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Interactions with Horses is Associated with Higher Mindfulness and Heart Rate Variability and Lower Electrodermal Response in College Students

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Abstract

A wealth of research has revealed psychological and physiological benefits of interactions with animals. As yet, research is limited to smaller animals such as dogs and cats and has not examined the benefits of human-horse interactions. The present study examined the effects of video-simulated human-horse interactions compared with simulated interactions with a car and a person on state mindfulness and physiological arousal. The relationship between trait mindfulness and horse experience was also examined. Undergraduate students with (n = 16) and without experience with horses (n = 26) were recruited with the exclusion criteria of a fear of horses. Results provided support for hypotheses in that participants with horse experience had significantly higher HRV, $p = .01$, $\eta_p^2 = .15$, and higher mindful awareness, $p = .01$, $d = 0.72$, than participants without experience with horses. The current study suggests that the positive benefits of human-animal interactions may be extended to interactions with horses.

Horses, Mindfulness, and Physiological Response: Simulated Interactions

"There is something about the outside of the horse that is good for the inside of a man." This quote dates back to ancient Greece and, perhaps even further; the precise origins are unknown (O'Brien, 2012). While horses have been utilized for various therapeutic purposes for over 2,000 years, they have only recently been used in a formally therapeutic setting. Therapeutic horseback riding emerged after World War II to assist soldiers with amputated limbs as well as children with polio to regain postural control; today, this is known as *hippotherapy* (Freund, Brown, & Buff, 2011). The success of hippotherapy for physical rehabilitation led to the creation of the North American Riding for the Handicapped Association (NARHA) during the 1960s. Hippotherapy has increased in popularity since the 1960s, with some evidence of the benefits extending from physical rehabilitation to verbal communication (Freund et al., 2011). Unfortunately, most therapeutic claims are based upon anecdotal data rather than empirical scientific evidence. Problems in the available research on the topic including poor study designs, lack of standardized procedures, and small sample sizes (Fruend et al., 2011).

Large sample sizes are difficult to obtain in field studies which require a significant commitment of time and energy for participants. Simulated interactions provide researchers with an opportunity to obtain a larger sample size. A laboratory setting also allows for greater control of variables to provide an empirical examination of the impact of interactions with a horse.

Currently, horses are integrated into several different types of therapeutic interventions, collectively referred to as *equine-assisted treatments*. Practitioners of equine-assisted treatments have described that horses, being herd animals of prey with a complex communication system based in body language, have a sense of present moment awareness and provide nonjudgmental, honest feedback that mirrors a person's emotional states (Denim 'n Dirt, n.d.). This description indicates a belief that horses facilitate *mindfulness*—a nonjudgmental focused attention on the present moment—which has been found to have many benefits including diminished mental health problems and improved psychological and physiological wellbeing (Rygh & Sanderson, 2004; Baer, 2003; Prazak et al., 2012). A goal of the current study was to explore three potential correlates of human-horse interactions that may explain why interactions with horses are beneficial. Interactions with horses were proposed to increase mindfulness, improve cardiovascular functioning, and increase relaxation.

Benefits of Interactions with Animals

A recent comprehensive literature review found an abundance of evidence that human interactions with animals provided improved psychological and physiological wellbeing (Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012). The 69 articles included in the review by Beetz et al. (2012) were published in peer-reviewed journals, included control groups, and contained a minimum of 10 participants per group. Several studies found significant increases in oxytocin, a hormone released in the hypothalamus associated with sensory stimulation, in both humans and animals in response to *human animal interactions* (HAI), particularly in women. Beetz and colleagues (2012) proposed that oxytocin was a mechanism of change mediating improved physiological and psychological wellbeing (Beetz et al., 2012). An earlier literature review, that looked specifically at the physiological effects of HAI, found similar results indicating that HAI may improve cardiovascular health and mitigate the adverse effects of acute stress (Virués-Ortega & Buela-Casal, 2006).

Vormbrock and Grossberg (1988) examined the possibility that the improved cardiovascular effect of HAI may be due to a *conditioned relaxation response*. The researchers proposed that people tend to associate pets with relaxing, enjoyable activities because people tend to interact with pets during relaxing times and thus the pet becomes a conditioned stimulus for a conditioned relaxation response. Participants (*N* = 60) were male and female undergraduate students who reported having either positive or neutral feelings toward pet dogs (Vormbrock & Grossberg, 1988). A single small male pet dog was used in the experimental conditions. Each participant was placed in six randomly ordered conditions each of which lasted for 6 minutes followed by 2-minute periods for collection of physiological measures (Vormbrock & Grossberg, 1988). Conditions included a silent resting period without the dog (rest), a time in which participants were asked to physically interact with the dog in silence (tactile), a verbal condition in which participants were asked to talk to the dog that was out of physical reach (verbal), a condition in which participants were asked to interact with the dog verbally and tactilely (verbal-tactile), a period in which the experimenter conversed with participants in the presence of the dog (interview with dog), and a condition in which the experimenter conversed with participants without the dog present (interview without dog). Results indicated that, for those with positive feelings toward pet dogs as well as those with neutral feelings toward pet dogs, blood pressure was significantly higher during both interview conditions than any of the other conditions and blood pressure was at the same level as the resting condition only in the tactile condition in which participants were allowed to touch the dog but were restricted from speaking, which was significantly lower than in the verbal-tactile or the verbal condition (Vormbrock & Grossberg, 1988). Vormbrock and Grossberg (1988) concluded that spending time with a dog may induce physiological relaxation, consistent with the conditioned relaxation response theory.

Allen, Blascovich, and Mendes (2002) found that baseline blood pressure and heart rate were lower in married couples who had pets than those without pets. Pet owners exhibited less increases in physiological response and quicker recovery when compared with non-pet owners in response to stress, induced through 5 minutes of rapid mental subtraction or 2 minutes of hand submersion in ice water. In an earlier study, adult women who owned dogs were exposed to stress in the company of their pets, close friends, or alone (Allen, Blascovich, Tomaka, & Kelsey, 1991). During stress-induction, participants in the company of their pets exhibited little change in heart rate, skin conductance, or blood pressure compared with participants in the other conditions. Furthermore, in a study using a repeated-measures randomized experimental design, Cole, Gawlinski, Steers, and Kotlerman (2007) found that individuals who were hospitalized due to heart failure and were visited by a volunteer with a therapy dog for 12 minutes had lower blood pressure compared with patients in the control group who were given treatment as usual.

A recent three-part study found that young children preferred to interact with animals as compared with similarly shaped toys (LoBue, Pickard, Sherman, Axford, & DeLoache, 2013). Experiment 1 had an exploratory design in which toddlers ranging from 11-40 months of age were brought into a room with several common small toys that were randomly arranged as well as two live animals, a hamster and a Beta fish, in small enclosures (LoBue et al., 2013). Participants were told that they could play with anything that was in the room and were allowed to play on their own for 5-10 minutes. Frequency and duration of interactions with each stimulus and other behaviors were coded for analysis (LoBue et al., 2013). Participants interacted with the two animals with significantly greater frequency than the two toys they interacted with the most.

Experiment 2 followed a similar procedure to Experiment 1 with toddlers ranging from 18 to 36 months of age who were placed in a room with the four most favored toys from Experiment 1 as well as four enclosed animals: the hamster and Beta fish used in Experiment 1 as well as a tarantula and a king snake (LoBue et al., 2013). Consistent with findings of

Experiment 1, toddlers interacted with the animals overall significantly more than they interacted with the toys.

Finally, Experiment 3 was a more controlled experiment with three animals (hamster, gecko, and Beta fish) and three toy animals (stuffed hamster, plastic gecko, and plastic fish) all attached to their displays (LoBue et al., 2013). Each display, which included a live animal and its toy replica, was initially covered with a sheet. The experimenter uncovered one display, asked participants what they saw, allowed time for interactions, and then moved to the other displays following the same procedure. The children spent significantly more time overall interacting with the live animals than with the replicas. LoBue and colleagues (2013) concluded that the study supported the hypothesis that humans are naturally drawn to animals.

Beetz, Turner, Hediger, Uvnäs-Moberg, and Julius (2011) found clinical implications for HAI in children with unhealthy attachment styles. Boys between the ages of 7 and 12 years, all of whom displayed insecure/disorganized attachment styles, were introduced to a situation that was socially stressful in the presence of a live dog, a toy dog, or a friendly adult (Beetz et al., 2011). Cortisol levels were measured several times before, during and after the stress induction. Participants who were placed in the condition with a live dog had significantly lower cortisol levels during, as well as after, stress induction when compared with participants in the other two conditions (Beetz et al., 2011). Thus, children with attachment problems may be better able to cope with stressful events with the companionship of a dog.

DeMello (1999) studied the effect that a companion-animal may have on physiological responses of heart rate (HR), systolic pressure (SP), diastolic pressure (DP), and mean arterial pressure (MAP) following exposure to cognitive stressors. As opposed to the majority of research in the area, this study utilized random assignment with a repeated measures design.

Men and women ranging from 26 to 50 years of age, were motivated to perform optimally on three cognitive tasks by being informed that they could earn as much as $10 contingent upon speed and accuracy (DeMello, 1999).

Participants were asked to complete three separate, but similar, cognitive tasks in a randomly assigned order (DeMello, 1999). Each participant was exposed to three conditions with regard to a companion animal: either one of two small dogs or a kid goat. The specific animals used in this study were chosen for their size, friendly disposition, and availability; they were all the researcher's or colleagues' pets. The three cognitive tasks were completed during each of three conditions which coincided with task changes: (a) pet absent, (b) pet present within visual reach, and (c) pet present within physical reach. Participants were given a resting period following each task during which time they were informed that they could look at the animal during Condition B and pat the animal during Condition C (DeMello, 1999).

Cardiovascular responses reduced significantly more during the rest period following the task in Condition B compared with the rest period in either of the other conditions (DeMello, 1999). The lack of more significant decreases in Condition C, when participants were allowed to pat the pet, were accounted for by the point that movement increases cardiovascular measures and petting is a form of movement. This account is supported by the finding that those participants who chose not to touch the pet during condition c displayed comparable blood pressure to condition b though statistics were not provided for this finding (DeMello, 1999). A comparison was not provided between responses to the type of pet that participants were exposed to.

Somerville, Kruglikova, Robertson, Hanson, and MacLin (2008) examined the immediate physiological effects of physical contact with a dog and a cat on undergraduate participants. All participants held a dog for 5 minutes and a cat for 5 minutes with a 5 minute interval of sitting without an animal present before and after each presentation. The study revealed that, on average, systolic and diastolic blood pressure significantly decreased immediately after participants held a dog or a cat (Somerville et al., 2008). These findings provide support for the calming, therapeutic effect of animals.

Support for animal-assisted therapy at a neurochemical level was found through a study of changes in both dog and human participants (Odendaal, 2000). Human participants (n = 18) were placed in the following groups: interaction with their own pet dog, interaction with an unfamiliar dog, and reading a book quietly. Data collection included sampling levels of neurochemical plasma and checking blood pressure in both human and canine participants before and after experimental manipulation (Odendaal, 2000). Results indicated that oxytocin, β-endorphin, prolactin, phenylacetic acid, and dopamine, neurochemicals that are related to psychological wellbeing, increased significantly in both human and dog participants and cortisol, a stress hormone, significantly decreased in humans.

Overall, research has supported that the presence of animals positively affects a variety of physiological responses including blood pressure, heart rate, and cortisol levels (Allen et al., 1991; Cole et al., 2007; Beetz et al., 2012; Beetz et al., 2011; DeMello, 1999; Sommerville et al., 2008). Additionally, according to LoBue and colleagues (2013), young children preferred interactions with animals over non-living substitutes (LoBue et al., 2013).

A theoretical basis was necessary in order to empirically support the value of HAI. Three related theories have been proposed. The first theory emphasizes the conditioned relaxation response. Vormbrock and Grossberg (1988) proposed that people tend to associate pets with relaxing, enjoyable activities because people tend to interact with pets during relaxing times and thus the pet becomes a conditioned stimulus for a relaxation response. Alternatively, pets may provide nonjudgmental social support which buffer adverse effects of stress (Virués-Ortega & Buela-Casal, 2006). A third theoretical basis is that HAI may increase the production of oxytocin, a peptide hormone released in response to certain types of sensory stimulation and has been found to increase empathy and social skills, counter stress, increase pain tolerance, decrease anxiety, and improve parasympathetic nervous system functioning (Beetz et al., 2012).

The three theories are not mutually exclusive and may collectively provide a basis for the benefits of HAI. A conditioned relaxation response may be formed as a result of the release of oxytocin in the brain and nonjudgmental social support provided by an animal. Most of the HAI research has been with small pets; the current study extends these concepts to interactions with horses. This eclectic approach may be more simply explained through the theoretical basis of the present study that HAI, particularly interactions with horses, facilitates mindfulness. That is, horses provide nonjudgmental support and feedback in the present moment which brings the person into a mindful state and, overtime, elicits a conditioned relaxation response and increases oxytocin levels. It was expected that the present study would find that trait mindfulness in individuals with a significant positive history of interactions with horses would be high and that while viewing the horse-human interaction video, those individuals would exhibit relative decreases in autonomic arousal, improved cardiovascular responses, and high state mindfulness.

Equine Facilitated Interventions

Research has emerged recently on the impact of interactions between humans and horses using various methods with various populations. Some research methods have been highly structured and even manualized (e.g. Klontz, Bivens, Lienart, & Klontz, 2007) while other recent research has been unstructured and qualitative (e.g. Yorke, Adams, & Coady, 2007).

Populations under study have included in-patient adults from a psychiatric facility, youth with cerebral palsy, children with Autism Spectrum Disorder (ASD), First Nations and Inuit youth with substance dependence, and at-risk youth (e.g. Bass, Duchowny, & Llabre, 2009; Ewing, MacDonald, Taylor, & Bowers, 2007; Dell et al., 2011; Davis et al., 2009; Schultz, Remick-Barlow, & Robbins, 2007). Results of studies on equine-human interactions have indicated significantly improved postural control in children with cerebral palsy, decreased symptomology and improved social skills in children with ASD, and increased Global Assessment of Functioning (GAF) scores in at-risk youth who had been exposed to intra-family violence.

Equine facilitated psychotherapy (EFP; Freund et al., 2011) focuses on psychological healing through interactions with horses. EFP has been utilized in therapy with various populations including children with learning disabilities, depression, anxiety, intellectual disabilities, and autism. Anecdotal support suggests that horses are able to assist children with Autism Spectrum Disorder (ASD) in increasing awareness of and interaction with the world around them (e.g. Friedman, 2009). A news report depicted one such case of a young boy with autism whose symptoms diminished significantly after he began regularly interacting with horses (Friedman, 2009). While this anecdote lacked scientific soundness, it did suggest that research was merited to discover the true therapeutic value of interactions with horses.

The impact of interactions between adults and horses was investigated in two recent studies (Klontz et al., 2007; Yorke et al., 2007). The studies differed with regards to goals, populations, and type of equine-human interaction. Yorke and colleagues (2007) demonstrated that the relationship between a horse and the horse's human owner may assist in recovery from a life-altering traumatic event. Klontz and colleagues (2007) provided evidence for the utility of a specific equine-assisted intervention in the psychological healing of patients in a residential program. Such changes have also been observed in studies of youth with various disabilities (e.g. Zadnika & Kastrin, 2011; Gabriels et al., 2012).

Several studies have examined the effects of hippotherapy programs on the physical and psychological functioning of youth with cerebral palsy, ASD, and learning disabilities (Zadnika & Kastrin, 2011; Davis et al., 2009; Bass et al., 2009; Gabriels et al., 2012; Macauley & Gutierrez, 2004). These studies all described their respective interventions as hippotherapy, though descriptions of protocol varied from study to study including the number of, activities within, and length of sessions. Despite the limitations, the research available for the effects of hippotherapy on youth with physical and psychological disabilities has indicated that horses have therapeutic value (Zadnika & Kastrin, 2011; Davis et al., 2009; Bass et al., 2009; Gabriels et al., 2012; Macauley & Gutierrez, 2004). Overall, these studies have provided preliminary support for the helpfulness of equine-human interactions with special populations of children including those with LLD, ASD, and cerebral palsy as well as at-risk youth in a variety of areas of functioning.

Equine-assisted interventions have also been implemented with at-risk youth. The term *at-risk youth* encompasses an array of children and adolescents who are at risk for social failure due to their individual circumstances including low SES and unsafe communities. Studies of the effectiveness of equine-assisted interventions with at-risk youth examine samples of First Nations and Inuit youth with substance abuse disorders (Dell et al., 2011), youth with a history of exposure to violence within their families (Schultz et al., 2007), students attending alternative schools (Ewing et al., 2007), and children who were individually identified by their school as being “at-risk” for social and academic failure (Trotter, Chandler, Goodwin-Bond, & Casey, 2008). The available research on the use of equine-assisted interventions with "at-risk" youth indicates that such interventions result in positive changes.

Researchers and therapists have suggested that interactions with horses have many therapeutic implications with various populations and that they may facilitate mindfulness, though the researcher is not aware of any literature to date that has specifically examined the relationship between interactions with horses and mindfulness (Klontz et al., 2007; Bass et al., 2009; & Gabriel et al., 2012; Denim 'n Dirt, n.d.). The current study proposes that horses facilitate wellbeing and wellness by promoting mindfulness, improving cardiovascular health and decreasing stressful reactions. This may occur through a classically conditioned relaxation response in which people who have significant experience with horses are classically conditioned to respond to the presentation of a horse with relaxation. Initially, one may utilize horses as a break from work and other stress, thus taking the time to allow one's self to relax and spend time with a horse. Over time, the horse itself becomes associated with relaxation and elicits a relaxation response as a conditioned stimulus.

Though the researcher was unaware of any studies that specifically examined the relationship between interactions with horses and mindfulness, some research had suggested that horses may facilitate mindfulness, based on observed and reported changes found in populations including adult participants with heterogeneous psychological difficulties and children with ASD (Klontz et al., 2007; Bass, Duchowny, & Llabre, 2009; Gabriels et al., 2012). Klontz and colleagues (2007) noted that participants in their study of *equine assisted experiential therapy* with adults in residential care reported that they were oriented more towards the present upon completion of the study. They also reported that participants considered themselves to be able to live more in the present moment with a decreased focus on problems from the past as well as anxieties over the future. Bass and colleagues (2009) found improved directed attention in youth with ASD as a result of hippotherapy and Gabriel and colleagues (2012) noted that increased expressive communication in the same population following hippotherapy may have been a result of increased awareness of the impact that behavior makes in social situations. Though those studies did not mention such terminology, the aforementioned reported changes are characteristics of mindfulness.

The current research examined the immediate effects of video-simulated interactions with a horse in a laboratory setting. The researcher measured physiological responses and self-reported state-mindfulness while participants viewed videos of horse-human, human-human, and car-human interactions. The research design allowed for an empirical examination of the immediate impact of simulated interactions with horses through physiological and psychological measures.

Mindfulness

Mindfulness refers to the ability to focus attention on the direct experience in the present moment in a nonjudgmental fashion (Rygh & Sanderson, 2004, p. 153). More specifically, according to Bishop and colleagues (2004) mindfulness has been operationally defined in a two-component model of

> self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present moment…[and] adopting a particular orientation toward one's experiences in the present moment, an orientation that is characterized by curiosity, openness, and acceptance (p. 232).

Kabat-Zinn (2014) emphasized the importance of taking time to be mindful as a means to reduce stress. Research has found that mindfulness is significantly related to psychological wellbeing, competence and autonomy (Brown & Ryan, 2003). Also, a meta-analysis of the available literature as of 2003 indicated that mindfulness-based interventions have been shown to improve overall psychological functioning and assuaging an array of mental-health problems (Baer, 2003). Mindfulness training has been found to improve cognitive inhibition as measured by the Stroop Task (Bishop et al., 2004; Williams, Mathews, & MacLeod, 1996).

A trait is a characteristic of an individual, which is generally present from day-to-day, while a state is the way in which one is in the moment (Brown & Ryan, 2003). Thus, trait mindfulness is one's overall characteristic level of mindfulness and state mindfulness is the level of mindfulness with which one is functioning in the moment. Brown and Ryan (2003) created the Mindful Attention Awareness Scale (MAAS), which is a measure of trait mindfulness, and compared self-reported trait MAAS with a shortened and altered version of the MAAS which was worded to assess state mindfulness. Results indicated a predictive relationship in that those with higher trait mindfulness were significantly more likely to have higher state mindfulness at any given time. State and trait mindfulness measures, such as the Philadelphia Mindfulness Scale and the Toronto Mindfulness Scale respectively, have been well validated, but there is a lack of literature comparing state and trait mindfulness with measures outside of the MAAS (Cardaciotto et al., 2008; Lau et al., 2006; Brown & Ryan, 2003). Though Brown and Ryan (2003) found that state mindfulness was related to trait mindfulness, this was using the same constructs for each measure. Further research is needed to determine whether these findings are generalizable to other measures of state and trait mindfulness.

Mindfulness interventions. Mindfulness exercises have been incorporated into many therapies in recent years. For example, Mindfulness-Based Cognitive Therapy (MBCT) has been shown to be particularly effective in relapse-prevention for Major Depressive Disorder (Teasdale et al., 2002; Young, Rygh, Weinberger, & Beck, 2008). In a study of the effect of Mindfulness

Based Stress Reduction (MBSR) on women who had recently been diagnosed with breast cancer in its early stage, women who participated in 8 weeks of MBSR exhibited significant increases in health, reported quality of life, and coping skills as compared to a control group that did not participate in MBSR (Witek-Janusek et al., 2008).

Delgado and colleagues (2010) examined the physiological and psychological effects of a mindfulness-based intervention for individuals with chronic worry as compared with progressive muscular relaxation training. Both interventions equally produced clinical improvements as measured by self-reports of decreased worry. Both groups demonstrated significant decreases in heart rate and respiration following the interventions (Delgado et al., 2010). The mindfulness group displayed significantly higher emotional meta-cognition, which included perception, comprehension, and regulation of emotional experiences, following the intervention when compared to the relaxation group. Thus, while relaxation was helpful in decreasing symptoms of chronic worry, a mindfulness-based intervention was superior in facilitating emotional regulation to counter worry (Delgado et al., 2010).

Galantino, Baime, Maguire, Szapary, and Farrar (2005) conducted a study of the psychological and physical effects of a mindfulness meditation (MM) program with health-care professionals. The intervention included 8 weekly two-hour sessions and participants practiced the mindfulness techniques learned in session every day for 30 minutes. Upon completion of the program, participants reported significantly improved mood and level of emotional exhaustion as measured by the Profile of Mood States—Short Form, and the Maslach Burnout Inventory respectively (Galantino et al., 2005).

More and more studies have emerged in recent years in support of mindfulness-based interventions in the treatment of youth. Mindfulness-based interventions have been found to be helpful for several populations including those with ADHD or conduct disorder, incarcerated youth, and youth in a psychiatric facility (Himelstein, Hastings, Shapiro, & Heery, 2012; Singh et al., 2007; Weijer-Bergsma, Formsa, Bruin, & Bögels, 2012; Biegel, Brown, Shapiro, & Schubert, 2012; Ciarrochi, Kashdan, Leeson, Heaven, & Jordan, 2011). Findings have indicated that mindfulness-based interventions have resulted in positive change for youth with a variety of difficulties.

A qualitative study with incarcerated youth indicated that a mindfulness-based intervention may be both feasible and effective at increasing self-regulation, psychological wellbeing, and awareness (Himelstein et al., 2012). Researchers implemented the Mind Body Awareness (MBA) project, a 10-week intervention based in mindfulness that included training in mindfulness meditation, experiential activities focusing on emotional intelligence, group process, and discussions. The MBA was developed specifically for incarcerated youth (Himelstein et al., 2012). The intervention followed a structured group format of 10 weekly sessions as designed by Himelstein (2009) with a slight variation to 60 minute sessions from the 90 minute sessions comprising the original design (Himelstein et al., 2012). Twenty-three incarcerated teens, aged 14-18 years, volunteered to participate in a 10-minute semi-structured interview with regards to their experience with the MBA project immediately following the final session (Himelstein et al., 2012). Major themes that emerged from analysis of the interviews included improved self-regulation, subjective wellbeing, and self-awareness as well as acceptance towards the intervention.

Another recent study sought to understand the effects of two factors of mindfulness, experiential awareness and acceptance, with adolescents (Ciarrochi et al., 2011). A large sample of students (*N*= 776) from 10th grade was administered a packet of measures at the start of the study, then administered the same packet one year later in 11th grade (*n* = 572). Mindfulness was measured with a revised version of the Child and Adolescent Mindfulness Measure (CAMM-20) and results were compared with those from measures of emotional wellbeing, psychoticism, personality, emotional awareness, and psychological flexibility (Ciarrochi et al., 2011). Results indicated that acceptance and awareness, two aspects of mindfulness, were linked to adolescent psychological wellbeing.

In a randomized control trial (RCT), Biegel and colleagues (2009) examined the effects of MBSR on adolescents being treated at a psychiatric outpatient facility. Participants (*n* = 102) ranging from 14 to 18 years of age were recruited from an outpatient psychiatric facility and randomly assigned to either the adjunctive MBSR group or the Treatment As Usual (TAU) group. Those placed in the TAU group were treated as deemed appropriate for the presenting problems with treatment including individual psychotherapy, group therapy, and/or medication management. In addition to TAU, participants in the experimental group received eight 2-hour weekly sessions of MBSR modified from the manualized protocol for appropriateness with adolescents (Biegel et al., 2009). Self-report measures of change included the State-Trait Anxiety Inventory, Perceived Stress Scale , Rosenberg Self-Esteem , sleep quality change), and Symptom Checklist-90-R. Results indicated that participants in the MBSR group reported significantly greater decreases in anxiety, depression, and somatization as well as increased self-esteem and quality of sleep than participants in the control group whom received only TAU (Beigel et al., 2009). Significant changes were sustained at a 3-month follow-up. Therefore, based upon Beigel and colleagues (2009), MBSR may be an important treatment consideration for youth with a variety of presenting problems.

A study in the Netherlands investigated the effects of a mindfulness training program that was designed both for adolescents with ADHD and their parents (Weijer-Bergsma et al., 2012). Parents (*n* = 19) and adolescents (*n* = 10) received weekly 1.5 hour structured sessions for 8 weeks in a group format. Parents were trained in mindful parenting and adolescents were provided with mindfulness training to improve focus, attention, self-control, and awareness (Weijer-Bergsma et al., 2012). Measures of change used in the study had good psychometric properties and were designed to assess behavioral symptoms, executive functioning, mindful awareness, parenting stress, parenting style, fatigue, happiness, and attention (Weijer-Bergsma et al., 2012).

Results indicated that adolescent participants demonstrated significant reductions in externalizing and internalizing behaviors and attentional problems (Weijer-Bergsma et al., 2012). Also, improvements in executive functioning were indicated in self-report measures and through computerized tests of attention (Weijer-Bergsma et al., 2012). These results were maintained at the 8-week follow-up, but diminished at the 16-week follow-up. Though the treatment was intended to be a mindfulness-based intervention, no change was reported in mindful awareness (Weijer-Bergsma et al., 2012). This finding may be due to the measure used, the Mindful Attention and Awareness Scale (MAAS), a measure of trait mindfulness, though the researchers considered that a state mindfulness measure may have been more appropriate. Also, the small sample size may have inhibited the emergence of significant results (Weijer-Bergmsa et al., 2012). In conclusion results indicated that the mindfulness intervention did facilitate positive change in adolescents with ADHD, but failed to facilitate mindfulness as measured by the MAAS.

Greenberg and Harris (2012) presented positive results in addition to the shortcomings of research on mindfulness in youth and provided suggestions on how studies may be improved in a review of the current literature. They determined that preliminary results have indicated that mindfulness practices have several psychological, social, and health benefits including improved overall psychological wellbeing, decreased anxiety, improved focus, and decreased symptoms of asthma. Greenberg and Harris (2012) noted that most of the current literature is not without flaws that inhibit definitive conclusions with regards to the effects of mindfulness on youth such as a lack of randomized control, limited sample sizes, and poor explanation of design. Most mindfulness interventions under study were derived from adult interventions, some of which may not be appropriate for children, such as those requiring stillness for a period of time. Greenberg and Harris (2012) recommended that future mindfulness research include RCTs using age-appropriate interventions with clear descriptions of the interventions used including duration and collaboration across scientists and practitioners.

Connectedness to nature. There is mounting qualitative and quantitative evidence in support of the utility of mindfulness-based and equine-related interventions with at-risk youth as well as indications that horses may facilitate mindfulness. In support of the reports of increased mindfulness upon completion of equine-assisted interventions, research has supported that mindfulness significantly correlates with *nature connectedness*, one’s sense of meaningful involvement with nature, based upon a survey study with undergraduates (Howell, Dopko, Passmore, & Buro, 2011). Howell and colleagues (2011) found that the present moment awareness aspect of mindfulness was the strongest correlate of nature connectedness. Furthermore, Wolsko and Lindberg (2013) found that higher connectedness to nature was related to higher trait mindfulness and more time spent partaking in outdoor activities such as hiking, cross-country skiing, backpacking, and non-motorized boating.

The positive relationship between mindfulness and connectedness to nature was an important consideration for the present study because those without experience with horses may have still had a strong connectedness to nature (Howell et al., 2011; Wolsko & Lindberg, 2013). Therefore, connectedness to nature was statistically controlled. Howell and colleagues (2011) and Wolsko and Lindberg (2013) also provided a link for the hypothesis that individuals who have had experience with horses would have higher mindfulness since a relationship with a horse is a type of relationship with nature. The present study investigated whether interactions with horses facilitated mindfulness through video simulations. Relationships between long-term interactions with horses, and physiological responses were also explored.

Physiological Arousal

HAI has been linked to improved psychological and physiological functioning similar to improvements linked to mindfulness (e,g, Beetz et al., 2012; Zeidan, Johnson, Gordon, & Goolkasian, 2010). Changes in physiological arousal may be the process by which both HAI and mindfulness interventions relate to improvements in functioning. The sympathetic nervous system (SNS) is the part of the autonomic nervous system (ANS) which is activated in stress such that one is prepared for a fight or flight response (Andreassi, 2007). Heart rate and heart rate variability are both measures of cardiovascular functioning (Tursky & Jamner, 1982). Heart rate (HR) is the measure of the number of beats per minute (bpm; Tursky & Jamner, 1982) while *heart rate variability* (HRV) refers to the consistency of the interbeat interval between heart beats (Berntson et al., 1997). HRV is a commonly used measure of physiological as well as psychological wellbeing (Burg, Wolf, & Mickalak, 2012). Lower HRV is indicative of mortality and health problems including arrhythmia, and other major health concerns as well as increased SNS activation and a greater risk for psychopathology (Malik & Camm, 1990; Thayer & Lane, 2009). In general, lower HR is indicative of more efficient cardiovascular functioning and cardiovascular health (Laskowski, 2012).

Electrodermal Response (EDR), a measure of skin conductance, is also used to measure SNS arousal (Andreassi, 2007). Therefore, increased HRV and decreased EDR are indicative of lower physiological arousal and thus improved physiological and psychological wellbeing. Both Mindfulness and HAI have been found to be related to increased HRV and decreased EDR as well as improvements in psychological wellbeing (Allen et al., 2002; Prazak et al., 2012; Burg et al., 2012; Zeidan et al., 2010; Garland, Gaylord, Boettiger, & Howard, 2010; Lush et al., 2009; Wolever et al., 2012).

Prazak and colleagues (2012) examined relationships among mindfulness and physiological and psychological wellbeing. Physiological wellbeing was measured in terms of HRV; psychological wellbeing was measured through scales of existential wellbeing, overall psychological wellbeing, and social inhibition; and mindfulness was measured by the Kentucky Inventory of Mindfulness Skills (KIMS). Results indicated that mindfulness was a significant predictor of healthier and higher HRV as well as psychological wellbeing (Prazak et al., 2012).

In order to determine whether HRV was correlated with mindfulness, Burg and colleagues (2012) utilized a mindfulness breathing exercise and assessed the degree that participants maintained a state of mindfulness while measuring HRV. The mindful breathing exercise was a computerized task that measured the ability to maintain a state of mindfulness of breath during a 22-minute period by prompting participants to press the left button of a computer mouse if they are attending to their breath or the right button if they were not attending to their breath when a tone is presented at random intervals. Burg and colleagues (2012) found that HR was not associated with mindfulness, but that HRV was positively associated with mindfulness during the breathing exercise, $r = .36$, $p < .05$.

Zeidan and colleagues (2010) examined the short-term effects of a brief mindfulness intervention as compared with a sham mindfulness intervention and a control group. Participants were broken into small groups of 5 to 7 participants that met for 20 minutes daily for three consecutive days. All participants were informed that they were learning mindfulness (Zeidan et al., 2010). The mindfulness group consisted of mindfulness meditation exercises led by an experienced facilitator. The sham mindfulness group consisted of breathing exercises during which participants were reminded periodically that they were practicing mindfulness meditation (Zeidan et al., 2010). Participants in the control group were allowed to interact with one another while staying seated during sessions. Among the measures of change were heart rate (HR) and self-report measures of anxiety and mood (Zeidan et al., 2010). While negative mood and HR significantly decreased across all three groups, those decreases were greatest for the mindfulness meditation group.

Garland and colleagues (2010) examined the effects of a mindfulness-based intervention for alcohol recovery compared with an alcohol dependence support group in a pilot RCT. More specifically, the study aimed to determine the intervention effects on perceived stress, inhibition of alcohol response, alcohol cravings, psychological wellbeing, thought suppression, mindfulness, and recovery of HRV following stress-primed alcohol cues. Thought suppression increased in the support group, but significantly decreased in the mindfulness group during exposure to alcohol cues. Results also indicated that HRV was significantly higher and perceived stress was significantly lower in the mindfulness group during exposure to alcohol cues than participants in the support group condition (Garland et al., 2010).

Psychophysiological correlates of mindfulness meditation have been identified in a study of interventions intended to reduce symptoms of fibromyalgia (Lush et al., 2009). The study examined the activation of the SNS of women suffering from fibromyalgia during meditation prior to and following MBSR training through measurement of HR, EDR, and peripheral temperature. Results indicated that EDR significantly decreased following the intervention (Lush et al., 2009).

Wolever and colleagues (2012) analyzed ways in which stress reduction programs could be feasibly and effectively implemented in a high-stress work environment. In this randomized control trial, volunteers were placed in one of the following conditions: therapeutic yoga, mindfulness at work, or a control condition. Participants in the therapeutic yoga condition participated in a 12 week Viniyoga Stress Reduction program which taught yoga postures, breathing, guided relaxation, and other techniques to reduce stress (Wolever et al., 2012). The mindfulness at work condition was a stress management program that taught mindfulness meditation. Participants in the control condition were given a list of available resources for mental health and wellness. HRV significantly increased following the mindfulness intervention compared with therapeutic yoga or control conditions (Wolever et al., 2012).

Improvements in physiological and psychological wellbeing have been shown to occur in response to mindfulness interventions (Prazak et al., 2012; Burg et al., 2012; Zeidan, et al., 2010; Garland et al., 2010; Lush et al., 2009; Wolever et al., 2012). These improvements have included decreased EDR, increased HRV, and overall psychological wellbeing. The present study investigated markers of physiological and psychological wellbeing associated with interactions with horses. Expectations, based on review of studies involving HAI and mindfulness interventions, were that simulated interactions with horses would result in decreased EDR and increased HRV. Consistent with the theory of conditioned relaxation response, arousal was expected to be reduced, especially for participants who had prior experience with horses.

Video Simulations

Field studies are useful for understanding the clinical implications of intervention in a real-world situation. However, results are often clouded with confounding variables that are out of the control of the experimenter such as the presence of other animals and people, potential for negative interactions, and safety concerns. Thus, laboratory research is an important step in understanding the clinical implications of human-horse interactions with a greater ability to control for potentially confounding variables. This will be accomplished in the present study through video simulation of human-horse interactions.

Wingard and Maltzman (1980) examined whether recreational interest acted as a predeterminer for eliciting an orienting response (OR) as measured by galvanic skin response, also known as electrodermal activity (EDA). Orienting response can be measured by a spike in EDA in response to a conditioned stimulus (Fuhrer, Baer, & Cowan, 1973). Undergraduate students who were exclusively members of the campus surfing, fishing, or chess clubs were recruited for the study (Wingard & Maltzam, 1980). Participants viewed a series of images depicting surfing, playing chess, and fishing while EDA was recorded (Wingard & Maltzman, 1980). An increase in EDA was observed when participants viewed pictures of their activity of interest. Wingard and Maltzman (1980) concluded that participants displayed an OR to familiar stimuli.

Kjellgren and Buhrkall (2010) examined the restorative effects that relaxation may have on an individual in a natural environment compared with a video simulation of the same natural environment. Individuals on a waiting list at a stress clinic were recruited for the study and all participants were randomly selected from a wait-list at a stress clinic in Sweden and all suffering from stress or burnout syndrome per self-report or diagnosis by a physician. Participants in the natural environment condition sat on a bench in a nature park with trees, rivers, and lakes (Kjellgren & Buhrkall, 2010). Participants in the video-simulation group sat a table and viewed a slideshow of 97 images that were photographed from the bench where participants in the natural environment condition were seated. All participants were asked to complete a syllogism test in order to induce stress (Kjellgren & Buhrkall, 2010). Pulse and blood pressure were measured before and after 30 minutes of exposure to the environments. Results indicated that both environments equally reduced self-reported stress and no significant difference was found in pulse and blood pressure for the two conditions (Kjellgren & Buhrkall, 2010). Though more benefits were found in the natural environment, both environments induced positive changes following a stress-inducing task. Given the use of a simulated environment is a valid tool for psychological research for the simulation of a natural environment to effectively induce comparable restorative effects to being in a natural environment (e.g. Kjellgren & Buhrkall, 2010), it was expected that video-simulations utilized in the present study would induce changes similar to those that would be experienced in the actual environments.

Current Study

Video simulation was used to determine the impact of human-horse interaction on physiological arousal and self-reported mindfulness. In addition, associations among actual experience with horses, mindfulness, and physiological arousal were explored. Dependent variables included state mindfulness, EDR, and HRV. Independent variables included experience with horses, trait mindfulness, and video condition. Video order and connectedness to nature were controlled through inclusion as covariates in analyses. . .

The aim of the present study was to examine the impact of simulated interactions with a horse compared with other types of simulated interactions on levels of mindfulness and related physiological responses. This involved participants with and without experience with horses watching videos of horse-human, car-human, and human-human interactions while physiological measures of skin conductance and heart rate were recorded. Self-report measures of mindfulness were utilized in addition to physiological measures. Expected results of the study were as follows:

Hypothesis 1: Experience with horses will be associated with greater (a) trait mindfulness, (b) state mindfulness, and (c) higher HRV and lower EDA.

Hypothesis 1a: Based upon previous research in which trait mindfulness was found to be significantly correlated with nature connectedness (Howell et al., 2011), trait mindfulness, as measured by the Philadelphia Mindfulness Scale at the beginning of the experiment, will be higher overall in individuals who have had significant recent experience with horses as compared with individuals without significant recent experience with horses.

Hypothesis 1b: Several studies have found changes in individuals following human-horse interactions, which are indicative of increased mindfulness (Klontz et. al, 2007; Bass et al., 2009; and Gabriels et al., 2012). As such, individuals with horse experience are expected to have higher state mindfulness overall than those without experience with horses. Since participants who did not have experience with horses may still have had high levels of nature connectedness and Howell and colleagues (2011) found that nature connectedness was related to mindfulness, nature connectedness was be statistically controlled to examine the relationship of horse experience with mindfulness over and above general nature connectedness.

Hypothesis 1c: Research has indicated that both long-term and short-term HAI are related to improvements in cardiovascular responses and lower EDR (Allen, et al., 1991; Cole et al., 2007; Beetz et al., 2011; Beetz et al., 2012; DeMello, 1999; Sommerville et al., 2008). Individuals with horse experience were expected to have lower EDA and higher HRV overall after controlling for nature connectedness.

Hypothesis 2: Higher levels of trait mindfulness will be associated with (a) higher state mindfulness, and (b) higher HRV and lower EDA.

Hypothesis 2a: Brown and Ryan (2003) found that trait mindfulness, as measured by the MAAS, and state mindfulness, as measured by an altered and shortened version of the MAAS, had a significant predictive relationship ($r = .70$, $p < .001$). Also, studies have provided evidence that the Toronto Mindfulness Scale and the Philadelphia Mindfulness Scale are reliable and valid measures of state and trait mindfulness respectively (Lau et al., 2006; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). It is predicted that individuals with higher self-reported trait mindfulness will have higher self-reported state mindfulness than individuals with lower trait mindfulness.

Hypothesis 2b: A significant relationship has been found between mindfulness and lower EDR and as well as higher HRV (Burg et al., 2012; Zeidan et al., 2010; Lush et al., 2009). Therefore, a negative relationship is predicted between trait mindfulness and EDR and a positive relationship was predicted between trait mindfulness and HRV.

Hypothesis 3: HVR and EDR are known to increase as a response to the introduction of a stimulus (Andreassi, 2007). During the baseline blank screen condition, no stimulus was introduced while stimuli were introduced in all other video conditions. Thus, EDR and HRV are expected to be lower during baseline than during any video.

Hypothesis 4: Experience with horses will be associated with greater (a) state mindfulness, and (b) higher HRV and lower EDA, when viewing the horse video.

Hypothesis 4a: Several studies have found changes in individuals following human-horse interactions which are indicative of increased mindfulness (Klontz et. al, 2007; Bass et al., 2009; Gabriels et al., 2012). As such, an interaction is predicted between horse experience and the horse video which was expected to be related to higher state mindfulness in which participants with horse experience during the horse video were predicted to have the highest state mindfulness.

Hypothesis 4b: Vormbrock and Grossberg (1988) posited that improved cardiovascular measures as a result of HAI may be due to a conditioned relaxation response. The EDR and HRV were therefore expected to be particularly impacted when those with horse experience watch the horse video. Thus, it was expected that the interaction between horse experience and the horse video would be related to decreased EDR and increased HRV.

Hypothesis 5: Experience with horses, combined with high trait mindfulness will be associated with greater (a) state mindfulness, and (b) higher HRV and lower EDA, especially when viewing the horse video.

Hypothesis 5a: Given that individuals with experience with horses are expected to have higher state mindfulness and trait mindfulness is expected to be related to state mindfulness, those with significant experience with horses and high trait mindfulness are predicted to have the highest level of state mindfulness.

Hypothesis 5b: Given that individuals with experience with horses are expected to have lower EDR and higher HRV and trait mindfulness is expected to be related to EDR and HRV, those with significant experience with horses and high trait mindfulness were expected to have the lowest EDR and the highest HRV.

Method

Participants

The sample consisted of 42 undergraduate students at University of South Carolina Aiken (USCA). More participants lacked experience with horses (*n* = 26) than were experienced with horses (*n* = 16). Following University of South Carolina Institutional Review Board (IRB) approval, participants were recruited through two separate signup sheets; the signup sheets were separated by condition to recruit both those with experience with horses and those without experience. Qualifications for group inclusion were determined at the start of the experiment. Participants who reported having interacted with horses for a minimum of one hour per week on average this year or having owned a horse, taken horseback riding lessons, or interacted with a horse more than 3 times in the last 10 years were placed in the horse experience group. Those who reported being very much afraid of horses or very much afraid to touch or sit on a horse were excluded from the study (*n* = 1).

Due to a limited pool of students in Psychology 101 at USCA with experience with horses, the participant pool was expanded to all undergraduate students following IRB approval. Psychology 101 students received course credit for participation and one biology class was offered extra credit for participation. All other participants received no compensation for participation. American Psychological Association (APA) ethical guidelines for research with human participants were abided throughout the course of the study.

Design

The present study followed a 4 (video condition) x 2 (horse experience) mixed between and within ANOVA design with trait mindfulness, connectedness to nature, and video order as covariates. The within subject component of the experiment was the type of video watched. All participants watched short (approximately 5 minute) videos of close interactions between a horse and a human, a car and a human, and two humans. The order of the videos was randomized for each participant. The between subject component of the experiment was participants with experience with horses as compared to participants without experience with horses.

The four video conditions were used to determine to what extent human-horse interaction elicited a relaxation response as compared with other normal interactions (human-car and human-human) and no interaction (baseline). A human-horse interaction video was used to elicit a conditioned relaxation response among those with horse experience. This was a video of a woman practicing *natural horsemanship* with a horse in a pasture. Natural horsemanship has been described as a special way of interacting with horses in which "the emphasis is on kindness, with particular emphasis on communicating with—and learning to understand from the horse's point of view—the natural behavior of horses" (p. 218, Birke, 2007). The purpose of using the selected video was to simulate positive interactions with a horse through natural communication. A human-car interaction video was used as a presentation of interaction between a human and an inanimate object which was not designed to elicit a relaxation response. This was a video of a woman washing her vehicle. A human-human interaction video was used to elicit a response to intimate human interactions. This was a video of a man and a woman learning to dance together. A baseline condition was used to obtain resting physiological responses before manipulation as well as state mindfulness with no video simulated interactions. This was obtained by asking participants to sit quietly while viewing a blank screen. The two control videos and the baseline video were included to assess the unique effects of human horse interaction over and above other types of interactions.

The video conditions of different types of interactions may elicit positive and negative emotions. Following each condition, a brief assessment of positive and negative affect was performed. This allowed the researcher to control for affective responses to ensure that significant findings related to physiological responses were not due to affective consequences.

Procedure

Participants were tested individually in a University of South Carolina Aiken research laboratory room by the researcher. The total time for each participant to complete the experiment averaged approximately 30 minutes. Each participant was seated in front of a computer monitor for the entirety of the experiment. First, written consent was obtained and then participants were asked to complete a packet which included a brief demographics questionnaire, the Philadelphia Mindfulness Scale, and the Connectedness to Nature Scale. After completing the packet, the researcher prepared participants for collection of physiological data. The R-R interval data collected through the ECG was optimized for the study of HRV (BioPac, Inc., nd). First, the researcher ensured that the ECG100C amplifier was set up appropriately as follows: the gain was set to 1000, the mode was set to “NORM”, the LPN filter read “35Hz LPN ON”, and the HP filter read “0.5Hz HP ON”. Next, the acquisition sample rate on the software was set to 1000 Hz (BioPac, Inc., nd). After the hardware and software were properly setup, participants were prepared for data collection. Prior to application of the electrodes, the electrode sites were prepared by removing dead skin with a scrubbing pad, cotton swabs, and water (BioPac, Inc., nd). The wires for HRV were attached to disposable electrodes with gel and an adhesive surface. For the present study, the only required movement was pressing buttons on the keyboard between conditions. The ECG electrodes were placed on the arms were applied to the outside of each arm above the elbow. EDA electrodes with adhesive surfaces were place on both sides of the palm of the nondominant hand. Tape was applied when necessary on an individual basis. An E-Prime 2 program was created for the experiment and linked with BioPac. The program displayed instructions, randomly ordered the three interaction videos to follow the baseline blank screen, and presented questions to be answered between conditions.

After participants were connected to the physiological recording device, they were told by the researcher to, "Please sit still and quietly while looking forward at the screen in front of you. Read the directions on the screen and follow the directions. You will first see a blank screen which will be presented for 5 minutes and then you will be prompted to answer some questions before watching a few other short video clips after which you will respond to questions. The videos have people in them and I want you to consider that you are the person in the video." After the participant read the directions and pressed the space bar as prompted to begin the blank screen condition, AcqKnowledge software automatically calibrated to the individual and established a baseline HRV and EDR. Following the completion of each video and baseline condition, the computer program prompted the participant to respond to the items Toronto Mindfulness Scale, a measure of state mindfulness, as well as the Positive and Negative Affect Scale. Answers were automatically recorded with E-Prime 2 software. When the participant has completed the questionnaires the procedure was repeated for the next two randomly assigned video conditions.

Measures

Trait mindfulness. The Philadelphia Mindfulness Scale, a 20-item, bidimensional measure broken into present-moment awareness and acceptance was used to assess trait mindfulness (Cardaciotto et al., 2008). Written instructions are to endorse to what degree each item is true in reference to the past week on a 5-point Likert scale ranging from 1 = *Never* to 5 = *Very often*. The 10-item Awareness subscale is described as measuring one's continuous attention to the present moment experience without distraction from thoughts of the past or future (e.g. "When I walk outside, I am aware of smells or how the air feels against my face.", Cardaciotto et al., 2008). The 10-item Acceptance subscale is described as measuring the extent to which one attends to the present moment with nonjudgmental acceptance of the experience (e.g. "I try to distract myself when I feel unpleasant emotions."). Both subscales of the Philadelphia Mindfulness Scale can range from a total score of 10 to 50 with higher scores on the Awareness subscale indicating higher present moment awareness and lower scores on the Acceptance subscale indicating higher acceptance (Cardaciotto et al., 2008). Howell and colleagues (2011) noted that the Philadelphia Mindfulness Scale was better able to detect mindfulness in relation to nature connectedness as compared to the Mindful Attention Awareness Scale (MAAS). Validation analyses in a nonclinical sample showed that the awareness and acceptance subscales of the Philadelphia Mindfulness Scale were significantly related to the MAAS, $r(164) = .21$, $p <.001$, $r(164) = .32$, $p < .001$ respectively (Cardaciotto et al., 2008). Internal consistency reliability (Cronbach's alpha) for the current sample was .90 for the 10 item acceptance subscale and .78 for the 10 item awareness subscale. Acceptance and awareness were not significantly correlated at $r(36) = .16$, $p = .17$.

State mindfulness. The Toronto Mindfulness Scale (TMS) is a well validated bi-dimensional 13-item measure of state mindfulness standardized for adults (Lau et al., 2006).

Written instructions are to endorse to what extent each statement describes what one just experienced on a 5-point Likert scale ranging from 0 = *not at all* to 4 = *very much*. The 6-item Curiosity subscale of the TMS is intended to measure present moment awareness with a sense of curiosity (e.g. “I was curious about each of the thoughts and feelings that I was having.”, Lau et al., 2006). The 7-item Decentering subscale is intended to measure present moment awareness while experiencing one’s self as separate from the experience (e.g. “I experienced myself as separate from my changing thoughts and feelings.”). The Curiosity subscale ranges from a total score of 0 to 24 and the Decentering subscale ranges from a total score of 0 to 28 with higher scores for both subscales indicating higher mindful curiosity and decentering respectively (Lau et al., 2006). This scale was designed to measure state mindfulness and was intended to be administered immediately following a mindfulness exercise to determine the extent to which individuals found themselves in a mindful state during the exercise. Discriminant validity testing indicated that curiosity and decentering are two separate constructs, $\chi^2(1) = 349.74$, $p < .001$ (Lau et al., 2006). The TMS was further shown to be a valid measure of state mindfulness with a pre- and post- Mindfulness Based Stress Relief which showed a significant effect of the intervention on curiosity, $t(98) = 3.41$, $p < .001$ and decentering, $t(98) = 5.07$, $p < .001$, with higher scores following intervention (Lau et al., 2006). The TMS will be used in the present study following each condition to measure the degree to which participants find themselves in a mindful state during each condition. Cronbach’s alpha was calculated for the curiosity and decentering subscales during each of the video conditions and ranged from .87 for curiosity during the baseline screen to .92 during the dance video and .36 for decentering during the horse video to .68 during the car wash video.

Connectedness to Nature Scale. The Connectedness to Nature Scale is a14-item measure of feeling of oneness with nature (Mayer & Frantz, 2004). Items involve endorsement of how close one feels to nature (e.g. "I think of the natural world as a community to which I belong"). This is a self-report questionnaire with a 5-point Likert scale ranging from 1 = *Strongly disagree* and 5 = *Strongly agree* with higher overall scores, after reverse scoring items 4, 12, and 14, indicating higher nature connectedness. The Connectedness to Nature Scale was shown to have high convergent validity with a measure of beliefs regarding and relationship with earth, the New Environmental Paradigm, ($r = .52$, $p < .001$). Internal consistency reliability for the current sample was .53.

Positive and Negative Affect Schedule. The Positive and Negative Affect Schedule (PANAS) is a 20-item measure of affect with two subscales, Positive Affect and Negative Affect (Watson, Clark, & Tellegen, 1988). Items involve endorsement of how strongly one experiences 10 positive (e.g. "interested") and 10 negative (e.g. "irritable") feelings on a 5-point Likert scale ranging from 1 = *very slightly or not at all* to 5 = *extremely* with higher scores indicating higher positive and negative affect respectively. Watson and colleagues (1988) found that convergent validity was supported with good correlations, .76 to .92, with the PANAS subscales and other related measures including measures used by Diener and Emmons (1985). Cronbach's alpha was calculated for the positive and negative affect subscales during each of the video conditions in the current study and ranged from .88 for positive affect during the baseline screen to .94 during the car wash video and .36 for negative affect during the horse video to .57 during the dance video.

Physiological Measures. BioPac system was utilized to obtain physiological measures of EDR and electrocardiography (EKG; Biopac Systems, Goleta, CA). EDR is the measure of change in skin conductance (SC) which is used in research to reflect change in the level of sweat secretion in response to physical and psychological factors such as fear and arousal (Andreassi, 2007). HRV, time between heart beats, and HR were measured by an EKG device. Physiological data from each condition was manually split into ten 30-second intervals. Artifacts were visually identified and removed. Two participants without horse experience were excluded from analyses due to an excess of artifacts. In order to optimize the reliability of the data based upon statistical analysis, the first and last two 30-second intervals were removed for analysis.

Electrodermal response. The inner layer of the skin, the dermis, contains blood vessels, and hair follicles among other structures (Andreassi, 2007). In addition to other protective factors, the skin is important for thermoregulation in which sweating is increased and blood vessels in the skin are dilated in order to decrease temperature in the skin and the body. Alternatively, *piloerection*, more commonly known as "goose bumps", occurs through the constriction of the blood vessels located in the skin and functions to maintain warmth in the body (Andreassi, 2007).

Sweating is also important in areas other than thermoregulation including emotional arousal which is indicative of changes in SC as well as skin potential (SP) or the potential difference between sites on the skin (Andreassi, 2007). Eccrine sweat glands in the palm of the hand and finger tips are activated primarily in response to psychological, rather than physical, stimuli. This is the type of sweat that occurs when one is nervous or fearful and notices "clammy" or sweaty palms (Andreassi, 2007).

Changes in electrodermal activity (EDA) or EDR occur in response to both sensory and psychological stimulation (Andreassi, 2007). EDA is highly correlated with the sympathetic nervous system (SNS). It is thought that the SNS fibers, which begin in the spinal cord's ventral roots, stimulate the secretion of sweat and the muscles which control piloerection. An EDR may be detected 1 to 3 seconds following the presentation of a stimulus (Andreassi, 2007). Increased sweat production leads to lower skin resistance and higher skin conductance. Cronbach's alpha was calculated for the EDR between the six 30-second intervals during each of the video conditions and ranged from .52 during the baseline screen to .68 during the car wash video.

Heart rate. Heart rate, measured in heart beats per minute, is controlled by the sinoatrial node, which is a natural pacemaker, and is moderated by vagus nerve activation (Klabunde, 2014). The rhythm of the heart rate is affected by mechanisms in the parasympathetic and sympathetic nervous systems (Berntson et al., 1997). For example, acetylcholine is released by the parasympathetic nervous system (PNS) to slow the heart rate and norepinephrine is released by the sympathetic nervous system (SNS) to increase the heart rate. Cronbach's alpha was calculated between the six 30-second intervals for the HR during each of the video conditions and ranged from .95 in the dance video to .98 in the blank screen condition.

Heart rate variability. A well validated measure of changes in heart rate is heart rate variability (HRV; Berntson et al., 1997). The measure of HRV will be accomplished with BioPac hardware and AcqKnowledge software which will follow an automatic three-stage algorithm (BioPac, Inc., nd; See table 1). First, R-R intervals are extracted with a modified Pan-Tompkins QRS detector. Next, R-R intervals are resampled to obtain a continuous sampling rate which allows for the extraction of frequency information (BioPac, Inc., nd). Finally, the extracted frequency information is analyzed for the product of standard ratios in sec^2/Hz.

The ECG measures a series of five deflections, the "P", "Q", "R", "S", and "T" waves (BioPac, Inc., nd). Of interest in the study of HRV is the succession of the Q, R, and S waves, collectively known as the QRS Complex which occurs rapidly in response to a single event and is measured by the Pan-Tompkins algorithm and is used to convert individual HRV into a standardized measure. The Q wave is a downward deflection following the P wave (BioPac, Inc., nd). Next, the R wave is a significant upward deflection followed by the downward deflection of the S wave which deflects further down than the Q wave. Figure 1 showed a schematic representation of a normal ECG. HRV is measured as changes in the amount of time that passes during R-R intervals or the peak of one R wave to the next R wave peak (Berntson et al., 1997). Cronbach's alpha was calculated for the HRV based on the six 30-second intervals during each of the video conditions and ranged from .81 in the blank screen condition to .87 in the horse video for HRV.

Results

Descriptive information is provided for the current sample, and on normative samples, on the Philadelphia Mindfulness Scale, TMS, CNS, and PANAS. Only information from the current sample was available for EDA, HR, and HRV. The current sample scored somewhat higher on the Awareness (*M* = 37.03, *SD* = 5.10) and Acceptance (*M* = 33.76, *SD* = 7.17) subscales of the Philadelphia Mindfulness Scale than a previous normative sample (*M* = 36.65, *SD* = 4.93 and *M* = 30.19, *SD* = 5.84, respectively, Cardaciotto et al., 2008). The current sample scored lower on average on the Curiosity subscale of the TMS with mean scores ranging from 12.43 (*SD* = 6.19) in the car wash video condition to 14.68 (*SD* = 5.67) in the blank screen condition compared with a previous sample mean of 19.46 (*SD* = 9.74; Lau et al., 2006). The Decentering subscale of the TMS was similarly low in the current sample with mean scores ranging from 14.84 (*SD* = 4.15) in the blank screen condition to 16.92 (*SD* = 3.51) in the horse video condition compared with the previous sample mean of 19.15 (*SD* = 8.41; Lau et al., 2006). Despite the mean scores for subscales of the Philadelphia Mindfulness Scale and the TMS in the current sample being somewhat different from the mean scores in the normative samples, they all were less than one standard deviation away from the normative means, indicating that the scores fell in the normative range.

The mean score on the CNS was slightly lower for the current sample (*M* = 47.18, *SD* = 5.08) than a previous normative sample (*M* = 51.1, *SD* = 8.96; Mayer & Frantz, 2004). The current sample scored similarly on the Positive Affect subscale of the PANAS with mean scores ranging from 22.14 (*SD* = 8.98) during the car wash video to 29.22 (*SD* = 7.96) during the horse video compared with a previous normative sample mean of 29.70 (*SD* = 7.90; Watson & Clark, 1988). However, the current sample mean for the Negative Affect scale of the PANAS was lower with mean scores ranging from 11.51 (*SD* = 2.30) during the dance video to 12.73 (*SD* = 2.47) during the blank screen condition compared with the previous sample mean of 19.15 (*SD* = 8.41; Watson & Clark, 1988). Despite the mean scores in the current sample for the CNS and the two subscales of the PANAS being somewhat lower than the mean scores in the normative samples, they all were less than one standard deviation away from the normative means, indicating that the scores fell within the normative range. Table 1 shows means and standard deviations for EDA, HR, and HRV. EDA, HR, and HRV remained within one standard deviation throughout the experiment.

A 2 (experienced with horses or not) x 4 (video: blank screen, horse, car wash, dance) mixed ANOVA was the main analysis used for hypothesis testing. The between subjects independent variables included experience with horses or no horse experience and the within subjects independent variable was type of video with dependent variables of physiological measures and state mindfulness and covariates of connectedness to nature (CNS) and video order. Hypothesis 1 examined main effects of horse experience on the dependent variables, and

Hypothesis 2 tested differences between participants with and without horse experience on trait mindfulness using an independent samples *t* test. Hypothesis 3 focused on individual differences in trait mindfulness. An additional independent variable of trait mindfulness was included as a covariate in the 2 x 4 mixed ANOVA to test Hypothesis 3. The within subjects independent variable for Hypothesis 4 was video condition. An interaction effect between the independent variables of horse experience and video condition was examined to test Hypothesis 5. A 2 x 2 x 4 mixed ANOVA was conducted as the analysis for testing Hypothesis 6. The independent variables for Hypothesis 6 included horse experience, trait mindfulness, and video condition with connectedness to nature and video order as covariates.

The first hypothesis proposed differences between two groups of people – those with and without significant past experience with horses – on the Awareness and Acceptance subscales of the Philadelphia Mindfulness Scale, and on the Curiosity and Decentering subscales of the TMS, EDA, and HRV during the video manipulation. **Hypothesis 1a**, trait mindfulness was predicted to be higher overall in individuals who had significant recent experience with horses as compared with individuals without significant recent experience with horses, was tested by a simple *t* test between trait mindfulness and horse experience. An independent-samples *t* test indicated that awareness was significantly higher for those with horse experience (M = 37.0, SD = 4.06) than those without horse experience (M = 32.8, SD = 7.19), $t(36) = 2.31$, $p = .01$, d = 0.72, and acceptance was marginally significantly lower for those with horse experience (M = 33.7, SD = 6.24), than those without horse experience, (M = 37.0, SD = 5.70), $t(36) = 1.68$, p = .05, d = 0.56.

Hypothesis 1b, individuals with horse experience will have higher state mindfulness overall than those without experience with horses, was tested with the between subject comparison within the mixed ANOVA with nature connectedness and order of the conditions as covariates. The 2 x 4 mixed ANOVA with horse experience (significant, none) and condition (baseline, horse video, dance video, car video) failed to show a main effect of horse experience on state curiosity, $F(1, 33) = .56$, $p = .23$, $\eta_p^2 = .02$, but a separate ANOVA revealed a main effect of horse experience on state decentering, $F(1, 33) = 6.36$, $p < .01$, $\eta_p^2 = .16$. Participants with horse experience reported lower decentering ($M = 13.98$, $SD = 0.75$) than did participants without horse experience ($M = 17.25$, $SD = 0.75$).

Hypothesis 1c, individuals with horse experience were expected to have lower EDA and higher HRV, was tested with the between subject comparison within separate mixed ANOVAs with nature connectedness and order of the conditions as covariates. The test of between-subject factors indicated a marginal effect for horse experience on EDA, $F(1, 33) = 1.84$, $p = .09$, $\eta_p^2 = .05$, and a significant main effect on HRV, $F(1, 33) = 5.81$, $p = .01$, $\eta_p^2 = .15$. Participants with horse experience had lower EDA ($M = -0.04$, $SD = 0.05$) and higher HRV ($M = 0.30$, $SD = 0.10$) than participants without horse experience ($M = -0.03$, $SD = 0.03$; $M = 0.25$, $SD = 0.09$ respectively).

The second hypothesis focused on the relationships between trait mindfulness and EDA, HRV, and state mindful curiosity and decentering during the four video conditions. **Hypothesis 2a**, individuals with higher self-reported trait mindfulness were expected to have higher state mindfulness than individuals with lower trait mindfulness, was tested two ways: correlational analyses and separate 2 (experienced with horses or not) x 4 (video: blank screen, horse, car wash, dance) mixed ANOVAs with the Philadelphia Mindfulness Scale, video order, and the CNS as covariates. First, self-report scores on the Acceptance and Awareness subscales of the Philadelphia Mindfulness Scale were correlated with the Curiosity and Decentering subscales of the Toronto Mindfulness Scale completed following each video condition. Table 2 shows the values of the Pearson correlations between these state and trait measures. Out of 20 correlations none supported the hypothesis.

The relationship between trait and state mindfulness was also tested with a 2 x 4 mixed ANOVA with trait mindfulness subscales of Awareness and Acceptance, video order, and the CNS included as covariates. The between subjects factor was horse experience (significant, none) and the within factor was video condition (baseline, horse video, dance video, car video). The state mindfulness subscales of curiosity and decentering were dependent variables. Results revealed a main effect of trait mindful awareness on state curiosity, $F(1, 29) = 3.31$, $p = .04$, $\eta_p^2 = .10$, but the relationship between awareness and decentering was not significant, $F(1, 29) = 0.47$, $p = .25$, $\eta_p^2 = .02$. Relationships between acceptance and curiosity, $F(1, 29) = 0.47$, $p = .25$, $\eta_p^2 = .02$, and decentering, $F(1, 29) = 0.31$, $p = .29$, $\eta_p^2 = .01$, were also not significant.

Hypothesis 2b, a negative correlation was predicted between trait mindfulness and EDA as well as a positive correlation between trait mindfulness and HRV, was tested with a Pearson correlation of total acceptance and awareness subscales of the Philadelphia Mindfulness Scale with the total for each condition of EDA and HRV. Table 3 shows the values of the Pearson correlations between these trait mindfulness and these measures of physiological responses. Out of 16 correlations, only one supported the hypothesis. HRV and mindful acceptance during the car video were negatively correlated, Pearson's $r(33) = -.34$, $p = .02$.

The relationship between trait mindfulness and physiological responses was also tested with separate 2 (experienced with horses or not) x 4 (video: blank screen, horse, car wash, dance) mixed ANOVA with trait mindfulness subscales of awareness and acceptance included as covariates. The physiological responses of EDA and HRV were dependent variables. Results revealed a marginally significant main effect of trait mindful acceptance on EDA, $F(1, 29) = 2.28$, $p = .07$, $\eta_p^2 = .07$, but the relationship between awareness and EDA was not significant, $F(1, 29) = 0.21$, $p = .32$, $\eta_p^2 = .01$. Relationships between acceptance and HRV, $F(1, 29) = 0.66$, $p = .21$, $\eta_p^2 = .02$, and awareness and HRV, $F(1, 29) = 0.01$, $p = .46$, $\eta_p^2 < .001$, were also not significant.

The third hypothesis proposed differences within participants on physiological responses during the blank screen video condition when compared with the other video conditions. **Hypothesis 3**, EDA and HRV were expected to be lower during baseline than during any video condition, was tested with the within-subjects contrasts of the 2 (experienced with horses or not) x 4 (video: blank screen, horse, car wash, dance) mixed ANOVA. Results showed no significant effect of video condition on HRV, $F(2.39, 78.75) = 0.39$, $p = .36$, $\eta_p^2 = .01$. Results showed a main effect of video on EDA when baseline EDA was compared with EDA during the dance video, $F(1, 33) = 3.98$, $p = .03$, $\eta_p^2 = .11$, and a main effect of video on EDA approaching significance when baseline EDA was compared with EDA during the horse video, $F(1, 33) = 2.59$, $p = .06$, $\eta_p^2 = .07$. EDA was higher during the dance video ($M = -0.02$, $SD = 0.01$) than during baseline condition ($M = -0.03$, $SD = 0.01$) and lowest during the horse video ($M = -0.04$, $SD = 0.01$).

Additional post-hoc analyses explored differences in heart rate and positive and negative emotions during the four video conditions. The differences in heart rate and affect were tested with separate 2 (experienced with horses or not) x 4 (video: blank screen, horse, car wash, dance) mixed ANOVAs with video order and CNS as covariates. HR and the Positive Affect and Negative Affect subscales of the PANAS were dependent variables. Results failed to show a main effect of video on HR, $F(1.21, 99) = 0.55$, $p = .25$, $\eta_p^2 = .02$, or the Positive Affect subscale of the PANAS, $F(3, 99) = 0.20$, $p = .45$, $\eta_p^2 = .01$. However, results showed a marginal effect of video as well as a significant interaction effect of video and horse experience on the Negative Affect subscale of the PANAS, $F(3, 99) = 1.96$, $p = .06$, $\eta_p^2 = .06$ and $F(3, 99) = 4.07$, $p = .005$, $\eta_p^2 = .11$ respectively.

Follow-up tests of within-subjects contrasts revealed a significant difference between the dance video and the blank screen condition $F(1, 33) = 4{,}19$, $p = .02$, $\eta_p^2 = .11$. Participants were less negative about the dance video ($M = 11.55$, $SD = 0.37$) than the blank screen condition ($M = 12.62$, $SD = 0.42$). Follow-up tests of within-subjects contrasts also revealed interactions between video condition and horse experience on the Negative Affect subscale of the PANAS when comparing the dance video and the blank screen condition, $F(1, 33) = 3.91$, $p = .03$, $\eta_p^2 = .11$, and when comparing the car wash video and the blank screen, $F(1, 33) = 11.28$, $p = .001$, $\eta_p^2 = .26$. Overall, participants with horse experience reported less negative feelings during the dance video ($M = 11.55$, $SD = 0.37$) than during the blank screen condition ($M = 12.62$, $SD = 0.42$). Participants without horse experience reported a greater decrease in negative feelings from the blank screen condition ($M = 13.41$, $SD = 0.61$) to the dance video ($M = 11.29$, $SD = 0.54$) compared with participants with horse experience ($M = 11.83$, $SD = 0.73$, vs. $M = 11.81$, $SD = 0.64$ respectively). Negative affect increased from baseline to the car wash video in participants with experience with horses ($M = 12.23$, $SD = 0.54$) while it decreased compared to baseline in participants without experience with horses ($M = 11.01$, $SD = 0.45$). A simple *t* test for the Negative Affect subscale of the PANAS between participants with and without experience with horses during the blank screen condition revealed that negative affect was marginally higher for participants without experience with horses ($M = 13.19$, $SD = 2.78$) than participants with horse experience ($M = 12.13$, $SD = 1.89$), $t(34.63) = 1.38$, $p = .09$, $d = 0.45$.

The fourth hypothesis proposed an interaction between experience with horses and the horse video on state mindfulness and physiological responses. **Hypothesis 4a**, an interaction between horse experience and the horse video was predicted which would be related to higher state mindfulness, was tested with separate 2 (experienced with horses or not) x 4 (video: blank screen, horse, car wash, dance) mixed ANOVA. Tests of within-subjects effects failed to show an interaction effect of horse experience and video condition on state mindful curiosity, $F(3, 99) = 0.76$, $p = .26$, $\eta_p^2 = .02$, or decentering, $F(3, 99) = 1.13$, $p = .17$, $\eta_p^2 = .03$. **Hypothesis 4b**, the interaction between horse experience and horse video would be related to decreased EDA and increased HRV, was tested with the 2 x 4 mixed ANOVA. Tests of within-subjects contrasts failed to show an interaction effect of horse experience with video on EDA, $F(3, 99) = 0.35$, $p = .39$, $\eta_p^2 = .01$, or HRV, $F(3, 99) = 0.72$, $p = .27$, $\eta_p^2 = .02$.

The sixth hypothesis proposed an interaction between horse experience and trait mindfulness on state mindfulness and physiological responses. Measures of EDA, HRV, and the Curiosity and Decentering subscales of the TMS were analyzed by experience with horses, high versus low trait mindfulness, and video condition. **Hypothesis 5a**, those with experience with horses and high trait mindfulness would have the highest level of state mindfulness, was tested by a between subject repeated measure analysis with connectedness to nature and video order as covariates. The Acceptance and Awareness subscales of the Philadelphia Mindfulness Scale were split into high and low groups based upon a median split in order to test Hypothesis 6a. For both subscales, scores of 35 or higher were considered high and scores below 35 were considered low. Participants were broken into group of high ($n = 22$) and low ($n = 13$) awareness, high ($n = 24$) and low ($n = 11$) acceptance, and horse experience ($n = 14$) or no experience with horses ($n = 21$). Subgroups included participants with horse experience and high ($n = 11$) or low ($n = 3$)

awareness and high (n = 7) or low (n = 7) acceptance as well as participants without horse experience with high (n = 11) or (n = 10) low awareness and high (n = 17) or low (n = 4) acceptance. Results were examined for both between subjects interaction effects of horse experience by trait mindfulness, and for within subjects interactions between video condition, horse experience and trait mindfulness.

Separate 2 x 2 x 4 within subject ANOVAs with horse experience (significant, none), trait mindfulness (high, low), and condition (baseline, horse video, dance video, car video) test of between-subject factors failed to show a significant interaction effect of video condition, trait awareness, and experience with horses on state curiosity, $F(3, 87) = 0.46$, $p = .36$, $\eta_p^2 = .02$. A between subject ANOVA failed to show a significant interaction effect of trait awareness and experience with horses on state curiosity, $F(1, 29) = 0.48$, $p = .25$, $\eta_p^2 = .02$. Similarly, a 2 x 2 x 4 within subject ANOVA failed to show a significant interaction effect of video condition, trait acceptance, and experience with horses on state curiosity, $F(3, 87) = 0.31$, $p = .41$, $\eta_p^2 = .01$, nor was a significant interaction effect of a between subject ANOVA for trait acceptance and horse experience on state curiosity found, $F(1, 29) = 1.32$, $p = .13$, $\eta_p^2 = .04$.

A 2 x 2 x 4 mixed between and within subject ANOVA showed a significant within subject interaction effect of video condition, trait awareness, and horse experience on state decentering, $F(3, 87) = 2.80$, $p = .02$, $\eta_p^2 = .09$, and a significant between subject interaction effect of trait awareness and horse experience on state decentering, $F(1, 29) = 2.80$, $p = .05$, $\eta_p^2 = .09$, as displayed in Figure 2.

A test of within subjects contrasts showed a significant interaction effect of video condition, trait awareness, and horse experience in the horse video compared with the blank screen condition, $F(1, 29) = 7.74$, $p = .005$, $\eta_p^2 = .21$, and in the car washing video compared with the blank screen condition, $F(1, 29) = 5.09$, $p = .02$, $\eta_p^2 = .15$, on state decentering. A 2 x 2 x 4 ANOVA failed to show an interaction effect of video condition, horse experience, and trait acceptance on state curiosity, $F(3, 87) = 0.39$, $p = .38$, $\eta_p^2 = .01$, but approached significance for a between subject interaction effect of horse experience and trait acceptance on state decentering, $F(1, 29) = 2.20$, $p = .08$, $\eta_p^2 = .07$.

Hypothesis 5b, those with significant experience with horses and high trait mindfulness would have the lowest EDR and the highest HRV, was tested by a between subject repeated measure of analysis with connectedness to nature and video order as covariates. The Acceptance and Awareness subscales of the Philadelphia Mindfulness Scale were split into high and low groups based upon a median split in order to test Hypothesis 6b. For both subscales, scores of 35 or higher were considered high and scores below 35 were considered low. A 2 x 2 x 4 ANOVA with horse experience (significant, none), trait mindfulness (high, low) and condition (baseline, horse video, dance video, car video) test of between and within subject factors failed to show a main effect of video condition, trait awareness, and experience with horses on HRV, $F(3, 87) = 1.15$, $p = .17$, $\eta_p^2 = .04$, or a between subject effect of trait awareness and experience with horses on HRV, $F(1, 29) = 1.24$, $p = .14$, $\eta_p^2 = .04$. Likewise, a 2 x 2 x 4 ANOVA failed to show a significant main effect of video condition, horse experience, and trait acceptance on HRV, $F(3, 87) = 0.17$, $p = .46$, $\eta_p^2 = .01$, or a between-subject effect of horse experience and trait acceptance on HRV, $F(1, 29) = 0.35$, $p = .28$, $\eta_p^2 = .01$.

A significant within-subject interaction effect was revealed for video condition, trait awareness, and horse experience on EDA, $F(3, 87) = 7.83$, $p < .001$, $\eta_p^2 = .21$ with a significant contrast when comparing responses to the horse video and those to the blank screen condition, $F(1, 29) = 7.05$, $p = .007$, $\eta_p^2 = .20$, as well as the car wash video to the blank screen, $F(1, 29) =$

19.05, $p < .001$, $\eta_p^2 = .40$, as displayed in Figure 3. A simple *t* test between participants with and without horse experience within the high and low awareness subgroups during each video condition revealed that, within those with low awareness, participants with horse experience had significantly lower EDA ($M = -0.07$, $SD = 0.03$) than participants without horse experience ($M = -0.03$, $SD = 0.02$) during the horse video, $t(13) = 2.62$, $p = .01$, $d = 1.57$. Within the same grouping, participants with horse experience had marginally lower EDA ($M = -0.12$, $SD = 0.08$) than those without horse experience ($M = -0.03$, $SD = 0.04$) during the car wash video, $t(2.21) = 1.92$, $p = .09$, $d = 1.47$.

However, no between-subjects effects were revealed for trait awareness and horse experience on EDA, $F(1, 29) = 0.94$, $p = .17$, $\eta_p^2 = .03$. A 2 x 2 x 4 mixed ANOVA failed to show a significant main effect for video condition, horse experience, and trait acceptance on EDA, $F(3, 87) = 1.31$, $p = .14$, $\eta_p^2 = .04$, nor was a between subject effect revealed for horse experience and trait acceptance on EDA, $F(1, 29) = 1.51$, $p = .12$, $\eta_p^2 = .05$.

Discussion

Results from the current study were, in part, consistent with prior research and theory. The hypotheses that individuals with horse experience would have higher trait mindfulness, higher HRV, and lower EDA than individuals without horse experience were supported. Partial support was found for the hypothesis that trait mindfulness would be related to state mindfulness and physiological responses. Video manipulation did have an impact on physiological responses in that EDA was much higher in the dance video than in the blank screen condition and was lowest in the horse video indicating that participants were most relaxed during the horse video. Hypotheses regarding an interaction between experience with horses and video condition failed to be supported in that individuals with experience with horses did not exhibit higher state mindfulness or healthier physiological responses than individuals without experience with horses during any of the video conditions when examined individually. Hypotheses that individuals with experience with horses and high trait mindfulness have the highest levels of state mindfulness and the healthiest physiological responses were not supported. The study was limited primarily by sample size and simulation rather than in-vivo experience. Even so, the overall findings extended HAI research to interactions with horses and were consistent with the theory that horses facilitate mindfulness.

Experience with Horses

The hypothesis that people with horse experience would differ from those without horse experience on mindfulness and cardiovascular health was largely supported. The present study found that participants with horse experience had higher trait mindfulness and better cardiovascular health than those without horse experience, while hypothesized differences on EDA approached significance.

Horse experience was not associated with state curiosity, and was significantly negatively related to state decentering. Both decentering and curiosity have to do with a sense of awareness, but the former focuses on noticing the experience as separate from the self while the latter focuses on a sense of curiosity about the experience (Lau et al., 2006). The TMS was designed to be administered following a mindfulness exercise (Lau et al., 2006). Upon critical examination of the items on the Decentering subscale of the TMS, the researcher questioned whether individuals who have not been educated in mindfulness practices would interpret the items as intended. Thus, it may not have been an appropriate measure for the current study. Also, the Decentering subscale had very poor reliability in the current sample. Individuals with horse experience may have not been more curious because they were not exposed to novel stimuli and they identified with their experiences during the video manipulation.

Individuals with horse experience reported higher trait mindfulness than those without horse experience. Present moment awareness was significantly higher and acceptance was marginally higher. Previous research has found a positive relationship between connectedness to nature and trait mindfulness and some literature has indicated that interactions with horses may facilitate mindfulness (e.g. Howell et al., 2011; Klontz et al., 2007). The current study included control for nature connectedness to ensure the aforementioned relationship with mindfulness was not attributable to more general experience with the natural environment. The current findings are consistent with the theory that horses facilitate mindfulness: interacting with horses may provide an opportunity to keenly tune in to the environment while the horse provides nonjudgmental responses and social support in the present moment (Vormbrock & Grossberg, 1988; Virués-Ortega & Buela-Casal, 2006; Beetz et al., 2012; Denim 'n Dirt, n.d.). The researcher expected that horse experience would have a greater influence on present moment awareness than on acceptance as was found particularly given that Howell and colleagues (2011) found that nature connectedness had a greater relationship with awareness than acceptance.

Horse experience also was related to HRV and EDA with individuals with horse experience having higher HRV and lower EDA overall indicating that individuals with horse experience may have better cardiovascular health and lower autonomic arousal than those without horse experience. These are correlational findings and it is possible that the health benefits are not specifically due to interactions with horses. An alternative explanation is that people who interact with horses regularly may be more physically active on average than those who do not interact with horses as it has been well established that regular exercise improves cardiovascular health (e.g. Meyers, 2003). However, the current results are consistent with previous literature which showed a relationship between HAI and improved cardiovascular responses as well as lower EDR (Allen, et al., 1991; Cole et al., 2007; Beetz et al., 2011; Beetz et al., 2011; DeMello, 1999; Sommerville et al., 2008). The current findings indicate that these positive benefits of HAI may also apply to with interactions with horses.

Mindfulness

Though mindfulness may be associated with interactions with horses, it may also be developed through other means. Thus, some participants without experience with horses may also have high levels of mindfulness. The relationships between trait mindfulness and dependent variables of state mindfulness and physiological responses were considered. Overall, few relationships were found related to trait mindfulness, providing scant support for this hypothesis. Trait mindful awareness and acceptance were not related to state mindful decentering, state mindful curiosity in any of the individual videos, EDA, or HRV. Only two of the relationships tested reached significance, and due to the number of tests performed, it is possible these may be chance findings. The two significant findings are discussed below followed by a more general discussion of why the expected relationships between trait and state mindfulness were not found.

Trait mindful awareness was related to state mindful curiosity, and trait mindful acceptance was related to HRV during only one of the four videos. Awareness as measured by the Philadelphia Mindfulness Scale involves constantly attending to the entirety of an experience (Cardaciotto et al., 2008). Curiosity as measured by the Toronto Mindfulness Scale involves present moment awareness with a sense of curiosity (Lau et al., 2006). Both of these constructs are described as forms of awareness which indicates that, as was found, they should be associated in some way overall. The analysis of variance which displayed a relationship between state and trait mindfulness included statistical control for connectedness to nature and video order which was not possible with the correlation analysis. This may be why the relationship was not revealed in the simple correlation analysis.

HRV increased as scores for the Acceptance subscale of the Philadelphia Mindfulness Scale decreased during the car video. Items were worded in such a way that a lower endorsement was indicative of higher acceptance (e.g. "I try to distract myself when I feel unpleasant emotions", Cardaciotto et al., 2008). This finding therefore indicated that higher HRV was associated with higher mindful acceptance as predicted during the car wash video, which is consistent with previous research which found a positive association between mindfulness and HRV (Burg, Wolf, & Michalak, 2012).

Trait mindfulness has been found to be related to state mindfulness and studies have indicated that the TMS and the Philadelphia Mindfulness Scale are both valid measures of state and trait mindfulness respectively (Brown & Ryan, 2003; Lau et al., 2006; Cardaciotto et al., 2008). Additionally, mindfulness has been linked to lower EDA and higher HRV (Burg et al., 2012; Zeidan et al., 2010; & Lush et al., 2009). However, trait mindfulness did not relate to self-reported state mindfulness, HRV, or EDA following any of the videos with the exception of the aforementioned findings. This may be because the Philadelphia Mindfulness Scale and the Toronto Mindfulness Scale, the trait and state mindfulness scales respectively, measure somewhat different constructs (Cardaciotto et al., 2008; Lau et al., 2006). The Philadelphia Mindfulness Scale measures awareness and acceptance while the Toronto Mindfulness Scale measures curiosity and decentering. Additional considerations are that the videos only provided visual stimulation. In order to mindfully experience something, one must be able to experience it with all of the senses. Though each participant was instructed to imagine that (s)he was the person in the video experiencing what the person was experiencing, this may have been a struggle. Alternatively, these instructions may have effectively led participants to be mindful of their experiences during the experiment regardless of whether or not they are generally mindful. Though the instruction was necessary in order to use the video manipulation to simulate interactions, it may have confounded results and prevented data from revealing a relationship between trait mindfulness and state mindfulness or physiological responses.

The lack of findings may have been due in part to poor reliability of measures in the current sample. The reliability of the scores on the Decentering subscale of the TMS ranged from questionable to unacceptable and EDA ranged from questionable to poor. More reliable results may have been obtained with a larger sample size.

Video Manipulation

A blank screen condition was utilized to obtain baseline measures. The horse video was selected as one which displays a natural bond between a horse and a human while each participant was asked to imagine that (s)he was the person in the video in order to elicit responses to interactions with a horse. A dance video which displayed a young couple learning to dance together was selected due to its similarity to the horse video, in that the horse and the human appeared to be dancing while bonding together, to elicit a response to dancing with another person. The car wash video was utilized as a video of an interaction between a person and an inanimate object that most people are familiar with to elicit a response to interacting with an inanimate object. The dance and car wash videos were necessary for the current study as controls for simulation of different types of interactions.

In addition to the relationships with horse experience and trait mindfulness, the differences in dependent variables of state mindfulness and physiological responses during video conditions with were considered. EDA was significantly higher on average for all participants during the dance video compared with the baseline blank screen, indicating that a greater level of arousal was experienced during the dance video. Also, negative affect was lower during the dance video than during the blank screen condition on average across participants. However, neither heart rate nor positive affect were associated with any video manipulation. This difference was greater in participants without horse experience than in those with horse experience. The dance video may have been interpreted as a love story as it was a video of a couple learning to dance together. Within all participants EDA was lowest on average during the horse video. This difference may have reached significance with a larger sample of participants. The difference was associated with an effect size of .07, meaning that seven percent of individual differences in EDA were explained by video type. An effect size of .07 could become significant with a larger sample.

Interactions with Horse Experience

Responses to video conditions were analyzed between participants with and without experience with horses in order to understand whether experience with horses is associated with physiological and self-reported responses to different types of simulated interactions. Previous research indicated that videos could elicit similar responses to in-vivo experiences such as sitting in the outdoors or practicing a familiar sport (e.g. Wingard & Maltzman, 1980; Kjellgren & Buhrkall, 2010). Thus, it was expected that the video simulations in the current study would elicit similar responses to those which would be elicited if the participants were engaging in the experience in-vivo. State mindfulness was not higher in individuals with horse experience compared with those without horse experience during the horse video. This may be due to judgment, which is counter to being mindful. One participant noted that while watching the horse video all she could think about was frustration that she did not think she could ever get her horse to do what the horse was doing in the video. One who is not experienced with horses may think that the exercises being performed in the video are easy to accomplish. However, one with experience with horses recognizes that a very strong bond is required in order to have a horse willfully comply with requests without using any physical cues or restraints with the exception of the rare occasional light touch as seen in the video. Likewise, participants with horse experience compared to those without horse experience did not demonstrate decreased EDA or increased HRV since these measures are thought to be related to mindfulness, which was not increased.

Previous research has indicated that both interactions with animals and mindfulness are related to healthier autonomic responses (e.g. Beetz et al., 2012; Burg et al., 2012; Zeidan et al., 2010; & Lush et al., 2009). The interaction between experience with horses and mindfulness was examined given these previous findings to determine whether individuals with experience with horses and higher trait mindfulness would yield healthier responses. Of participants with low awareness, those with horse experience had lower EDA and state decentering than those without horse experience both in the horse video and the car wash video. EDA was expected to be lower in individuals with experience with horses in support of the conditioned relaxation response theory applying to interactions with horses (Vormbrock & Grossberg, 1988). However, state decentering was expected to be higher for individuals with horse experience and the largest effects were expected to be in relation to high state mindfulness. Greater support for the conditioned relaxation response theory may have been provided with a larger sample size.

Summary of Findings and Implications

The current study provided initial support for interactions with horses being associated with higher trait mindfulness, consistent with prior practitioner and research indications that interactions with horses are associated with improved psychological health and wellbeing (Klontz et al., 2007; Bass et al., 2009; Gabriels et al., 2012; Denim 'n Dirt, n.d.). This study extends the HAI literature to the benefits of human-horse interactions. Individuals with experience with horses displayed healthier physiological responses and reported higher mindfulness than those without experience with horses, providing support for interactions with horses being associated with physiological and psychological benefits similar to other HAI (e.g. Vormbrock & Grossberg, 1988; Virués-Ortega & Buela-Casal, 2006).

Strengths and Limitations

The current study had several strengths and limitations. Strengths included controlling for video order, the use of the PANAS, and the use of physiological measures of HRV and EDA. The current study extends research on the effects of HAI beyond interactions with smaller animals such as dogs, cats, goats, and hamsters. We provided an analysis of video-simulated HAI in a laboratory setting which went beyond simple correlations and controlled for variables that may have otherwise been confounding. The use of the PANAS allowed for an investigation of feelings toward the videos which may assist in explaining results beyond levels of mindfulness. Physiological measures were used to directly examine physical responses that are elicited by the autonomic nervous system (Andreassi, 2007).

The participant pool was originally limited to Psychology 101 students at University of South Carolina Aiken (USCA) enrolled in the spring 2014 semester. However, this pool proved to be too limited to obtain a sufficient sample of participants with horse experience. Following IRB approval, the pool was extended to all USCA students with horse experience. Participants were further recruited through email, word of mouth, and sign-up sheets. No compensation was offered to participants outside of Psychology 101 course credit and one biology class which offered extra credit for participation. The sample size ended up being smaller than expected. A larger sample size may have yielded more significant results. Additionally, the videos in the current study only provided visual input due to a lack of resources. The videos may have more effectively simulated interactions if sound was included, especially for participants who did not have experience with horses as they may not have been able to imagine the sound of the horse's movement. Participants may have had a much different response to real interactions with a horse than imagined interactions. Though prior research has provided support for the validity of psychological research using simulations, this study did not involve imagined interactions (Kjellgren & Buhrkall, 2010). The interpretation of results for the current study is limited due to the majority of the findings being correlational. Thus, while results provide support for the hypothesis that interactions with horses facilitate mindfulness and cardiovascular health, this support is not conclusive and the results could have been due to other variables that were not examined such as physical activity.

Future research

Future research should examine the difference between interactions with horses and other animals to determine if there is a superior effect of human-horse interactions to other HAI. In light of limitations of the current study, future studies should seek to determine the impact of in-vivo interactions with horses compared with other types of interactions. Studies could compare the impact of mindfulness-based therapies with interactions with horses that are similar to interactions in the horse video condition of the current study, such as practicing natural horsemanship. Such research would provide a stronger understanding of how interactions with horses relate to mindfulness.

Despite limitations, the current study did provide valuable information; particularly, a difference was found between people with and without experience with horses. Individuals with horse experience reported greater trait mindfulness, both in awareness and acceptance. Those with experience with horses also had lower autonomic arousal and better cardiovascular health on average than those without experience with horses. Some hypotheses were statistically supported and others were not. However, the present study did provide a foundation for determining whether horses facilitate mindfulness and how they can be used in a therapeutic setting.

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Tables

Table 1

Means and Standard Deviations for EDA, HR, and HRV during Each Condition[a]

Condition	Physio. Responses	Mean	Standard Deviation
Blank Screen			
	EDA	-0.02	0.03
	HR	77.63	16.96
	HRV	0.27	0.10
Horse Video			
	EDA	-0.03	0.04
	HR	78.30	15.21
	HRV	0.27	0.10
Dance Video			
	EDA	-0.02	0.04
	HR	79.62	11.17
	HRV	0.27	0.09
Car Video			
	EDA	-0.04	0.05
	HR	78.14	15.02
	HRV	0.27	0.10
Mean Across Conditions			
	EDA	-0.03	0.04
	HR	78.42	14.59
	HRV	0.27	0.09

Note. [a] $N = 37$.

Table 2

Pearson's Correlations for Trait Mindfulness with State Mindfulness after Each Condition

		Trait Mindfulness[a]	
Condition	State Mindfulness	Awareness	Acceptance
Blank Screen			
	Curiosity	.29	.15
	Decentering	-.12	-.15
Horse Video			
	Curiosity	.17	.17
	Decentering	-.07	.26
Dance Video			
	Curiosity	.26	.14
	Decentering	-.20	-.24
Car Video			
	Curiosity	.18	.11
	Decentering	-.31	.24
Mean Across Conditions			
	Curiosity	.27	.17
	Decentering	-.24	.04

Note. [a] $N = 35$.

Table 3

Pearson's Correlations for Trait Mindfulness with EDA and HRV during Each Condition

		Trait Mindfulness[a]	
Condition	Physio. Responses	Awareness	Acceptance
Blank Screen			
	EDA	-.19	.05
	HRV	.04	-.18
Horse Video			
	EDA	-.06	-.15
	HRV	.25	-.21
Dance Video			
	EDA	.04	-.05
	HRV	.08	-.03
Car Video			
	EDA	.21	-.32
	HRV	.21	-.34*
Mean Across Conditions			
	EDA	.03	-.19
	HRV	.17	-.22

Note. * $p < .05$. [a]$N = 35$.

Figures

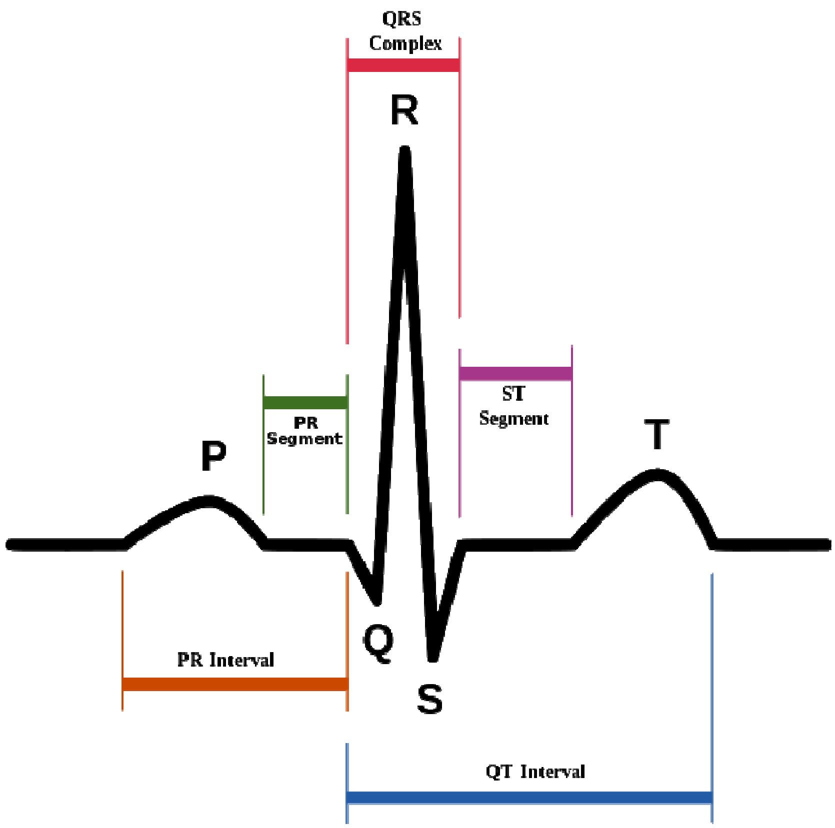

Figure 1. Schematic representation of a normal ECG

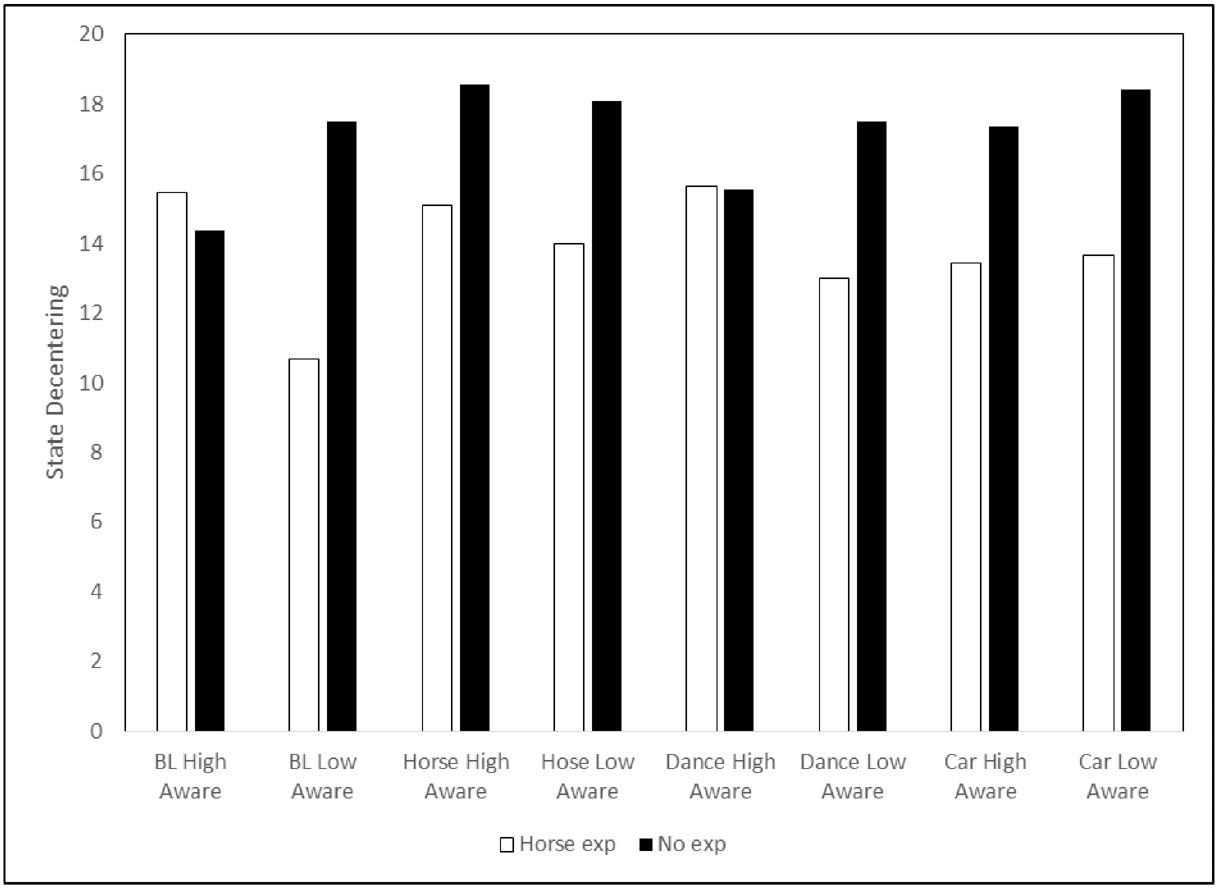

Figure 2. State Decentering for Participants with and without Experience with Horses and High and Low Trait Awareness during Each Condition. $N = 35$.

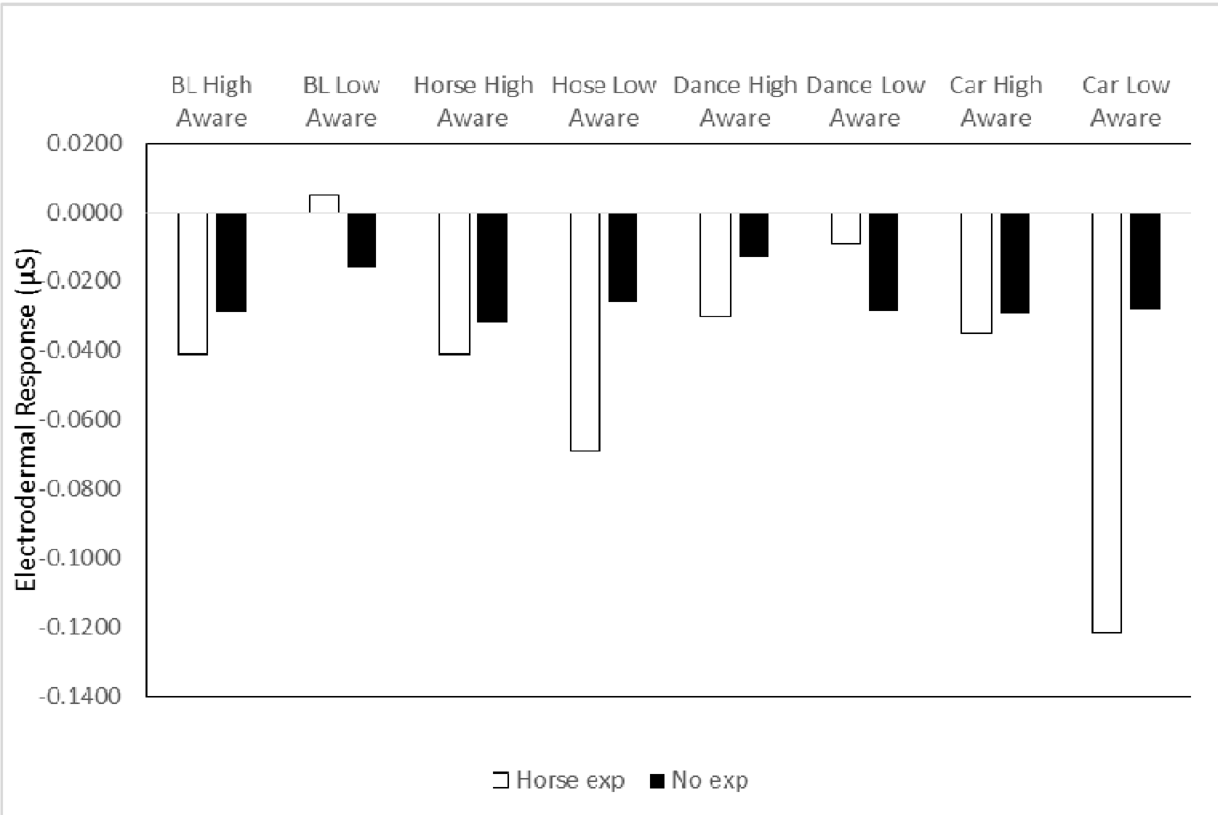

Figure 3. EDA for Participants with and without Experience with Horses and High and Low Trait Awareness during Each Condition. $N = 35$.

Appendices

Appendix A. Toronto Mindfulness Scale

Toronto Mindfulness Scale

Instructions: We are interested in what you just experienced. Below is a list of things that people sometimes experience. Please read each statement. Next to each statement are five choices: "not at all," "a little," "moderately," "quite a bit," and "very much." Please indicate the extent to which you agree with each statement. In other words, how well does the statement describe what you just experienced, just now?	**Not at all**	**A little**	**Moderately**	**Quite a bit**	**Very much**
1. I experienced myself as separate from my changing thoughts and feelings.	0	1	2	3	4
2. I was more concerned with being open to my experiences than controlling or changing them.	0	1	2	3	4
3. I was curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings or sensations.	0	1	2	3	4
4. I experienced my thoughts more as events in my mind than as a necessarily accurate reflection of the way things 'really' are.	0	1	2	3	4
5. I was curious to see what my mind was up to from moment to moment.	0	1	2	3	4
6. I was curious about each of the thoughts and feelings that I was having.	0	1	2	3	4
7. I was receptive to observing unpleasant thoughts and feelings without interfering with them.	0	1	2	3	4
8. I was more invested in just watching my experiences as they arose, than in figuring out what they could mean.	0	1	2	3	4
9. I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant.	0	1	2	3	4
10. I remained curious about the nature of each experience as it arose.	0	1	2	3	4
11. I was aware of my thoughts and feelings without overidentifying with them.	0	1	2	3	4
12. I was curious about my reactions to things.	0	1	2	3	4
13. I was curious about what I might learn about myself by just taking notice of what my attention gets drawn to.	0	1	2	3	4

Scoring:

Key: All items were written in the positively keyed direction, so no reverse scoring of items is required.

Curiosity score: The following items are summed: 3, 5, 6, 10, 12, 13
Decentering score: The following items are summed: 1, 2, 4, 7, 8, 9, 11

Appendix B. Philadelphia Mindfulness Scale

Philadelphia Mindfulness Scale (PHLMS)

Instructions: Please circle how often you experienced each of the following statements *within the past week.*

1. I am aware of what thoughts are passing through my mind.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

2. I try to distract myself when I feel unpleasant emotions.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

3. When talking with other people, I am aware of their facial and body expressions.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

4. There are aspects of myself I don't want to think about.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

5. When I shower, I am aware of how the water is running over my body.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

6. I try to stay busy to keep thoughts or feelings from coming to mind.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

7. When I am startled, I notice what is going on inside my body.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

8. I wish I could control my emotions more easily.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

9. When I walk outside, I am aware of smells or how the air feels against my face.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

10. I tell myself that I shouldn't have certain thoughts.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

11. When someone asks how I am feeling, I can identify my emotions easily.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

12. There are things I try not to think about.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

13. I am aware of thoughts I'm having when my mood changes.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

14. I tell myself that I shouldn't feel sad.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

15. I notice changes inside my body, like my heart beating faster or my muscles getting tense.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

16. If there is something I don't want to think about, I'll try many things to get it out of my mind.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

17. Whenever my emotions change, I am conscious of them immediately.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

18. I try to put my problems out of mind.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

19. When talking with other people, I am aware of the emotions I am experiencing.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

20. When I have a bad memory, I try to distract myself to make it go away.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often

**Note*: All items are rated on a 5-point Likert scale (1 = *never,* 2 = *rarely,* 3 = *sometimes,* 4 = *often,* 5 = *very often*) according to the frequency each item was experienced over the past week. To obtain the Awareness subscale score, all odd items are totaled; higher scores reflect higher levels of awareness. To obtain the Acceptance subscale score, all even items are reverse-scored and totaled; higher scores reflect higher levels of acceptance.

Appendix C. Connectedness to Nature Scale

Please answer each of these questions in terms of *the way you generally feel*. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1	2	3	4	5
Strongly disagree		Neutral		Strongly agree

____1. I often feel a sense of oneness with the natural world around me.
____2. I think of the natural world as a community to which I belong.
____3. I recognize and appreciate the intelligence of other living organisms.
____4. I often feel disconnected from nature.
____5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.
____6. I often feel a kinship with animals and plants.
____7. I feel as though I belong to the Earth as equally as it belongs to me.
____8. I have a deep understanding of how my actions affect the natural world.
____9. I often feel part of the web of life.
____10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.
____11. Like a tree can be part of a forest, I feel embedded within the broader natural world.
____12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.
____13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
____14. My personal welfare is independent of the welfare of the natural world.

Appendix D. Positive and Negative Affect Schedule

Worksheet 3.1 The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988)

PANAS Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. **Indicate to what extent you feel this way right now, that is, at the present moment *OR* indicate the extent you have felt this way over the past week (circle the instructions you followed when taking this measure)**

1	2	3	4	5
Very Slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely

___________	1. Interested	___________	11. Irritable
___________	2. Distressed	___________	12. Alert
___________	3. Excited	___________	13. Ashamed
___________	4. Upset	___________	14. Inspired
___________	5. Strong	___________	15. Nervous
___________	6. Guilty	___________	16. Determined
___________	7. Scared	___________	17. Attentive
___________	8. Hostile	___________	18. Jittery
___________	9. Enthusiastic	___________	19. Active
___________	10. Proud	___________	20. Afraid

Scoring Instructions:

Positive Affect Score: Add the scores on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19. Scores can range from 10 – 50, with higher scores representing higher levels of positive affect. Mean Scores: Momentary = 29.7 (*SD* = 7.9); Weekly = 33.3 (*SD = 7.2)*

Negative Affect Score: Add the scores on items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20. Scores can range from 10 – 50, with lower scores representing lower levels of negative affect. Mean Score: Momentary = 14.8 (*SD* = 5.4); Weekly = 17.4 (*SD* = 6.2)

The official citation that should be used in referencing this material is Watson, D., Clark, L. A., & Tellegan, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, 54(6), 1063–1070.