better*** than the average person looks
   - ☐ ***Just slightly better*** than the average person looks
   - ☐ ***About the same*** as the average person looks
   - ☐ ***Just slightly worse*** than the average person looks
   - ☐ ***Somewhat worse*** than the average person looks
   - ☐ ***Much worse*** than the average person looks
   - ☐ ***A great deal worse*** than the average person looks

PHYSICAL SELF-DESCRIPTION QUESTIONNAIRE (4 SUBSCALES)

Please **circle the number** which is the **most correct** statement about you.

Statement	False					True
I am too fat	1	2	3	4	5	6
I am attractive for my age	1	2	3	4	5	6
I am a physically strong person	1	2	3	4	5	6
I can run a long way without stopping	1	2	3	4	5	6
My waist is too large	1	2	3	4	5	6
I have a nice looking face	1	2	3	4	5	6
I have a lot of power in my body	1	2	3	4	5	6
I would do well in a test of physical endurance and stamina	1	2	3	4	5	6
I have too much fat on my body	1	2	3	4	5	6
I am better looking than most of my friends	1	2	3	4	5	6
I am stronger than most people my age	1	2	3	4	5	6
I could jog 5 kilometres without stopping	1	2	3	4	5	6
I am overweight	1	2	3	4	5	6
I am ugly	1	2	3	4	5	6
I am weak and have no muscles	1	2	3	4	5	6
I think I could run a long way without getting tired	1	2	3	4	5	6
My stomach is too big	1	2	3	4	5	6
I am good looking	1	2	3	4	5	6
I would do well in a test of strength	1	2	3	4	5	6
I can be physically active for a long period of time without getting tired	1	2	3	4	5	6
Other people think that I am fat	1	2	3	4	5	6
Nobody thinks that I am good looking	1	2	3	4	5	6
I am good at lifting heavy objects	1	2	3	4	5	6
I am good at endurance activities like distance running, aerobics, bicycling, swimming, or cross-country skiing	1	2	3	4	5	6

AEROBIC SELF-EFFICACY MEASURE

Instructions: Think about working out. Using any values from the scale below (0 to 100%), please indicate how confident you are in your ability to do each of the following:

0%---10%---20%---30%---40%---50%---60%---70%---80%---90%---100%
Not at all confident **Completely confident**

How confident are you that….

1. Cycle on a stationary bike for 10 minutes without stopping	
2. Cycle on a stationary bike for 20 minutes without stopping	
3. Cycle on a stationary bike for 30 minutes without stopping	
4. Cycle on a stationary bike for 40 minutes without stopping	
5. Cycle on a stationary bike for 50 minutes without stopping	
6. Cycle on a stationary bike for 60 minutes without stopping	

ACTIVATION DEACTIVATION ADJECTIVE CHECK LIST

Each of the words below describes feelings or mood. Please use the rating scale below each word to describe your feelings at this moment. Work rapidly, but please mark all the words. Your first reaction is best. This should take only a minute or two.

Active	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Placid	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Sleepy	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Jittery	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Energetic	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Intense	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Calm	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Tired	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Vigorous	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
At-rest	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Drowsy	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Fearful	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Lively	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Still	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Wide-awake	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Clutched-up	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Quiet	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Full of pep	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Tense	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely
Wakeful	1: not at all	2: slightly	3: somewhat	4: very much	5: Extremely

PHYSICAL ACTIVITY ENJOYMENT SCALE (PACES)

Instructions for participants in experimental group: Now that you have completed this *physical activity protocol*, we want to know how you enjoyed it. Think about how you are currently feeling about the *workout* you just completed as you respond to each of the following items. Please circle only one number for each item and try to respond as honestly as possible.

Instructions for participants in the control condition: Now that you have completed this *rest protocol*, we want to know how you enjoyed it. Think about how you are currently feeling about the *rest* you just had as you respond to each of the following items. Please circle only one number for each item and try to respond as honestly as possible.

I enjoyed it	1	2	3	4	5	6	7	I hated it
I felt bored	1	2	3	4	5	6	7	I felt interested
I disliked it	1	2	3	4	5	6	7	I liked it
I found it pleasurable	1	2	3	4	5	6	7	I didn't find it pleasurable
I was very absorbed in this activity	1	2	3	4	5	6	7	I was not at all absorbed in this activity
It was no fun at all	1	2	3	4	5	6	7	It was a lot of fun
It was very pleasant	1	2	3	4	5	6	7	It was very unpleasant
I felt as though I would rather be doing something else	1	2	3	4	5	6	7	I felt as though there is nothing else I would rather be doing

RATINGS OF PERCEIVED EXERTION SCALE

Participants were asked to indicate a number to represent their perceived exertion at a moment in time using this scale.

6	NO EXERTION AT ALL
7	
	EXTREMELY LIGHT
8	
9	VERY LIGHT
10	
11	LIGHT
12	
13	SOMEWHAT HARD
14	
15	HARD (HEAVY)
16	
17	VERY HARD
18	
19	EXTREMELY HARD
20	MAXIMAL EXERTION

EXERCISE/CONTROL CONDITION SCRIPT

NOTE*: Italics represent actions*

Hi (NAME), welcome to our lab. My name is____ and I am the (principle investigator/ volunteer investigator) for this study. Please have a seat and we can start going over the procedures.

Before I have you look over the consent form, I will give you a couple minutes to quickly fill out this checklist (*hand them printed copy of PAR-Q on clipboard to ensure eligibility before consent form).* This is the same criteria you reviewed via email, but we would like for a hard copy for reference. (*complete form*). Thank you. Also, have you exercised yet today? *(write down answer).*

Throughout the study you may find some of the things I say somewhat repetitive. This is simply for experimental purposes. We just want to make sure that every participant in this study receives the same information throughout.

Before we get started I'll have you come sit at the computer, and give you some time to read through the consent form. You can check off your agreement to participate in the study once you've read through it. This is your participant ID for the study, please use this ID number when filling out all surveys (*hand participant ID number on piece of paper).* If you have any questions or concerns at any time, please feel free to ask. (*complete form*) Thanks.

Before we move on, if you need water at any point throughout the rest periods of the study, there is a pitcher and cup here, feel free to help yourself (*point to pitcher and cup on table beside comfy chair).* Also, if you need to get changed I can direct you to the change room. If not, we can get started. (If yes: it is required that all participants wear sweatpants and a t-shirt during the study so you can wear the outfit provided by the lab (*hand them clothes)* and I will take you to where you can get changed).

First you will need to put on the heart rate monitor. It needs to wrap around your torso and the sensor (*point to it)* needs to sit at your sternum. Make sure that the part of the monitor that says 'left' is on the left side of your body to make sure it isn't upside down (*show them on the monitor and the direction it should wrap around).* If you need to adjust the straps you can do so here (*show them the adjuster part of the monitor).* I am spraying it with water as it helps with conducting a signal (*spray sensor with water).* I'll let you do this and I'll just step outside of the room. Please knock on the door once you are ready.

Okay I'll have you come sit at the computer again. I'm putting the heart rate watch beside you just to get it started with picking up a signal (*press red button so that it can begin picking up a signal).* It may beep and say check sensor on the screen but no worries, I will take care of it. *(if "check sensor" comes up, make sure to press the red button, but only when you are checking on the watch, don't do this while the participant is completing surveys).* The following survey is a demographics survey you can complete. Any time during the study when you are completing the surveys on the computer I'll be sitting at the table facing the wall doing paper work. Please let me know once you have completed it.(participant completes it) Thanks.

Just a reminder, everything will be kept confidential so please answer as honestly as possible. Next, you will complete some baseline questions. Please take your time working through each page and there are several pages so make sure not to miss any of them. Let me know once you are finished.

EXPERIMENTAL CONDITION
(Can explain to participant while sitting at computer). Okay I'll now have you begin a workout on the bike. First, you will be asked to begin pedaling lightly and we will give you five minutes to warm up. At 2 minutes and 30 seconds into your warm-up, we will ask you to indicate a number to represent **you're perceived exertion at that moment in time** according to this scale on the wall (*point to the RPE*).

You will then be asked to complete 30 minutes of moderate intensity cycling and the bike will automatically adjust to the proper difficulty. The bike will continually adjust throughout the 30 minutes to make sure you are working at the proper intensity. Every five minutes you will be asked to indicate a number to represent **you're perceived exertion at that moment in time** again using this same scale (*point to wall*).

You will then be asked to cool-down for 3 minutes and again the bike will adjust the difficulty automatically. At 1 minute and 30 seconds you will be asked to indicate a number to represent **you're perceived exertion at that moment in time** again using this same scale (*point to wall*).

Please take a moment to review the RPE, the scale on the wall. Feel free to ask me for any clarification, and take your time to get familiar with it as you will be asked to report answers to this measure at various time points throughout this study. *(bring heart rate monitor over to the bike and place on table close to the computer mouse).*For heart rate purposes could you please tell me your age? (*calculate target heart rate based on participant's age).* Do you have any questions before we begin?

Okay, lets begin. You can now get yourself set up on the bike. Your knees should be slightly bent while your foot is flat on the pedal and the seat should line up to your hip when standing beside it. If you need to adjust the bike, pull the lever at the back of the seat to move it up or down (*show them if needed; person then gets on bike)*. Also, would you like the fan on for while you are cycling? I won't be able to walk around while you are exercising, so I can only turn it on now if you would like. During your workout, I need to remain in the room in case there are any medical issues, but I will be sitting here (*point*) facing the wall (*sit down*). I'll count down from three and then you can begin. You can begin your warm-up for the next 5 minutes and I will then give you a heads up for when you are to begin your exercise bout. 3-2-1- begin! (*press start on the computer*).

**During warm-up (monitor heart rate to ensure it is within 40% - 50% of max heart rate).*

(At 2.5 minutes) Please indicate a number on the RPE scale. (*enter into computer and record heart rate).*

Okay, in 30 seconds we will ask you to start your 30 minute workout. Your workout will begin in 5-4-3-2-1).

**(monitor heart rate on monitor every five minutes to ensure participant is at 65-85% of the maximum heart rate; it does not need to be exact but should aim to keep it as close as possible; if participant deviates away from this rangee, adjust wattage)*

(Every five minutes) Please indicate a number on the RPE scale. (*record value).*

Okay, in 30 seconds we will ask you to start your cool-down. Your cool down will begin in 5-4-3-2-1). *(monitor heart rate decreases)

(At 1.5 minutes) Please indicate a number on the RPE scale. (*record value)*
(After 3 minutes of cool down) Your workout is complete. When you're ready please step off the bike.

CONTROL CONDITION
Okay, you will now be asked to sit in this chair (*point to comfy chair in corner)* and read the following materials (*hand participant magazines)* for the next 38 minutes. You will not be able to read through your own materials or your be on your phone so I will ask you to place your bag under the desk. I must remain in the lab but will be sitting at the desk facing the wall working on documents.

Do you have any questions before you begin? Okay please get comfortable and begin reading.

POST-EXPERIMENTAL AND CONTROL CONDITIONS
(Post-0 minutes) I'll now have you come sit at the computer to complete some follow-up surveys. Please take your time working through each page and there are several pages so make sure not to miss any of them. Let me know once you are finished. *(completes questionnaires).*You can now sit in this chair (*point to comfy chair in corner)* for some quiet rest. I will let you know when you will complete the next surveys. (*save workout on Lode computer system and log-off)*

(Post-10 minutes) I'll have you come sit at the computer again to complete some follow-up surveys. Please take your time working through each page and there are several pages so make sure not to miss any of them. Let me know once you are finished. (*completes questionnaires).*You can now sit in this chair (*point to comfy chair in corner)* for some quiet rest. I will let you know when you will complete the next surveys.

(Post-20 minutes) I'll have you come sit at the computer again to complete some follow-up surveys. Please take your time working through each page and there are several pages so make sure not to miss any of them. Let me know once you are finished. Thank you. You can now take off the heart rate monitor. I'll step out of the room while you do this. Please knock once you have done so.

Lastly, please take your shoes off and step on the scale so we can take a measure of your body weight. Next I'll have you stand against the wall here (*point to scale*) to measure your height. This will be used to calculate your body mass index. **(record height and weight)*

That is the end of the study. Thank you for your time. Now that the study is over I am able to tell you a little bit more about it. We are investigating the ways in which exercise improves body image, if it occurs through changes in mood, physical self-perceptions and self-efficacy. Here is a summary of the study (*hand them printed debrief sheet)* I'll let you take a minute to read it but please do not share this information with anyone you know who may participate in the study in the future.

Also, for your time we are offering you a gift card to either Tim Horton's or Starbucks. Which one would you like? (*give participant gift card.* And I'll have you sign this form to confirm that you have received your gift card (*have them sign the research subject payment form).*

Thank you again for participating, you are free to go. Have a nice day!

RECRUITMENT POSTER

Department of Kinesiology

Health and Exercise Psych Lab (AB132A)
Ivor Wynne Center

1280 Main St. W
Hamilton, ON
L8S 4K1

EARN $20 FOR PARTICIPATING IN AN EXERCISE STUDY

- Are you **female**?
- Between **17 – 23** years of age?
- Exercise regularly (**at least 3** times/ week at moderate intensity)
- Have a Body Mass Index in the **normal** range (18.5 – 24.9 Kg/m^2)?

If you answered yes to all the above, you may be eligible to participate in this study!

The study consists of **one** lab visit for a total of **90 minutes**. You will be required to complete questionnaires to assess self-efficacy, mood, physical self-perceptions and body image. As well, you will perform a moderate-intensity workout on a stationary bike for 30 minutes (excluding warm-up and cool-down).

This study has been reviewed and approved by the McMaster Research Ethics Board. If you have concerns or questions about your rights as a participant or about the way the study is conducted, you may contact:

McMaster Research Ethics Board Secretariat
Telephone: (905) 525-9140 ext. 23142
c/o Office of Research Services
E-mail: ethicsoffice@mcmaster.ca

If interested please contact Lauren at salcile@mcmaster.ca