EVALUATION OF THE WELFARE OF THE LESSON HORSE USED FOR EQUINE ASSISTED ACTIVITIES AND THERAPIES

by

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ABSTRACT

The welfare of horses used in Equine Assisted Activities and Therapies (EAAT) has long been debated due to a lack of agreement in interpreting horse behavior, specifically in response to stress factors. This study was constructed to analyze changes in heart rate to determine if horses experienced identifiable stress responses when used in an EAAT lesson program. Eight healthy, regularly working therapeutic riding horses were randomly selected and monitored on two testing days. Both "stressful" and "relaxed" behavioral observations were recorded during lessons for each subject. Neither stress responses nor relaxed responses were affected by the number of lessons ($P > 0.30$) or the age of horses ($P > 0.38$) when horses participated in two lessons in a given day. Horses managed with proper care and well-being practices are well suited to participate in at least two EAAT lessons daily, as minimal stress responses were observed.

Keywords

Therapeutic riding horse, Heart rate, Stress, Behavior

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CHAPTER I: REVIEW OF LITERATURE

INTRODUCTION

For thousands of years, the history of the horse often paralleled the history of humans. While originally used for war and work most horses in present day are used for recreation. The continued development of regional, national, and international competitions, as well as riding lesson programs and 'dude ranches,' demonstrates that horses still have an important role to play in many people's lives. One important, new role for working horses is that of a 'therapy' animal.

Equine-assisted therapy made its debut in Europe after Liz Hartel, a woman physically impaired by polio, won the silver medal for dressage in the 1952 Olympics in Helsinki (PATH International, 2015). Since then Equine-Assisted Activities and Therapies (EAAT) have been utilized for a wide variety of individuals, including those with physiological and/or psychological challenges. The move from Europe to North America came with the foundation of the North American Riding for the Handicapped Association (NARHA) in 1969. NARHA became the first organization in the United States devoted to promoting safe and effective therapeutic riding standards (PATH Intl, 2015). The association is recognized today as the Professional Association of Therapeutic Horsemanship International (PATH Intl) and has members from countries all over the world. PATH Intl has developed from focusing primarily on therapeutic riding, or teaching horsemanship to riders with disabilities, to encompass other activities such as hippotherapy, vaulting, equine facilitated psychotherapy, and therapeutic driving. While each of these activities requires utilization of the horse in a different way, they all seek to provide benefits to individuals who face both physical and/or mental challenges.

Numerous studies have shown riding a horse can promote muscle strengthening and mobility due to the movement of the horse's body (Garner and Rigby, 2015; Granados and Agis, 2011; Sterba, 2007; Uchiyama et al., 2011). A horse's center of gravity is displaced three-dimensionally providing a rhythmical pattern similar to the human gait (Drnach et al., 2010; Homnick et al., 2013). The balance and core strength required to ride means merely sitting astride a moving horse can benefit participants. It takes a certain degree of balance and core strength to ride a horse, so clients who do not normally possess such skills can improve or obtain these skills. Children with cerebral palsy showed significant improvements in overall balance, postural ability, and lower body strength when assessed with the Gross Motor Function Measurement after having completed 5 weeks of therapeutic horseback riding (Drnach et al., 2010). Similar improvements in balance and quality of life measures were found when Homnick et al. (2013) studied the effects of therapeutic riding on older adults who previously demonstrated balance deficits. These test subjects improved their overall balance only during the 8-week intervention period of therapeutic horseback riding and saw no further improvements after the intervention period had concluded.

Along with the physical benefits, EAAT have also been shown to provide psychological benefits to participants, including children and adolescents with autism spectrum disorders (ASD), children with bipolar disorders, and persons with schizophrenia. Gabriels et al. (2012) studied the effects of 10 weekly riding lessons on clients diagnosed with ASD and found horses helped organize the participants sensory system as noted with overall improvements in motor skills, communication, and self-regulation. This study, as well as others (Drnach et al., 2010; Homnick et al. 2013), help to demonstrate the benefits of developing a human-horse relationship, focusing on the impacts horses have on humans. However, little research has evaluated the impact on the horses used for these activities and whether or not they are treated with an acceptable standard of care.

All centers affiliated with PATH Intl are expected to adhere to equine standard of care and workload guidelines, but even so, these guidelines are minimal and primarily under-researched. Currently, horses working for a PATH Intl facility are limited to a maximum of 6 total workday hours with 3 hours of work to be completed continuously, as stated by Equine Management guideline number 6 in the PATH International Standards Manual (PATH Intl, 2014). Other guidelines specifically address the physical needs of the horse such as health, maintenance, and conditioning, but few guidelines mention mental stressors that could affect the horse (PATH Intl, 2014). Further research should identify whether or not therapy horses generally incur any mental stress in their work. This will help establish acceptable standard of care and welfare practices for equines used for therapeutic riding.

WELFARE OF THE RECREATIONAL HORSE

Perceptions of Welfare

The welfare of working horses is largely debated due to varying opinions regarding acceptable workloads and management practices. In a Romanian study, horses demonstrating good welfare indicators showed an absence of wounds, abrasions, and airway disease symptoms such as coughing (Popescu et al., 2014). These horses also showed alertness, as opposed to depression, and were friendlier toward the approaching assessor in comparison to horses deemed to be not exhibiting good welfare indicators (Popescu et al., 2014). Horses not managed with good welfare practices would most likely demonstrate unfriendliness because of underlying health issues negatively affecting equine behaviors. As the workloads of these horses increased from light to heavy work, the well-being of the horses decreased dramatically, as noted by the negative correlations for all welfare indicators assessed. These results showed that owners were unaware of the significance of good welfare practices and unknowingly imposed larger amounts of work without taking into account the increased needs of the horse (Popescu et al., 2014)

Misconceptions regarding the welfare of horses and the ability to apply knowledge into practice are growing concerns as the horse industry continues to expand. Of the 9.2 million horses in the United States in 2005, more than 3 million of those horses were used primarily for recreational purposes (American Horse Council, 2015). A survey administered to horse enthusiasts about equine welfare showed these enthusiasts have more conceptual knowledge than procedural knowledge (Visser and Van Wijk-Jansen, 2012). In this survey, designed to assess the diversity in horse enthusiasts in regards to their perceptions on equine welfare, most horse owners understood the concepts of good horse management practices, but few applied these concepts to their own daily practices. For example, horse owners may know horses need adequate forage in order to maintain optimal gut health and to provide structural support, yet they often lack the knowledge to implement this information into their own care practices.

A lack of agreement on effective management procedures can negatively impact the horse industry and lead to welfare issues for horses. While working with the same horses day in and day out, horse owners and facility managers can become oblivious to obvious stress factors horses may exhibit (Lesimple and Hausberger, 2014). Someone who does not regularly spend time with a horse may notice abnormal behavior exhibited by the animal that the owner may have become accustomed to and accept as normal. Horse caretakers can underestimate the severity of behaviors exhibited and under-evaluate the abnormal and stereotypical behaviors of their horses, which could in turn lead to inappropriate management practices (Lesimple and Hausberger, 2014). Almost 65% of 4,265 people surveyed declared that there are discrepancies in regards to equine welfare with 77% believing the horse industry needs to impose its own regulations (Visser and Van Wijk-Jansen, 2012). If owners already cannot identify stress factors in their own horses, then it seems establishing standards to protect horse welfare may be a more daunting task than previously realized.

Assessment Scales and Parameters

Because it can be difficult to make a fair evaluation of whether or not horses are experiencing stress, further research is needed to determine the best method of assessment. Some horses may appear to be in distress when evaluated with one method while demonstrating no stress if analyzed with a different method (Seamen et al., 2002). Further, the same horse may react differently to the same situation on a different day due to environmental factors. By creating a practical test that can predict and assess the behaviors of horses, individuals can more accurately and efficiently investigate the welfare of their animals.

Many behavioral tests have been conducted in the course of research, but none of the tests thus far have been used as a standardized method of welfare assessment for horses (Gehrke et al., 2011; Seamen et al., 2002; Young et al., 2012). Behavioral scores are common indicators of stress in animals but fail to address other stress responses that may provide valuable information (Young et al., 2012). A study assessing horses' behavior through observation of various tests (arena test, person test, and object test), concluded horses vary greatly in responses and cannot be predicted to behave the same in any given test comparison (Seamen et al., 2002). As with many other tests, only the behaviors of horses were analyzed and found to be inconclusive in determining the reactions of horses under certain circumstances.

Measuring stress should be done on a multi-tier evaluation scale where a combination of stress indicators are reviewed before determining if an animal is experiencing agitation. Tests using individual parameters, such as behavior assessments, do not account for factors such as bias toward perceptions of horse behavior, especially when the evaluator works with the horse on a daily basis (Rietmann et al., 2004; Young et al., 2012). A combination of physiological indicators and behavioral responses can provide reliable information that can be used in a variety of situations to determine levels of stress an animal may be exhibiting (Ellis et al., 2014; Young et al., 2012). Physiological indicators that are non-invasive and do not add additional stress to the horses include salivary cortisol concentrations, heart rate, and heart rate variability. One or more of these variables can be measured and assessed in conjunction with behavioral records to better validate the welfare of equine subjects.

When evaluating physiological variables as indicators of stress, it is important to select variables that will not impose additional stress to the horse, which could confound the results. Heart rate variability as a measurement of stress can be used to assess the autonomic nervous system and its regulation of cardiovascular function (Gehrke et al., 2011). While this measurement has been used extensively in humans and some in horses, heart rate variability has only been studied minimally in horses used for EAAT. Heart rate variability is the complex beat-to-beat variation in the heart rate that can be used to assess differences between sympathetic and parasympathetic neural activity (Gehrke et al., 2011; Von Borell et al., 2007). These differences in the two major autonomic nervous system branches show how training, temperament, and clinical diagnoses affect heart rate variability due to stimulation from emotional responses that cause changes in peaks for each of these branches (Rietmann et al., 2004). However, the methods used to investigate the heart rate variability of horses are limited in the reliability of data collected.

Portable devices that record and store electrocardiograms (ECG) for up to 24 hours, much like a Holter system, are able to produce precise and especially long recordings of the complete ECG (Von Borell et al., 2007). These devices are used primarily in the medical field and are adapted to humans. Because humans and horses have been found to have similar distribution intervals or frequency ranges, these devices can be used to detect ECG in horses (Gehrke et al., 2011; Rietmann et al. 2004). This similarity in heart rate variability frequencies can provide a direct comparison between horse and human heart rate variability measures (Gehrke et al., 2011).

The potential challenge to using commercially produced portable monitors is the expense. Holter type monitors used to assess heart rates are a more affordable alternative than commercially produced monitors that have been used in determining stress responses in other animals. However, when it comes to their use in measuring heart rates and variability in horses, Holter devices could register false values, as only R-peaks of the ECG are detected (Von Borell et al., 2007). Heart rate monitors that detect only R-peaks are calibrated to record a dramatic increase in voltage, which could be inaccurately noted by pronounced t-waves (repolarization of ventricles) in the horse (Von Borell et al., 2007). To account for this limitation, placement of the electrodes to reduce presence of t-waves is important. Also, false readings could be identified and corrected using automatic correction tools. The use of such software needs to be treated with the utmost care and sensitivity so as to not misinterpret data.

External Stimulation

The reactivity of a horse and the duration of a reaction can help determine the temperament of a horse. As well, an evaluator can note whether or not that horse exhibits stressful behaviors during a given situation. Several tests have been created in an attempt to quantify stress and reactivity in horses. When exposed to novel objects or unusual situations, horses elicited varying responses and often showed high reactivity when least expected (Anderson et al., 1999; Merkies et al., 2014; Minero et al., 2006). When compared to jumping horses, therapeutic riding horses were just as reactive in response to novel stimuli but demonstrated a larger increase in heart rate after being startled (Minero et al., 2006). Similarly, in a reactivity test that involved three novel stimuli (a vocalizing toy pig, popping of a balloon, and opening an umbrella), therapeutic riding horses received the highest average reactivity scores, as compared to non-therapeutic riding horses, with one horse warranting the highest score of 4.7 out of a maximum of 5 points (Anderson et al., 1999). This is interesting, as therapeutic riding horses are generally chosen for their overall calm demeanor with reduced reactivity. These studies show that therapeutic riding programs may need to be more selective in choosing horses for their programs. The studies also show there may be a common misconception that therapy horses are less reactive than other lesson horses. This may further suggest more desensitization needs to occur to ensure these horses are most fit for their jobs.

In order to develop a less reactive and less stressed horse, therapy programs need to be aware of novel stimulus that could arouse a reaction from a horse. Therapeutic centers can limit or prevent avoidable stressors that can negatively impact the health of the horse by anticipating situations or objects that could potentially cause undesired reactivity or stress. Exposure to novel objects, such as red balls or blue sails, for the first time typically elicited the strongest response from a horse, while repeated exposure lead to weaker and weaker responses through habituation (Munsters et al., 2012; König von Borstel et al., 2011). A study conducted by König von Borstel et al. (2011) discovered that responses to different visual, tactile, and moving/auditory stimuli (red ball, brown floor mat, and plastic bag filled with empty tin cans) produced varied reactions. In a series of tests, horses were required to observe the stationary ball, walk over the floor mat, and listen to/watch the falling bag of tin cans. The movement and auditory stimulus was noted to create the most response of the three, with the visual stimulus resulting in the weakest response (König von Borstel et al., 2011).

Reactivity of a horse may also be influenced by novel stimuli related to horse-human interaction (Munsters et al., 2012). A new aspect of influence is introduced when human subjects are used as novel objects instead of items such as red balls. This is because horses mirror or mimic the behaviors of humans by demonstrating similar behaviors (Fazio et al., 2013). In a study by Munsters et al. (2012), horses matched with a less competent rider demonstrated non-compliance, that is, they expressed more stress responses toward novel objects that were presented to them. It is hypothesized this is because they gain confidence from having a competent handler (Munsters et al., 2012). A compatible relationship between horse and rider minimizes additional stress for the horse and provides a union of trust, which can build confidence in the horse. König von Borstel et al. (2011) examined human-horse relationships in reaction to novel stimuli via three test types: being ridden, being led, and allowed to freely run. When led past three stimulus objects, horses demonstrated consistently lower reactions, as compared to being ridden past or allowed to freely run past the objects (König von Borstel et al., 2011). The reactions of horses being ridden were consistently higher than reactions when being led, while free-running produced inconsistent high and low reactions (König von Borstel et al., 2011). Thus, positive interaction between a horse and its human handler can provide the horse with a better sense of companionship; and therefore, less reactivity to challenging objects.

In contrast, horses freely exposed to increasingly fearful humans had decreasing heart rates as compared to exposure to persons who were calm and comfortable around equines (Merkies et al., 2014). Horses are ranked based on social order or herd hierarchy, so a fearful demeanor in humans could be interpreted by the horse as acquiescence to the horse as the leader of the group, ultimately leading to lower stress in the horse as noted by a lower heart rate (Houpt et al., 1978). Merkies et al. (2014) showed that horses were not influenced to exhibit stressful behaviors exhibited by fearful and/or stressed humans when in close proximity to them (Merkies et al., 2014). Furthermore, horses free from human handling are not influenced to behave in a particular manner but rather decide for themselves their behavior patterns and their position in the herd hierarchy.

EVALUATION OF BEHAVIORS

Stressful Behaviors

Certain behaviors of horses are indicative of underlying stress, so it is important to describe these behaviors and identify distinguishing characteristics of these behaviors that can be noted in agitated or frustrated horses. Horse ethograms have been used in research to help observers identify and record behaviors deemed important to the investigation at hand (Kaiser et al., 2006; Seaman et al., 2002; Young et al., 2012). An ethogram is typically a table or chart listing specific animal behaviors and providing a brief description of what those behaviors look like when exhibited by an animal. Figure 1 depicts a modified ethogram to be used specifically when assessing stressful behaviors presented by therapeutic riding horses: head toss, ears pinned back, head raise, head down, head shake, head turn, and defecation (Kaiser et al., 2006). An ethogram providing behaviors classified as more severe or aggressive may include bite threat, bite, kick threat, kick, strike, rear, and chase (Seaman et al., 2002). All of the aforementioned behaviors signify distress in a horse and can be used to assess potential stress and welfare implications for therapeutic riding horses and other lesson horses.

Other negative behaviors include rearing, pawing, and tail swishing. However, sometimes it takes more than one negative behavior in order to identify if in fact the horse is demonstrating underlying stress. For example, a horse can exhibit tail swishing when around its handler, but this behavior does not necessarily identify stress, as it can also be indicative of pesky flies that the horse tries to flick away by use of its tail (Kaiser et al., 2006). When a horse exhibits both tail swishing and ear pinning, it is more likely that the horse is reacting to a stressful situation. This can be concluded because there are two indicators of stress instead of one, with one predominantly noted when agitation occurs. These behaviors allow horse owners or researchers to assess the welfare of their horses and note when a change needs to be made, but they are not the only behaviors that can be examined to assess the welfare of a horse.

Behavior	Description
Head Toss*	Head lowered with the ears pinned back interrupted with momentary sharp tossing or rotating gestures of the head.
Ears Pinned Back*	Ears pressed caudally against the head and neck.
Head Raised*	Head held higher than the normal carriage with the nose extended upward and with slight extension of the neck.
Head Down*	Head held lower than the normal carriage; neck may be stretched out with nose pushed forward.
Ears Turned	Ear movement from pointing forward to pointing backward; may be unilateral or bilateral.
Head Shake*	Repeated rhythmic, mild flipping motions of the head
Head Turn*	Moving head left or right independent of the rider.
Moving Tail	Any exaggerated movement of the tail, usually more of a wringing motion than a rhythmic or directed swing.
Chomping Bit	Any mouth or tongue manipulation of the bit independent of the rider's use of the reins.
Whinny (neigh)	Loud, prolonged (typically 1 to 3 seconds) call beginning high pitched and ending lower pitched; head is elevated and the mouth opened slightly.
Halt	Cessation of movement of all 4 feet.
Walk	An even 4-beat gait in which the sequence of beats is lateral in that both feet on 1 stride strike the ground before the feet on the opposite side strike the ground.
Trot	A 2-beat gait in which diagonal pairs of legs strike and leave the ground simultaneously.

**Behaviors classified as stress-related behaviors. More extreme behaviors indicative of stress while being ridden, such as bucking or rearing, were never observed. None of the horses attempted to bite, strike at, or kick a rider, a leader, or a side-walker.*

Figure 1. Ethogram of behaviors in horses ridden in a therapeutic riding program as adapted from Kaiser et al. (2006).

Relaxed Behaviors

Researchers tend to focus on the negative side of welfare and address what needs to be changed in order to accommodate better management practices. The other approach that can be taken is to assess the positive side of animal welfare and the indicators that provide evidence of good management practices. Being able to identify behaviors that are associated with a calm and relaxed horse can help therapeutic riding centers evaluate how well their programs are managing horse care. On a behavioral score scale developed by Munsters et al. (2012), a score of 0 out of 10 identifies a horse that is completely relaxed with ears relaxed toward the front, neck relaxed, and a normal stride. A horse with relaxed ears will hold them in a lateral position or let them droop to the front or sides. A relaxed neck qualifies as a neck that is lowered or without any strain. This same behavioral scale scored horses as a 1, or slightly relaxed, if they had ears pointed toward the front, neck relaxed, and a normal stride (Munsters et al., 2012). Other relaxed behaviors include but are not limited to licking, lowered head carriage, cocked hind leg, and chewing. Identifying such relaxed behaviors as well as the previously mentioned stressed behaviors provides horse owners with a foundation to determine how mentally fit a horse is for its job.

Coping Strategies and Personality Tests

While it can be worthwhile to investigate the behaviors of horses in regards to stress or relaxation factors, these behaviors are not always indicative of perceived well-being of the animal. Some horses are capable of masking their true feelings through adapted coping styles, appearing relaxed when they are in fact in distress (Koolhaas et al., 1999). An animal's ability to cope with environmental stressors is dependent on the controllability and the predictability of the stressor and how well that animal can master the situation (Koolhaas et al., 1999). Sometimes, horses that seem outwardly calm and relaxed may actually be in distress. These horses are termed as "passive copers" (Wechsler, 1995). In comparison, active coping horses actively express emotional distress via various and consistent strategies (Wechsler, 1995; Koolhaas et al., 2010). Active coping horses are those that researchers can identify as being mentally or physically stressed without having to cross-examine the animal with various stress measurements. Passive coping horses exhibit stoic behaviors that require examination beyond visual assessments such as previously mentioned heart rate or cortisol levels as indicators of stress.

If an animal is unable to cope with its environment, then negative health consequences could occur that go beyond behavior issues. The two coping styles mentioned vary in susceptibility to health problems such as ulcers, cardiovascular pathology, and infectious diseases (Koolhaas et al., 1999). Animals exhibiting active or passive coping styles may have differences in physiological stress responses depending on the animal's ability to handle environmental stressors (Koolhaas et al., 1999). These differences in physiological response determine the detrimental effect of environmental stressors, with a severe reaction causing maximal stress that can induce stress related diseases. Prior exposure to stress stimulators is a factor in determining this severity in reactivity and how flexible an animal is in coping to the stressor (Koolhaas et al., 2010).

By determining which coping style a horse expresses, equine caretakers can better predict the health of their horse and prevent an overload of stress that could lead to underlying health ailments.

The problem with distinguishing between an active and a passive coping horse is that it is difficult to categorize a horse into just these two groups. Seamen at al. (2002) found some horses behaved as passive copers in one test and as active copers in another test. This interchangeable quality that horses seem to possess limits the ability to predict how a horse might react in any given situation. However, it has been found beneficial to implement a personality test on horses before labeling them as either passive or active (Ijichi et al., 2013; Kristiansen and Kuczaj, 2013; Lloyd et al., 2007). Many different personality tests have been constructed to examine the behaviors and reactions of horses with some tests using contrasting traits and others using specific questions to assess horse personality. These personality tests are conducted on the horse to better assess a horse's personality and to better understand how that horse mentally operates. Ijichi et al. (2013) created a questionnaire scoring five personality factors of agreeableness, neuroticism, extroversion, gregariousness toward people, and gregariousness toward other horses. Questionnaires were completed by the person most knowledgable about the horse. These horses were also assessed behaviorally when completing objective measurements such as a bridge test, reactivity test, recovery test, and novel objects test in order to correlate the five personality factors with novel stimuli and the response to each. By using behavioral and objective methods to analyze a horse, greater insight has been given into identifying more reliable and practical assessments of horse behaviors (Ijichi et al., 2013).

Researchers have yet to identify and agree upon an equine personality assessment encompassing all the personality types of horses. The model mentioned earlier was adapted from a five-factor model (FFM) of the human Big Five model, which was first used on the study of horse behaviors by Morris et al. (2002). The human Big Five model includes the following personality traits: openness, conscientiousness, extroversion, agreeableness, and neuroticism. The use of this FFM has been controversial in correspondence to equine behaviors because some of the items are irrelevant to horses (Kristiansen and Kuczaj, 2013). Since not all researchers are supportive of this FFM, Kristiansen and Kuczaj (2013) developed a study that extracted eight instead of the proposed five personality traits and applied these traits to equine personality assessment. The study found neuroticism, active, conscientiousness, agreeableness, openness, social extroversion, temperamental, and disciplined to be adequate traits in assessing horse personality with these traits closely following the FFM as evidenced by an overlap of traits.

These findings determine that the FFM of human personality traits can be effective in analyzing horse personality if modifications are made to better identify non-human characteristics. Three of the five personality traits from the FFM were found to closely apply to horse personality traits (conscientiousness, extroversion, and neuroticism), but openness and agreeableness are difficult to apply to horses, as these characteristics are more specifically tailored to human personalities (Lloyd et al., 2007). Further development of the personality assessments created for horses will provide horse owners or caretakers with a better understanding of how to establish a personality type for horses across disciplines and help improve welfare of the horses through better human-horse relationships.

Facial Expressions in Horses

While personality tests have been sufficient in providing basic groundwork for analyzing the behaviors of horses, recent research examining facial movements of horses has been more accurate in creating an unbiased coding system for specific use in the domestic horse (Wathan et al., 2015). Facial Action Coding Systems (FACS) is a method of identifying facial expressions based on muscle movement and actual musculature of the face (Wathan et al., 2015). This method can be used to decode different social contexts of facial expressions. This system was adapted for use in horses by first comparing face anatomy through high quality video as well as illustrations. After identification of all the unique facial actions that a horse makes, a code was assigned to the facial action and the muscle(s) associated with the mechanism used to create that facial expression (Wathan et al., 2015). Horses demonstrate facial expressions and movements unique to their species due to the elongated structure of their face and the lateral placement of their eyes. This system showed surprising similarities between horses and humans or other primates demonstrating the ability to make direct comparisons across species (Wathan et al., 2015).

The anatomically based FACS provides investigators with a tool to record and understand horse facial expressions as a standardized, objective method of assessment. Horse enthusiasts, as well as persons having no prior experience with horses, can use the relatively simple system to decode the behaviors of their horses. People working in the horse industry can use the standardized language denoted in the FACS to address problems relevant to management and welfare of horses. Further analysis of horse musculature and the behaviors associated with these muscles needs to be conducted to validate the recent findings in facial expressions of horses. Horse welfare can be better understood through more thorough investigations of horse communication and social cognition.

CHAPTER II: THE EVALUATION OF STRESS RESPONSES IN THERAPEUTIC RIDING HORSES DURING LESSONS

Therapeutic riding and other forms of equine assisted activities and therapies have become more prevalent in recent years as people embrace alternative ways to manage physiological and/or psychological issues. Previous research conducted has focused primarily on benefits to humans with almost no research focused on the effects on the horse (Drnach et al., 2010; Homnick et al. 2013). The welfare of these lesson horses has long been debated due to a lack of agreement in interpreting horse behavior, specifically in response to stress factors and novel stimuli. This discontinuity makes it difficult to implement a standard of care that accounts for mental stress a lesson horse might face. PATH Intl has created minimal standards for lesson horse welfare that its members are required to follow. However, these standards may not pertain to mental stress of the horse nor may they account for the low level of activity actually occurring during these lessons.

Analysis of horse behaviors and factors that may cause stress behaviors can help identify a universal standard of care to maintain a mentally fit horse population. Research shows assessing a combination of both physiological indicators and behavioral responses can better quantify the levels of stress a horse may experience (Ellis et al., 2014; Young et al., 2012). In order to minimize confounding stress, noninvasive collection techniques can be used to determine physiological indicators including salivary cortisol concentrations, heart rate, and heart rate variability. Further research should include use of one or more of these objective indicators along with an ethogram of particular behaviors to be examined and recorded for a more thorough evaluation.

This study was constructed to quantify average work load and analyze changes in heart rates of therapeutic riding horses in order to determine if the horses were experiencing identifiable stress responses when used in an EAAT lesson program. Horses were observed using an ethogram of behaviors determined to be indicative of stress and relaxation. As of now there is very little research to determine the workload of an EAAT horse, making it difficult to create standards of acceptable workloads. By determining what may constitute to stress for an EAAT horse, programs can better modify their lessons to avoid any stressors that may impact the horse. This research will help programs to better utilize their horses, as well as to quantify and validate standards of care and use of their equines.

MATERIALS AND METHODS

All study methods were approved by the Institutional Animal Care and Use Committee (Protocol ID 15-012) at Middle Tennessee State University. Eight healthy and regularly working therapeutic riding horses were randomly selected from the lesson horse population at the Shangri-La Therapeutic Academy of Riding (STAR) in Lenoir City, TN.

Horses were individually monitored on two testing days each, with a total of four testing days in Summer 2015. Testing days occurred over a two-week period with each horse monitored on one day each week, either a Wednesday or a Thursday. Horses monitored on a Wednesday the first week were subject to testing on a Thursday the following week and vice versa. All testing occurred at STAR, and horses were observed during all lessons in their "normal" schedule on that given day.

Horses were 10 to 25 yrs of age, with horses aged ≤ 15 yrs classified as middle-aged (MID) and horses aged ≥ 16 yrs classified as old (OLD). The experience level of each horse was determined by the number of years they had participated in EAAT, as provided by the program director. Horses deemed experienced (EXP) had participated in EAAT for ≥ 6 yrs, while horses deemed inexperienced (NEW) had participated in EAAT for ≤ 5 yrs.

Daily activities and routines of horses were not altered in any manner during the testing period, except for the addition of the heart rate monitors. As is normal management for the facility, horses were fed two times a day with unlimited access to water. All horses used for lessons were stalled from approximately 7am to 9pm or until lessons were completed each day. Once lessons were completed, horses were returned to their assigned paddocks for the night.

Research horses participated in lessons with other horses and riders uninvolved with the study. The number of riders and horses varied from lesson to lesson, with riders grouped based on skill level and their individual progression. The riding portion of each lesson contained activities to be determined and completed at the discretion of the instructor. Such activities included, but were not limited to, walking and trotting around the arena, weaving between cones, and tossing rings onto cones. Each horse/rider pair was assisted with a horse handler to manage the horse and either 1, 2 or no side-walkers to assist the rider. A typical lesson consisted of approximately 30 min of grooming and tacking and 30 min of riding. Grooming and tacking took place at crossties inside the main barn. All lessons were conducted in an indoor arena adjacent to the main barn. Each lesson was analyzed during time spent standing (grooming), standing saddled, walking, and trotting. Horses were observed during all activities during a lesson and were video recorded both in the crossties and in the riding arena.

Horses wore equine heart rate monitors (Polar Equine RS800CX, Polar Electro, 2012) to record heart rates for the duration of the testing day. After all heart rate monitor sets were attached to their assigned horses, the training computers (watch receivers) were simultaneously started to record activity.

Behavioral observations were recorded for each horse on individual charts that were created for behaviors noted as “stressful” and for behaviors noted as “relaxed.” Behaviors determined to be stressful included pinned ears, head tossing, head shaking, defecation/urination, pawing, biting, and other (Appendix C). Behaviors determined to be relaxed were licking, lowered head, cocked hind leg, chewing, yawning, neighing, ears relaxed, and other (Appendix D). The time point during lessons was noted for behaviors exhibited. Time horses spent trotting during a lesson were also observed and recorded.

Immediately upon lesson completion, horses were un-tacked and returned to their stalls. After all research horses completed their lessons, the heart rate monitors were stopped and detached from the horses. Data on the monitors were transferred to computer software, and then all monitors were cleared and reset before data collection the following day.

Data were tested for normality and analyzed using mixed model procedures (SAS Ver. 9.2, SAS Inst. Inc., Cary, NC). Data for horses participating in lesson one on their first day of testing were analyzed for effects of age, years in EAAT, and duration of lesson (mins) on mean heart rate (HR), stress amounts, relaxed amounts, and HR standing saddled (tacked and mounted). Data for horses participating in two lessons during their first day of testing were analyzed for effects of lesson, age, and duration of lesson on stress amounts, relaxed amounts, mean HR, HR standing (un-tacked and un-mounted during grooming), and HR standing saddled. A Tukey-Kramer adjustment was used when appropriate to account for multiple comparisons. Results were considered significant at $P < 0.05$, while trends were considered when $0.05 < P < 0.10$.

Table 1. General information provided about each horse including sex, age, and years participated in EAAT for horses utilized in a study to evaluate the influence of these parameters on heart rate and conflict behavior in EAAT lesson horses.

Horse Name	Age	Years in EAAT
Apache	25	10
Brandy	19	1
Sampson	10	6
Penrose	17	4
Gordy	18	4
Oliver	20	8
Ox	15	3
Elmo	13	4

RESULTS

In this study, lesson durations for the horses used ranged from 40 to 60 min. The average duration of time horses spent participating in lesson activities included 28.8 ± 1.3 min standing, 7 ± 1.3 min standing saddled, 21.5 ± 3.5 min walking, and 0.4 ± 0.2 min trotting. There was no effect of lesson duration on the mean HR for horses participating in lesson one on their first day of testing (P = 0.35) or on mean HR of horses participating in two lessons on their first day of testing (P = 0.76). Both the highest (52 bpm) and lowest (40 bpm) mean HR for test subjects were noted during lesson duration of 60 min, the longest duration measured.

Years in EAAT were found to have an effect on the mean HR of horses participating in lesson one on their first day of testing (P = 0.048). EXP horses had a mean HR of 49.9 ± 2 bpm, while NEW horses had a mean HR of 41.4 ± 1.9 bpm.

During their first lesson, horses had anecdotally higher average HR when standing saddled compared to HR of horses that were just standing. The number of lessons had an effect on mean HR of horses (P = 0.035), with lesson one (48.3 ± 2.6 bpm) warranting higher average HR than lesson two (43 ± 2.6 bpm). The number of lessons also had an effect on the HR of standing horses (P = 0.039), with lesson one (44.3 ± 2.3 bpm), again, noting higher HR than lesson two (37.8 ± 2.3 bpm).

Stress behaviors for horses participating in lesson one on their first day of testing were not affected by duration of lesson (P = 0.73), age of the horses (P = 0.79), or years in EAAT (P = 0.69), with stress behaviors averaging 5.4 ± 0.8 responses per lesson.

Stress responses recorded were also not affected by either the number of lessons (P = 0.47) or the age of the horses (P = 0.60) when horses participated in two lessons in a given day. Stress responses were uniform across both lessons for 3 out of the 4 horses, with a single horse eliciting 3 times as many stress responses for the second lesson. While the amount of stress recorded for this horse was higher in the second lesson, the horse's mean HR was anecdotally lower during the second lesson (40 bpm) as compared to the first (46 bpm).

Neither the duration of lesson (P = 0.85), age of horses (P = 0.98), nor the years in EAAT (P = 0.92) had an effect on the relaxed behaviors of horses participating in lesson one on their first day of testing. Further, there was no effect of either lesson number (P = 0.30) or age of horse (P = 0.38) on the number of relaxed responses recorded for horses participating in two lessons on their first day of testing. However, a single horse elicited a combined total of 53 relaxed responses for the testing day in comparison to all other horses that recorded individual relaxed amounts below 13 responses per day. Interestingly, 2 of the 8 horses participating in lesson one had greater than 18 relaxed amounts recorded, with one horse eliciting almost 30 relaxed responses. The mean amount of relaxed behaviors among the eight horses was 9.3 ± 3.5 responses per lesson.

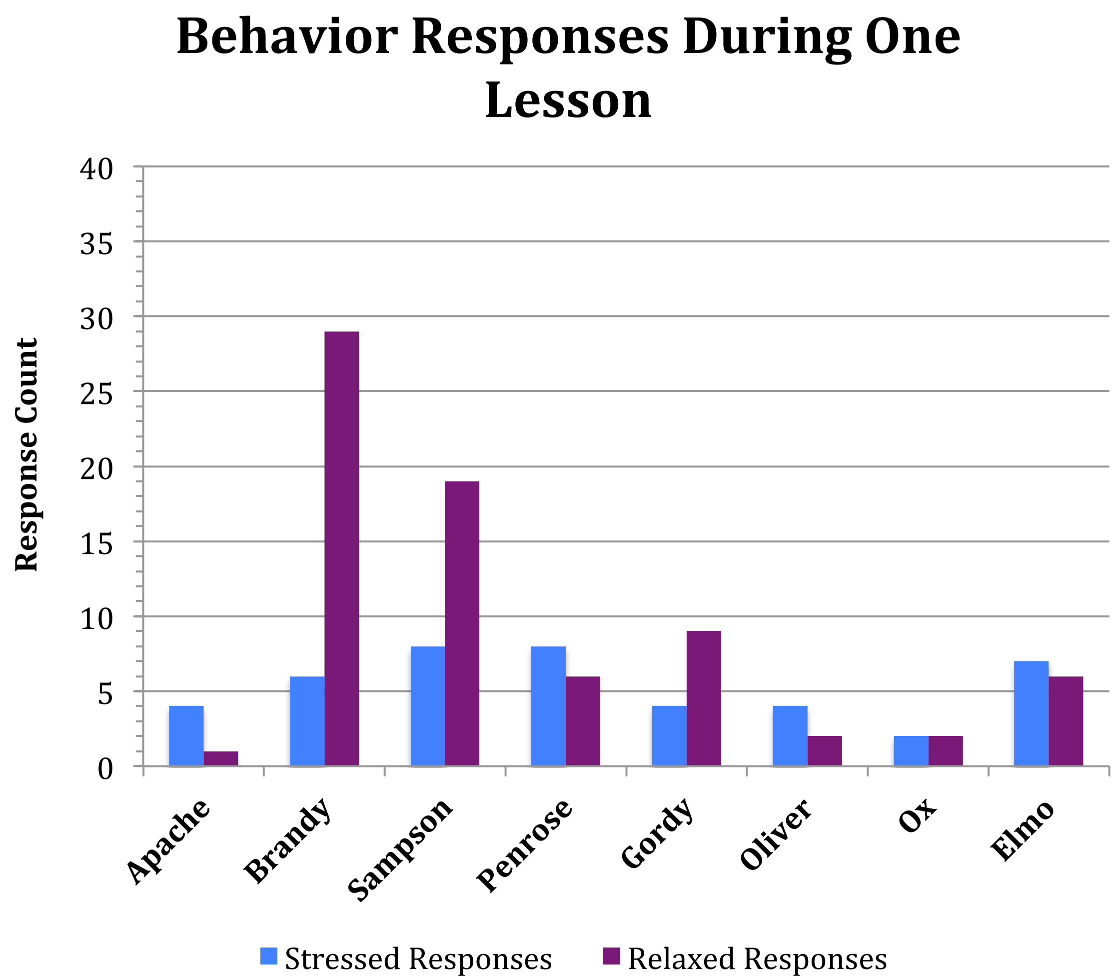

Figure 2. Relaxed and stressed behavior responses noted for each horse participating in lesson one on their first day of testing.

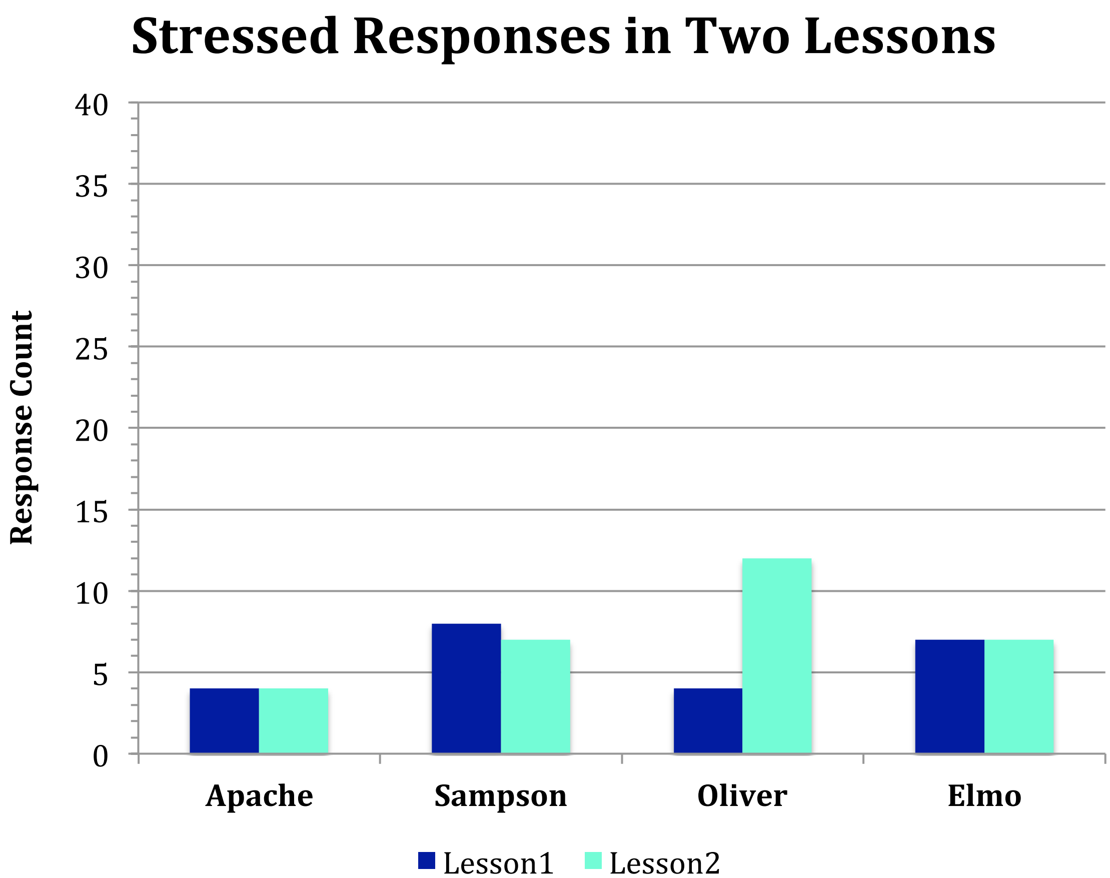

Figure 3. Stressed responses recorded for horses participating in two EAAT lessons in a given day. Stress responses recorded were not affected by the number of lessons (P = 0.47) when horses participated in two lessons in a given day.

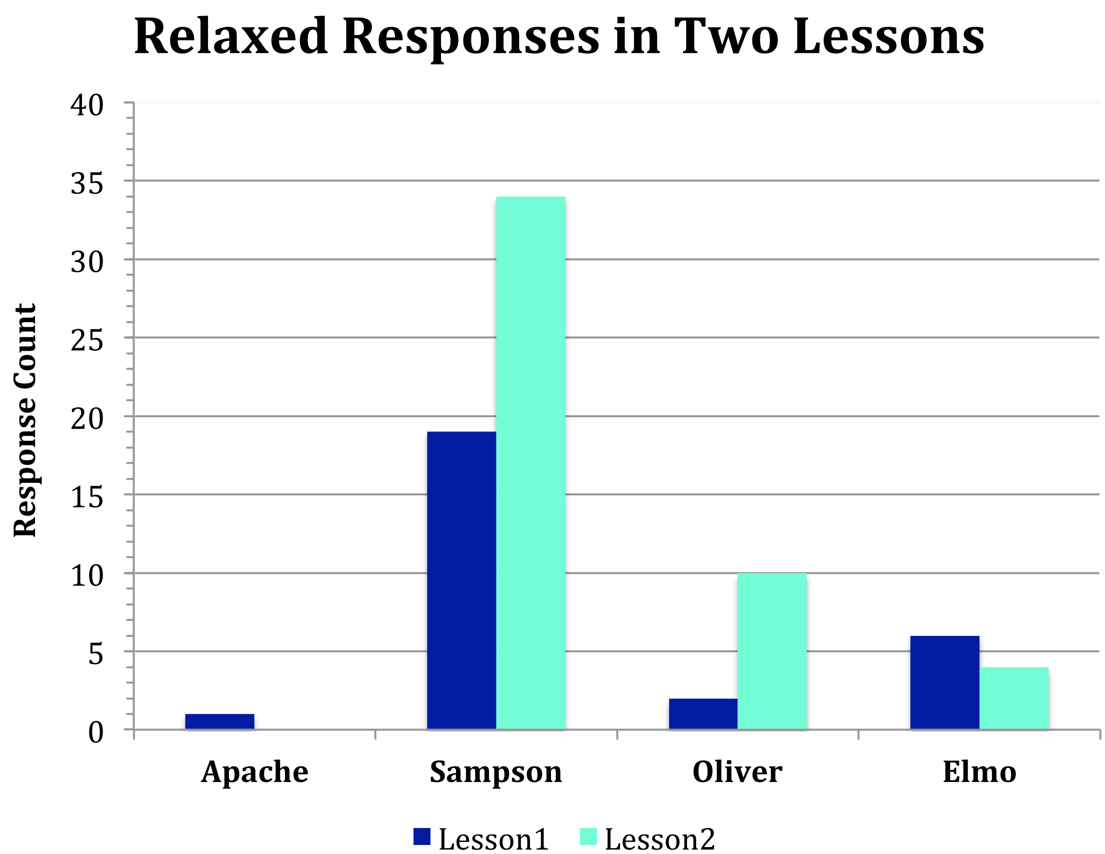

Figure 4. Relaxed responses recorded for horses participating in two EAAT lessons in a given day. There was no effect of lesson number (P = 0.30) on the number of relaxed responses recorded.

Table 2. Break down of time spent (min) participating in each activity during the first lesson for each horse.

Horse Name	Standing (min)	Standing Saddled (min)	Walking (min)	Trotting (min)
Apache	25	3	32	0
Brandy	30	3	27	0
Sampson	30	8	22	0
Penrose	30	.	.	1
Gordy	25	.	.	1
Oliver	25	8	7	0
Ox	30	11	19	1
Elmo	35	9	22	0

**Data were not available for time spent standing saddled or time spent walking for neither Penrose nor Gordy.*

DISCUSSION

The results of this study indicate that the therapeutic riding horses used did not experience elevated HR or stress responses during lessons. Observed stress responses did not have a significant effect on HR of horses during two different lessons. This suggests that horses used in this study may be termed as actively coping, as physiological differences were not found and stress responses averaged 5.4 responses per lesson. Previous research coincides with these results, with actively coping horses exhibiting more behavioral responses than physiological responses (Koolhaas et al., 1999). Any increase in behavioral responses of horses used in this study may be due to investigator error or the effect of different riders.

Contrary to common belief that therapeutic riding horses are more calm and relaxed in demeanor than other lesson horses, relaxed amounts recorded for therapeutic riding horses used in this study were not different from stressed amounts recorded. Only 2 of the 8 horses had noticeably higher relaxed responses recorded than stressed responses recorded. Previous studies similarly suggested therapeutic riding horses may not be as calm, tolerant, or desensitized in lessons as riding centers assume (Anderson et al., 1999; Minero et al., 2006). While results of this study did not suggest the horses were ill tempered, it was hypothesized horses would exhibit significantly higher relaxed responses than stressed responses. Furthermore, Anderson et al. (1999) and Minero et al. (2006) conducted studies comparing responses of therapeutic riding horses to other lesson horses not used for therapeutic purposes, warranting possible discrepancy in comparison to the present study. These two studies also analyzed reactivity of horses in response to novel stimulus tests instead of reactivity of horses in actual lessons.

It may be interesting to note horses participating in this study had mean HR ranging from 40 bpm to 52 bpm. Since the resting HR of horses can range from 32 to 48 bpm in a 10 to 27 degrees C climate (Brady et al., 2004), the data here suggest horses were barely working above resting conditions. The average temperature over the four testing days was 31 degrees C, which was only 4 degrees higher than the maximum of 27 degrees C previously reported. An elevation in temperature has been found to increase HR of horses (Brady et al., 2004). The minute difference in resting HR and HR of horses participating in therapeutic riding lessons may be attributed to the temperature. However, no research has been conducted to determine whether or not a 4 degree difference is enough to account for a difference in HR. Thus, this study may provide evidence that therapeutic riding horses may not engage in activities warranting physical activity above that of resting levels even when there is a slight elevation in temperature.

Level of experience for the horses in this study was determined by the years engaged in therapeutic riding activities, with years in EAAT $\geq$ 6 yrs indicative of EXP horses and years in EAAT $\leq$ 5 yrs indicative of inexperienced or NEW horses. It was expected that EXP horses would be more fit or trained for their job, and thus have lower HR than NEW horses. EXP horses were found to have a higher average HR of 49.9 $\pm$ 2 bpm than NEW horses at an average of 41.4 $\pm$ 1.9 bpm. In contrast, Munsters et al. (2013) found that trained horses had significantly lower HR than untrained horses when assessed over the course of an exercise test. Differences between this study and Munsters et al. study could be due to a difference in definition of a 'trained' horse. Trained in the current study would mean being desensitized and mentally prepared to perform therapeutic jobs, while trained in Munsters et al. study may relate to physical fitness of the horse. Still, it may be assumed that in completing EAAT activities for longer, the EXP group should also be more conditioned for the work at hand. Thus, they should be able to complete the work with lower heart rates, which is contradictory to findings from this study. Training level of horses may also be irrelevant in the current study, since equine management practices of the facility seemed to be exceptional. Additionally, all horses appeared suitable for their job, perhaps reflecting that time spent in use is not indicative of training, as new horses may have been subjected to a great deal of sensitization training in a short amount of time. Due to the small sample size and ages of the horses in this study, it may be that the definition of "new" was inappropriately assigned and perhaps differences could have been identified for horses in their first few months to year of work.

In addition to training or fitness level of the test subjects, perceivable workloads of the horses may play a factor in interpreting results. The standing HR of horses were found to be lower than the standing HR of horses when saddled. These results were expected, since horses carried more weight when saddled, or perhaps as a result of anticipating the upcoming riding session. The results of this study were similar to Sloet van Oldruitenborgh-Oosterbaan et al. (1995), who determined that HR of unloaded horses were significantly lower than HR of mounted or lead-loaded horses. Interestingly, this study also found minimal differences between experienced riders and dead weight on workload and locomotion of horses (Sloet van Oldruitenborgh-Oosterbaan et al., 1995). While no data were analyzed for the effect of different riders on horse HR in this study, it may be a relevant area to investigate in future research.

Another area warranting further research is that of lesson duration on HR of therapeutic riding horses. This study found no significant effect of lesson duration on mean HR of horses participating in lesson one or two lessons on their first day of testing. This may be attributed to the relatively small variation in lesson duration and the small sample size tested in this study. It would prove interesting to investigate similar parameters in horses working more near the maximal levels established by PATH Intl.

Therapeutic riding horses present in this study did not appear to experience any mental or physical stressors that would hinder their job performance. This may be attributed to PATH Intl accredited centers, like the one where this study was conducted, adhering to specific guidelines for the care and welfare of their horses. None of the horses in this study exceeded or reached the maximum 6 workday hours implemented in the PATH International Standards Manual (PATH Intl, 2014). However, it is important to note that this testing center may not be ‘typical’ of therapeutic riding centers with its exemplary equine management practices that go beyond the scope of PATH Intl requirements.

CONCLUSION

According to this study, therapeutic riding horses managed well below the current PATH Intl guidelines for horse workload did not experience elevated HR or high stress responses during lessons. Horses managed with proper care and well-being practices are well suited to participate in at least two EAAT lessons daily, as minimal stress responses were observed at this level. Additional testing should be conducted to determine if equine management practices are comparable across multiple centers and to define what a 'typical' therapeutic riding center is. This study also determined lesson duration and age did not have an effect on stress responses or HR of horses participating in one or two therapeutic riding lessons. Further research is needed to determine if horses participating in greater than two therapeutic riding lessons experience elevated HR or stress responses or if greater variation in lesson duration has an effect.

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APPENDICES

APPENDIX A: IACUC Approval

IACUC

INSTITUTIONAL ANIMAL CARE and USE COMMITEE
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

PROTOCOL APPROVAL NOTICE

7/20/2015

Investigator Name(s): Holly Nobbe, Holly Spooner and Sarah Newton-Cromwell
Investigator Email(s): hrn2g@mtmail.mtsu.edu, sarah.newton-cromwell@mtsu.edu; holly.spooner@mtsu.edu
Department/Unit: Horse Science Center

Protocol ID: 15-012
Protocol Title: Investigating heart rate as an indicator of workload and identification of clinflict behavior inhorses used in therapeutic riding programs

Dear Investigator(s),

The MTSU Institutional Animal Care and Use Committee has reviewed the animal use proposal identified above and has approved your protocol in accordance with PHS policy. This approval is effective for three (3) years from the date of this notice. Your study **expires 7/20/2018**. Investigator(s) MUST file a Progress Report annually regarding the status of the study and submit an end-of-project report.

MTSU Policy defines an investigator as someone who has contact with animals for research or teaching purposes. Anyone meeting this definition needs to be listed on your protocol and needs to complete IACUC training through the CITI program. Addition of investigators requires submission of an Addendum Approval to the Office of Research Compliance.

The IACUC must be notified of any proposed protocol changes prior to their implementation. Unanticipated harms to subjects or adverse events must be reported within 48 hours to the Office of Compliance at (615) 494-8918.

Also, all research materials must be retained by the MTSU faculty in charge for at least three (3) years AFTER the study is completed. Be advised that all IACUC approved protocols are subject to audit at any time and all animal facilities are subject to inspections at least biannually. Furthermore, IACUC reserves the right to change, revoke or modify this approval without prior notice.

Sincerely,

Compliance Office
(On behalf of IACUC)
Middle Tennessee State University
Tel: 615 494 8918
Email: compliance@mtsu.edu

APPENDIX B: Stressed Behaviors Ethogram

Name of Horse: ______________________ **Date:** ______________________.

Behavior	Times Noted
Ears Pinned Back	
Head Tossing (lowered head, Side-to-Side reaching toward rider)	
Head Shaking (Up-and-Down motions)	
Defecation/Urination (note which one: D or U)	
Pawing	
Biting	
Tail Swishing	
Other (describe incident)	

APPENDIX C: Relaxed Behaviors Ethogram

Name of Horse:________________________ **Date:**______________________.

Behavior	Times Noted
Licking	
Lowered Head Carriage	
Cocked Hind Leg	
Chewing	
Yawning	
Neigh	
Ears Relaxed (lateral position)	
Other (describe incident)	