THE EFFECTS OF AEROBIC VERSUS ANAEROBIC EXERCISE ON ANXIETY SENSITIVITY

A Thesis
by
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Abstract

THE EFFECTS OF AEROBIC VERSUS ANAEROBIC EXERCISE ON ANXIETY SENSITIVITY

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Anxiety sensitivity (AS) is a risk factor for the development and maintenance of anxiety disorders. Research has demonstrated that regular physical exercise can have salubrious effects on a variety of physical and mental health outcomes, including depression and anxiety; however, little is known regarding whether alternative forms of exercise may impact AS. The present study examined the comparative effects of anaerobic exercise and aerobic exercise on AS among individuals with elevated AS. Twenty-four college students with elevated AS were randomly assigned to complete 20 minutes of aerobic exercise, anaerobic exercise, or no exercise condition. Results indicated that AS scores generally declined over time, with scores decreasing from baseline to session three, $p = .02$, $d = .9$. The results suggest that anaerobic exercise significantly decreased AS scores over time, $p = .03$, $d = .85$, whereas aerobic exercise did not display significant reduction in AS over time, $p = .22$, $d = .81$. Although change scores for the aerobic condition did not significantly differ from the control condition, the observed effect sizes were comparable to those noted in previous research. The implications of these results and potential directions for further research are discussed.

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Table of Contents

List of Tables

List of Figures

The Effects of Aerobic versus Anaerobic Exercise on Anxiety Sensitivity

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The Effects of Aerobic versus Anaerobic Exercise on Anxiety Sensitivity

Anxiety Sensitivity

Anxiety sensitivity is defined as the fear of experiencing anxiety and anxiety related sensations (Reiss & McNally, 1985). Individuals with heightened levels of AS believe that physiological sensations associated with anxiety can lead to negative consequences, such as a heart attack (Reiss, 1991). The misinterpretation of physiological arousal may result in avoidance of stress evoking situations (Keogh & Cochrane, 2002; Keogh, Dillon, Georgiou, & Hunt, 2001; McNally, 1990 for a review) and heightened attention to perceived physical threats.

There is evidence that high AS is a vulnerability factor for a variety of forms of psychopathology, including panic attacks (Schmidt, Lerew, & Jackson, 1997), agoraphobia (Taylor, Koch, Woody, & McLean, 1996), generalized anxiety disorder (GAD; Naragon-Gainey, 2010), posttraumatic stress disorder (PTSD; Naragon-Gainey, 2010), simple phobia (SP; Reiss, 1991), and depression (Taylor et al., 1996). Additionally, research suggests that AS is most strongly associated with panic disorder (PD; Taylor, Koch, & McNally, 1992), and AS has been shown to precede panic attacks and PD (Maller & Reiss, 1992). Given that AS serves as a vulnerability factor for panic symptomology, it has been suggested that interventions designed to reduce AS may also be able to diminish the risk of developing panic and anxiety related symptomology (Keough & Schmidt, 2012).

Interventions for Anxiety Sensitivity

Numerous studies have investigated interventions to abate symptoms of AS by focusing on the interaction between attention to physiological changes (e.g., increased heart

rate), automatic thoughts (e.g., I am having a heart attack), feelings (e.g., panic), and behaviors (e.g., avoiding situations that increase heart rate; Watt & Stewart, 2008). Presently, cognitive-behavioral therapy (CBT) is the most widely researched intervention for AS, with the majority of these studies reporting positive outcomes (Watt & Stewart, 2008). Although research indicates that CBT can reduce an individual's AS, the recommended number of therapy sessions varies in the literature. Some studies suggest that completion of 10 to 12 sessions of CBT results in a significant reduction in AS (McNally & Lorenz, 1987; Telch, Lucas, Schmidt, Hanna, Jaimez, & Lucas, 1993), whereas other research indicates that as few as one to six sessions of CBT may be sufficient to reduce fears of uncomfortable bodily sensations (Gardenswartz & Craske, 2001; Kenardy, McCafferty, & Rosa, 2003).

Although research indicates that CBT can reduce AS, CBT is associated with high costs, and qualified practitioners can be difficult to locate in many areas. The Agency for Healthcare Research and Quality (AHRQ; NIMH, 2006) reported that the average cost for mental health care was approximately $1591 per person. Furthermore, geographical location can act as a barrier for mental healthcare (Handley et al., 2014). Rural areas are often underserved, forcing individuals to travel to other localities to seek mental healthcare. Moreover, many individuals fear the stigma attached to seeking mental health services; as a result, they are reluctant to attend therapy (Corrigan, 2004). Thus, researchers have begun to look for alternative modes of treatment that may be more cost effective, less stigmatizing, and widely accessible.

Aerobic Exercise Interventions

Aerobic exercise has been defined as "physical work sustained for long periods (e.g., distance running or swimming), with training designed to increase the efficiency of the

oxygen transport system" (de Coverley Veale, 1987). Research accumulated over the past two decades indicates that regular aerobic exercise is associated with a variety of positive physical and mental health outcomes, including reductions in anxiety and depressive disorders (de Moor, Beem, Stubbe, Boomsma, & de Geus, 2006; Fremont & Craighead, 1987) and provides an alternative to other psychological interventions (Salmon, 2001). For example, research has consistently demonstrated that aerobic exercise is effective in significantly reducing symptoms of depression, anxiety, and panic (Broocks et al., 1998; de Moor et al., 2006; Fremont & Craighead, 1987; McAuley, Mihalko, & Bane, 1996; McEntee & Halgin, 1999; Sexton, Maere, & Dahl, 1989); and studies have shown that light and moderate forms of aerobic exercise are equally effective in producing the psychological benefits that are associated with exercise (Sexton, Maere, & Dahl, 1989).

Additional benefits of exercise interventions include providing a cost-effective alternative to psychotherapy and medication for some psychological disorders. Studies (Fremont & Craighead, 1987; McEntee & Halgin, 1999) suggest that aerobic exercise is as effective as cognitive therapy in reducing symptoms of depression (Fremont & Craighead, 1987) and anxiety (McEntee & Halgin, 1999). Other studies suggest that aerobic exercise is comparable to anti-depressants at reducing symptoms of depression (Blumenthal et al., 1999; Rethorst, Wipfli, & Landers, 2009), and individuals who previously engaged in aerobic exercise are less likely to develop remerging symptoms of depression compared to individuals who stopped taking anti-depressants (Babyak et al., 2000).

Although limited, several investigators have examined the effects of regular aerobic exercise on AS (Broman-Fulks, Berman, Rabian, & Webster, 2004; Broman-Fulks & Storey, 2008; Smits, Berry, Rosenfield, Powers, Behar, & Otto, 2008). In the first study to directly

examine the effects of aerobic exercise on AS, Broman-Fulks et al. (2004) randomly assigned 54 college students with high AS (i.e., one SD above the mean on the ASI) to six 20-minute sessions of high intensity aerobic exercise (i.e., jogging) or low intensity, non-aerobic activity (i.e., walking). Individuals in the aerobic exercise group maintained a heart rate between 60 to 90 percent of their age-adjusted and predicted maximal heart rate, whereas participants in the low-intensity exercise group were required to maintain a walking pace of one mile per hour. Analyses revealed that both conditions exhibited significant decreases in AS at follow-up. However, the aerobic exercise produced more rapid reductions in AS (i.e., ASI scores decreased > 1 *SD*) than the non-aerobic condition. Additionally, only the high intensity aerobic exercise resulted in significant reductions in fears of anxiety-related physical sensations.

A subsequent study by Broman-Fulks and Storey (2008) compared the effects of a two-week aerobic exercise regimen on AS to a no exercise group. The sample consisted of 35 college students with elevated AS (i.e., scores > 26 on the ASI-R) who did not participate in regular aerobic exercise. Individuals in the aerobic exercise group completed six 20-minute sessions of aerobic exercise over a period of two weeks. Participants in the exercise group exhibited a significant pre- to post-session reduction in AS compared to the no treatment control condition.

In a similar study by Smits et al. (2008), researchers examined the effects of aerobic exercise and cognitive restructuring on AS. The study was comprised of 60 participants with elevated AS (i.e., scores on the ASI-3 > 25) randomly assigned to one of three treatments: exercise only intervention, exercise intervention along with cognitive restructuring, or waitlist control condition. The results exhibited significant pre- to post-session reduction in

AS scores for individuals assigned to the exercise interventions compared to the waitlist control group, and results of the pre- to post-session comparison found that a combination of exercise and cognitive restructuring was not superior to exercise alone.

Anaerobic Exercise Interventions

Anaerobic exercise has been defined as "high intensity work sustained for very short periods of time" (e.g., weight lifting or sprinting; de Coverley Veale, 1987). To date, there is a paucity of research on the salutary effects of anaerobic exercise on mental health outcomes. Although limited, existing research suggests that anaerobic exercise is also associated with multiple, positive physical and mental health outcomes (de Coverley Veale, 1987), including reductions in anxiety sensitivity (Broman-Fulks, Kelso, & Zawilinski, 2015), trait (Asmundson, Fetzner, DeBoer, Powers, Otto, & Smits, 2013) and state anxiety (Asmundson et al., 2013; Bartholomew & Linder, 1998; Heidary, Emami, Eskandaripour, Saiah, Hasanlu, & Shahbazi, 2011; Herring, Jacob, Suveg, Dishman, & O'Connor, 2012), depression (Doyne, Chambless, & Beutler,1987; Martinsen, Hoffart, & Solberg, 1989; Norvell & Belles, 1993; Singh, Stavrinos, Scarbek, Galambos, Liber, & Fiatarone, 2005), anger (Norvell & Belles, 1993; Wolff, Gaudlitz, von Lindenberger, Plag, Heinz, & Strohle, 2011), and somatization (Norvell & Belles, 1993).

Norvell and Belles (1993) examined the effects of circuit weight training on psychological symptoms in law enforcement officers. The participants were assigned to either an anaerobic exercise condition consisting of 20-minute exercise sessions or weight list control group. Participants engaged in 12 different exercises on a circuit weight machine a total of three times per week for 16 weeks. The results from the pre- to post-session comparison indicated that participants in the exercise group experienced a significant

reduction in psychological symptoms compared to the control group, including a reduction in anxiety, depression, somatization, and hostility.

A subsequent study by Tsutsumi, Don, Zaichkowsky, Takenaka, and Ohno (1998) compared the effects of high- and low-intensity resistance training to a no exercise control group. The sample consisted of females between the ages of 60 and 86. Participants were asked to engage in three weekly exercise sessions over a six week period. Upon completion of the study, both conditions displayed an increase in positive affect as well as a reduction in anxiety and tension, compared to the no exercise control group.

In a more recent study, Bibeau, Moore, Mitchell, Vargas-Tonsing, and Bartholomew (2010) explored the relationship between differing levels of intensities in resistance training, and its influence on anxiety, negative affect, and positive affect. A total of 104 participants were randomly assigned to resistance training groups that varied in intensity and rest-time duration. Participants were assigned to one of the following: high-intensity exercise with a brief rest period (i.e., 30 to 60 seconds), high-intensity exercise with a long rest period (i.e., 90 seconds), low-intensity exercise with a short rest period, or low-intensity exercise with a long rest period. The results indicated both low-intensity and high-intensity exercises significantly reduced symptoms of anxiety, irrespective of the rest period length.

Herring et al. (2012) compared the effects of resistance training versus aerobic exercise on GAD symptoms. The sample consisted of 30 physically inactive females, ages 18 to 37, diagnosed with GAD. Participants were randomly assigned to either an anaerobic exercise, aerobic exercise group (i.e., cycling), or no exercise control group. Individuals were asked to report to the lab twice a week over the duration of six weeks. Results from the

pre- to post-session comparison indicated females assigned to both active conditions displayed a significant reduction in worrying behavior compared to the no exercise condition.

A recent study by Broman-Fulks et al. (2015) was the first to compare the effects of a single session of aerobic exercise and resistance training to a no-exercise control condition on AS. Participants in the aerobic condition were asked to walk or jog on a treadmill for 20 minutes, whereas participants in the resistance training condition completed two sets of three different resistance training exercises until muscle failure, with two-minute rest periods between each set so that sessions lasted a total of 20 minutes. In contrast, individuals in the rest condition sat quietly for 20 minutes. The results indicated that both aerobic exercise and resistance training significantly and equally reduced AS compared to the control condition, suggesting that brief, intense bursts of physical activity over a 20 minute duration may be equally effective in reducing AS compared with 20 minutes of prolonged physiological arousal. However, the results indicated that resistance training may be less effective compared to aerobic exercise at reducing reactivity to biological challenges (e.g., CO_2 inhalation), with participants in the anaerobic condition displaying a significant increase in panic symptoms in response to CO_2 that the aerobic group did not. Although both aerobic and anaerobic exercise engendered a reduction in AS, it appears that aerobic exercise may have specific advantages compared to anaerobic exercise, such as decreased likelihood participants will respond to biological challenges.

Taken together, research indicates that anaerobic exercise can positively influence a variety of mental and physical health-related variables, with the effects generally being comparable to aerobic exercise and CBT interventions. Given recent research suggesting

that a single session of resistance training may have positive effects on AS, it is possible that more regular anaerobic exercise may be an effective intervention to reduce symptoms of AS.

Interoceptive Exposure

Although the exact mechanisms through which exercise exerts its effects on AS are unclear, it is hypothesized that exercise serves as a form of interoceptive exposure (IE; Asmundson et al., 2013), a technique designed to expose participants to feared bodily sensations (e.g., rapid heartbeat, shortness of breath, and sweating; Craske & Barlow, 2008) by imitating anxiety symptomatology (Asmundson et al., 2013). Traditional theories for exposure therapy (i.e., emotional processing theory) suggest that individuals should continuously be exposed to a feared stimulus (e.g., rapid heartbeat) until one reaches their peak fear level; in turn, this will more effectively engender habituation of the feared objects or sensations (Foa, Huppert, & Cahill, 2006; Foa & Kozak, 1986). However, emerging research suggests that brief bursts of exposure, such as those experienced during resistance training, may be equal to or superior to prolonged exposure (Craske, Kircanski, Zelikowsky, Mystkowski, Chowdhury, & Baker, 2008). For instance, memory research suggests that new learning occurs over time in which there are no changes to the individual's performance, because minimal learning occurs when there are extreme changes in performance (i.e., maximum fear level; Bjork & Bjork, 2006). As a result, the delivery of IE should focus on individuals developing an increased tolerance toward feared stimuli, rather than individuals experiencing peak fear levels until the fear habituates (Craske et al., 2008). Other research suggests that individuals may be more likely to establish new non-threat associations if the exposure intervention incorporates multiple excitatory factors (e.g., anaerobic exercise) to extinguish feared stimulus (Rescorla, 2001); by incorporating multiple excitatory factors, this

reduces the likelihood of spontaneous recovery of feared sensations (Rescorla, 2006). In addition, brief intervals of exposure may be less aversive, involve fewer safety and avoidance behaviors (Seim, Waller, & Spates, 2010), and increase the likelihood new learning will generalize outside the exposure session (Craske et al., 2008).

Summary

Given that AS predisposes individuals to develop anxiety disorders and have panic attacks, it has become increasingly important to research cost-effective and widely accessible interventions to reduce AS. Research suggests that exercise has salutary effects on a variety of mental health concerns (e.g., depression and anxiety symptoms). Even though research suggests that exercise can positively influence one's mental health, research has primarily investigated the anxiolytic effects of aerobic exercise on anxiety (Fremont & Craighead, 1987), AS (Broman-Fulks et al., 2004; Broman-Fulks & Storey, 2008; Ströhle et al., 2009), and depression (de Moor et al., 2006). As a result, little is known regarding whether alternative forms of exercise, such as anaerobic exercise, may impact AS in a comparable manner. Initial research appears to suggest that aerobic and anaerobic forms of exercise are equally effective in reducing symptoms of depression (Doyne et al., 1987; Martinsen et al., 1989; Norvell & Belles, 1993; Singh et al., 2005) anxiety (Heidary et al., 2011; Norvell & Belles, 1993), and AS (Broman-Fulks et al., 2015).

To date, only one study (Broman-Fulks et al., 2015) has directly compared a single session of aerobic and anaerobic exercise to a resting condition. However, the sample consisted of healthy college students without elevated AS. Although research appears to indicate that aerobic and anaerobic exercise may reduce AS symptoms in healthy participants, researchers have yet to investigate the effects of anaerobic exercise on AS

among individuals with elevated AS. Moreover, researchers have yet to examine the effects of a multi-session intervention that directly compares anaerobic and aerobic exercise to determine if multiple exposure sessions will display superior effects to a single session of exercise. In addition, despite emerging research on optimizing inhibitory learning, there has been a paucity of research implementing techniques that promotes new learning to generalize over time and situation (Deacon, Kemp, Dixon, Sy, Farrell, & Zhang, 2013). Thus, the purpose of the present study was to address these gaps in the literature by investigating whether repeated sessions of anaerobic exercise, which involves the elicitation of intense bursts of physiological arousal followed by rest, generates comparable reductions in AS to repeated sessions of aerobic exercise, which involves prolonged exposure to physiological arousal sensations over the course of six exercise session. It is hypothesized that:

1. Participants in both treatment conditions (aerobic and anaerobic exercise) will exhibit significant reductions in AS compared to participants in a no-intervention control condition.
2. Aerobic and anaerobic exercise will lead to comparable reductions in AS.

Methods

Participants

An a priori power analysis using G* - Power (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that 30 participants were needed for the present study to detect a medium effect size (f = .25) using a mixed model ANOVA design with three conditions, alpha set at .05, and power set at .80. The effect size was determined based on research using a similar methodological design (e.g., Broman-Fulks & Storey, 2008; within exercise group effect, d =

.91). To qualify for the study, participants had to be 18 years of age or older, in good physical health (i.e., without a history of cardiovascular, respiratory or bone/joint conditions, and not be taking medication for a cardiac or respiratory condition; Figure 1 denotes the constraints from which participants were excluded from the present study), not currently involved in a regular exercise regimen (i.e., engaging in exercise lasting at least 20-minutes more than twice per week), and report high AS on the Anxiety Sensitivity Index-3 (ASI-3 score $\geq$ .5 *SD* above the normative mean of 12.8; Taylor et al., 2007).

After screening participants to ensure they reported elevated AS and were in good health, a total of 321 participants were invited to participant in the study, and a total of 31 participants were recruited for the study, though only 19 participants completed all seven sessions (See Figure 1 for participant flow). Due to participant attrition, analyses were conducted on participants who completed at least 4 sessions (n = 24). On average, participants were 20.57 years old (*SD* = 1.83; See Table 1 for additional demographic information by condition), and primarily female (80.6%) and Caucasian (80.6%).

Measures

Demographics. Participants were administered an online demographics survey to determine their age, sex, ethnicity, marital status, and school year classification (e.g., freshman, sophomore, junior, and senior). The questionnaire included items, such as "how old are you?" and "what is your race/ethnicity?"

Appalachian Screening Questionnaire for Research Involving Exercise. The Appalachian Screening Questionnaire for Research Involving Exercise is a 29 item questionnaire based on recommendations from the American Heart Association and the American College of Sports Medicine. The questionnaire is divided into two sections, with

section one assessing for medical history, health issues, and other symptoms and section two assessing cardiovascular risk factors. Participants were asked to assess their current health status by endorsing items relevant to them. Items in section one assessed for a variety of medical symptoms, such as "heart attack," "heart failure," and "asthma," whereas section two asked questions, such as "are you a man older than 45?" or "are you a woman older than 55 years, had a hysterectomy, or are postmenopausal?" If participants endorsed items in section one, they were advised to consult with a physician prior to participating in the study, whereas if participants endorsed zero to one items in section two they were classified as safe to participate without consulting with a physician. However, if two or more items were endorsed, then participants were dismissed from the research study (See Appendix A for measure).

Anxiety Sensitivity Index-3. The Anxiety Sensitivity Index- 3 (ASI-3; Taylor et al., 2007) is an 18-item questionnaire designed to measure AS as well as three lower order factors: social, cognitive, and physical concerns. Participants respond to statements, such as "When my chest feels tight, I get scared that I won't be able to breathe properly," and "When I feel pain in my chest, I worry that I am going to have a heart attack." Participants responded using a 5-point Likert scale (0 = very little to 4 = very much), indicating their level of anticipated anxiety in a specific situation. The ASI-3 has been found to be reliable and contains sound psychometric properties (Wheaton, Deacon, McGrath, Berman, & Abramowitz, 2012), including alpha scores of .86 for physical concerns, .91 for cognitive concerns, and .86 for social concerns in North American samples (Taylor et al., 2007; See Appendix B for measure). The Cronbach's alpha for the present study was highly reliable (18 items, α = .89).

The ASI-3 has been supported by six confirmatory factor analyses in replication samples, including both clinical (n = 390) and non-clinical samples (n = 4,494), with clinical samples including participants from the United States and Canada and non-clinical samples from the United States, Canada, Mexico, the Netherlands, France, and Spain. In studies comparing the ASI-3 to the original measure containing 16-items, the ASI-3 had higher total scale validity for wide array of sample characteristics, such as race, sex, and diagnosis, and the ASI-3 had less error variance compared to the original ASI. Overall, the ASI-3 displays excellent discriminant, convergent, and criterion-related validity (Taylor et al., 2007).

Physical Activity Readiness Questionnaire. The Physical Activity Readiness Questionnaire (PAR-Q) is a seven item questionnaire that determines if individuals are able to participate in physically demanding research studies. Participants were asked to answer questions such as "Has a doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?," or "Do you feel pain in your chest when you do physical activity?" If any question was endorsed "yes," participants were excluded from participating in the study or encouraged to undergo a physical examination by a physician before participating in the exercise study (Bredin, Gledhill, Jamnik, & Warburton, 2013; See Appendix C for measure).

Heart Rate. All participants wore a Polar heart rate strap for each session. Heart rates were monitored from a wrist watch at baseline and throughout the aerobic (i.e., every 2 minutes), anaerobic (i.e., after completion of each weight lifting set and after 1 minute rest session), or rest procedures (i.e., every 2 minutes). Procedures for examining heart rates followed protocols from previous aerobic and anaerobic exercise studies (Broman-Fulks et al., 2015), and the participants' maximum heart rates were calculated based on age (i.e., 220-

participants age) using guidelines from the American College of Sports Medicine (ACSM; 2000).

Procedure

Recruitment. Prior to recruiting participants, researchers applied for and received IRB approval to ensure the research design met IRB standards (See Appendix D). Subsequently, participants were recruited from the undergraduate research pool at Appalachian State University by administering preliminary measures online, including the demographic information (e.g., age, sex, race), ASI-3, and PAR-Q. Participants scoring at least a half a standard deviation above the mean on the ASI-3 (i.e., > 17; Taylor et al., 2007) and who self-reported on the PAR-Q they were physically healthy enough to engage in exercise were invited to participate in the study. If eligible for participation, students were invited to enroll in the study via email. Individuals accepting the invitation were asked to report to the Anxiety and Exercise Research Laboratory.

Laboratory procedures. Prior to arriving at the lab, the participants were randomly assigned to either an aerobic, anaerobic, or resting condition, allowing the research assistant adequate time to prepare for the correct condition. Upon arrival at the lab, which consisted of two aerobic exercise rooms containing treadmills and a weight training room containing a large circuit trainer, the experimenter verbally administered an exercise screening questionnaire provided by Appalachian State University, providing additional assurance the students were healthy enough to participate in the study. If participants endorsed two or more items on the ASU exercise screening questionnaire, they were classified as at-risk and dismissed from the study. Afterwards, the experimenter reviewed the overall study design, reviewed risk and benefits, answered questions regarding the study, and obtained the

participant's consent (Refer to Appendix E, F, and G for informed consent measures).

After consent was obtained, the participants' heights and weights were assessed. Subsequently, the participants were instructed to wear a Polar heart rate monitor directly on the sternum and to wear a lanyard with an attached heartrate monitor wristlet, allowing the experimenter to monitor the participants' heart rate without informing the participant of their heart rate. Participants were asked to remain sedentary for approximately five minutes, providing a baseline for their resting heart rate. Prior to engaging in exercise/rest session, participants were asked to complete a series of self-report measures online via Qualtrics, including the demographic information, PAR-Q, and ASI-3. Afterwards, participants were instructed to engage in their assigned condition. In following sessions, participants also responded to questionnaires before engaging in their assigned condition.

Aerobic Exercise. Individuals assigned to the aerobic exercise group were asked to complete six sessions of aerobic exercise in the laboratory over a two-week period. Each exercise session required the participant to stretch for two minutes, walk slowly on the treadmill for two minutes, and then walk or jog on the treadmill for 20 minutes. During this time, participants maintained a heart rate between 65 and 75 percent of their maximum estimated heart rate (Broman-Fulks et al., 2004; Broman-Fulks & Storey, 2008; Smits et al., 2008), and treadmill speed was adjusted as necessary. Every two minutes, the participant's heart rate was recorded, and the treadmill's speed was adjusted to maintain heart rate in the desired range. After exercising for 20 minutes, participants completed a two minute cool down, which involved walking slowly on the treadmill followed by two minutes of stretching.

Anaerobic Exercise. Individuals assigned to the anaerobic exercise condition were required to stretch for two minutes prior to lifting weights. During the weight lifting session, participants completed three sets of three distinct exercises designed to utilize several major muscle groups, including the bench press, squat, and lateral pull down exercises. Prior to lifting weights, the experimenter demonstrated how to perform each exercise using the weight machines. After demonstrating the weight lifting technique, the participant was asked to complete ten repetitions without weights. During this time, the research assistant provided feedback, ensuring the participant understood how to accurately and safely lift weights. Thereafter, the research assistant added a predetermined amount of weight to the machine. Weight was determined by accounting for participants' sex, height, and weight lifting experience. Participants completed each set of the exercise until muscle failure (i.e., the participant was unable to complete any additional repetitions). If necessary, the weight for subsequent sets was adjusted downward to ensure the participant was able to complete a minimum of 10 repetitions before muscle failure occurred. After completion of each set, the participant was asked to rest for approximately one minute before beginning another set of repetitions. During this time, the participant's heart rate was recorded immediately after completion of the set. After resting for one minute, the participant's heart rate was recorded for a second time. Upon completion of all nine sets, the participant was asked to stretch for two minutes.

Rest Condition. Participants assigned to the rest condition were asked not to engage in any physical exercise (e.g., stretching, walking, running, or lifting weights) until the study was completed. In session, participants were asked to sit in a comfortable chair in an office for approximately 20 minutes, three times per week for two weeks. During the sessions, the

participant sat quietly and refrained from using use mobile devices, reading books, completing homework, or communicating with the research assistant. The research assistant monitored participant heart rates throughout the session and recorded them every two minutes throughout the rest-session. Unlike the aerobic and anaerobic condition, participants did not stretch before and after the rest session, and they were not asked to provide a RPE rating.

Experiential learning credits. To encourage completion of the study, participants who were completing the study for course credit were compensated with 15 experiential learning credits (ELC). The ELC credits were granted through SONA, an online experiment management website. Participants were awarded 1 ELC per 30 minutes expended upon the study. As a result, students were awarded one ELC for completing the preliminary online survey, three ELC for the first and sixth session, and two ELC per remaining session. To further encourage completion of all seven sessions, students were paid a $20.00 incentive at the follow-up session.

Data Analytic Plan

As noted above, due to attrition, outcome analyses were restricted to data from the first four sessions. Thus, 3x4 (group by time) mixed model analysis of variance (ANOVAs) were conducted on ASI-3. If violations of the sphericity assumption were detected, significance tests were conducted using the Greenhouse-Geisser correction method. Significant interactions were analyzed by examining within-group simple effects, followed by post hoc mean comparisons. Post hoc mean comparisons were only conducted if results were statistically significant. Tukey's HSD procedure was used for all mean comparisons. All significance tests conducted were two-tailed.

Results

Preliminary Analyses

One-way ANOVA and chi square analyses indicated the aerobic exercise, anaerobic exercise, and no exercise groups were comparable at baseline on all demographic variables (e.g., age, race, sex), with all *p*s > .10. Separate one way ANOVAs were used to determine if there were significant differences on the ASI-3 scores. The results indicated that baseline ASI-3 scores were not significantly different between the three groups, with all *p*s > .10.

A chi-square test of homogeneity was performed to determine if the condition influenced the likelihood participants would complete all seven sessions. The analysis revealed that the assigned condition significantly related to whether participants did or did not complete all seven sessions, χ^2 (2, N = 31) = 6.98, p = .03. The chi-square test revealed participants assigned to the aerobic condition were more likely to discontinue prematurely than participants assigned to the control condition, χ^2 (1, N = 21) = 6.99, p = .02, whereas those assigned to the anaerobic and control conditions did not significantly differ (*p*s>.05).

Manipulation Check: Heart Rate during Exercise/Rest Session. A 3x2 (group x time) mixed-model ANOVA was computed to test the impact of the assigned condition on participants' heart rates. Participants' average baseline heart rates were compared to mean heart rates during exercise/rest (i.e., across sessions 1, 2, 3, and 4). Results showed a significant main effect for time, F(1, 30) = 326.70, p < .001, d = .65, with heart rates at baseline (M = 82.38, SD = 1.83; Refer to table 3 for heart rate averages) generally increasing over time (M = 114.69, SD=1.87). The main effect for group, F(2, 30) = 34.3, p < .001, d = .55, was significant. Contrast revealed that the aerobic exercise condition exhibited significantly higher heart rates during the intervention than participants assigned to the

resting condition, $p < .001$. Additionally, contrasts revealed the anaerobic condition displayed trends toward significance, with heart rates displaying higher arousal than participants assigned to the resting condition, $p = .06$; and the heart rates did not significantly differ between participants assigned to the aerobic and anaerobic condition, $p = .86$. Additionally, the interaction effect, $F(2, 30) = 154.01$, $p < .001$, $d = .65$, was significant. Contrasts that were performed comparing baseline heart rates to post intervention heart rates revealed that participants assigned to the control condition displayed a significant reduction in scores from base line heart rate ($M = 87.52$, $SD = 2.51$) to average heart rate during rest ($M = 80.74$, $SD = 80.74$), $p = .03$. In contrast, participants assigned to the aerobic condition displayed a significant increase in heart rate from base line ($M = 79.45$, $SD = 2.51$) to intervention heart rate ($M = 145.01$, $SD = 3.08$), $p < .001$. In addition, participants assigned to the anaerobic displayed a significant increase in heart rate from baseline ($M = 80.16$, $SD = 2.90$) to exercise heart rate ($M = 118.34$, $SD = 3.56$), $p < .001$. Refer to Figure 3 for a graph containing changes in heart rate.

Pre- and- Post Weight Lifting Heart Rate. A one-way repeated-measures ANOVA was computed to test the impact of the anaerobic exercise condition immediately after engaging in the weight lifting session that compared the results to participants' heart rates after observing a one minute rest session. The average was taken of participants' post-weight lifting heart rates and compared to the average heart rate after observing a one minute rest session. Results showed a significant main effect $F(1, 8) = 36.80$, $p < .001$, with heart rate decreasing from post-exercise ($M = 115.96$, $SD = 15.35$) to post-rest session ($M = 98.50$, $SD = 13.48$).

Anxiety Sensitivity Index-3. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, χ^2 (5) = 21.86, $p < .001$. Thus, within-subjects effects are reported using the Greenhouse-Geisser correction statistic. A 3 (Condition) × 4 (Time point) ANOVA on ASI-3 scores revealed a significant main effect of time, $F(1.8, 38.1) = 4.20$, $p = .03$, $d = .9$, with scores generally decreasing from baseline ($M = 29.62$, $SD = 12.30$) to time 4 ($M = 24.38$, $SD = 16.09$), $p = .02$. The main effect of condition was not significant, $F(2,21) = 1.24$, $p = .31$, $d = .7$, though there was a trend towards significance for the interaction between condition and time, $F(3.6, 38.1) = 2.12$, $p = .10$, $d = .9$. A post hoc comparison of change scores (i.e., baseline ASI-3 score – post session 4 ASI-3 score) revealed that scores for participants assigned to the anaerobic condition ($M = 10.67$, $SD = 9.19$; Refer to Table 2 for ASI-3 means and standard deviations) decreased significantly more over time compared to participants assigned to the rest condition ($M = -1.00$, $SD = 4.11$), $t(16) = 2.28$, $p = .03$, $d = .85$. However, change scores for participants assigned to the aerobic condition ($M = 6.50$, $SD = 8.59$) did not significantly differ from those in the rest condition, $t(13) = 1.29$, $p = .22$, $d = .81$. In addition, change scores for the two exercise conditions did not differ, $t(13) = -.88$, $p = .39$, $d = .41$. Refer to Figure 2 for graph containing change scores.

Correlation between ASI-3 and Heart Rate. A series of correlation analyses were computed to determine the relationship between the averaged within-session heart rate and the ASI-3 total scores for individuals assigned to the aerobic and anaerobic conditions. There was no significant relationship between the averaged heart rate at baseline, session 2, or session 3 in the aerobic condition, with all ps > .1. Additionally, there was not a

significant relationship between the averaged within-session heart rate and the ASI-3 total scores at baseline, session 2, and session 3 in the anaerobic condition, with all *p*s > .1.

Discussion

Prior research suggests that exercise is an effective treatment for panic symptoms and anxiety (Broman-Fulks & Storey, 2008). Even though the exact mechanism through which exercise exerts its effects is unclear, it is believed that exercise serves as a method of exposure by eliciting anxiety related physical sensations (Asmundson et al., 2013). Similar to prior research, the results of the present study indicated that individuals engaging in multiple sessions of aerobic exercise (Broman-Fulks & Storey, 2008) displayed a significant decrease in ASI-3 scores over time. However, in contrast to previous research, the reduction in AS scores generated by aerobic exercise was not significantly greater than that observed in the rest condition. Although the aerobic exercise condition did not engender a statistically significant reduction in AS, it should be noted that the effect size for the change in AS scores for the aerobic condition compared to the rest condition (d = .81; Cohen, 1962; Watson, 2015) was relatively large and comparable to that observed in previous exercise research, suggesting the small sample size (n = 6) in the aerobic condition may have impeded the detection of meaningful reductions in AS among the aerobic group.

The results of the present study also indicated that three sessions of resistance training led to significant reductions in AS. In addition, unlike the aerobic condition, the reduction in AS scores following three session of resistance training was significantly greater than the change in scores among the control condition. This finding is consistent with the results of previous research, which indicated that a single session of anaerobic exercise (Broman-Fulks

et al. 2015) generated significant reductions in AS, suggesting that multiple exposure sessions over time contributed to a reduction in AS scores.

Additionally, the results of the present study found that the overall effects of the aerobic (d = .81) and anaerobic (d = .85) were comparable, with the anaerobic condition exerting marginally larger effects than individuals assigned to the aerobic condition. Similar to previous research (Broman-Fulks et al., 2015; d = .8), the effect sizes from the present study indicated both aerobic and anaerobic exercise engender a comparable reduction in AS. However, it is important to note, previous research suggests (Broman-Fulks et al., 2015) that aerobic exercise displayed several distinct advantages compared to the anaerobic condition, with individuals in the aerobic condition displaying less reactivity to biological challenges.

Even though both the aerobic and anaerobic condition displayed relatively large effects, it is important to note the variance within the sample. Analyses for the ASI-3 displayed relatively large means (anaerobic M = 33.56 and aerobic M = 23.00) and standard deviations (anaerobic SD = 9.19 and aerobic SD = 8.59), whereas the mean and standard deviations in the rest condition were relatively small (M = 30.11, SD = 4.11) in comparison. This indicates there was variability in the data (Fields, 2013), suggesting that extreme values may be influencing the results of the present study. Although the research design recruited participants with elevated AS from the online SONA system, at times, participants displayed a reduction in AS prior to engaging in the assigned condition (i.e., session 1). Specifically, two participants in the aerobic condition and one participant in the control condition reported non-clinical scores (ASI-3 < 17) at baseline. However, given the small sample size, removing influential data points would have significantly reduced the size of the sample,

making it challenging to make meaningful comparisons between the groups. Therefore, the present finding may not generalize to other samples.

Despite variability in the data, the observed effect sizes of the present study were comparable to those noted in previous research (Broman-Fulks et al., 2015), which found that a single session of both aerobic and anaerobic exercise displayed meaningful changes, d = .8, in self-reported AS. In a similar research design, Broman-Fulks et al. (2004) found that six sessions of high-intensity exercise (i.e., running) and low-intensity exercise (i.e., walking) engendered a significant reduction in AS scores, with individuals assigned to the high-intensity exercise (d = .5) displaying larger effects than individuals assigned to the low-intensity exercise (d = .11). Although the aforementioned research differs from the present study, the results suggest that both low- and high-intensity exercise can reduce AS, though the magnitude of the reduction may differ. Other research by Smits et al. (2008) implemented a similar research design, with participants engaging in six session of aerobic exercise, cognitive restructuring and aerobic exercise, or wait-list control group. The results reported large effect sizes for individuals assigned to the aerobic condition (d = .29), whereas those assigned to the exercise and cognitive restructuring group (d = .12) and wait list control group (d = .1) displayed smaller effects. Given that post hoc analyses of the present study reported large effect sizes, similar to effect sizes of previous exercise studies, it suggests that if the current pattern of change scores were to hold across a larger sample, results would be comparable to previous research and indicate that both aerobic and anaerobic exercise can significantly reduce AS. However, additional research with a larger sample size is needed to determine if the exercise conditions exerts comparable effects.

With respect to the manipulation check of the heart rate data, the results indicated that heart rates significantly increased for individuals assigned to the aerobic and anaerobic condition over time, whereas participants assigned to the rest condition displayed a significant reduction in heart rate. The reduction in heart rates in the control condition is likely attributed to the prolonged sedentary activity, because heart rates generally increase with more physical activity (Welk, 2002). Additionally, results revealed that the heart rates of participants assigned to the aerobic condition significantly differed from individuals assigned to the control condition, and individuals assigned to the anaerobic condition displayed trends towards significance compared to heart rates of individuals assigned to the control condition. As a result, the findings suggest that individuals engaging in aerobic exercise may have received a slightly more intense session of exposure, whereas participants in the anaerobic condition experienced marginally less physiological arousal compared to the aerobic group. Additional analyses displayed that individuals engaging in anaerobic exercise displayed significant decrease from post-weight lifting heart rate to post-one minute rest session heart rate. Although the delivery of exposure varied between the two exercise groups, the heart rate comparisons suggest that both exercise groups received more intense exposure than individuals assigned to the resting condition. As a result, this suggests the intensity of exposure varied for each group.

In addition, the aforementioned results from the heart rate analysis suggests that even though exposure appears to have engendered a reduction in AS, it does not appear to be necessary for individuals to maintain continuous physiological arousal (i.e., aerobic exercise) to obtain a significant reduction in fears regarding physiological sensations (e.g., rapid heartbeat). Rather, it appears that repeated bursts of physiological arousal (i.e., anaerobic

exercise) throughout the exposure session can render a similar reduction in fears regarding physiological sensations. Correlational analyses revealed the average heart rate was not significantly related to ASI-3 scores at baseline, session one, session two, or session three in the aerobic and anaerobic groups, suggesting that physiological arousal (i.e., elevated heart rate) is not related to within session habituation of AS.

Contributions. The present study has the potential to contribute to the literature base in multiple ways. First, the study has added to a growing research on inhibitory learning that indicates that prolonged physiological arousal (i.e., aerobic exercise) may not be superior to less intense sessions of exposure (i.e., anaerobic) at promoting learning that will generalize over time and situation. It is believed that anxious individuals have deficits with regards to inhibitory learning, and exposure interventions should aim to maximize inhibitory learning by integrating specific techniques, such as variability with the intensity of IE and incorporating multiple exposure interventions (e.g., squats, lateral pull downs, and bench press; Craske, Treanor, Conway, Zbozinek, & Vervelite, 2014). Even though the present study did not perform a long-term follow-up (i.e., > 1 week) to determine if exercise intensity impacts new learning and its ability generalize over time and situation, the research design attempted to compare traditional ET theories (i.e., initial activation of fear followed by a reduction in fear) and newly emerging inhibitory learning based approaches (i.e., enhancing the ability to retrieve newly learned associations across time and situation). Participants assigned to the anaerobic condition completed nine separate weight-lifting sets, and based on the participants' performance, their total weight was adjusted (i.e., increased or decreased) after completion of each set. In contrast, participants assigned to the aerobic condition were continuously exposed to feared sensation over a 20 minute duration. Both conditions

incorporated dispersed exposure over three sessions, providing participants with the opportunity to consolidate new learning over time. Despite differences in physiological arousal between groups (Refer to Table 3 for heart rate data), the effect sizes of change scores on the ASI-3 suggests that both high- and low-intensity IE can reduce AS over the duration of three exposure sessions. Even though the present study does not possess long-term data to determine which exposure modality is superior, these preliminary data suggest that both aerobic and anaerobic exercises are comparable at reducing AS.

Second, there are a limited number of studies examining the efficacy of anaerobic exercise as an intervention to reduce AS, with even fewer studies directly comparing aerobic and anaerobic exercise. To date, this is the first study implementing a multi-session intervention that directly compared anaerobic and aerobic exercise among individuals with elevated AS. Prior research has primarily focused on examining the efficacy of aerobic exercise at reducing symptoms of depression, anxiety (de Moor et al., 2006; Fremont & Craighead, 1987), and AS (Broman-Fulks & Storey, 2008). Although preliminary research suggests that a single session of aerobic or resistance training exercise can reduce AS (Broman-Fulks et al., 2015), the research design did not include participants with clinically elevated AS; thus, it is unclear whether these findings generalize to at-risk or clinical populations. As a result, the present study addresses a gap in the literature, because this is the first study to implement a multi-session intervention in a sample of participants with clinically elevated AS.

Limitations. Although this study had numerous strengths, such as preselecting participants with elevated AS, randomized design, multi-session intervention and assessment design, and a control condition, there were also several limitations worth noting. Most

importantly, and as noted above, the use of a small sample may have significantly restricted the ability to detect changes in AS scores over time. This was largely attributed to participant attrition. Initially, the research design included six sessions of aerobic, anaerobic, or resting sessions, with a one week follow-up session. However, attrition rates for the original research design were as followed: 63.6%, 40%, and 10% for the aerobic, anaerobic, and control conditions, respectively. Due to the high attrition in the aerobic condition, data analyses included the baseline scores, session one, two, and three, resulting in a sample of 24 participants (aerobic $n = 6$, anaerobic $n = 9$, and control $n = 9$). By restricting analyses to the first four sessions, the attrition rate for the aerobic, anaerobic, and control condition reduced to 45.5%, 10%, and 10%, thereby increasing the likelihood data analysis could detect meaningful changes in self-reported anxious symptoms. It is important to note that failure to adhere to a regular exercise regimen is a common occurrence in exercise research studies, suggesting that participant dropout is not unique to this study. A study by Broocks et al. (1998) found as many as 36% of participants in an aerobic exercise condition withdrew from a 10-week exercise regimen, whereas 0% withdrew from the control condition. Although sample attrition is a common occurrence in multi-session exercise interventions, the attrition in the present study was notably higher than previous research studies.

Some studies have found that exercise adherence may be influenced by the level by the perceived pleasurably of the exercise, with more individuals adhering to pleasurable exercise regimens (Williams, Dunsiger, Ciccolo, Lewis, Albrecht, & Marcus; 2008). This presents a distinct challenge for individuals with elevated AS, because they are more likely to avoid strenuous exercise which elicits feared bodily sensations (Smits et al., 2008), likely viewing strenuous exercise as not pleasurable. Although perceived pleasure was not

formally assessed in the present study, heart rate data suggests that aerobic exercise elicited higher heart rates compared to individuals engaging the anaerobic and the rest conditions. Individuals assigned to the aerobic condition may have perceived aerobic exercise as less pleasurable, because of their increased physiological arousal. Similar attrition rates were found by Smits et al. (2008). The research design consisted of six sessions of aerobic exercise or cognitive restructuring and aerobic exercise that targeted individuals' with elevated AS. Results of the study found that 18% of participants assigned to the aerobic exercise group and 33% from the cognitive restructuring and exercise group prematurely terminated from the study, though the attrition between groups did not significantly differ.

Furthermore, participant dropout may have been influenced by the length of the study. The study required seven to 10 hours of in-lab participation at an off-campus location. Other influential factors may include the participant's motivation to be in the study. The majority of participants enrolled in the study to obtain a specific number of ELC to fulfill academic requirements for their coursework, which is a readily used recruitment technique in exercise studies on college campuses (Broman-Fulks et al., 2015). However, many participants obtained the required number of ELCs prior to the end of the study, which may have further contributed to the sample attrition.

Future Directions. Although the present study found that the effect sizes for low intensity IE (i.e., anaerobic exercise) is comparable to high intensity IE (i.e., aerobic exercise) over three exposure session, several key questions emerge. For example, given the effect sizes from a multi-session exercise intervention (d = .9) were only slightly larger than the effect size of a single session exercise intervention (d = .8), researchers should explore whether participants need to engage in multiple sessions of exercise for treatment gains to be

maintained. For instance, traditional theories for exposure therapy, such as the emotional processing theory, suggests that continuous exposure (e.g., aerobic exercise) to feared stimuli (e.g., shortness of breath) will more effectively lead to habituation to feared bodily sensations (Foa & Kozak, 1986), with habituation of feared sensations occurring within the same session. However, memory research suggests that new learning occurs over time in which there are no changes in the participant's performance, because minimal learning occurs when there are extreme changes in performance (Bjork & Bjork, 2006; Craske et al., 2008). Despite theoretical differences, there is a dearth of long-term follow up data to determine which exposure modality exerts superior effects for long-term learning. The majority of exercise studies collect data within the same day as the intervention (Broman-Fulks et al., 2015) or one week (Broman-Fulks & Storey, 2008) post-exercise intervention. As a result, future research should analyze the long-term (e.g., six months to one year) impact of aerobic and anaerobic exercise interventions. Follow-up data would determine if treatment gains were maintained over time, the likelihood exercise behaviors are maintained, and if exercise intensity impacts the creation and maintenance of new learning.

Additionally, given the high attrition in the study, research should continue to investigate influential factors impacting one's likelihood to maintain exercise behavior. Even though aerobic and anaerobic exercise exerts anxiolytic effects on mental health symptoms, the intervention is ineffective if individuals are unwilling to participate in the treatment. As a result, researchers should investigate other excise modality that may be perceived as more pleasurable (e.g., yoga) to determine if less intense exercise exerts similar effects on AS as well as minimizes participant dropout from the research study.

Even though the present study has contributed to the growing field of inhibitory learning research, future research should continue to explore how to maximize inhibitory learning. For example, inhibitory learning theory suggests exposure interventions should incorporate techniques (e.g., altering IE intensity and order of IE) to increase new learning to generalize over time and situation. The present study attempted to apply inhibitory learning concepts to the anaerobic condition by adjusting the total weight lifted upon completion of each weight lifting set. However, the research design did not randomize the order of each weight lifting exercise (e.g., squat, lateral pull downs, and bench press). As a result, future research would benefit from adjusting the intensity as well as randomizing the order of the weight lifting exercises to optimize the acquisition of new learning.

Additionally, research should focus on altering the environment the exercise intervention is delivered and its influence on AS scores. For instance, the present study administered the exercise intervention in an exercise research lab for each session. However, corrective learning research suggests that new learning will more effectively occur by altering the environment IE is delivered (Craske et al., 2008). Future research should also consider administering exercise sessions within the lab (i.e., running on the treadmill), as well as requiring participants to run outside at other sessions, thereby allowing participants to generalize the new learning over time and situation.

Given there was significant attrition in the sample, future research should investigate influential variables that impact one's likelihood to engage in exercise in a sample of individuals with elevated AS. Additionally, future studies should consider ways to reduce barriers to participating in exercise studies, such as administering exercise sessions in closer

proximity to the college campus. In so doing, it increases the accessibility of the research lab, thereby potentially minimizing participant dropout.

Conclusion. Given the promising nature of the present findings, additional research is necessary to assess the full magnitude of the effect both aerobic and anaerobic exercise exerts on AS. As previously noted, many methodological considerations have been identified, such as obtaining a larger sample size and minimizing participant dropout. Despite multiple methodological limitations, the effect sizes of the present study suggest meaningful changes in AS occurred in both the aerobic and anaerobic exercise condition (Cohen, 1962), even though the results were not statistically significant. Research suggests that effect sizes may be better indicators of meaningful change than null hypothesis statistical testing, with the $p < .05$ providing no indication if the intervention engendered a meaningful change (Anderson, Burnham, & Thompson, 2000; Cohen, 1962).

Future research should continue to examine the effects of aerobic and anaerobic exercise on AS. Exercise interventions provide a cost effective alternative to psychotherapy and increase accessibility and affordability to treat psychopathology. Although the present study failed to unveil statistically significant results, effect sizes suggest that both aerobic and anaerobic exercise may be able to meaningfully reduce AS. Future research should focus on integrating inhibitory learning techniques to maximize new learning. To understand the full impact of inhibitory learning techniques, future research should focus on collecting long-term outcome data for exercise studies. Additionally, research should also focus on the methods to increase acceptability and willingness to engage in exercise. In so doing, it will increase the likelihood individuals will experience the benefits of exercise.

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Table 1. *Demographic characteristics for aerobic exercise, anaerobic exercise, and rest conditions*

	Aerobic Exercise (n=6)			Anaerobic Exercise (n=9)			Rest (n=9)		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Age		20.82	1.83		20.5	1.78		20.4	2.37
Race									
Caucasian	6			7			8		
African American	0			0			0		
Hispanic	0			1			1		
Other	0			1			0		
Gender									
Male	2			1			1		
Female	4			8			8		

Note. The groups did not differ on any of the above variables.

Table 2. *Means and standard deviations of ASI-3 total scores for aerobic exercise, anaerobic exercise, and control condition at baseline, and following session 2, 3, and 4*

	Aerobic	Anaerobic	Rest
Session	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	*23.00 (13.81)*	*33.56 (11.00)*	*30.11 (11.99)*
Session 2	*21.17 (14.13)*	*27.33 (9.93)*	*33.11 (17.60)*
Session 3	*20.00 (15.50)*	*24.22 (11.27)*	*30.90 (17.03)*
Session 4	*16.50 (17.47)*	*22.89 (11.02)*	*31.11 (18.22)*

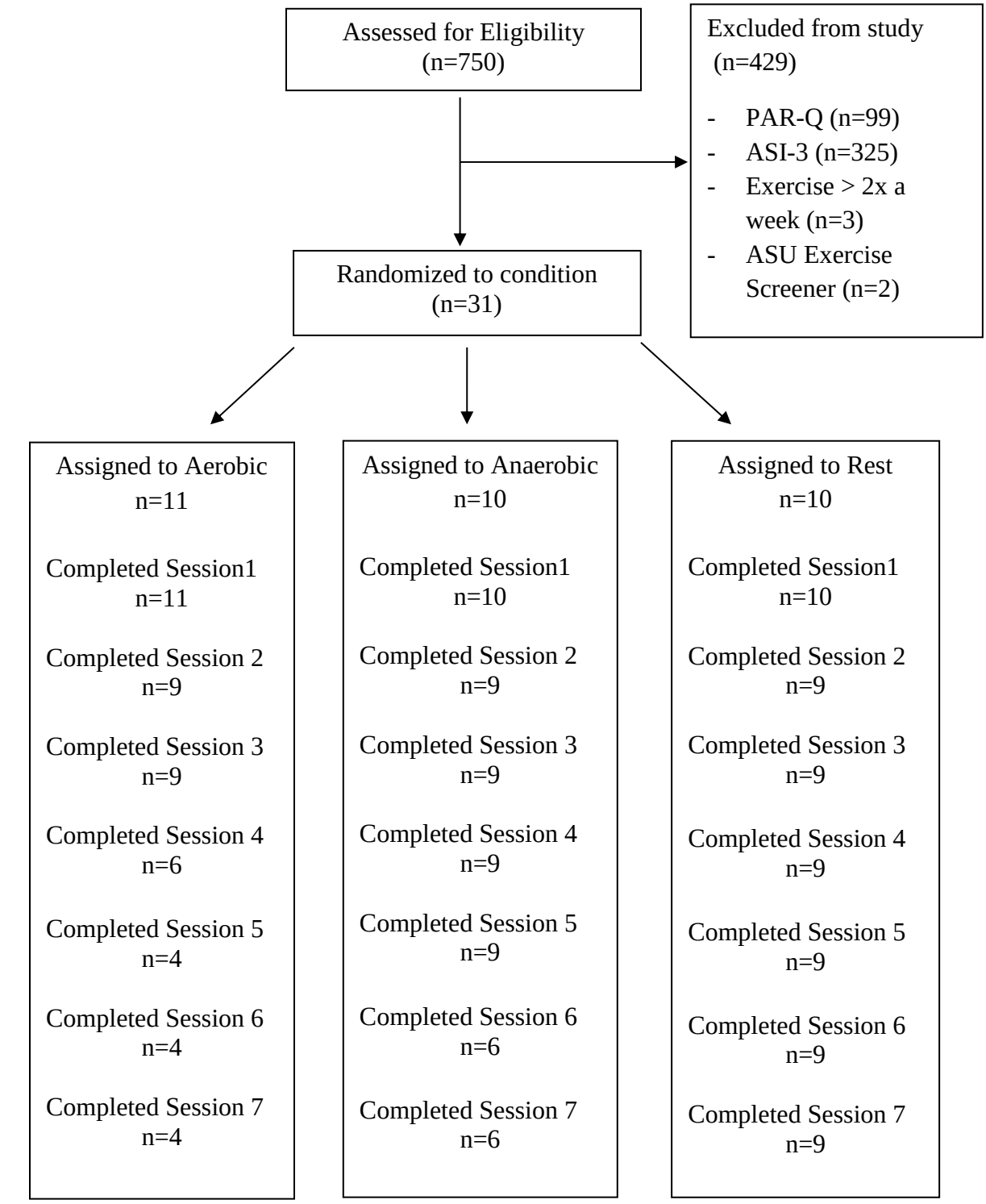
Note. The groups did not differ on any of the above measures.

Table 3. *Means and standard deviations of heart rate measurements for the aerobic exercise, anaerobic exercise, and control condition at baseline and post-baseline*

	Aerobic	Anaerobic	Rest
	M (SD)	*M (SD)*	*M (SD)*
Baseline	*79.45(2.52)*	*80.17(2.90)*	*87.52 (2.52)*
Post Baseline	*145.01(3.08)*	*118.34 (3.56)*	*80.74 (2.90)*

Note. The groups did not differ on any of the above measures.

Figure 1. Participant flow.



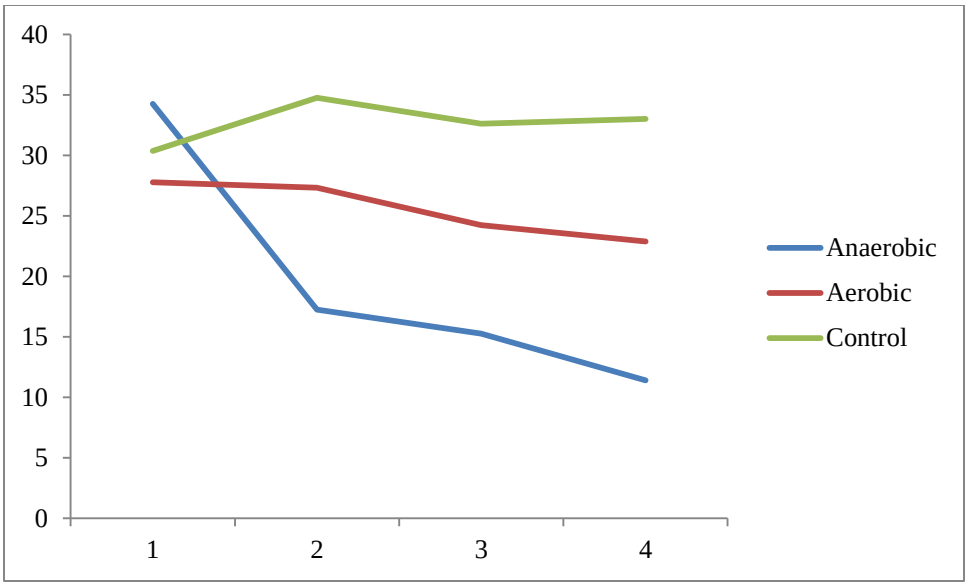


Figure 2. Mean ASI-3 Scores for the anaerobic, aerobic, and resting conditions. This figure represents the mean ASI-3 scores for aerobic exercise, anaerobic exercise, and control groups at baseline and sessions two, three, and four.

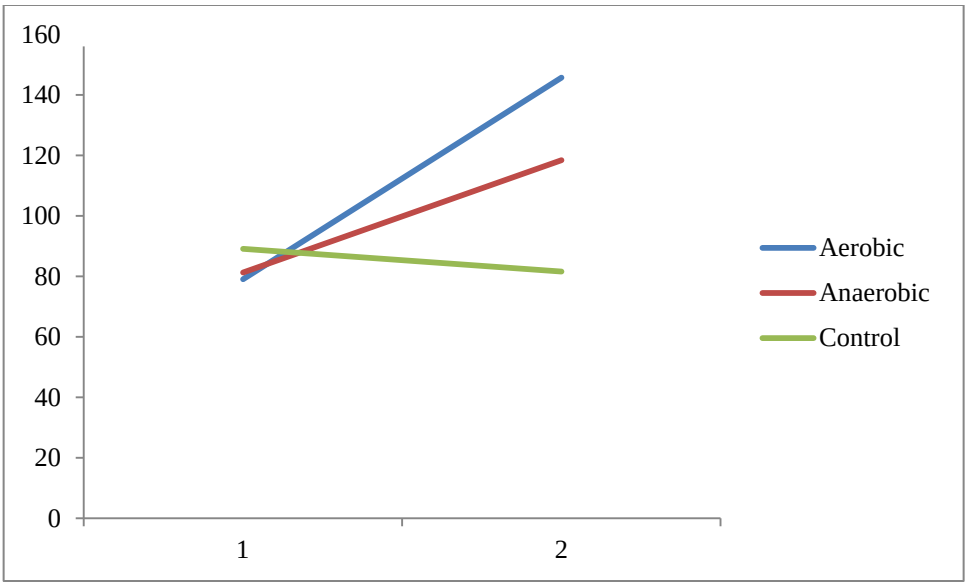


Figure 3. The effects of condition on heart rate. This figure represents the mean heart rate prior to exercise/rest compared to the mean heart rate during exercise/rest across the four sessions of aerobic exercise, anaerobic exercise, and rest.

Appendix A

Appalachian Screening Questionnaire for Research Involving Exercise

Based on recommendations by the American Heart Association (AHA) and American College of Sports Medicine (ACSM): *AHA/ACSM Joint Position Statement: Recommendations for cardiovascular screening, staffing, and emergency policies at health/fitness facilities. Med Sci Sports Exerc. 1998 Jun;30(6):1009-18.*

ID NUMBER _____

Instructions: Assess your health status by marking all true statements

SECTION 1: MEDICAL HISTORY, SYMPTOMS and OTHER HEALTH ISSUES

____ a heart attack
_____ heart surgery
_____ cardiac catheterization
_____ coronary angioplasty (PTCA)
_____ pacemaker/implantable cardiac
_____ defibrillator/rhythm disturbance
_____ heart valve disease
_____ heart failure
_____ heart transplantation
_____ congenital heart disease

_____ You experience chest discomfort with exertion.
_____ You experience unreasonable breathlessness.
_____ You experience dizziness, fainting, or blackouts.
_____ You take heart medications.
_____ You have diabetes.
_____ You have asthma or other lung disease.
_____ You have burning or cramping sensation in your lower legs when walking.
_____ You have musculoskeletal problems that limit your physical activity.
_____ You have concerns about the safety of exercise.
_____ You take prescription medication(s).
_____ You are pregnant.

SECTION 2: CARDIOVASCULAR RISK FACTORS

_____ You are a man older than 45 years.
_____ You are a woman older than 55 yrs, had a hysterectomy, or are postmenopausal.
_____ You smoke, or quit smoking within the previous 6 months.
_____ Your blood pressure is >140/90 mm Hg, or you take medication for blood pressure.

_____ Your blood cholesterol level is >200 mg/dL (borderline or high), or take meds.
_____ You have a close blood relative who had a heart attack or heart surgery before age 55 (father or brother) or age 65 (mother or sister).
_____ You are physically inactive (i.e., you get <30 minutes of physical activity on at least 3 days per week).
_____ Your body mass index is 30 or higher.

If you marked any of the statements in Section 1, you should consult your physician or other appropriate health care provider before engaging in exercise. You may need to use a facility with a medically qualified staff.

If you marked no statements in Section 2 or just one statement in Section 2, you should be able to exercise safely without consulting an MD in a self-guided program or almost any facility that meets your exercise program needs.

If you marked two or more of the statements in Section 2 you should consult your physician or other appropriate health care provider before engaging in exercise. You might benefit from using a facility with a professionally qualified exercise staff to guide your exercise program.

2010 ACSM Risk Stratification

Low Risk – individuals classified as Low Risk are those who do not have signs/symptoms of or have diagnosed cardiovascular, pulmonary, and/or metabolic disease, and have no more than one (i.e., ≤1) CVD risk factor. The risk of an acute cardiovascular event in this population is low and a physical activity/exercise program may be pursued safely without the necessity for medical examination and clearance.

Moderate Risk – individuals classified as Moderate Risk do not have signs/symptoms of or diagnosed cardiovascular, pulmonary, and/or metabolic disease, but have two or more (i.e., ≥2) risk CVD factors. The risk of an acute cardiovascular event in this population is increased although in most cases individuals at moderate risk may safely engage in low to moderate intensity physical activities without the necessity for medical examination and clearance. However it is advisable to have a medical examination and an exercise test before participation in vigorous intensity exercise (i.e., >60% VO2max).

High risk – individuals classified as High Risk are those who have one or more signs/symptoms of, or have diagnosed cardiovascular, pulmonary, and/or metabolic disease. The risk of an acute cardiovascular event in this population is increased to the degree that a thorough medical examination should take place and clearance given before initiating physical activity or exercise at any intensity.

Appendix B

ASI-3

Please circle the number that best corresponds to how much you agree with each item. If any items concern something that you have never experienced (e.g., fainting in public) answer on the basis of how you think you might feel *if you had* such an experience. Otherwise, answer all items on the basis of your own experience. Be careful to circle only one number for each item and please answer all items.

	Very Little	Little	Some	Much	Very Much
1. It is important for me not to appear nervous.	0	1	2	3	4
2. When I cannot keep my mind on a task, I worry that I might be going crazy.	0	1	2	3	4
3. It scares me when my heart beats rapidly.	0	1	2	3	4
4. When my stomach is upset, I worry that I might be seriously ill.	0	1	2	3	4
5. It scares me when I am unable to keep my mind on a task.	0	1	2	3	4
6. When I tremble in the presence of others, I fear what people might think of me.	0	1	2	3	4
7. When my chest feels tight, I get scared that I won't be able to breathe properly.	0	1	2	3	4
8. When I feel pain in my chest, I worry that I am going to have a heart attack.	0	1	2	3	4
9. I worry that other people will notice my anxiety.	0	1	2	3	4
10. When I feel "spacey" or spaced out I worry that I may be mentally ill.	0	1	2	3	4
11. It scares me when I blush in front of people.	0	1	2	3	4
12. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.	0	1	2	3.	4
13. When I begin to sweat in a social situation, I fear people will think negatively of me.	0	1	2	3	4
14. When my thoughts seem to speed up, I worry that I might be going crazy.	0	1	2	3	4
15. When my throat feels tight, I worry that I could choke to death.	0	1	2	3	4
16. When I have trouble thinking clearly, I worry that there is something wrong with	0	1	2	3	4

me.					
17. I think it would be horrible for me to faint in public.	0	1	2	3	4
18. When my mind goes blank, I worry there is something terribly wrong with me.	0	1	2	3	4

Appendix C

Physical Activity Readiness Questionnaire (Par-Q)

Please read each item carefully and circle **YES** or **NO** if it applies to you. If a question is answered with **YES**, ***please use the available space to explain your answer and give additional details.***

1.	Has a doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	**YES**	**NO**
2.	Do you feel pain in your chest when you do physical activity?	**YES**	**NO**
3.	In the past month, have you had chest pain when you were not doing physical activity?	**YES**	**NO**
4.	Do you lose your balance because of dizziness or do you ever lose consciousness?	**YES**	**NO**
5.	Do you have a bone or joint problem that could be made worse by a change in your physical activity?	**YES**	**NO**
6.	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?	**YES**	**NO**
7.	Do you know of any other reason why you should not do physical activity?	**YES**	**NO**

Appendix D

From: Dr. Lisa Curtin, Institutional Review Board Chairperson
RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Date: 11/03/2014
Study #: 13-0076**Study Title:** Aerobic and Anaerobic Exercise and Psychological Functioning
Submission Type: Renewal
Expedited Category: (7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.,(4) Collection of Data through Noninvasive Procedures Routinely Employed in Clinical Practice
Renewal Date: 11/03/2014
Expiration Date of Approval: 11/02/2015

The Institutional Review Board (IRB) renewed approval for this study for the period indicated above. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

Regulatory and other findings:

The IRB determined that this study involves minimal risk to participants.

Approval Conditions:

Appalachian State University Policies: All individuals engaged in research with human participants are responsible for compliance with the University policies and procedures, and IRB determinations.

Principal Investigator Responsibilities: The PI should review the IRB's list of PI responsibilities. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records.

Modifications and Addendums: IRB approval must be sought and obtained for any proposed modification or addendum (e.g., a change in procedure, personnel, study location, study instruments) to the IRB approved protocol, and informed consent form before changes may be implemented, unless changes are necessary to eliminate apparent immediate hazards to participants. Changes to eliminate apparent immediate hazards must be reported promptly to the IRB.

Approval Expiration and Continuing Review: The PI is responsible for requesting continuing review in a timely manner and receiving continuing approval for the duration of the research with human. participants. Lapses in approval should be avoided to protect the welfare of enrolled

participants. If approval expires, all research activities with human participants must cease.

Prompt Reporting of Events: Unanticipated Problems involving risks to participants or others; serious or continuing noncompliance with IRB requirements and determinations; and suspension or termination of IRB approval by external entity, must be promptly reported to the IRB.

Closing a study: When research procedures with human subjects are completed, please complete the Request for Closure of IRB review formand send it to irb@appstate.edu.

Appendix E

Appalachian State University

Informed Consent for Participating in
Research Projects involving Human Subjects

Title of study: Aerobic and Anaerobic Exercise and Psychological Functioning
Investigators: Joshua J. Broman-Fulks, Ph.D. & Aimee M. Tolbert, B.S.

Participant Name: _____

I. Purpose of the study:

The purpose of this study is to examine psychological functioning and health in college students. During the study, you will be asked to participate in an exercise session involving jogging or walking on a treadmill for 20 minutes.

II. Procedures:

Who can participate?

You must be 18 years old and in good physical health to participate in this study. If you have any physical conditions that would prevent you from exercising, you cannot participate in this study. If you have questions about your health, you will need to get clearance from a health care provider prior to participating in this study. There may be fees associated with this service, for which you will be responsible. Women who are pregnant or planning to conceive during this study are strongly encouraged not to participate in this study.

Description and Explanation of Procedures

- If you choose to take part in this study, you will be asked to participate in seven (7) distinct participation sessions.
- These sessions will begin with you being asked to complete a series of questionnaires. You will then participate in an exercise session that will last approximately 20 minutes. The researcher will attach a heart monitor to you, which will be worn as a belt around the torso, with a receiver placed nearby on the treadmill.
- The exercise session will begin with two minutes of stretching exercises, followed by a two-minute warm up on the treadmill.
- Then, you will be asked to exercise on the treadmill for a period of 20 minutes at a comfortable aerobic pace. At the conclusion of the exercise, you will be provided with the opportunity to walk slowly on the treadmill for two minutes, and then asked to sit quietly in a chair for five minutes to allow for cool down. Additional questionnaires will then be completed following the exercise session.
- Next, you will be instructed on vital capacity breathing and complete both a brief inhalation task and a hyperventilation task. During these tasks, anxiety symptoms may be provoked. A third series of questionnaires will be completed following these tasks.

- The entire session should take approximately 90 minutes to complete. You will be asked not to take any drugs or consume any alcohol for 24 hours prior to the exercise session. You will also be asked to complete a series of questionnaires one week after the exercise session which will take approximately 20 minutes to complete.

When the study is complete and the results have been analyzed, the researcher will attempt to contact all participants of the study to invite them to come in for a debriefing session. In this session, participants will be informed of the findings of the study and given the opportunity to ask questions concerning these findings.

At any time for any reason, you may stop the procedure and withdraw from the study without penalty. You will be monitored at all times to ensure your safety, and the researcher may decide to discontinue the procedure if you report severe psychological distress or significant physical pain.

III. Risks and Discomforts:

Although every effort will be made to minimize the occurrence of problems by screening participants and monitoring heart rate and behavior during the procedures, the possibility of experiencing some discomfort exists. During the completion of the questionnaires related to mood states, you might become uncomfortable or embarrassed. During the exercise session and inhalation tasks, you may experience increased heart rate, respiration rate, dizziness, and/or perspiration. In the unlikely event of an accident occurring while on the treadmill, other possible discomforts that may be incurred during the exercise session include: skin wounds, bruises, sprains or strains, or pain or discomfort in the chest, neck, or arms. If exhaustion, dizziness or hyperventilation occurs, the procedure will be immediately ceased and you will be asked to sit in a chair until you regain your composure. If the problem continues or an accident occurs in which injuries are incurred, you will be referred to the ASU health center in order for a physician to assess and/or treat you.

IV. Benefits:

The information that you provide in this study may enable researchers to improve their understanding of the effects of physical activity on college students. This will be discussed with you further after you complete the study.

V. Extent of Anonymity and Confidentiality

All information obtained during this study is confidential. That is, we protect the privacy of subjects by withholding their names and other identifying information from all persons not connected with this study. The researcher will code all questionnaires and data by number and store them in a locked and secure area. Data that we may report in scientific journals or presentations will not include any information that identifies you as a participant in this study. Five years after the final publication of this study, all potentially identifiable information and paper records will be destroyed.

VI. Compensation:

You may receive course credit for your participation in this study. You will receive 15 credits for completing the entire study. It is important that you complete all seven sessions in order to receive full credit for your participation in the study. Your grade will not be affected if you choose not to participate in or withdraw from this study.

VII. Freedom to Withdraw

Participation in this research is completely voluntary. Therefore, at any time for any

reason, you may choose to stop and withdraw from the study without penalty.

Liability Statement:

If you experience physical or emotional problems because of your participation, please notify Dr. Broman-Fulks immediately. There will not be money set aside for any participant to receive medical care; however, if any participant needs medical attention, the counseling and health centers on campus will be available for you at no extra cost.

Other Considerations:

If significant new information relating to this study becomes known which may relate to your willingness to continue to take part in this study, this information will be given to you by the investigator.

VIII. Approval of Research

This research project has been approved, as required, by the Institutional Review Board of Appalachian State University.

_____ _____

IRB Approval Date Expiration Date

IX. Subject's Responsibilities

I voluntarily agree to participate in this study. I have to following responsibilities: complete all questionnaires, exercise on treadmill, and to complete the inhalation and hyperventilation tasks.

X. Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____Date_____

Subject signature

Should I have any questions about this research or its conduct, I may contact:

Aimee M. Tolbert, tolbertam@email.appstate.edu
Graduate Student, Clinical Health Psychology Masters Program, Appalachian State University, Boone, NC 28608

Dr. Joshua J. Broman-Fulks, (828) 268-2713, bromanfulksj@appstate.edu
Assistant Professor, Psychology Department, Appalachian State University, Boone, NC 28608

Questions regarding the protection of human subjects may be addressed to the:
IRB Administrator, Research and Sponsored Programs
Appalachian State University, Boone, NC 28608
(828) 262-2130, irb@appstate.edu

Appendix F

Appalachian State University

Informed Consent for Participating in
Research Projects involving Human Subjects

Title of study: Aerobic and Anaerobic Exercise and Psychological Functioning
Investigators: Joshua J. Broman-Fulks, Ph.D. & Aimee M. Tolbert, B.S.

Participant Name: _____

I. Purpose of the study:

The purpose of this study is to examine psychological functioning and health in college students. During the study, you will be asked to participate in an exercise session involving lifting weights for 20 minutes.

II. Procedures:

Who can participate?

You must be 18 years old and in good physical health to participate in this study. If you have any physical conditions that would prevent you from exercising, you cannot participate in this study. If you have questions about your health, you will need to get clearance from a health care provider prior to participating in this study. There may be fees associated with this service, for which you will be responsible. Women who are pregnant or planning to conceive during this study are strongly encouraged not to participate in this study.

Description and Explanation of Procedures

- If you choose to take part in this study, you will be asked to participate in seven (7) distinct participation sessions.
- These sessions will begin with you being asked to complete a series of questionnaires. You will then participate in an exercise session that will last approximately 20 minutes. The researcher will attach a heart monitor to you, which will be worn as a belt around the torso, with a receiver placed nearby.
- The exercise session will begin with two minutes of stretching exercises, followed by a 10 warm up lifting weights.
- Then, you will be asked to lift weights for a period of 20 minutes at a comfortable pace. At the conclusion of the exercise, you will be provided with the opportunity to lift weights until muscle failure, and then asked to sit quietly in a chair for five minutes to allow for cool down. Additional questionnaires will then be completed following the exercise session.
- Next, you will be instructed on vital capacity breathing and complete a brief inhalation task. During these tasks, anxiety symptoms may be provoked. A third series of questionnaires will be completed following these tasks.
- The entire session should take approximately 90 minutes to complete. You will be asked not to take any drugs or consume any alcohol for 24 hours prior to the exercise

session. You will also be asked to complete a series of questionnaires one week after the exercise session which will take approximately 20 minutes to complete.

When the study is complete and the results have been analyzed, the researcher will attempt to contact all participants of the study to invite them to come in for a debriefing session. In this session, participants will be informed of the findings of the study and given the opportunity to ask questions concerning these findings.

At any time for any reason, you may stop the procedure and withdraw from the study without penalty. You will be monitored at all times to ensure your safety, and the researcher may decide to discontinue the procedure if you report severe psychological distress or significant physical pain.

III. Risks and Discomforts:

Although every effort will be made to minimize the occurrence of problems by screening participants and monitoring heart rate and behavior during the procedures, the possibility of experiencing some discomfort exists. During the completion of the questionnaires related to mood states, you might become uncomfortable or embarrassed. During the exercise session, inhalation and hyperventilation tasks, you may experience increased heart rate, respiration rate, dizziness, and/or perspiration. In the unlikely event of an accident occurring while on the treadmill, other possible discomforts that may be incurred during the exercise session include: skin wounds, bruises, sprains or strains, or pain or discomfort in the chest, neck, or arms. If exhaustion, dizziness or hyperventilation occurs, the procedure will be immediately ceased and you will be asked to sit in a chair until you regain your composure. If the problem continues or an accident occurs in which injuries are incurred, you will be referred to the ASU health center in order for a physician to assess and/or treat you.

IV. Benefits:

The information that you provide in this study may enable researchers to improve their understanding of the effects of physical activity on college students. This will be discussed with you further after you complete the study.

V. Extent of Anonymity and Confidentiality

All information obtained during this study is confidential. That is, we protect the privacy of subjects by withholding their names and other identifying information from all persons not connected with this study. The researcher will code all questionnaires and data by number and store them in a locked and secure area. Data that we may report in scientific journals or presentations will not include any information that identifies you as a participant in this study. Five years after the final publication of this study, all potentially identifiable information and paper records will be destroyed.

VI. Compensation:

You may receive course credit for your participation in this study. You will receive 15 credits for completing the entire study. It is important that you complete all seven sessions in order to receive full credit for your participation in the study. Your grade will not be affected if you choose not to participate in or withdraw from this study.

VII. Freedom to Withdraw

Participation in this research is completely voluntary. Therefore, at any time for any

reason, you may choose to stop and withdraw from the study without penalty.

Liability Statement:

If you experience physical or emotional problems because of your participation, please notify Dr. Broman-Fulks immediately. There will not be money set aside for any participant to receive medical care; however, if any participant needs medical attention, the counseling and health centers on campus will be available for you at no extra cost.

Other Considerations:

If significant new information relating to this study becomes known which may relate to your willingness to continue to take part in this study, this information will be given to you by the investigator.

VIII. Approval of Research

This research project has been approved, as required, by the Institutional Review Board of Appalachian State University.

_____ _____

IRB Approval Date Expiration Date

IX. Subject's Responsibilities

I voluntarily agree to participate in this study. I have to following responsibilities: complete all questionnaires, exercise on treadmill, and to complete the inhalation and hyperventilation tasks.

X. Subject's Permission

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____Date_____

Subject signature

Should I have any questions about this research or its conduct, I may contact:

Aimee M. Tolbert, tolbertam@email.appstate.edu
Graduate Student, Clinical Health Psychology Masters Program, Appalachian State University, Boone, NC 28608

Dr. Joshua J. Broman-Fulks, (828) 268-2713, bromanfulksj@appstate.edu
Assistant Professor, Psychology Department, Appalachian State University, Boone, NC 28608

Questions regarding the protection of human subjects may be addressed to the:
IRB Administrator, Research and Sponsored Programs
Appalachian State University, Boone, NC 28608
(828) 262-2130, irb@appstate.edu

Appendix G

Appalachian State University

Informed Consent for Participating in
Research Projects involving Human Subjects

Title of study: Aerobic and Anaerobic Exercise and Psychological Functioning
Investigators: Joshua J. Broman-Fulks, Ph.D. & Aimee M. Tolbert, B.S.

Participant Name: _____

I. Purpose of the study:

The purpose of this study is to examine psychological functioning and health in college students. During the study, you will be asked to participate in a rest session that involves sitting for 20 minutes.

II. Procedures:

Who can participate?

You must be 18 years old and in good physical health to participate in this study. If you have any physical conditions that would prevent you from exercising, you cannot participate in this study. If you have questions about your health, you will need to get clearance from a health care provider prior to participating in this study. There may be fees associated with this service, for which you will be responsible. Women who are pregnant or planning to conceive during this study are strongly encouraged not to participate in this study.

Description and Explanation of Procedures

- If you choose to take part in this study, you will be asked to participate in seven (7) distinct participation sessions.
- These sessions will begin with you being asked to complete a series of questionnaires. You will then participate in a rest session that will last approximately 20 minutes. The researcher will attach a heart monitor to you, which will be worn as a belt around the torso, with a receiver placed nearby.
- Then, you will be asked to sit in a comfortable chair for a period of 20 minutes. At the conclusion of the rest session, you will be asked to complete additional questionnaires will then be completed following the rest session.
- Next, you will be instructed on vital capacity breathing and complete both a brief inhalation task and a hyperventilation task. During these tasks, anxiety symptoms may be provoked. A third series of questionnaires will be completed following these tasks.
- The entire session should take approximately 90 minutes to complete. You will be asked not to take any drugs or consume any alcohol for 24 hours prior to the exercise session. You will also be asked to complete a series of questionnaires one week after the exercise session which will take approximately 20 minutes to complete.

When the study is complete and the results have been analyzed, the researcher will attempt to contact all participants of the study to invite them to come in for a debriefing session. In this session, participants will be informed of the findings of the study and given the opportunity to ask questions concerning these findings.

At any time for any reason, you may stop the procedure and withdraw from the study without penalty. You will be monitored at all times to ensure your safety, and the researcher may decide to discontinue the procedure if you report severe psychological distress or significant physical pain.

III. Risks and Discomforts:

Although every effort will be made to minimize the occurrence of problems by screening participants and monitoring heart rate and behavior during the procedures, the possibility of experiencing some discomfort exists. During the completion of the questionnaires related to mood states, you might become uncomfortable or embarrassed. During the inhalation task you may experience increased heart rate, respiration rate, dizziness, and/or perspiration. In the unlikely event of an accident occurring while on the treadmill, other possible discomforts that may be incurred during the exercise session include: skin wounds, bruises, sprains or strains, or pain or discomfort in the chest, neck, or arms. If exhaustion, dizziness or hyperventilation occurs, the procedure will be immediately ceased and you will be asked to sit in a chair until you regain your composure. If the problem continues or an accident occurs in which injuries are incurred, you will be referred to the ASU health center in order for a physician to assess and/or treat you.

IV. Benefits:

The information that you provide in this study may enable researchers to improve their understanding of the effects of physical activity on college students. This will be discussed with you further after you complete the study.

V. Extent of Anonymity and Confidentiality

All information obtained during this study is confidential. That is, we protect the privacy of subjects by withholding their names and other identifying information from all persons not connected with this study. The researcher will code all questionnaires and data by number and store them in a locked and secure area. Data that we may report in scientific journals or presentations will not include any information that identifies you as a participant in this study. Five years after the final publication of this study, all potentially identifiable information and paper records will be destroyed.

VI. Compensation:

You may receive course credit for your participation in this study. You will receive 15 credits for completing the entire study. It is important that you complete all seven sessions in order to receive full credit for your participation in the study. Your grade will not be affected if you choose not to participate in or withdraw from this study.

VII. Freedom to Withdraw

Participation in this research is completely voluntary. Therefore, at any time for any reason, you may choose to stop and withdraw from the study without penalty.

Liability Statement:

If you experience physical or emotional problems because of your participation, please notify Dr. Broman-Fulks immediately. There will not be money set aside for any

participant to receive medical care; however, if any participant needs medical attention, the counseling and health centers on campus will be available for you at no extra cost.

Other Considerations:

If significant new information relating to this study becomes known which may relate to your willingness to continue to take part in this study, this information will be given to you by the investigator.

VIII. Approval of Research

This research project has been approved, as required, by the Institutional Review Board of Appalachian State University.

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IRB Approval Date Expiration Date

IX. Subject's Responsibilities

I voluntarily agree to participate in this study. I have to following responsibilities: complete all questionnaires, exercise on treadmill, and to complete the inhalation and hyperventilation tasks.

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Should I have any questions about this research or its conduct, I may contact:

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Assistant Professor, Psychology Department, Appalachian State University, Boone, NC 28608

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Vita

Aimee Tolbert graduated from Virginia Tech in May, 2013. She graduated with dual degrees in Psychology and Sociology with a minor in Women's Studies. During her time at Virginia Tech, Ms. Tolbert worked in a number of research laboratories, including the Child Study Center with Dr. Thomas Ollendick and the Center of Applied Behavior Systems with Dr. Scott Gellar. The following fall semester of 2013, Ms. Tolbert accepted her research assistantship working in the Anxiety and Exercise Research Lab and began studying toward a degree in Clinical Health Psychology at Appalachian State University. After completing her academic coursework, Ms. Tolbert completed her internship at Wake Forest Baptist Medical Center, working in the Comprehensive Cancer Center. While at her internship, Ms. Tolbert met with cancer patients in the inpatient settings and facilitated a weekly caregiver support group.