THE ANXIOLYTIC EFFECTS OF OBSERVING AEROBIC EXERCISE

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By
Sarah Ann Yonan
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CERTIFICATION OF APPROVAL

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Dr. Gary Williams Assistant Professor of Psychology	Date
Dr. AnaMarie Guichard Associate Professor of Psychology	Date
Dr. Jessica Lambert Assistant Professor of Psychology	Date

DEDICATION

To Joe and Alice Yonan. I know you would be so proud.

To Mom and Dad, this is for you – I did it!

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ABSTRACT

A 2 (video condition) x 2 (imagination condition) between-subjects study was conducted to examine if observing others engage in an aerobic exercise, while imagining participating in the exercise, has anxiolytic properties. The video condition variable consisted of two levels: an *exercise video* and a *non-exercise video*. The imagination condition variable also consisted of two levels: *imagination* and *no imagination*. Participants' experience with exercise and participants' attitude towards exercise were also examined. I hypothesized that the group who watched the exercise video would score higher in mood and lower in stress than the non-exercise video group. The data did not support this hypothesis. There were no significant differences in mood and stress levels between the two groups. I also predicted a positive correlation between attitude towards exercise and mood, and a negative correlation between attitude towards exercise and stress after watching the exercise video. These hypotheses were partially supported. There was a significant positive correlation between attitude towards exercise and mood, and no significant correlation between attitude towards exercise and stress after watching the exercise video. Additionally, it was hypothesized that there would be a positive correlation between regular exercise and mood, and a negative correlation between regular exercise and stress after watching the exercise video. These hypotheses were also partially supported. Results showed a significant positive correlation between days spent exercising per week and mood. There was also a significant positive correlation between minutes spent exercising per day and stress levels. Lastly, I hypothesized that the group who imagined themselves exercising while watching the exercise video would score higher in mood and lower in stress compared to all other groups. This hypothesis was not supported. There was no significant interaction between the video condition and the imagination condition. Implications, limitations, and suggestions for future research are discussed.

INTRODUCTION

Among the many mental illnesses seen in American adults, anxiety disorders are the most prevalent, resulting in significantly impaired functioning and high levels of distress (Anderson & Shivakumar, 2013; Asmundson et al., 2013). According to the National Institute of Mental Health (NIMH) in 2013, approximately 20.1% of American adults, about 42 million individuals, were living with some type of anxiety disorder such as: panic disorder, obsessive-compulsive disorder (OCD), posttraumatic stress disorder (PTSD), generalized anxiety disorder (GAD) or specific phobias. Additionally, 75% of Americans with an anxiety disorder experience a first episode by age 22 (Anxiety Disorder Association of America, 2010). According to a survey from the American Psychological Association (2013), researchers found that 41.6% of psychiatric disorders on college campuses appear to be related to anxiety.

Developing coping skills and techniques to handle life stressors is crucial in order to stop the debilitating cycle of chronic anxiety before it starts. Strong empirical research exists supporting physical activity, specifically aerobic exercise, as a way of elevating mood and combating daily stress and anxiety (Acevado, 2012; Anderson & Shivakumar, 2013 Ledwidge, 1980; Petruzzello, 2012). However, less empirical support exists on the power of observing and imagining exercising. Can simply imagining yourself exercising while watching someone else engage in physical exercise have similar anxiolytic, or anxiety-relieving, effects as active participation in exercise? The present paper will examine the physiological components of stress and anxiety, the anxiolytic properties of physically engaging in aerobic exercise, and how those anxiolytic properties could be present while watching and imagining doing physical exercise due to mirror neuron effects. A research study was conducted to determine if watching an exercise video clip has similar effects on mood and stress as engaging in exercise. Furthermore, the study addressed if watching an exercise video clip, while being instructed to imagine doing the activity depicted in the video, would show larger effects in mood and stress level compared to watching an exercise video without being instructed to imagine, watching a non-exercise video clip while being instructed to imagine doing the sedentary task, and watching the non-exercise video without being instructed to imagine. Participants' overall attitude towards exercise and experience with exercise were also considered.

Understanding Stress and Anxiety

Anxiety, as it is clinically defined, goes beyond everyday worries and fears (Petruzzello, 2012). In anxious individuals, fear becomes so prolonged and intense that it manifests into disturbances in moods, distorted cognitions, maladaptive behaviors, and heightened physiological arousal (Mahmound, Staten, Hall, & Lennie, 2012; Petruzzello, 2012). Anxiety is created when a stimulus is interpreted as a threat, resulting in an acute, or intense, stress response (National Institute of Mental Health, 2013). Specific factors that have been reported to significantly increase levels of anxiety include threats to one's self-image (i.e., the social self-image), novelty, unpredictability, uncontrollability, and anticipation of negative consequences (Andrews et al., 2007; Dickerson & Kemeny, 2004). A stress response occurs due to increased arousal produced by a complex interaction between the central and sympathetic nervous systems (Asmundson et al., 2013; Petruzzello, 2012).

The Sympathetic Nervous System (SNS)

The SNS functions as a survival mechanism, preparing humans to fight, escape, or freeze when presented with a threat (Andrews et al., 2007; Asmundson et al., 2013; Cannon, 1929; De Vente, Olff, Van Amsterdam, Kamphuis, & Emmelkamp, 2003; Dickerson & Kemeny, 2004; Ratey, 2001). The term 'fight-or-flight', coined by Cannon (1929), refers to an automatic self-protective response to a perceived threat. The fight-or-flight response was so integral to the survival of early humans that the automatic physiological responses to stressful or fearful stimuli remain a part of humans today (Ratey, 2001). Real life-threatening experiences, as well as anxiety provoking thoughts and images, can activate a fight-or-flight response. Both real and perceived stress can trigger an SNS response. For example, while watching a scary movie, the SNS can have a similar response to the depicted threats as it would to real threats (Andrews et al., 2007; De Vente et al., 2003).

The SNS operates through two interrelated systems: the sympathetic-adrenomedullary (SAM) axis, and the hypothalamic-pituitary-adrenocortical (HPA) axis. These systems balance each other and are triggered by the hypothalamus, located near the center of the brain. The hypothalamus, when presented with threatening stimuli, begins a cascade of events that lead to the adrenal glands secreting the hormones epinephrine and glucocorticoid (i.e., adrenaline and cortisol).

These hormones are responsible for preserving and protecting the body by getting it ready to react to a perceived threat (Ratey, 2001).

Effects of the SAM axis on anxiety. The SAM axis is involved in rapid responses to stressful events (De Vente et al., 2003; Gray & McNaughton, 1996; Ratey, 2001). It releases epinephrine and norepinephrine via the hypothalamus and adrenal glands, prompting the fastest physical reaction possible (Gray & McNaughton, 1996; Ratey, 2001). This process stimulates a quick mobilization of metabolic resources including: increased heart rate, increased blood pressure and blood glucose, rapid breathing, inhibition of digestive processes, constriction of blood vessels in some parts of the body and dilation of blood vessels for muscles, pupil dilation, perspiration, endorphin release, acceleration in reflexes, and a shift in focus in order to respond quickly to danger (De Vente et al., 2003; Dickerson & Kemeny, 2004; Gray & McNaughton, 1996; Ratey, 2001).

It is crucial for the cardiovascular system to respond this way during times of stress, or danger, because it pumps blood more rapidly to the vital areas of the body. Blood is immediately sent to bigger working muscles such as the biceps and thighs, to assist in preparing the body to defend or escape (Ratey, 2001). As a result, cold, clammy hands and tingling sensations in the feet and toes are often symptoms reported by individuals who experience panic attacks (American Psychiatric Association, 2013).

The respiratory effect produced by the SNS also serves important function. The accelerated breathing helps in preparation for fight-or-flight by getting the tissues of the body more oxygen. Consequently, the side effects of this action, seen in anxious individuals, include choking sensations, smothering, tightness in the chest, and, because the blood to the head is decreased by shallow breathing, feelings of dizziness or lightheadedness. It can also cause what has been described as a sense of de-personalization, or a feeling of unreality and confusion (American Psychological Association, 2013).

HPA axis involvement in anxiety. The HPA axis is involved in secreting cortisol, and works more slowly as a back-up response to the SAM axis (De Vente, 2003). Cortisol aids in regulating metabolism, immune response, and maintaining homeostasis. When individuals suffer from anxiety or stress for longer periods of time, there a significant increase of cortisol in the body. As a result, the immune system is suppressed and metabolism is significantly slower in individuals suffering from chronic anxiety (Yueh-Tzu, 2009).

Although we can adapt to and cope with stress and anxiety in the short-term, prolonged activation of the SNS and excessive cortisol release due to the HPA axis can be detrimental to our health. Chronic anxiety can result in diabetes, high blood pressure, heart disease, digestive problems, obesity, developing depression, burnout, ulcers, migraines, and chronic fatigue (Andrews et al., 2007; De Vente et al., 2003; Yueh-Tzu, 2009). Additionally, individuals who suffer from anxiety disorders, resulting in heightened stress, suffer from physical ailments more frequently than the general population (Ratey, 2001). They also have increased incidences of cancer, which may be attributed to a compromised immune response due to excessive cortisol released in the body (Ratey, 2001). HPA activation is associated with the inability to cope, helplessness, affective distress, and perceived uncontrollability (Henry, 1992; Peters et al., 1998).

Anxiety and Stress Differentiation

The physiological reaction to stress is not always harmful to humans; on the contrary, it is what keeps humans and other living organisms alive during threatening situations. It is normal to have fleeting feelings of anxiety when presented with new or potentially uncomfortable experiences. The discomfort stress puts on the body motivates humans to get tasks accomplished in order to survive and feel comfortable again. As previously mentioned, when experiencing a normal stress response, the body naturally produces the hormone cortisol, and typically cortisol subsides once the stressful event has ended. The parasympathetic nervous system quiets the stressed body, and creates homeostasis. However, when stress becomes chronic, and cortisol is continually released, the number, intensity, and duration of anxious symptoms increase, becoming debilitating (Anderson & Shivakumar, 2013; Judah et al., 2013; Ledwidge, 1980; & Petruzzello, 2012). Anxiety is separate from brief stress in the fact that (a) perceptions and concerns over the threat are disproportionate to the actual threat, (b) cognitive and behavioral actions are taken to avoid panic attack symptoms, and (c) anxiety can be present, even if the threat is not (Acevedo, 2012). Symptoms cluster around irrational fear, excessive worry, and constant dread (National Institute of Mental Health, 2013).

Anxiety can be characterized by both psychological and physiological symptoms related to the SNS response. Symptoms are described as unpleasant feelings (e.g., feeling uncertain; vulnerable; extremely fearful; or overwhelmed), physical symptoms activated by the autonomic nervous system (e.g., muscle tension; increase in heart-rate [commonly misinterpreted as a heart attack in anxious individuals]; rapid/shallow breathing; trembling; nausea; dizziness; etc.), altered cognitive processes (e.g., persistent obsessions; compulsions; irrational uncertainties regarding certain situations; objects; or activities), altered behavior (e.g., avoidance), and constant vigilance (e.g., feeling on guard; American Psychological Association, 2013; Clark, 1986; Judah et al., 2013; Ledwidge, 1980; Petruzzello, 2012).

These symptoms can become problematic, and cause serious dysfunction in the daily activities of individuals experiencing chronic anxiety. For instance, Altchiler and Motta (1994) report that chronic stress is a common precursor to absenteeism and loss of job satisfaction. Additionally, chronic stress can damage components to psychological well-being including: balance in mood, self-concept, self-esteem, self-efficacy, emotions, and reactivity (Bass, Enochs, & DiBrezzo, 2002).

The Anxiolytic Properties of Exercise

The clinical treatment of choice for anxiety disorders and anxiety symptoms continues to be medication, cognitive behavioral therapy (CBT), and other forms of behavioral therapy (American Psychological Association, 2013; DeBoer, Powers, Utschig, Otto, & Smits, 2012; Hofmann & Smits, 2008). These forms of treatment can be performed individually, or work as a combined intervention with other treatment modalities (Mermon et al., 2008). Though effective, many patients do not respond to CBT treatment alone, and 30% of patients using medication experience a return in anxiety symptoms within six months (Barlow, Gorman, Shear, & Woods, 2000; DeBoer et al., 2012). Additionally, the use of psychotherapy and medication can be expensive and time consuming, resulting in an economic burden of up to 42.3 billion dollars for the treatment of anxiety disorders alone (Anderson & Shivakumar, 2013; Asmundson et al., 2013; DeBoer et al., 2012; Petruezzllo, 2012). Because of these inconveniences, more than half of the people with anxiety disorders do not seek clinical treatment (National Institute of Mental Health, 2013).

Studies have shown that physical exercise can be just as beneficial as either psychotherapy or medication without the cost, side effects, or perceived stigma associated with them (Acevado, 2012; Anderson & Shivakumar, 2013; Asmundson et al., 2013; Chan & Grossman, 1988; Davidson & McEwen, 2012; DeBoer et al., 2012; Ledwidge, 1980; Petruzzello, 2012). Mermon et al. (2008) assessed whether CBT combined with exercise, was more effective in treating anxiety symptoms than CBT alone. Participants included outpatients suffering from general anxiety disorder (GAD), social anxiety disorder (SAD), or panic disorder. Each participant in the exercise with CBT group walked, and was instructed to increase walking to 150 minutes a week. Results indicated that the exercise group coupled with CBT had significantly greater reductions in anxiety, depression, and stress post-treatment than CBT alone (Mermon et al., 2008).

In addition, a study compared pre/post-test results of ten weeks of aerobic exercise, clomipramine (antidepressant medication), and a pill placebo (i.e., sugar pill) in 46 patients with panic disorder (Broocks et al., 1998). The exercise group was asked to run four miles three times a week, while the antidepressant group took 112.5mg of clomipramine a day, and the control group took a placebo pill once a day. At the end of treatment, both the exercise and clomipramine groups reported significantly fewer panic symptoms compared to baseline. Clomipramine was found to reduce panic symptoms earlier than exercise. Although exercise was not superior to medication, data demonstrated that it was just as effective in lowering panic symptoms (Broocks et al., 1998). This indicates that exercise might assist in anxiety reduction, and can be considered as an alternative or complementary treatment to CBT and medication.

When physical exercise increases the endurance of the cardiovascular system, it is referred to as aerobic exercise (i.e., oxygen-consuming). For instance, running, swimming, cycling, walking, cross-fit, rowing, jump-roping, and dance aerobics are all considered forms of aerobic exercise. On the other hand, exercises such as weight lifting, calisthenics, isotonics, and ‘stop and go’ exercises are considered nonaerobic or anaerobic exercises (Ledwidge, 1980).

The benefits of both aerobic and anaerobic exercise are vast. Some benefits include a 30% lower mortality rate in men and women as well as a decrease in the prevalence of chronic diseases and mental disorders (Anderson & Shivakumar, 2013). Higher positive affect, self-esteem, and self-efficacy have also found to be benefits of exercise (Anderson, King, Stewart, Camacho, & Rejeski, 2005). For example, higher positive affect and lower anxiety levels were reported in employees who were given time to exercise (both aerobic and anaerobic) during the work day (Altchiler & Motta, 1994). Initially, aerobic exercise seemed to be superior to nonaerobic exercise, but after the eight-week program, individuals in both aerobic and nonaerobic exercise groups reported a decrease in anxiety, an increase in positive affect, and an overall increase in job satisfaction (Altchiler & Motta, 1994). During times of stress, exercise has been shown to result in quicker heart rate recovery and fewer self-reported cognitive, somatic, and behavioral symptoms of anxiety as compared to a non-exercise group (Calvo, Szabo, & Capafons, 1996; Kagan & Berg, 1988). Even individuals who exercise routinely continue to experience the lasting positive effects of physical activity. Laszay (1998), along with Chan and Grossman (1988), report that on average, routine runners experience less anxiety and better moods than non-runners. Additionally, on the days that they run, as compared to non-running days, routine runners report even greater positive affect and lower levels of anxiety.

Additionally, exercise can act as a sleep aid, with slow wave sleep increasing due to physical activity (Ledwidge, 1980). Further, exercise enhances physiological changes that promote sleep (e.g., depletes energy sources, breaks down tissue, and elevates body temperature; Brand et al., 2010). This can result in deeper, more restful sleep along with a reduction in fatigue associated with depression and anxiety (Ledwidge, 1980). Sleep can serve as a source of motivation to begin an exercise routine for chronically anxious or depressed individuals, who commonly suffer from insomnia. In addition to According to Ledwidge (1980), it takes as little as eight minutes of running four times a week to start seeing some positive changes in affect, self-efficacy, and sleep.

Research indicates that aerobic exercise increases overall health and wellness. For example, Anderson and Shivakumar (2013) report that 30 minutes of moderate to high intensity activity a day, five days a week, is recommended to reduce the risk of chronic disease (Anderson et al., 2013, DeBoer et al., 2012). An additional study poses that a single session of swimming is associated with lower self-perceived anxiety levels and elevated positive affect (Netz & Lindor 2003). Collectively, the current research indicates that exercise may be an ideal coping mechanism for anxiety because it is time efficient, cost efficient, flexible, and has little to no adverse side-effects (Acevedo, 2012; DeBoer et al., 2012; de Vries, 1968; Ledwidge, 1980; Lu et al., 2012).

Simply put, higher levels of anxiety are associated with little or no exercise, while lower levels of anxiety are associated with higher levels of exercise (i.e., more time spent exercising; Oeland, Laessoe, Olsen, & Monk-Jorgensen, 2010). This is illustrated in King, Taylor, and Haskell's (1993) study examining depression and anxiety levels in participants (n = 357) randomly assigned to a high activity exercise group, a high activity exercise home-based group, a low activity exercise home-based group, or a sedentary control group for one year. Results indicated that depression and anxiety levels were significantly lower in all exercise groups, as compared to the sedentary control. Further, greater exercise participation was linked to decreases in anxiety and depressive symptoms (King et al., 1993). Also, after a 20 week intervention of aerobic exercise (i.e., aerobic dance class, *n* = 35), weight lifting (i.e., weight training course, *n* = 45), or a sedentary control group (*n* = 34) with clinically anxious and depressed patients, both exercise interventions led to significantly higher ratings in self-perceived quality of life than the sedentary control group (Bass et al., 2002). Higher ratings in quality of life, due to exercise, relates to other research indicating that physical exercise, of any kind, can improve self-esteem, sense of well-being, lower rates of cognitive decline, and is associated with fewer depressive and anxious symptoms (Anderson & Shivakumar, 2013; Bass et al., 2002; DeBoer et al., 2012; Oeland et al., 2010; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991).

The Mind-Body Connection: A Thin Line between Thinking and Doing

Research has provided evidence regarding how thoughts influence the physical body. An example of this connection appears in a study looking at the overall growth in muscle strength between a group that exercised for four weeks, a group that imagined exercising for four weeks, and a sedentary control group. Physiological measures, before and after training, included: maximal abduction force, flexion/extension force, electrically evoked twitch force (i.e., abduction), and maximal integrated electromyograms (EMG) of muscles. Researchers found that the group that exercised gained 30 percent more muscle strength, while the group that just imagined exercising gained 22 percent more muscle strength compared to baseline measures. One possible explanation for this interesting finding is because the same neurons that fire while imagining an activity are the same ones that fire while physically engaging in the activity. Although the muscles are not being physically exercised, the same regions of the brain responsible for activating the muscle groups are strengthened. This results in increased strength in muscles when they were actually contracted (Yue &Cole, 1992).

A separate study (Pascual-Leone et al., 1995) found similar results regarding the power of imagination. The study was comprised of two groups of individuals who had never played the piano prior to the experiment. Both groups were taught a sequence of notes involving one hand, proper finger placement on the keyboard, and were allowed to hear what each note sounded like. One group was physically able to practice the piano for two hours each day, while the other was instructed to sit in front of the keyboard and imagine practicing for two hours each day. Each participant had his or her brain mapped using transcranial magnetic stimulation, prior to, each day of, and after the experiment. The resultant scans indicated that regions in the motor cortex of the brain targeting the long finger flexor and extensor muscles enlarged, and activation thresholds decreased in both groups. After three days, both groups performed the sequence taught, and accuracy between groups were the same (i.e., the amount of errors made while performing). After five days, the group that physically practiced the piano began to excel over the mental practice only group. However, the mental practice only group was able to quickly catch up to their level with just one two hour session of physical practice (Pascual-Leone et al., 1995). This research is a clear example of how the mind and body closely interact. When imagining something, the same regions of the brain are working as if the individual were physically doing the imagined activity (Doidge, 2007).

Can Watching Exercise Elicit a Physical and Emotional Response?

Although the power of thinking and imagining an exercise can result in physical growth and improved performance, the power of observing exercise may also elicit notable mind-body connections. When observing an action, brain cells react as if the body were physically doing whatever is being watched (Cort & Fine, 2005). More specifically, neurons become activated in areas of the brain responsible for executing the action being observed (Rizzolatti & Craighero, 2004; Rizzolatti, Fadiga, Fogassi, & Gallese, 1996). The brain's ability to mirror what one sees is suggested to explain how individuals are able to imitate and relate to others (Ramachandran, 2009).

Even if an individual has never directly experienced a certain sport or activity, for example, he or she has most likely acquired skillsets and experiences directly related to the activity (Keysers, 2010). Therefore, the individual can indirectly experience the athletes' point of view. For instance, one does not need to have been a professional boxer in order to have a reaction while watching a boxing match. Similar to the movements of a boxer, most people have had to dodge something in one form or another, made contact with an object, moved around on the balls of their feet, and have had protected their body from some type of impact. The brain is able to store personal skill sets and the experiences acquired over a lifetime (e.g., dodging something, blocking our bodies, etc.) (Ramachandran, 2009). When observing something, an individual's memory is able to automatically retrieve and match what is observed to similar experiences (Rizzolatti & Craighero, 2004). This is how one is able to adopt another's point of view (Premack & Woodruff, 1978; Ramachandran, 2009; Rizzolatti & Craighero, 2004).

Although a large part of why individuals are able to connect with other humans is due to the physical skills recognized and shared with one another, there is another important piece that strengthens the human ability to relate. The connection to each other is heightened because of individuals' ability to recognize emotions in others as well. An example of how humans connect with one another emotionally is shown in the research done by Carr, Iacoboni, Dubeau, Mazziotta, and Lenzi, (2003). In Carr et al.'s, (2003) study, an fMRI scanner was used to look at the brain activity of participants observing different facial expressions (e.g., fear, anger, sadness, happiness, excitement, etc.). Participants were shown different pictures of facial expressions, and asked to imitate the faces they saw. Then, participants were shown the same pictures again, and asked not to imitate the faces as they saw. Results indicated that the parts of the brain that were active when participants made the faces were the exact same parts that worked when they only observed the faces. When looking at a smiling face, for example, the area related to happiness in the prefrontal cortex was activated. When participants imitated the smiling face while observing the smiling face, the area in the prefrontal cortex related to happiness had an even larger reaction (e.g., larger area of neuronal activity; Carr et al., 2003). Also, while looking at the more negative facial expressions, participants reported feeling more negative, and while looking at positive facial expressions participants felt happier. It can be inferred that by observing an action, the individual is not only affected physically, but emotionally as well. By watching someone, humans are able to connect, relate, and almost live in another's mind or body (Ramachandran, 2009). This can help to explain why individuals wince when observing someone getting hit, or jump up out of their seats with excitement when observing a victory – almost as if it was the individual's own pain or victory (Keysers, 2010).

Mirror Neurons

Mirror neurons are cells in the brain that become active when individuals engage in an activity and/or watch someone else perform the same activity (Keysers, 2010; Rizzolatti & Craighero, 2004; Rizzolatti, Fadiga, Fogassi, & Gallese, 1996). These neurons are what allow humans and other living organisms to learn and refine skills through observation and imitation (Heyes, 2011). Mirror neurons also allow individuals to empathize, sense what others might think or feel, and adopt another person's point of view. This is also known as "theory of mind" (Premack & Woodruff, 1978; Rizzolatti & Craighero, 2004). The discovery of these brain cells happened by accident when Rizzolatti and colleagues (1996) were conducting an experiment looking at brain activation in macaque monkeys. Researchers were looking at areas of the brain that were active when the monkey would reach out and grab certain objects, for example, a peanut. When a researcher grabbed a peanut for himself, he noticed that the monkey's brain was reacting as if it were picking up the peanut. The area of the brain that was active when the monkey physically picked up the peanut was also active when the monkey observed the researcher picking up the peanut (Rizzolatti, Fadiga, Fogassi, & Gallese, 1996).

Similar results were found in humans in a magnetic stimulation study conducted by Fadiga and Rizzolatti (1995). Researchers were interested in observing hand-muscle twitching while participants watched or participated in an action. Motor-evoked potentials, which signal that a muscle is ready for movement, were recorded from participants' hand muscles. Participants were instructed to watch researchers grasp objects, and later were asked to grasp the objects themselves. The potentials recorded were equal when participants observed, and when they actually grasped the objects themselves. The result of equal potentials between observation and participation reveals that when one sees an action take place, the brain automatically mimics the action and primes the body to act it out.

Experience level and mirror neuronal reaction. Although most spectators are able to adopt the perspective of an athlete, direct experience level with the sport or activity relates strongly to how mirror neurons respond. A relevant study supporting the idea of more experience correlating with stronger perspective taking abilities involved professional basketball players, coaches, and sports journalists (Aglioti, Cesari, Romani, & Urgesi, 2008). All participants had much experience watching basketball, but only the professional athletes had most direct experience of playing the sport. The researchers' aim was to have the participants watch a video of a basketball player taking free shots at the basket. Participants were asked to predict whether or not the basket would be made or missed. The athletes had the highest ability to predict whether or not the shot would be made. The athletes could even predict the outcome of the shot before the ball left the hands of the shooter. This piece of evidence suggests that because the athletes have had more experience playing the sport, they are better able to adopt the perspective of the video shooter. Although the athletes were superior at relating to and predicting the behavior of the video shooter, all participants had an increase in brain activity and motor-evoked potentials in areas related to shooting a basketball while watching the video (Aglioti et al., 2008). Mirror neurons allow individuals to experience what is being observed, but when one has had actual experience with whatever it is he/she is observing, the connection to the experience appears to be stronger.

Calvo-Merino, Grezes, Glaser, Passingham, and Haggard (2006) also found that the brain's response to seeing an action depends on previous visual and motor experience of the action. In their study, the researchers used fMRI scanners to record the brain activity of professional ballet dancers while the dancers looked at videos of specific ballet moves. The videos depicted gender-specific male and female classic ballet movements, all of which the participants had seen, but had not necessarily preformed themselves. Results from the fMRI scans showed higher levels of premotor, parietal, and cerebellar activity when dancers viewed their own gender-specific moves, compared to opposite-gender moves. This research indicates that mirror circuits respond at a greater level when individuals have had direct experience with an activity rather than visual experience alone.

Wrap up: Mirror Neurons and the Human Response

What can be gathered so far from mirror neurons and the effect on human behavior is that whatever the eyes see, the brain actively participates in (Aglioti, Cesari, Romani, & Urgesi, 2008; Calvo-Merino, Grezes, Glaser, Passingham, & Haggard, 2006; Ramachandran, 2009). The more experience an individual has had with an activity, the larger the neuronal response will be in the individual while watching the activity idly (Calvo-Merino, Grezes, Glaser, Passingham, & Haggard; 2006; Krendi, Gainsburg, & Ambady, 2012). The brain of the idle observer reacts as if his or her body is physically involved. Individuals are also able to react emotionally to what they observe (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003). Mirror neurons fire the entire duration while observing the action (Doidge, 2007; Heyes, 2011). During this time, individuals are better able to understand the action, its meaning, the overall goal of the action, and can identify feelings associated with it (Ramachandran, 2009).

For example, if a bystander happened to observe a runner crossing his/her path on the street, and the bystander happened to be an experienced runner, the bystander would automatically have a physical and emotional response while watching the runner. Additionally, the individual's brain would have a stronger response in motor cortex areas related to running than someone with less experience in running, making the individual's muscles primed for running movements. In addition to a physical response, the emotional tags related to running would allow the bystander to feel an emotional response while watching as well. If the runner looks focused, the bystander will be able to recognize those feelings, adopt those feelings as his or her own and, in turn, might feel more focused or motivated. In conclusion, if an individual has participated in, and benefited from regular exercise, then the possibility of him or her experiencing anxiolytic properties of exercise while simply observing and imagining his/herself exercising is possible. Watching others exercise while imagining exercising might have similar anxiolytic properties as participating in exercise due to mirror neuron effects (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Doidge, 2007; Heyes, 2011; Ramachandran, 2009).

Observation Time

Mirror neurons become active the moment an individual's eyes look at someone else (Ramachandra, 2009). As previously stated from Carr et al.'s (2003) study, mood is affected the minute a person notices the emotions presented by another person. In addition, when an individual watches someone else do an activity, his or her brain reacts as if it is participating in the observation simultaneously (Ramachandra, 2009). The centers of the brain that involve movement help prime muscles to get ready to imitate what is being seen (Fadiga & Rizzolatti, 1995; Rizzolatti, Fadiga, Fogassi, & Gallese, 1996). All of these reactions happen instantly. This makes it difficult to place a time on approximately how long it would take to watch an aerobic exercise before affects in mood and stress levels are seen. In a study done by Choe, Chun, Noh, Lee, and Zhang (2013), researchers obtained human evoked emotions from 33 videos, which included movie and television show clips. The researchers gave a list of emotions to participants in order for them to record what they felt while watching each clip. Video clips ran for approximately 81 seconds, and were successful in changing participants' moods within that timeframe. According to the Motion Picture Association of America (MPAA), theatrical trailers can run as short as 30-60 seconds, and are successful in influencing emotions for large audiences in that amount of time. This suggests that watching a video clip of aerobic exercise lasting approximately 30-60 seconds is sufficient time to notice changes in mood and stress level.

The Current Study

The purpose of the present study was to determine if observing others engage in an aerobic exercise, while imagining participating in the exercise, has anxiolytic properties. It was hypothesized that:

(1a) Participants who watched a brief exercise video clip (EV), versus a non-exercise video clip (NV), would score higher in pleasant mood via the BMIS pleasant/unpleasant mood scale.

(1b) Participants who watched EV versus NV would score lower in stress levels via the VAS-A.

(2a) For participants in EV group there would be a positive correlation between attitude towards exercise and mood.

2b) For participants in EV group there would be a negative correlation between attitude towards exercise and stress level.

(3a) For participants in EV group there would be a positive correlation between regular exercise and mood.

(3b) For participants in EV group there would be a negative correlation between regular exercise and stress level.

(4a) Participants who imagined themselves exercising while watching the exercise video clip (IE) would score higher in mood compared to all other groups (i.e., participants who imagined playing Jenga while watching the Jenga clip (IJ), the EV group, and the NV group).

(4b) Participants in IE would score lower in stress level compared to all other groups.

METHODOLOGY

Participants

Participants included 245 males (54.4%), 204 females (45.3%), and one participant responding as 'other' (.2%). Recruiting took place via Amazon's Mechanical Turk (MTurk), originally resulting in 490 participants. The final number of participants used in this study was 450, after eliminating participants who did not complete the survey accurately (n =40). The participants consisted of an adult population, with an age range of 18-68 years old (M = 35.56, SD = 11.16). Participants reported exercising an average of 4 days a week (M = 4.13, SD = 1.88), and exercising approximately 60 minutes (M = 60.76, SD = 58.88) each session.

Participants' average responses to how much they enjoy exercise was approximately 6 out of 10, with 10 representing the highest level of enjoyment (M = 5.72, SD = 2.846). Preferred exercises included: walking (56.9%, n = 256), weight training (34%, n = 153), running/sprinting (26.4%, n = 119), jogging (16.9%, n = 76), yoga (16.7%, n = 75), cycling (15.6%, n = 70), stair master/elliptical (8.9%, n = 40), swimming (8.4%, n = 38), team sports (5.3%, n = 24), CrossFit (4%, n = 18), group exercise classes (3.6%, n = 16), climbing (2%, n = 9), and other (11.1%, n = 50). Participants in this study were limited to the United States, and identified themselves as the following: White/Caucasian/European-American (72.9%, n = 328), Asian or Pacific Islander (10.4%, n = 47), Latino/Hispanic/Mexican (7.8%, n = 35), Black/African American (7.6%, $n = 34$), or other (2.2%, $n = 10$). All participants received fifty cents for their participation in the study.

Materials

All materials in this study were completed online.

Informed Consent

(Appendix A) The informed consent provided participants with information about their rights as participants in a research study. At the end of the form, they were asked to electronically indicate whether they were at least 18 years of age, and voluntarily agreed to participate.

Demographic Questionnaire

(Appendix B) Participants were asked to fill out a brief demographic questionnaire assessing their age, gender, ethnicity, how often they exercise, overall attitude towards exercise, and what type of exercise they regularly engage in.

Video Clip Instruction

(Appendix C) Participants received instructions before viewing the video clips. Instructions asked participants to watch the video clip or to watch and imagine doing the activity in the video clip. Participants were asked to answer questions following the video to assess whether the video was watched. These questions can be found in appendix G.

Video Clips

Participants were asked to watch a 30 second exercise video clip or a non-exercise video clip. The exercise clip showed an individual running indoors on a treadmill, whereas the non-exercise video clip showed the same individual playing Jenga. A short video was viewed beforehand in order to test for sound. This clip included a car horn sounding off two times.

Visual Analogue Scale for Anxiety

(VAS-A; Appendix D) Participants completed the computerized version of the VAS-A. The VAS-A was a measure used to record state anxiety levels in participants. The scale was a horizontal line ranging from 0-30. The left edge was labeled "calm" while the right edge was labeled "anxious". A sliding locator was positioned at the midpoint of the scale. The question presented above the scale asked "How anxious do you feel right now?" Participants were asked to use the computer mouse to position the locator at their current level of anxiety. Scores were determined by recording the number the participant selected between 0-30 (Abend, Dan, Maoz, Raz, & Bar-Haim, 2014).

Previous researcher compared the VAS-A to the State and Trait Anxiety Inventory – State test (STAI-State; Speilberger, Gorsuch, & Lushene, 1970), a well-established anxiety measure, to investigate the test-retest reliability, convergent validity, and sensitivity of the computerized version VAS-A. Experiment 1 revealed the test-retest reliability of the VAS-A ($r = .44$, $p < 0.001$), and convergent validity with the STAI-State test ($r = .60$, $p < 0.001$). These results indicate a high correlation between the STAI-State test and the VAS-A. With the addition of a stressor, experiment 2 demonstrated the VAS-A's ability to accurately report changes in anxiety, similar to the STAI-State test ($F(1,48) = 25.13$, $p < 0.001$; Abend, Dan, Maoz, Raz, & Bar-Haim, 2014).

Brief Mood Introspection Scale

(Appendix E) Participants completed the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988). The BMIS asked participants to describe the way they felt at a particular moment by rating sixteen mood adjectives on a 4-point response scale (i.e., 1 = *definitely do not feel*, 2 = *do not feel*, 3 = *slightly feel*, 4 = *definitely feel*). The sixteen mood adjectives (i.e., two from each of the eight mood states) included: (a) happy (*happy, lively*), (b) loving (*loving, caring*), (c) calm (*calm, content*), (d) energetic (*active, peppy*), (e) fearful/anxious (*jittery, nervous*), (f) angry (*grouchy, fed up*), (g) tired (*tired, drowsy*), and (h) sad (*gloomy, sad*; Mayer & Gaschke, 1988). Results indicated overall pleasant-unpleasant mood.

To score the BMIS (Appendix F), all responses for pleasant mood adjectives were added together using original scores, while unpleasant mood adjectives were calculated using reverse scoring (e.g., if a participant responded with a '1' for an unpleasant mood adjective, the score was reversed to '4', etc.; Mayer & Gaschke, 1988). Adding the scores for pleasant mood adjectives (i.e., *active, calm, caring, content, happy, lively, loving,* and *peppy*) with the reverse scores of unpleasant mood adjectives (i.e., *drowsy, fed up, gloomy, grouchy, jittery, nervous, sad,* and *tired*), determined the overall score was on the pleasant/unpleasant mood scale. Scores range from sixteen (i.e., very unpleasant) to 64 (i.e., very pleasant). Participants ($n = 30$) who did not complete the BMIS were eliminated from the final analyses of the study.

Mean replacements were given for participants (*n* = 15) who left certain mood adjectives blank. The psychometric properties of this scale are well established. Previous research reported Cronbach's alpha reliability ranging from α = .76 to .83. Cronbach's alpha reliability for the BMIS in this research study equated to α = .88 (Mayer & Gaschke, 1988).

Debriefing Form

(Appendix H) Participants read a debriefing form after they completed the study. This form explained the purpose of the study, how the study could have benefited or adversely affected them, provided resources, and provided references for participants to do further research on the topic if they wish to do so.

Design

The present 2 x 2 between-subjects study examined if observing others engage in an aerobic exercise, while imagining participating in exercise, had anxiolytic properties. Participants' experience with exercise and attitude towards exercise were also examined. The first independent variable (video condition) consisted of two levels: *exercise video* (50.9%, *n* = 229) and a *non-exercise video* (49.1%, *n* = 221). Participants in the exercise video condition watched a 30 second exercise video clip involving an individual actively engaged in running on a treadmill. Participants in the sedentary video condition watched a 30 second non-exercise video clip involving an individual playing Jenga. The second independent variable (imagination condition) also consisted of two levels: *imagination* (49.5%, *n* = 223) and *no imagination* (50.4%, *n* = 227). Participants in the imagination condition were instructed to imagine themselves engaged in the activity depicted in the video whereas those in the no imagination condition were only instructed to view the video. These variables yielded four conditions: (1) a video condition where participants watched a 30 second exercise video clip involving an individual actively engaged in running on a treadmill (26.9%, *n* = 121), (2) a video condition where participants watched the same video, and were instructed to imagine themselves doing the activity in the video (24%, *n* = 108), (3) a video condition where participants watched a 30 second non-exercise video clip involving an individual playing Jenga (23.6%, *n* = 106), and (4) a video condition where participants watched the same Jenga video, and were instructed to imagine themselves doing the activity in the video (25.6%, *n* = 115).

Participant variables included how often participants exercise, and participants' overall attitude towards exercise. These variables were ascertained through specific demographic questions: '*On average, how many days a week do you exercise? How many hours/minutes on the average day do you exercise?*' and '*How much do you enjoy exercise?*' Participants' responses were measured using the number of their choice out of seven, the hours/minutes of their choice (i.e., time was converted into total minutes), and a Likert scale of 1-10.

The dependent variables included mood and anxiety level. The mood of participants was assessed using the BMIS which measured overall pleasant/unpleasant mood on a scale of 16-64. Anxiety level of participants was assessed using a computerized version of the VAS-A, where anxiety levels were measured on a scale of 0-30.

Procedure

Participants signed onto MTurk and were directed to Qualtrics where the informed consent form was presented (Appendix A). If the participant chose to continue, he or she must have electronically agreed to the terms of the informed consent. All participants, whether they agreed or disagreed to the terms of the informed consent, were provided with a link to a PDF version of the consent form for their records. Next, the demographic questionnaire was presented (Appendix B). Following the demographics questionnaire, participants were randomly assigned to one of four groups. Then, participants viewed directions to a five second sound test video. The directions stated, "The following video is a sound test. Please make sure the video is audible." The sound test video showed a vehicle drive forward and honk the horn twice. After the test video, participants were asked to confirm if they were able to hear and see the test video. Once confirmed, instructions were presented asking participants to watch a video clip, or to watch and imagine themselves doing the activity displayed in a video clip. Instructions also asked participants to answer the questions regarding the video at the end of the study as an attention check (Appendix C).

The first group watched a 30-second exercise video clip of an individual running on a treadmill, and the second group watched the same video while being asked to imagine doing the activity. The third group watched a 30-second non-exercise video clip of an individual playing Jenga, and the fourth group watched the same video while being asked to image doing the activity. After the video clips were watched, participants recorded their stress level on the VAS-A (Appendix D). Immediately following the VAS-A, participants were asked to complete the BMIS in order to measure overall pleasant/unpleasant mood (Appendix E). Participants finished by answering questions regarding the video clip they watched (Appendix G), and reviewing the debriefing form (Appendix H). A link to a PDF version of the debriefing form was provided to participants for their records. Finally, participants were given a code in order to receive credit from MTurk.

RESULTS

It was hypothesized that the group who watched a brief exercise video clip, versus a non-exercise video clip, would score higher in pleasant mood via the BMIS pleasant/unpleasant mood scale. An independent samples *t*-test was conducted to compare pleasant mood scores of participants who watched the exercise video to those who viewed the non-exercise video. The test revealed no significant difference between the group who watched the exercise video clip (M = 46.35, SD = 8.79), and the group who watched the non-exercise video clip (M = 45.91, SD = 9.06) in overall mood scores after watching the videos, $t(448) = 0.522$, $p = .598$. Cohen's effect size value ($d = .05$) indicates a small effect size. Mean mood scores of video conditions are presented in Figure 1.

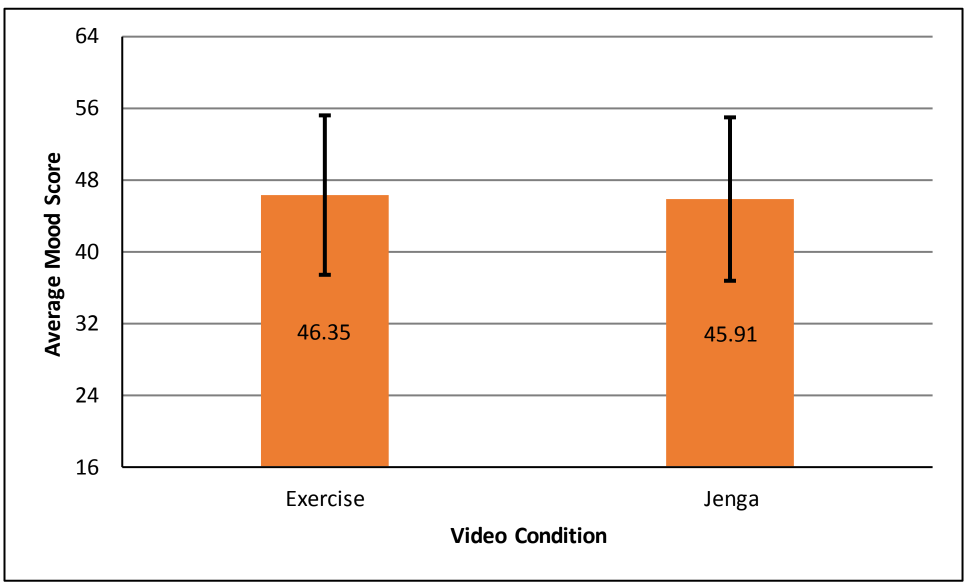

Figure 1. Mean mood scores of video conditions

It was also hypothesized that the group who watched the exercise video clip versus the non-exercise video clip would score lower in stress levels via the VAS-A. An independent samples *t*-test revealed no significant difference between the group who watched the exercise video clip (M = 8.12, SD = 8.19), and the group who watched the non-exercise video clip (M = 8.53, SD = 8.41) in average stress level after watching the videos, $t(444) = 0.525$, $p = .263$. Cohen's effect size value ($d = .05$) revealed a small effect size. Mean stress levels of video conditions are presented in Figure 2.

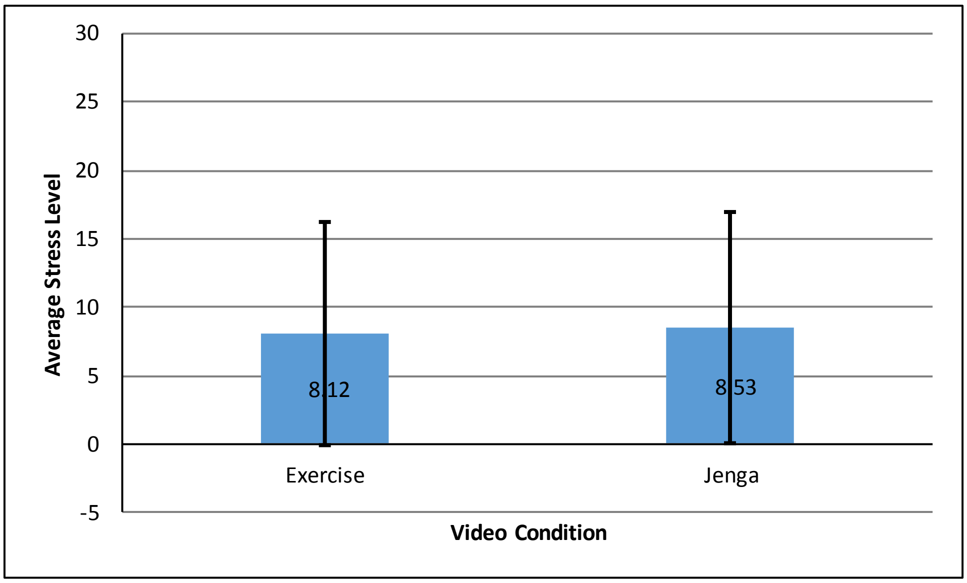

Figure 2. Mean stress levels of video conditions

It was hypothesized that for the group that watched the exercise video clip, there would be a positive correlation between attitude towards exercise and mood. A bivariate correlation revealed a significant, moderate positive correlation between attitude towards exercise and mood, $r(226) = .380$ $p < .001$. These findings are presented in Figure 3.

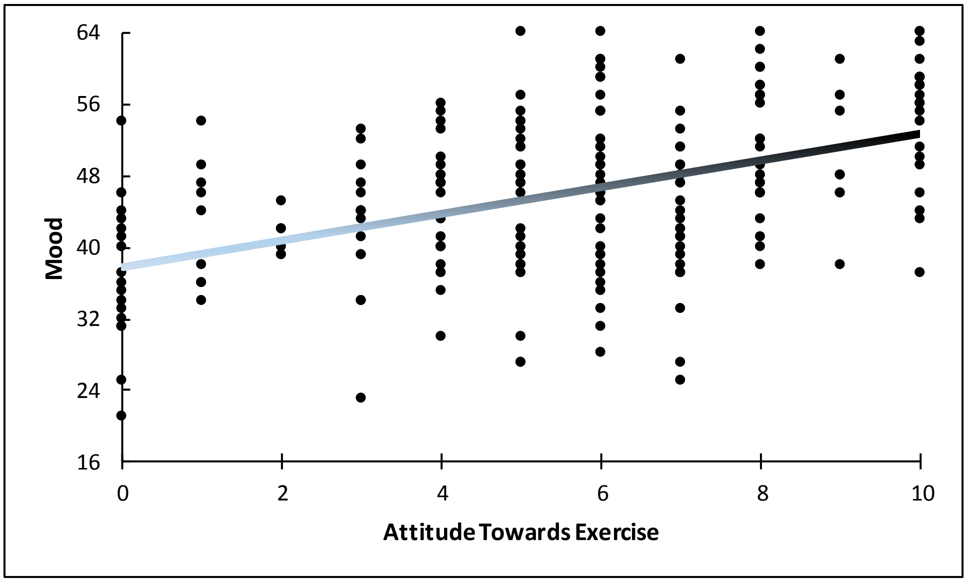

Figure 3. Bivariate correlation between mood and attitude towards exercise

Although it was not hypothesized, a bivariate correlation was conducted to examine the relationship between attitude towards exercise and mood for the group who watched the non-exercise video clip. This was done in order to compare the effect of video condition on mood. Results revealed a significant, moderate positive correlation between attitude towards exercise and mood, $r(219) = .416$, $p < .001$ (Figure 4). To compare the relationships between attitude towards exercise and mood in the exercise video and non-exercise video conditions, an independent-samples *t*-test was conducted comparing slopes of the best-fitting lines from the video conditions. The test revealed that the slopes were not significantly different, $t(445) = 0.674$, $p > .05$.

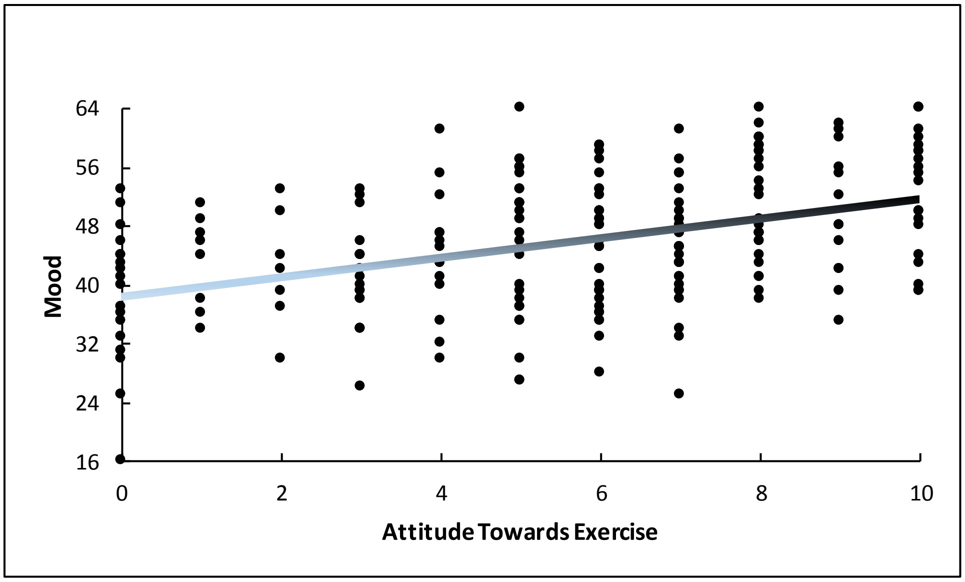

Figure 4. Bivariate correlation between mood and attitude towards exercise (NV group)

Furthermore, a bivariate correlation was conducted to test the hypothesis that the group who watched the exercise video clip would have a negative correlation between attitude towards exercise and stress level. Results showed a non-significant, weak correlation between attitude towards exercise and stress level, $r(226) = -.018$, $p = .794$. These findings are presented in Figure 5.

It was hypothesized that the group who watched the exercise video would have a positive correlation between regular exercise and mood. Two separate bivariate correlations were conducted to test the hypothesis. The first included a correlation between mood and days exercised per week. A significant, moderate positive correlation was found between number of days a week spent exercising and mood, $r(227) = .261$, $p < .001$. These findings are presented in Figure 6. The

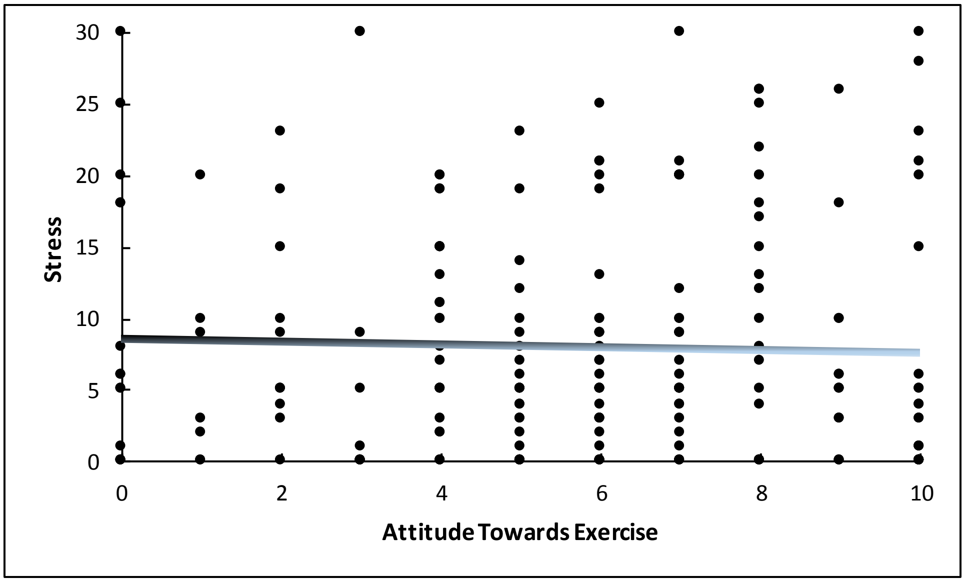

Figure 5. Bivariate correlation between attitudes towards exercise and stress

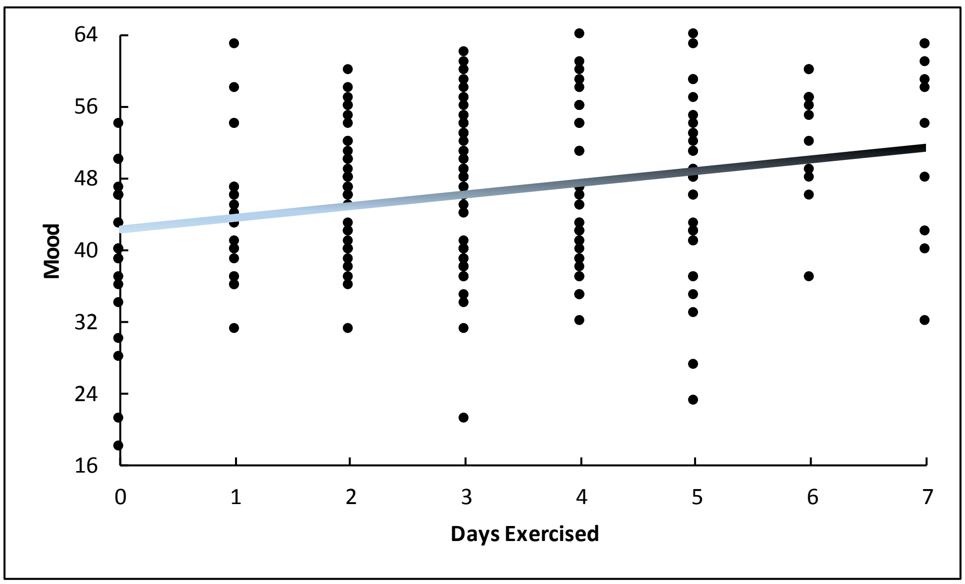

Figure 6. Bivariate correlation between number of days per week spent exercising and mood

second correlation included mood and total minutes per day spent exercising. A non-significant, weak correlation was found between total minutes spent exercising per day and mood, $r(227) = .049$, $p = .464$. These findings are presented in Figure 7.

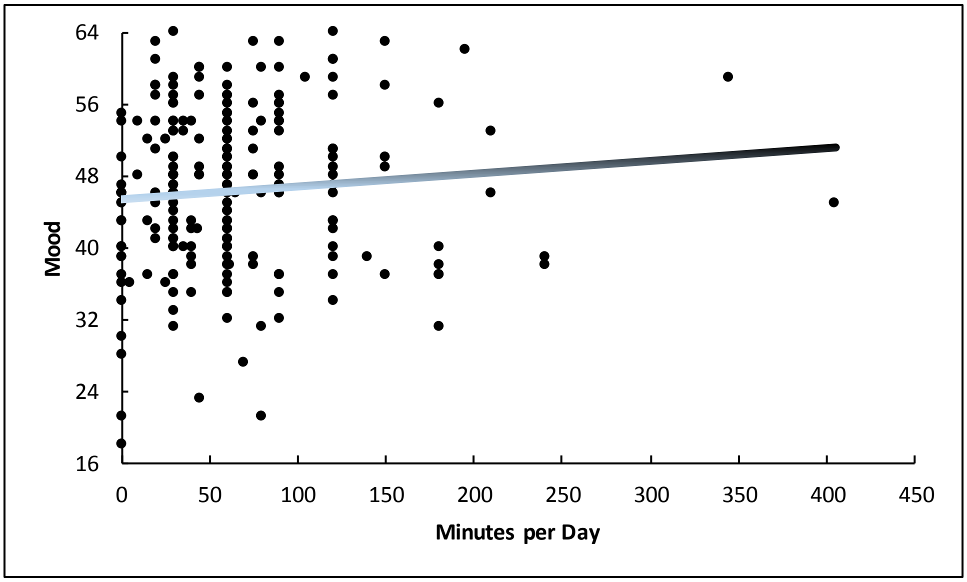

Figure 7. Bivariate correlation between minutes exercised per day and mood

It was hypothesized that the group who watched the exercise video clip would have a negative correlation between regular exercise and stress level. Two bivariate correlations were conducted to test the hypothesis. The first included a correlation between stress and days exercised per week. A non-significant, weak correlation was found between days spent exercising and stress level, $r(224) = -.007$, $p = .918$. These results are presented in Figure 8. The second correlation included stress and minutes exercised per day. A significant, weak positive correlation was found between minutes per day spent exercising and stress level, $r(224) = .141$, $p < .05$ (Figure 9).

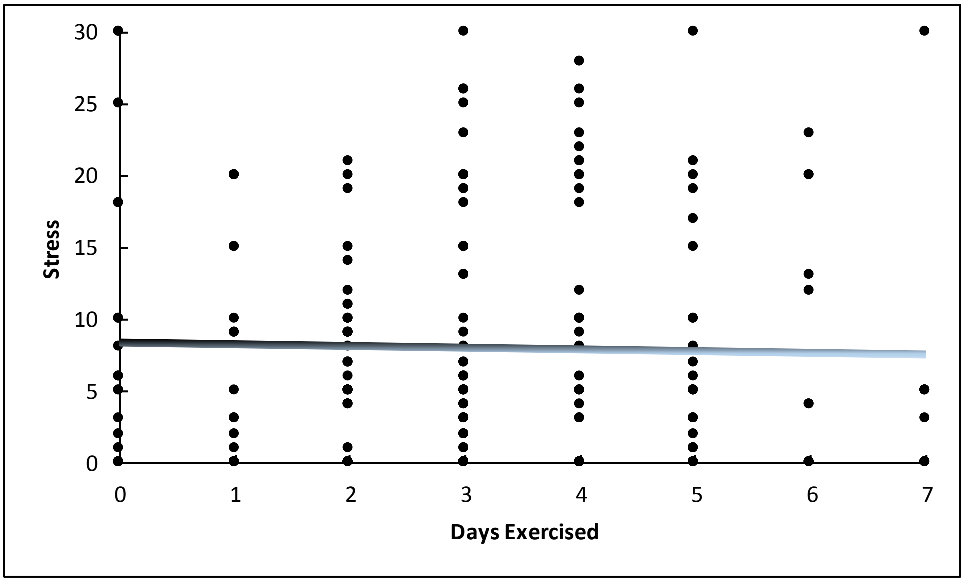

Figure 8. Bivariate correlation between days per week spent exercising and stress

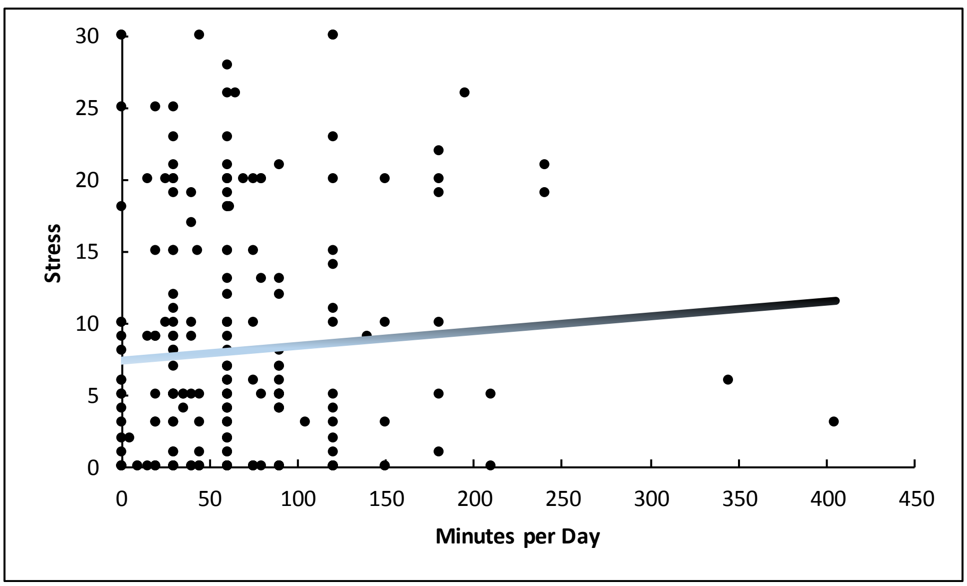

Figure 9. Bivariate correlation between minutes exercised per day and stress

It was hypothesized that the group who imagined themselves exercising while watching the exercise video clip would score higher in pleasant mood compared to all other groups (i.e., the group who imagined playing Jenga while watching the Jenga clip, the group who watched the exercise video clip, and the group who watched the non-exercise video clip). To test this hypothesis, a two-way ANOVA was conducted, examining the effect of video condition and imagination condition on mood scores. The results showed no significant interaction between video condition and imagination condition, $F(1, 446) = 1.63$, $p = .203$, $\eta^2 = .004$ (Figure 10). Mood scores were similar for all four conditions.

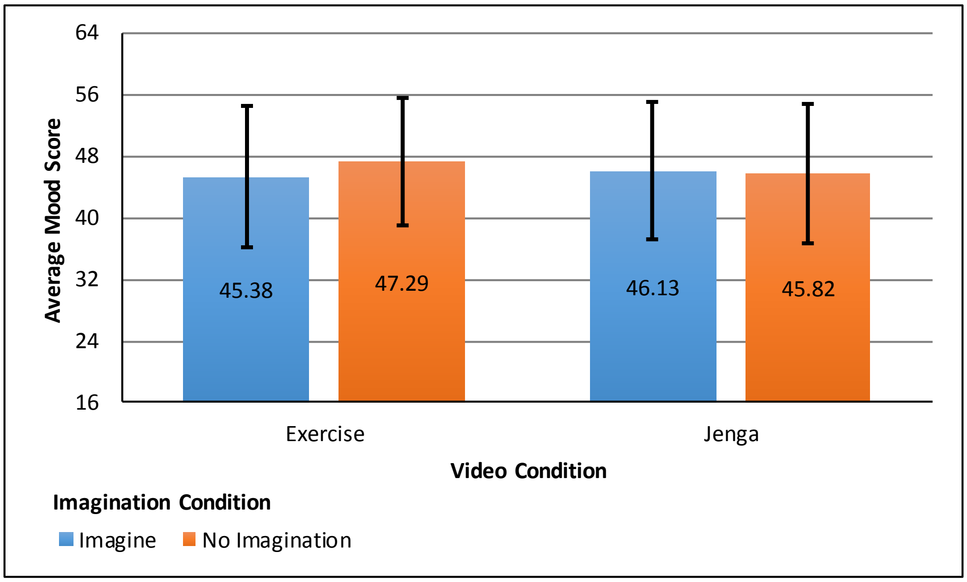

Figure 10. Mean mood scores of all groups

Finally, it was hypothesized that the group who imagined themselves exercising while watching the exercise video clip would score lower in stress level compared to all other groups (i.e., the group who imagined playing Jenga while watching the Jenga video, the group who watched the exercise video clip, and the group who watched the non-exercise video clip). A two-way ANOVA was conducted to examine the effect of video condition and imagination condition on stress levels. Results revealed no significant interactions between video condition and imagination condition, $F(1, 442) = 2.67$, $p = .103$, $\eta^2 = .006$ (Figure 11). Stress levels were similar among all four groups.

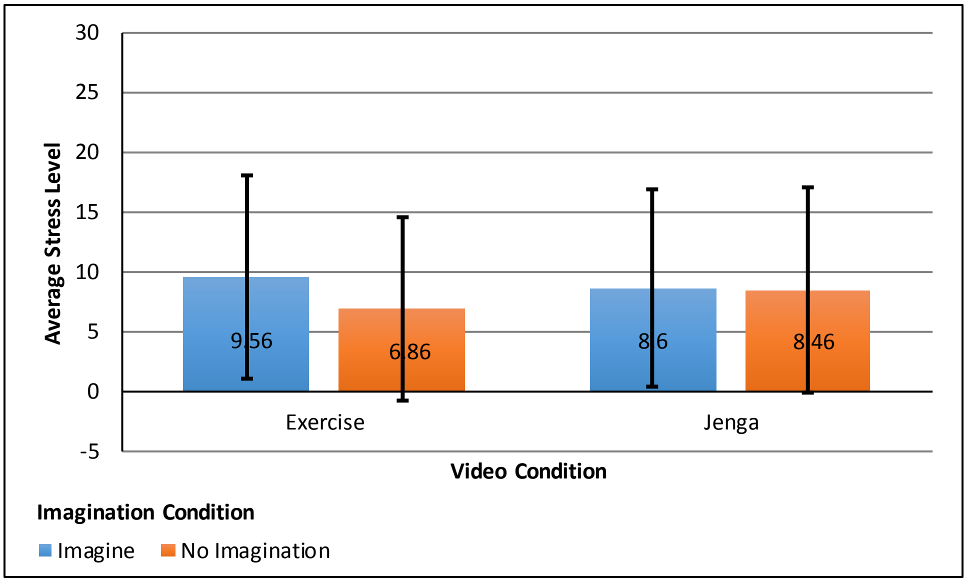

Figure 11. Mean stress level of all conditions

DISCUSSION

The present study examined if observing others engage in an aerobic exercise, while imagining participating in exercise, had anxiolytic properties. Participants' experience with exercise and attitude towards exercise were also examined. It was hypothesized that the group who watched a brief exercise video clip versus a non-exercise video clip, would score higher in pleasant mood via the BMIS pleasant/unpleasant mood scale (Mayer & Gaschke, 1988). Results did not support this hypothesis. Although the mean mood score for participants who watched the exercise video was higher, there was no significant difference found between the two groups.

It was also hypothesized that the group who watched the exercise video clip versus the non-exercise video clip would score lower in stress levels via the VAS-A (Abend et al., 2014). Similar to findings of the first hypothesis, results did not support this hypothesis. The mean stress level of participants who watched the exercise video was lower than the non-exercise video group, however the difference was not found to be significant. Results of the first two hypotheses could be due to the content of both videos conditions. Each video condition demonstrated anxiety reducing coping skills (i.e., playing a game and running). According to research, games have been shown to lower stress level and increase positive mood (Becic, 2017). It could be that the content in each video was perceived by participants to have similar anxiolytic properties, and therefore taking the perspective of the video model resulted in similar mood and stress scores for both groups.

Additionally, it was predicted that the group who watched the exercise video clip would have a positive correlation between participants' attitude towards exercise and mood. Results supported this hypothesis, and revealed a moderately significant positive correlation between attitude towards exercise and mood. However, an additional bivariate correlation between attitude towards exercise and mood, for the group who watched the non-exercise video clip, revealed a significant, moderate positive correlation as well. When comparing the slopes of the best-fitting lines of the two correlations, there was no significant difference found. These findings demonstrate that the more participants enjoyed exercise, the higher their mood scores were regardless of video condition. Although results supported this hypothesis, the second bivariate correlation revealed that the exercise video clip did not have an effect on mood.

Furthermore, it was hypothesized that the group who watched the exercise video clip would have a negative correlation between attitude towards exercise and stress level. Results did not support this hypothesis, and revealed a negative, but non-significant relationship between attitude towards exercise and stress level. It is surprising that attitude towards exercise would have a positive correlation with mood, but no significant correlation with stress level. Previous research demonstrates that exercise promotes positive mood and lower stress level; it is interesting that there was not a significant correlation between the predictor and outcome variables (Judah et al., 2013; Lazay, 1998; Ledwidge, 1980; Mahmound, Staten, Hall, & Lennie, 2012).

It was predicted that the group who watched the exercise video would have a positive correlation between regular exercise and mood. Two bivariate correlations were conducted for this hypothesis. The first examined the relationship between mood, and days spent exercising per week. Results supported this hypothesis, and a moderately significant positive correlation was found between number of days a week spent exercising and mood. This finding supports previous research discussing how the brain's response to visual stimuli (e.g., running) depends upon previous visual and motor experience of the action (Aglioti, Cesari, Romani, & Urgesi, 2008). According to previous research, direct experience with running would result in an ability to better adopt the perspective of the video runner (Aglioti, Cesari, Romani, & Urgesi, 2008; Calvo-Merino, Grezes, Glaser, Passingham, & Haggard, 2006; Ramachandran, 2009). The second correlation involved minutes spent exercising per day and mood. Results did not support this hypothesis. A positive but non-significant correlation was found between total minutes spent exercising per day and mood.

It was also hypothesized that the group who watched the exercise video clip would have a negative correlation between regular exercise and stress level. Again, two bivariate correlations were conducted to test this hypothesis. The first examined the relationship between days spent exercising per week and stress level. Results did not support this hypothesis. A negative, but non-significant correlation was found between days spent exercising and stress level. The second correlation included minutes spent exercising per day and stress level. Results did not support this hypothesis. In contrary to what was hypothesized, a weak significant positive correlation was found between minutes per day spent exercising and stress level.

This is in accordance with previous research suggesting that in some cases, exercise at competitive levels (i.e., more strenuous time spent exercising) can be liable to result in feelings of stress (Yeung, 1996). This research could account for the reason that mood had no significant correlation to minutes spent exercising per day, and for the positive correlation found between stress and minutes spent exercising per day. More research is needed in order to decipher why minutes per day spent exercising related to mood and stress in this way.

It was hypothesized that group who imagined exercising while watching the exercise video clip, would score higher in pleasant mood compared to all other groups (i.e., group who imagined playing Jenga while watching the Jenga clip, the exercise video clip group, and the non-exercise video clip group). Results did not support this hypothesis, and there were no significant interactions between video condition and imagination condition. Mood scores were similar for all four conditions. Although no significant differences in mean scores were found, the group who imagined exercising while watching the exercise video had the lowest mean overall pleasant mood score (M = 45.39, SD = 9.19). Interestingly, the group that watched the exercise video clip without being asked to imagine doing the activity had the highest mean mood score of all four groups (M = 47.21, SD = 8.37). Since aerobic exercise has been found to have anxiolytic properties, it would appear that watching and imagining an aerobic exercise would also have a similar effect on mood, however this was not the case (Asmundson et al., 2013). Although there were no significant differences in mean mood scores, more research is needed to understand why the group who imagined themselves exercising while watching the exercise video had the lowest mean mood score of all groups.

Lastly, it was predicted that the group who imagined themselves exercising while watching the exercise video would score lower in stress level compared to all other groups. Results did not support this hypothesis. There were no significant interactions found between the video condition and the imagination condition. Although there were no significant interactions found, the group who imagined themselves exercising while watching the exercise video had the highest mean stress level of all groups (M = 9.56, SD = 8.54). However, the group who watched the exercise video without being asked the imagine exercising scored the lowest in mean stress level compared to all groups (M = 6.86, SD = 7.68). Similar to the previous hypothesis, this finding relates to past research on the anxiolytic properties of aerobic exercise (Broocks et al., 1998; Cotman & Berchtold, 2002). Therefore, watching someone exercise can decrease stress due to the human ability to take on another's perspective (Cort, 2005; Rizzolatti & Craighero, 2004). Although, imagining participating in an activity while watching should show larger effects in stress reduction (Pascual-Leone et al., 1995; Yue & Cole, 1992).

Overall, the results of this study suggest that the more one enjoys exercising, the more positive one will feel regardless of video condition. Additionally, the more days a week one exercises, the more positive one will feel while watching exercise. However, results indicated that the more time one spends exercising per day, the more stressed one will feel while watching exercise.

Limitations

The present study included several limitations. Some participants had technical problems when watching the video (e.g., some reported watching without sound, some reported that the video was too small). The content in the exercise video (i.e., an individual running on a treadmill) could have included different forms of exercise in order for a wider variety of participants to relate. Not all participants who reported exercising throughout the week preferred running. This could have had an impact on mood or stress if exercising participants did not favor running. In fact, running was not listed first in the participants' regular exercise preferences. Exercises in order of preference included: walking (56.9%, n = 256), weight training (34%, n = 153), running/sprinting (26.4%, n = 119), jogging (16.9%, n = 76), yoga (16.7%, n = 75), cycling (15.6%, n = 70), stair master/elliptical (8.9%, n = 40), swimming (8.4%, n = 38), team sports (5.3%, n = 24), CrossFit (4%, n = 18), group exercise classes (3.6%, n = 16) climbing (2%, n = 9), and other (11.1%, n = 50).

The vast majority of participants reported White/Caucasian/European-American as their race/ethnicity (72.9%, n = 328). Other race/ethnicities identified in this sample included: Asian or Pacific Islander (10.4%, n = 47), Latino/Hispanic/Mexican (7.8%, n = 35), Black/African American (7.6%, n = 34), or other (2.2%, n = 10). A more diverse sample of participants would have been preferred to more accurately represent the general population.

In addition, the survey was launched from MTurk at approximately 10 PM to 2 AM. It is possible that participant's overall mood and anxiety level were affected by the hour the survey was taken. According to research in the area of mood and sleep, night owls consistently have higher rates of depression and anxiety than morning larks (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010). Launching the survey during daytime hours could have represented the general population more accurately.

Future Research

Future research could benefit by adding an additional non-video control group in order to assess the effect of the video content. Also, many studies researching the anxiolytic properties of exercise include a pre-test post-test design in order to compare baseline to post-manipulation results (e.g., video condition; Abend et al., 2014; Andrews et al., 2007). It could also be beneficial to add a stressor before viewing the videos in order to gauge how the videos affected real-time stress (Andrews et al., 2007). Creating a longer video was found to have an effect on participants' mood in some research (Choe, Chun, Noh, Lee, & Zhang, 2013). Additionally, incorporating a compilation of exercises to the exercise video could make it more relatable to a wider variety of people (Calvo-Merino et al., 2006) Finally, launching the survey during daytime hours could also change data and reflect more accurate results (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010).

Conclusion

Much research has been done on the effects of aerobic exercise on mood and stress. Very little research has investigated the anxiolytic properties of observing exercise. Overall, the present study did find that the more participants enjoyed exercising, the more pleasant they felt, regardless of video condition. Also, the more days participants reported exercising during the week, the more pleasant they felt after watching the exercise video. Although there was not a significant difference found between mean mood and stress scores, it is telling that the group who watched the exercise video had the highest mean mood score and lowest mean stress level of all groups. In addition, and in contrary to predictions, the more time participants spent exercising per day resulted in more stress after watching the exercise video. In conclusion, this study adds to the body of research on the effects of observing aerobic exercise on mood and stress.

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APPENDICES

APPENDIX A

INFORMED CONSENT

1. Summary: This research study will examine factors related to stress and mood. If you agree to participate, you will be asked to complete questionnaires, watch a short video clip, and answer some questions regarding the video.

2. Your right to withdraw/discontinue: You are free to discontinue your participation at any time without penalty. You may also skip any item on the questionnaire that makes you feel uncomfortable.

3. Benefits: This research study guarantees participants fifty cents for completing the study. An additional benefit includes possibly learning something about how research studies are conducted, and about this area of research.

4. Time commitment: If you agree to participate in the study, it will take approximately 15 minutes to complete your session.

5. Guarantee of confidentiality: All data from this study will be kept from inappropriate disclosure and will be accessible only to the researcher and her faculty advisor. The researcher is not interested in anyone's individual responses, only the average responses of everyone in the study.

6. Risks: The present research is designed to reduce the possibility of any negative experiences as a result of participation. Risks to participants are kept to a minimum. However, if your participation in this study causes you any concerns, anxiety, or distress, please refer to Psychology Today's website http://therapists.psychologytoday.com to find a mental health provider in your area and discuss your concerns.

7. Researcher contact information: This research study is being conducted by Sarah Yonan. The faculty supervisor is Dr. Gary Williams, Department of Psychology and Child Development, California State University, Stanislaus. If you have any questions or concerns about your participation in this study, you may contact the researcher through Dr. Williams at (209) 667-3065.

8. Results of the study: You may obtain information about the outcome of the study at the end of the academic year by contacting Dr. Williams or Sarah Yonan:

syonan@csustan.edu

gwilliams1@csustan.edu

9. Psychology Institutional Review Board contact information: If you have any questions about your rights as a research participant, you may contact the Chair of the Psychology Institutional Review Board of California State University Stanislaus, Dr. Jessica Lambert, at psychologyIRB@csustan.edu or (209)513-9432.

10. Personal Copy of Consent Form: You may print/download a blank, unsigned copy of this consent form by clicking on this link: *consent form link.*

11. Verification of adult age: By clicking below, you attest that you are 18 years or older.

12. Verification of informed consent: By clicking below, you are indicating that you have freely consented to participate in this research study.

APPENDIX B

DEMOGRAPHICS

Instructions: Please answer the following questions about yourself.

1. How old are you?

____________years old

2. What gender do you consider yourself?

   - Male
   - Female
   - Other

3. What race/ethnicity do you identify with?

   - White/Caucasian/European-American
   - Latino/Hispanic/Mexican
   - Black/African American
   - Asian or Pacific Islander
   - Other (please specify____________________________________)

4. On average, how many days a week do you exercise?

   How many hours/minutes on the average day do you exercise?

5. What type of exercise do you typically engage in? (*Choose all that apply*)

   - Running/sprinting
   - Weight training
   - CrossFit
   - Yoga
   - Jogging
   - Walking
   - Cycling
   - Climbing

- Team sports
- Group exercise
- Stairmaster/elliptical
- Swimming

6. How much do you enjoy exercise?

0
10

Strongly Dislike Love It

APPENDIX C

VIDEO CLIP INSTRUCTION

Please watch the following video clip and answer the questions regarding the clip at the end of the study.

Thank you for participating!

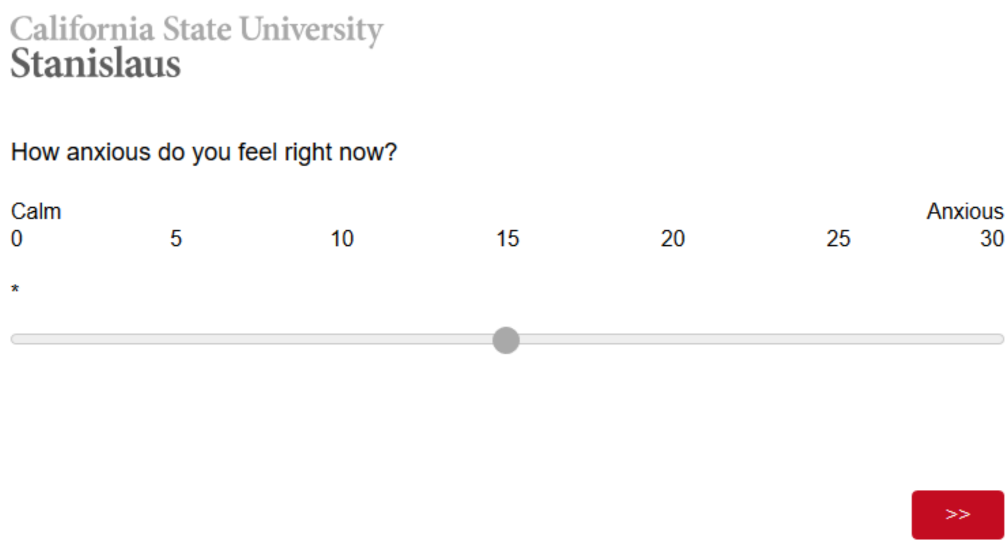
-OR-

Please watch the following video clip and imagine yourself doing the activity as you watch. At the end of the study, please answer the questions regarding the video clip.

Thank you for participating!

APPENDIX D

VISUAL ANALOGUE SCALE FOR ANXIETY- VAS-A



California State University
Stanislaus

How anxious do you feel right now?

Calm 0 5 10 15 20 25 30 Anxious

*

>>

APPENDIX E

BRIEF MOOD INTROSPECTION SCALE (BMIS)

Brief Mood Introspection Scale (BMIS)

by John D. Mayer

INSTRUCTIONS: Circle the response on the scale below that indicates how well each adjective or phrase describes your present mood.

(definitely do not feel) (do not feel) (slightly feel) (definitely feel)

1 2 3 4

Lively	1 2 3 4	Drowsy	1 2 3 4
Happy	1 2 3 4	Grouchy	1 2 3 4
Sad	1 2 3 4	Peppy	1 2 3 4
Tired	1 2 3 4	Nervous	1 2 3 4
Caring	1 2 3 4	Calm	1 2 3 4
Content	1 2 3 4	Loving	1 2 3 4
Gloomy	1 2 3 4	Fed up	1 2 3 4
Jittery	1 2 3 4	Active	1 2 3 4

Overall, my mood is:

Very Unpleasant	Very Pleasant

-10 –9 –8 –7 –6 –5 –4 –3 –2 –1 0 1 2 3 4 5 6 7 8 9 10

Please Note: The "Overall, my mood is" section is usually omitted, although some people use it and fold it into the overall score.

Original Citation: Mayer, J. D., & Gaschke, Y. N. (1988). The experience and meta-experience of mood. Journal of Personality and Social Psychology, 55, 102-111. [Scoring instructions are described there]

Some Other Articles that Have Used the Scale:*

- Examination of the paths between personality, current mood, its evaluation, and emotion regulation. Kokkonen, Marja; Pulkkinen, Lea; European Journal of Personality, Vol 15(2), Mar-Apr 2001. pp. 83-104.
- Resolution of lexical ambiguity by emotional state. Halberstadt, Jamin B.; Niedenthal, Paula M.; Kushner, Julia; Psychological Science, Vol 6(5), Sep 1995. pp. 278-282.
- Intrusive thoughts as determinants of distress in parents of children with cancer. Hall, Martica; Baum, Andrew; Journal of Applied Social Psychology, Vol 25(14), Jul 1995.

Special issue: Rumination and intrusive thoughts. pp. 1215-1230.

- Mood inductions for four specific moods: A procedure employing guided imagery vignettes with music. Mayer, John D.; Allen, Joshua P.; Beauregard, Keith; Journal of Mental Imagery, Vol 19(1-2), Spr-Sum 1995. pp. 151-159.
- Mood-congruent judgment over time. Mayer, John D.; Hanson, Ellen; Personality & Social Psychology Bulletin, Vol 21(3), Mar 1995. pp. 237-244.

*The scale has been used in many other articles; I do not have a comprehensive list at this time. If you know of other uses, I would be delighted to hear of them.

APPENDIX F

SCORING THE BRIEF MOOD INTROSPECTION SCALE (BMIS)

Scoring the BMIS for Pleasant-Unpleasant Mood

To score Pleasant-Unpleasant, first:

- Definitely do not feel = 1
- Do not feel = 2
- Slightly feel = 3
- Definitely feel = 4

1. Add up the responses for: Active, Calm, Caring, Content, Happy, Lively, Loving, and Peppy.

2. Next, reverse score the responses for: Drowsy, Fed up, Gloomy, Grouchy, Jittery, Nervous, Sad, and Tired. That is, recode, such that:

- Definitely do not feel = 4
- Do not feel =3
- Slightly feel = 2
- Definitely feel = 1

3. Now, add up the scores for the reverse scored items. That is, Drowsy, Fed up, Gloomy, Grouchy, Jittery, Nervous, Sad, and Tired.

4. Finally, add up the regular and reverse-scored items. That is the total on the Pleasant-Unpleasant scale.

APPENDIX G

VIDEO CLIP QUESTIONS

1) Did you watch the video clip?

Yes
No

2) Did the runner stumble during the video? - OR - Did the Jenga player drop one of the pieces during the video?

Yes
No

3) Was the sound on while you watched the video?

Yes
No

4) Did you imagine yourself doing the activity?

Yes
No

5)

Aside from understanding the general purpose of this study, do you think you know what the researchers expect to find in this study?

○ No

○ Yes, please provide a brief explanation:

APPENDIX H

DEBRIEFING FORM

Thank you for participating in this study! The purpose of the present study is to examine if observing others engage in an aerobic exercise, while imagining participating in the exercise, can reduce stress and anxiety. In this study, participants were assigned to one of four groups. Instructions were given either asking participants to watch a video clip, or to watch and imagine themselves doing the activity featured on the video clip. One video clip consisted of a person running on a treadmill for 30 seconds (i.e., exercise video), and the other featured an individual playing Jenga for 30 seconds (non-exercise video). The first group watched the 30 second exercise video clip, and the second group watched the same video while being asked to imagine doing the activity. The third group watched the 30 second non-exercise video clip, and the fourth group watched the same video while being asked to imaging doing the activity. It is hypothesized that the group that watched the exercise video while imagining doing the exercise will have the lowest stress levels and highest scores in overall mood than all other groups.

All of the information collected in this study will be kept safe from inappropriate disclosure, and there will be no way of identifying your responses in the data archive. I am not interested in anyone's individual responses; rather, I want to look at the general patterns that emerge when all of the participants' responses are put together. I ask that you do NOT discuss the nature of the study with others who may later participate in it, as this could affect the validity of my research conclusions.

If you have any questions about the study or would like to learn about the results of the study, you may contact me (Sarah Yonan) through my research supervisor, Dr. Gary Williams, at gwilliams1@csustan.edu. If you have questions about your rights as a research participant, you may contact the Chair of the Psychology Institutional Review Board of California State University Stanislaus, Dr. Jessica Lambert, at psychologyIRB@csustan.edu or (209)513-9432. If participation in the study caused you any concern, anxiety, or distress, you may contact a mental health professional in your area through Psychology Today's website http://therapists.psychologytoday.com to discuss your concerns.

You may print/download a copy of this form at by clicking on this link: *debriefing form link*.

<u>If you would like to learn more about this research topic, I suggest the following references:</u>

Aglioti, S.M., Cesari, P., Romani, M., & Urgesi, C. (2008). Action anticipation and motor resonance in elite basketball players. Nature Neuroscience, 11(9), 1109-1116. doi:10.1038/nn.2182.

Carr, L., Iacoboni, M., Dubeau, M.C., Mazziotta, J.C., & Lenzi, G.L. (2003). Neural mechanisms of empathy in humans: A relay from neural systems for imitation to limbic areas. Proceedings of the National Academy of Sciences, 100(9), 5497-5502. doi:10.1073/pnas.0935845100.

Ramachandran, V.S. (2009, November). The neurons that shaped our civilization.[Video file]. TED Talk Retrieved from www.ted.com/talks/vs_ramachandran_the_neurons_that_shaped_civilization