HOW WELL DO HORSE INDUSTRY MEMBERS INTERPRET AND APPLY ANIMAL BEHAVIOR AND WELFARE CONCEPTS?

by

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ABSTRACT

Misunderstanding or misinterpreting specific animal behavior and welfare terminology, as well as principles of learning theory, may influence an individual's perceptions of horse behavior. This error could potentially result in unnecessary applications of horse training principles and/or human interventions, which could potentially worsen the behavior or situation, leading to unnecessary welfare problems.

The purpose of this dissertation was to explore interpretations and understandings of specific animal behavior and welfare terminology, and learning theory principles, as applied to horses, among adults within the horse industry. Chapters 1 and 2 introduced, summarized, and linked the connection between horse behavior, horse welfare, learning theory, and schema theory. Chapter 3 and Chapter 4 each pilot-tested an online survey that was completed at the convenience of each participant to explore these interpretations and understandings. Chapter 3 (n = 46) utilized a survey containing general demographic questions, psychographic questions related to horse industry involvement, five videos of horse-human interactions (each with corresponding heart rate, HR, data), and 11 learning theory scenarios. Chapter 4 (n = 21) used a survey containing general demographic questions and five videos of various human-horse interactions, including the same five videos with horse HR information included. Using results from Chapter 3 and Chapter 4, further investigation of how individuals interpret and understand specific animal behavior and welfare terminology, and learning theory principles, as applied to horses was explored across a larger sample of adults within the horse industry. Chapter 5 (n = 1,145) utilized the same survey instrument as Chapter 3 among a more robust sample of adults within the horse industry.

Across all three studies, the main results suggest that although participants demonstrated a high level of agreement between each other when identifying fear, stress, and reactivity to describe a horse's behavior, participants could not correctly define fear, stress, reactivity, or principles of learning theory, as related to horses. They also could not connect these states to an important physiological factor, i.e., HR, when identifying these states. Results across all three studies suggest that most participant demographics (such as age, gender, or race) did not influence participants' abilities to correctly identify or define fear, stress, reactivity, or learning theory principles. Similarly, results from Chapters 3 and 5 suggest that most participant psychographics, such as

horse ownership, or level of involvement with horses, did not affect ability to correctly identify key horse behaviors related to fear, stress, and reactivity, or understanding of learning theory principles, or ability to correctly define these states and principles.

Overall, this dissertation identified the need for additional education when it comes to clearly defining specific states such as fear, stress, and reactivity for individuals across the horse industry. Additional psychographic factors, such as an individual's specific role or niche in the industry, or an individuals' overall view of horses, should be further explored.

CHAPTER 1. INTRODUCTION

For centuries, the roles the horse has played in human society have evolved from a being solely considered livestock to that of a beloved companion animal. Throughout history horses continue to represent power, courage, and unbridled passions (Frewin & Gardiner, 2005). The interdependent relationship between humans and horses was prominent for centuries as horses performed a variety of tasks that made human life easier. As the relationship between domestic horses and the people they serve has developed, horses have become more than livestock. They have become workmates who are cared for by the people who utilize their ability to work and their loyalty has earned them the care of respect of their owners.

1.1 Evolution of the Role and Perception of Horses in Society

Domestication of the horse is believed to have occurred nearly 5,500 to 6,000 years ago in the Eurasian Steppe, based on archeological and genetic analysis (Guimaraes et al., 2020). It is suggested one of the first motivations for early domestication of horses was for meat production (Hausberger et al., 2008). Another theory is horses greatly impacted human culture and society because of their ability to carry people on their backs (Clutton-Brock, 1992). Horses allowed their caretakers to travel further, carry more goods to trade, farm more acres, and successfully win in battle. They therefore gained iconic status due to their indispensable qualities related to transportation, migration, war, agriculture, and the dominance of some languages (Anthony, 2010; Freeman, 2010). Horses represented wealth and power, and strong human-horse relationships have been documented across various societies (Hausberger et al., 2008). Although the role of horses as primarily "tools" for farm work and transport has declined, other roles have been established. Until 100 years ago, horses were prevalent in most western society. They pulled carts and carriages, worked on farms and timbering operations, carried cowboys and ranchers, moved mail across the country, allowed hunters access to remote lands, and carried humans through war. Since the 1960s, the use of horses for sport and hobby has increased and continues to rise (Robinson, 1999). Horses now serve in different roles with some including performance, competition, racing, mounted patrol, and therapeutic riding. The domestic horse we see today, although different in conformation, shares many similarities to its wild ancestors. Despite these similarities, however, basic behavioral characteristics may have been slightly altered by domestication, which may impact today's common perception of the recreational horse.

1.1.1 Perceptions of Horses in Society

Previous research has focused on anthropomorphic characteristics that influence human perspectives regarding animals. These categories have included gender (Heleski & Zanella, 2006; Mazas et al., 2013), empathy or sympathy (Heleski et al., 2004; Mazas et al., 2013), personality traits of agreeableness, openness (Furnham et al., 2003), sensitivity and imagination (Matthews & Herzog, 1997), political status (Heleski et al., 2004), socioeconomic status (Heleski & Zanella, 2006), and education (Furnham et al., 2003; Mazas et al., 2013).

As the roles of horses continue to evolve, so does the societal perception of horses, and this perception often impacts their welfare. Whereas society used to see the horse as working livestock, more people now see horses as companion animals. In the 2015 American Horse Publications Equine Industry Survey (Stowe, 2015), of the 10,662 respondents, a majority reported they viewed horses as family members (67.4%), companion animals (62.7%), performance partners (57.6%), or best friends (55.9%), while fewer reported they viewed horses as an investment (22.4%), a livestock animal (21.1%), or an employee (7.8%). Luna and colleagues (2017) explored two administrative regions of Chile and determined that individuals within these cultural regions perceived horses used for work either through an emotional lens or viewing the horse as purely a tool used for work. Even though the emotional lens was widely shared among all owners, the horses in these regions were still in good welfare, suggesting that both of these perceptions can exist together (Luna et al., 2017). How society perceives horses is important because meeting the behavioral needs of companion animals has been viewed as more important than meeting those of farm animals (Heleski & Zanella, 2006). It is therefore possible people may perceive the needs of horses as being more important than species they would classify as livestock. This perception may impact their overall interpretation and understanding of the needs of horses, which could impact the horse's welfare and quality of life.

As the role of horses has changed from food to workmate, to companion, their relationship with their human caretakers has also changed. This relationship between horses and their human caretakers often results in positive welfare outcomes for the horse.

1.2 The Link Between the Human-Horse Relationship and Horse Welfare

Today humans interact with horses in various ways and to different degrees. This can fluctuate from those who pet the horse at the local barn to those who ride every day, to veterinarians who specialize in equine health. Some people own horses, house them on their property, and have daily interactions while providing daily care, while others own horses but they are not responsible for their day-to-day care. Some people provide daily care to horses, but are not considered their owners (Robinson, 1999). The relationship between humans and horses is mutual, which is the primary reason these two species were able to develop a bond some 6,000 years ago. Horses can easily adapt to their environment and humans are generally attracted to them due to the many benefits horses are able to provide, such as companionship, leisure, and sport. As a result of the benefits horses provide to humans, horses are provided protection, feed, and care by their owners.

In the most optimal situation for the recreational horse, humans provide visual, auditory, and physical contact, and may satisfy the social needs of the horse, especially if a strong bond between the human and horse exists. This experience is common within smaller horse boarding facilities in that humans provide the majority of the social contact horses experience in their day-to-day lives. Previous research has demonstrated how the human-horse relationship may impact the overall quality of life for the horse. During human approach tests, horses experienced a reduction in fear responses when intermittent direct contact by humans occurred (McCann et al., 1988). McDonnell (2000) determined proper handling and management of horses increased reproductive efficiency and lessened breeding problems. Minero et al. (2018) suggested "poor handling increases fear of humans in horses, influencing their mood and level or arousal, and drives them into a negative feedback cycle that progressively leads them to become more aggressive and unsafe to handle." As people continue to understand the horse-human relationship, injuries may still occur among individuals within the horse industry (Hausberger, 2008). The human-horse relationship between horses and riders can impact horse-related riding injuries, as several horse-related injuries have occurred due to miscommunication between the horse and rider (Keeling et al., 1999). These examples indicate the quality of life for the horse is influenced by their relationship with humans. This is important for people to understand because the quality of the human-horse relationship dictates how connected people feel towards horses and their obligations to them, in turn impacting horse welfare.

Enhancing the quality-of-life animals experience under human care depends on the quality of the relationship between humans and animals. The quality of the human-animal relationship focuses on the quality of the inter-individual relationships between humans and animals (Hemsworth & Coleman, 2011). In other words, the quality and frequency of human-animal interactions influence the relationship between the human and the animal. Hinde (1976) proposed that the inter-individual relationship is based on consistent interactions between two beings who are familiar with each other. Furthermore, Estep and Hetts (1992) agreed human-animal relationships are viewed similarly, as each partner's perception of the relationship influences the quality of the relationship. Since domestication has increased the dependence of animals on humans, most people recognize humans have ethical obligations towards farm, companion, and laboratory animals (Levy, 2004), and these perceived obligations are often reflected in their relationships with livestock animals as well. Relationships that develop between humans and companion animals are equally possible between humans and livestock since humans work closely with these animals.

Science has shown that there is a link between the human-horse relationship and horse welfare. Therefore, regardless of whether horses are viewed as companion animals or livestock, the quality of the human-horse relationship impacts the overall life for the horse that is created by the various interactions between people and horses. In addition to people's perceptions of horses, the extent to which the horse's welfare needs are met and understood depends on the quality of the relationship that exists between humans and horses. If there is a strong human-horse relationship, then there is potentially more desire to improve the welfare of a horse. For a strong human-horse relationship to exist, there needs to be sound understanding and reasonable expectations of people towards horses. When horses do not meet the expectations of humans, this causes the human-horse relationship to erode. If people have unclear expectations and/or interpretations of horses, it may be caused by a lack of understanding of what the horses need or want. It may also be a result of people not understanding how to determine if horses' needs or wants are being met. Understanding the needs and wants of horses requires an understanding of horse welfare. In addition to poor quality handling and poor welfare, factors that impact the human-side of the human-horse relationship include human understanding and learning. How humans obtain their perceptions, interpretations, and understanding of horse welfare concepts could be explained by exploring principles of learning theory and schema theory. Incorporating understanding of animal welfare and learning theory principles into schema theory pertaining to how people develop perceptions of horses and their needs offer unique insights into how to better support horse welfare.

CHAPTER 2. LITERATURE REVIEW

Since people began domesticating animals, there has been a connection between people and animals. The human-animal relationship is well established across species and the quality of these relationships potentially impacts the welfare of animals. Typically, when the human-animal relationship is stronger, there is a stronger desire for people to improve the welfare of the animal. But even in these cases, welfare issues can still occur. Before exploring possible welfare concerns faced by horses, it is important to understand animal welfare in general.

2.1 Animal Welfare

Accepted definitions of animal welfare are based on multiple dimensions, which include "a state of complete mental and physical health where the animal is in harmony with its environment" (Hughes, 1976) and "the animal's state as regards to its attempts to cope with its environment" (Broom, 1991). According to The World Organization for Animal Health (OIE, 2019), animal welfare is defined as 'how an animal is coping with the conditions in which it lives.' Subjective emotional experiences of animals have been characterized according to two sectors: valence (being the positive or negative, pleasant or unpleasant experiences) and arousal/intensity level ("contentment versus excitement") (Mendl et al., 2010).

Animal welfare is typically assessed based on either physical or behavioral metrics. Indicators of animal welfare used commonly for livestock include measurements involving the animal's general health and production. Examples of less-invasive physical metrics include heart rate, temperature, respiration, capillary refill time, blood pressure, body condition score, as well as checking health and performance records. One benefit is that these metrics can be measured by one individual in an efficient manner in the field. More-invasive physical metrics include analysis of serum or salivary cortisol concentrations, urinary excretion of catecholamines, oxidate stress biomarkers, blood glucose concentrations, or markers related to inflammation or compromised immune response, which require testing not readily available in a field setting. Examples of behavioral metrics include expressed body movements (such as focusing on the ears, head, body, and tail), body posture (freezing or tense posture versus relaxed and calm disposition), presence of stereotypies, and flight or fight responses.

On-farm welfare indicator systems have been developed based on environmental factors, management practices, and available resources for use when assessing agricultural animals. It is suggested that on-farm animal welfare assessment is most accurate when animal-based measures are used in combination with the farm management measures (AWIN, 2015). These measures are thought to be more accurate when assessing welfare because they provide specific information about the effects on animals as well as their responses. According to the European Food Safety Authority, animal-based measures are considered to be "the most appropriate indicators of animal welfare and a carefully selected combination of animal-based measures can be used to assess the welfare of a target population in a valid and robust way" (EFSA, 2012).

When measuring the emotional state of animals, unique methodologies are required. One of the different methods developed to identify the main dimensions of animal emotional states is the Qualitative Behavior Assessment (QBA), first developed by Wemelsfelder et al. (2000). The QBA allows the observer to address the whole animal, focusing on specific behaviors of the animal and then scoring these using different behavioral descriptors. The value of applying QBA has been used related to the context of human-animal relationships, which can impact animal welfare.

There are limitations to the use of behavioral metrics to assess animal welfare. Because behavioral metrics are subjective, it is difficult to interpret relative frequency of occurring behaviors. In other words, absence of the issue does not necessarily imply the absence of problems. Animals may be coping or adapting to their environment, but that does not equal positive welfare in all cases.

2.2 Horse Welfare

Many of the physical and behavioral metrics mentioned above can be used to assess horse welfare. In addition, there is research that addresses more specific welfare indicators and concerns about horses (Hemsworth et al., 2015; Preshaw, Kirton & Randle, 2016; Waran & Randle, 2017) and researchers have developed tools to assess the welfare needs of horses specifically. According to the AWIN Welfare Assessment Protocol for Horses (AWIN, 2015), there are four main categories to assess proper welfare in horses: Good feeding, Good housing, Good health, and Appropriate behavior. Positive descriptors include: At ease, Curious, Friendly, Happy, Playful, and Relaxed. Negative descriptors include: Aggressive, Agitated, Anxious, Apathetic, Distressed, Fearful, Pushy, Uncomfortable, and Withdrawn (AWIN, 2015). While researchers have used fixed lists of Qualitative Behavioral Assessment (QBA) descriptors to assess animal welfare within other species (Andreasen et al., 2013; Fleming et al., 2013; Grosso et al., 2016), a QBA procedure developed for horses living in single stalls explored the association between the horses' QBA scores with their scores on Avoidance Distance and Forced Human Approach tests (Minero et al., 2018). Horses that were scored higher on QBA descriptors such as "relaxed", "friendly", and "at ease" demonstrated more positive emotions with humans, suggesting a better human-horse relationship.

2.3 Common Metrics of Horse Welfare

Scientists and lay people are equally challenged with the ability to easily recognize the affective state of horses (Minero et al., 2018). While behavior can be challenging due to its subjectivity, behavioral measurements can still be valuable when evaluating the health and welfare of a horse. When a horse is healthy and experiencing positive welfare, its behavior tends to indicate its overall condition. When horse welfare is compromised, however, a veterinary exam is not required to notice symptoms immediately because there is typically a behavioral change associated along with a related physical or psychological response. Therefore, behavioral measurements can be used to indicate a change in the state of the horse that impacts its welfare. Common states that may compromise horse welfare include stress, fear, and reactivity.

2.3.1 Stress

Various terms are used to assess horse welfare, but one of the most commonly used is "stress". Broom (1991) suggested that using a combination of physical and behavioral measures is the best way to assess a stress response. This leads allows a more accurate measure of the animal's condition. It is suggested that chronic stress may influence all aspects of life and potentially result in behaviors similar to those linked to human depression (Hall & Heleski, 2017).

Stress has been categorized as both positive and negative, eustress and distress respectively. The difference between eustress and distress relies on the interpretation and perception of a given stimulus in the broad context in which it is presented. This includes the timing, source, and perceived desirability of the stimulus to the individual impacted. Harris (1970) related eustress to positive or pleasurable reactions to stressors. In contrast, Fevre et al. (2006) related distress to negative or undesirable reactions to stressors. Fevre et al. (2006) also pointed out that eustress seems to be lacking in current research and literature which may contribute to a narrow view of possible stimulus responses, which may lead to discussions of stress becoming one-sided and difficult to properly understand.

Eustress and Distress in Horses

The terms eustress and distress are commonly used when discussing horse welfare. Hausberger et al. (2016) related distress in horses to pain and discomfort. Waran and Randle (2017) acknowledged that the little research that has been previously conducted on emotion in horses has primarily focused on negative states, such as pain, fear, distress, and discomfort. These terms were noted to be highly subjective terms and researchers acknowledged the difficulty of appropriately identifying these states in humans, and, even more so, in non-human subjects. Limited research has documented the use of eustress when describing stress, however, Adamczyk et al. (2015) labeled competitive stress in horses as eustress.

2.3.2 Fear

A horse's response to a fear-inducing situation is critical to its safety and that of its handlers. The horse is a prey animal and therefore, flight is a major strategy for surviving in its environment. Therefore, it is not a surprise that traits associated with fear are central aspects of horse temperament (Olsen & Klemetsdal, 2017). Forkman et al. (2007) defined fear as 'a reaction to the perception of danger'. There are fear tests for horses that can accurately quantify the frequency of this state (Forkman et al., 2007). According to Manteca & Deag (1993), fear is "a reaction which includes physiological changes, including activation of the sympathetic system and behavioral changes, like avoidance and fleeing." Researchers have suggested that fear can be related to avoidance behaviors, or movement away from undesired stimuli. (Pereira-Figueiredo et al. 2017, Watson & McDonnell, 2018). Casey (2007) suggested that horses' behavioral responses to pain and fear are similar, such that horses will typically show evasive or flight responses to reduce exposure to painful stimuli.

2.3.3 Reactivity

Reactivity has previously been described as 'an increased state of arousal' and has been suggested to impact how useful horses may be for certain tasks (McCall et al., 2006). Reactivity is best measured using a combination of behavioral and physical metrics (McCall et al., 2006). During riot control training and night patrols, mounted patrol horses were found to have higher levels of reactivity when they were not being controlled by a rider (Munsters et al., 2013). Anderson et al. (1999) assessed the reactivity and temperament of horses used for therapy by comparing various riding instructors' opinions as well as cortisol, norepinephrine and epinephrine levels. Results suggested that 64% of the horses with the highest reactivity scores were classified as therapy horses. In comparison, reactivity levels of therapy horses and reactivity levels of jumping horses were compared by exposing them to two challenges while considering their behavioral and physiological reactions (Minero et al., 2006). The average heart rates of the horses used for therapeutic riding were higher than the average heart rates of the horses used for jumping. These results suggested that therapeutic riding horses may be desensitized to specific stimuli within their daily activities but may still be reactive to new stimuli. This also indicates that the horses' behavioral responses did not align with their physiological indicators.

When evaluating animal behavior, it is crucial to have sound understandings of specific terminology. States, such as stress, fear, and reactivity, are often confused, which may create diverse perspectives on the animal's behavior that is occurring. This common misunderstanding and incorrect utilization of these specific terms serves as just one example of potential welfare concerns to today's horse industry, yet there are additional welfare concerns in the horse industry today that should be addressed.

2.4 Welfare Issues in the Horse Industry

There is a range of underlying factors that have been suggested to influence the welfare of recreational horses. These factors include the horse owner's commitment to being a horse owner, their knowledge of and attitudes towards horse management practices, and demographic factors including age, income, and education (Hemsworth et al., 2015). While it would arguably be optimal for all contact with a horse, direct or indirect, to better support the human-horse relationship and the horse's welfare, specific situations can cause a horse to negatively react. For example, a careless handler who uses aggressive actions or loud sounds as a way to provoke a horse to move in and out of the barn may create a horse that is less willing to approach humans. Another example is a horse that has become head-shy due to previous experiences of a strike or other abuse toward that part of the body.

Although the goal may be that every human-horse interaction should create beneficial outcomes and not compromise the horse's trainability, a horse's welfare may be compromised from people's views of traditional horsemanship (Levine 2005, McLean 2013). Traditional horsemanship assumes the notion that some dominance is necessary for successful horse training (Mclean &McGreey, 2010). Traditional 'horse whisperers' utilized the universal concepts of learning and cognition, making connections between dominance, submission, respect, and leadership to successful horse training (Hinnemann & Van Baelen, 2003; McLean, 2013). Additional characteristic descriptors of horses evolved from these methods including 'alpha', 'dominant', 'submissive', respectful', 'disrespectful', and 'leader' (Roberts, 2000), which has led to the common issue of anthropomorphism.

Anthropomorphism has been defined as the attribution of human characteristics to animals (Eddy et al., 1993). Researchers have suggested it is common, cross-cultural, species typical, and nearly irresistible. Anthropomorphism has generally been viewed as something that needs to be avoided in discussions revolving around animal behavior (Gallant, 1981). Nevertheless, anthropomorphic words have been applied to horses in different contexts such as cognition ('understanding', 'knowledge', 'guilt', 'willingness', 'laziness', or 'stubbornness'), human-personality disorders ('crazy', 'erratic', 'psychotic', or 'pushy'), as well as terms associated with human war heroes ('loyal', 'brave', or 'bold') (McLean, 2013). While some may argue that anthropomorphism can be beneficial even to the horse industry, others claim it could be detrimental.

The level to which someone involved in the horse industry anthropomorphizes horses may impact their perception of them, which we now know can influence their horse-human relationship and the welfare of the horse. If the quality of the human-horse bond is impacted by the ability of people to correctly interpret and understand key welfare metrics, then it is important that there is consistent and correct behavioral terminology used in relation to horses and their welfare. One challenge, however, is that many of the physical and behavioral responses to the key terms described above can overlap. This creates a limitation in that, like humans, animals can express behaviors and emotions differently, which only muddles the interpretation more. If people are inadvertently anthropomorphizing horses, this could potentially blur their understanding of the horse's behavior further, any subsequently compromise the horse's welfare. To help address this issue, it may be beneficial to evaluate how individuals obtain this level of understanding by exploring principles of human learning.

2.5 Human Learning and Understanding

As previously stated, the quality of the human-horse bond impacts the welfare of both the human and the horse. For this bond to exist, there needs to be a well-developed and clear understanding of key welfare and behavior concepts. If people have unclear expectations or interpretations of horses, it may be because they lack an understanding of what horses need or want, or how to determine if horses' needs or wants are being met. How people obtain and arrive at these interpretations is critical for determining the best strategies for how to intervene to prevent this lack of understanding. One way to begin understanding how people conceptualize horse behavior and welfare is to consider the roles of learning theory and schema theory.

2.5.1 Learning Theory

Learning encompasses the process of changing behavior due to effects of experience through mental and/or physical adaptation (Thorpe, 1963). Learning theory integrates the combination of non-associative learning, such as habituation and desensitization, and associative learning, such as classical and operant conditioning. As a greater understanding of ethology emerged, there was simultaneously an increase in the independent constructs of learning theory.

Behavior change in various animal species (including horses) can be accounted for based on these processes of learning theory (McLean & Christensen, 2017). Aside from the benefits to horse management, the effective handling and training practices for horses did not benefit as greatly as expected from purely ethological discourse (McGreevy & McLean 2007). There is little research exploring the use of learning theory as it applies to horse training (McLean & Christensen, 2017). Typically, horse training is based on knowledge passed on through generations and the art of horsemanship is frequently discussed with little research to back it up (Pearson, 2015).

Ten horse management principles have been drafted specifically for individuals in the horse industry to promote the safety and welfare of both people and horses (McLean et al., 2018) (See detailed components of the principles in Table 2.5):

1. Regard for human and horse safety
2. Regard for the nature of horses
3. Regard for horses' mental and sensory abilities
4. Regard for current emotional states
5. Correct use of habituation/desensitization/calming methods
6. Correct use of operant conditioning
7. Correct use of classical conditioning
8. Correct use of shaping
9. Correct use of signals/cues
10. Regard for Self-carriage

These principles were designed for individuals involved in equitation science as a way to help make horse welfare concepts clearer to understand and more fun to learn and teach. Two of these principles were selected to frame this dissertation study: training principle 2 – regard for the nature of horses: use learning theory appropriately, and training principle 9 – correct use of signals/cues: avoid and dissociate flight responses. The second principle encompasses the appropriate use of habituation, sensitization, operant conditioning, shaping, and classical conditioning. These include the four subsets of operant conditioning: positive reinforcement, negative reinforcement, positive punishment, and negative punishment. The ninth principle encompasses flight responses of horses, understanding that they are natural to the species. This principle addresses two of the three selected behaviors that were explored in this study, e.g. fear and stress. While these industry principles serve as a guide to better understanding of horse welfare concepts, another way to ascertain how individuals think and learn could be through the use of schema theory.

2.5.2 Schema Theory

Understanding schema theory may help to clarify how people understand and interpret concepts related to horse behavior, horse welfare, and learning theory. Schema theory is a hypothetical way of organizing packets of information/knowledge and how it relates to a topic, previous knowledge, or concept (Driscoll, 2004). A person's schema includes information about constraints on what normally can fill a particular slot in their mind (Anderson, 1978) and what the relationships are among these slots (Kiato, 1989). A schema includes the network of associations that a concept is given (Pearson & Spiro, 1982). Arbib et al. (1987) states that a schema is both a process and a representation. One's schema refers to representations that sub-serve perception as it is embedded within one's ongoing interaction with its environment.

Schemata include information about what can or must fill each mental slot and what the relationships among pieces of information include as well as how to fill in information that is not explicitly mentioned (Kiato, 1989). The process of filling these mental slots is called "instantiation" of a schema. In addition to information about constraints on what can fill a slot, schemata include default values for each slot. If a slot is unable to be filled by available knowledge, the slot is subsequently filled by the individual with a concept that he/she assumes to be standard in that particular slot. Schemata are typically used in two ways – either in guiding actions in typical situations or in comprehension. For example, when an individual walks into a restaurant they typically know how to behave and what to expect if they have eaten at other restaurants in the past. A reader's who ability to infer that certain things are occurring just from reading the text, without the author having to explain every detail, is another example of the use of schemata. Schema theory therefore describes how schemata are presented and how that presentation encourages the use of knowledge (Driscoll, 2004).

Origins of Schema Theory

Frederic Bartlett (1932) is known for the first official definition of schema theory, which he used within his findings among memory research. In his early work, *Remembering* (1932), Bartlett proposed that relationships between existing knowledge and new information changed the way in which the new information would be perceived in the future. Bartlett contributed the ability to recall information as the operation of restructuring mental schemata that already exist.

In the 1950's, Jean Piaget (1952) explored schemata in the context of child learning and development. Piaget emphasized the constructive nature of knowledge development in children, in that schemata were thought to be the building blocks of knowledge and development. Piaget (1952) suggested behavioral schemata, symbolic schemata, and operational schemata, as three possible kinds of mental structures. He also suggested both assimilation and accommodation are used to develop schemata and impact additional perspectives.

Schema Theory Research

The application of Schema Theory is extensive across varying fields of study, but one of the more common fields in which it is used is education. Pickert and Anderson (1977) determined that the point of view from which an individual reads a text influences their comprehension of the specific text. When individuals were asked to read the same text explaining the layout of a house, but acting as different characters (e.g. home owner versus burglar), key concepts of the text were remembered differently, post-reading, depending on the character they were asked to portray (Pichert & Anderson, 1977).

Further, Hu (2012) noted that listening was once believed to be a passive, one-way comprehensive process, but argued that now, listening can be thought of as an interactive, two-way communicational process. It is suggested that the background of an individual plays an important role in their ability to listen effectively. Schema theory is, therefore, thought to facilitate listening comprehension and can be applied effectively to practical teaching strategies (Hu, 2012). As schema theory is believed to be an interactive process, An (2013) suggests that this theory is applicable to reading for students. Reading is an interactive process, and readers, consciously or unconsciously, use various processes interchangeably to facilitate comprehension. Schema theory can, therefore, guide readers as they make predictions about what they might expect to experience in any given context (An, 2013). Consequently, schema theory is appropriate background for teachers as they plan their curriculum, considering that students' past experiences and knowledge dictates their comprehension of future opportunities for educational growth (Fahriany, 2015).

Although schema theory has been used extensively within the field of education, it has been applied to other fields as well. From a cultural perspective, Bem (1981) explored the theoretical perspective of schema theory relative to how an individual becomes gendered in society based on cultural norms and societal views. In psychology medicine, Young et al. (2003) studied the effects of schema theory to create a therapeutic approach to treating personality disorders and depression. Plant and Stanton (2012) used schema theory to address situational awareness, naturalistic decision-making, and error among individuals working in the realm of ergonomic research. In business, Sherman et al. (2015) focused on how positive or negative experiences of individuals in previous organizations or interactions with previous employees influenced their future expectations of new work sites or fellow employees.

Despite the extensive amount of research utilizing schema theory across different subject areas, there is little research that relates schema theory to equitation science. Schema theory has been used to explain how individuals obtain and interpret knowledge in a variety of subjects, so it could be used in the horse industry to further explore how individuals acquire their overall interpretations, understanding, and knowledge related to horse behavior and welfare.

2.6 Integrating horse behavior, horse welfare, Learning Theory, and Schema Theory: Implications for Current Study

Misunderstanding learning theory, or confusing specific behavioral terminology, may impact human interpretation of horse behavior, potentially resulting in the improper application of equine training principles and human intervention when necessary. Specific states, such as fear, stress, and reactivity, require different training strategies to address each state individually. If an individual who is working with horses is unable to correctly identify the behavior being expressed by the horse, then the individual may incorrectly apply a training strategy that could worsen the behavior or situation. Similarly, by misunderstanding conditioning principles of learning theory, an improper training strategy may be applied to the horse, which would lead not only to poor learning outcomes, but also to unnecessary welfare problems.

Therefore, the purpose of this study was to explore and describe adult horse industry participants' interpretations and understanding of animal behavior and welfare terminology, as well as learning theory principles, as applied to horses. This study also aimed to explore the relationships between people's understanding of learning theory principles and their abilities to interpret horse behavior. In addition, potential relationships between participants' demographics/psychographics and their understanding of learning theory principles and horse behavior were examined.

This study will be significant for three primary reasons. It will: 1) describe current interpretations and understanding of specific horse behaviors and learning theory by individuals involved in the horse industry; 2) describe the ability of individuals involved in the horse industry to accurately identify operant conditioning principles of learning theory relative to horses; and 3) help to identify the interventions needed to increase ability of individuals to correctly interpret specific horse behaviors and principles of learning theory.

It is hypothesized that not all participants' interpretations of fear, stress, and reactivity in horses will be the same. Similarly, participants' interpretations of learning theory will not be consistent between one another. These assumptions will speak to the potential problem of individuals involved in the horse industry misunderstanding specific horse behaviors and relevant applications of learning theory.

Second, this study will describe the ability of individuals involved in the horse industry to illustrate their understanding of operant conditioning principles as applicable to horses. Enhancing participants' abilities to understand operant conditioning principles may help them to apply appropriate training methods in their horse management practices, which may benefit the horse and, subsequently, may enhance horse welfare.

By exploring the relationships between participants' abilities to accurately interpret and understand specific horse behaviors and their understanding of operant components of learning theory, we will determine which constructs potentially need more academic and applied attention.

CHAPTER 3. UNDERGRADUATE HORSE MANAGEMENT STUDENT ABILITY TO INTERPRET AND APPLY ANIMAL BEHAVIOR AND WELFARE TERMINOLOGY

3.1 Abstract

Misunderstanding behavior terminology especially related to learning theory may result in use of interventions that compromise welfare. The purpose of this study was to pilot test an instrument exploring undergraduate students' interpretations and understanding of animal behavior and welfare terminology, and learning theory, as applied to horses. A convenience sample of 46 senior level horse management students completed an online survey containing psychographic questions related to horse industry involvement, 5 videos of horse-human interactions (each with heart rate data), and 11 learning theory scenarios. At the time of the survey, most students did not own or work with a horse (70%) and 59% had never owned a horse. Students agreed that they viewed horses as companion animals/pets (100%), performance partners (90.9%), employees (88.6%), best friends (84.1%), livestock (75.0%), investments (72.7%), and family members (31.8%) Only 4.4% of students were able to provide complete definitions of fear and stress, by including both physical and physiological metrics, and no students were able to provide complete definitions for reactivity. Most (84%) correctly identified resting heart rate in horses but indicated that knowing the video horse's heart rate did not change their interpretation of behaviors in the seven videos. This suggests a lack of understanding by the students of the potential impacts of fear, stress, and reactivity on horse heart rate. Horse ownership and/or level of experience did not affect the ability of undergraduate students to correctly define the selected behaviors or learning theory terminology. When asked to define the learning theory principles, positive reinforcement was the easiest for students to correctly define (70.3%) followed by positive punishment (54.1%) and negative punishment (54.1%). Students had greater difficulty defining negative reinforcement, with only 27.0% correctly explaining this term. These findings suggest that horse ownership did not affect ability to correctly identify key horse behaviors related to fear, stress, and reactivity, or understanding of learning theory principles, and that education in these areas is equally important for individuals who interact with horses whether or not they own horses.
Key terms: Behavior, Learning Theory, Welfare

3.2 Introduction

While other livestock species are more popular in developed western nations for their levels of production, the roles of horses have recently evolved to various classifications that includes leisure, performance, and competition (Hausberger et al., 2008). They are also more likely to be classified as companion animals. Despite horses being highly adaptable to new environments, their need to express natural behaviors remains and the ability to do so may impact their overall welfare.

Physical metrics used to assess horse welfare include internal measures such as cortisol, catecholamines, heart rate, heart rate variability, health, injury, and production (Dawkins, 1998; Keeling & Jensen, 2009). Although heart rate is a commonly used measurement in horse research and many aspects of horse health care, little research has explored the connection between being able to accurately identify a normal resting HR on an adult horse and understanding how heart rate may connect to specific horse behaviors indicative of stress, or to associate HR with components of learning theory. Behavior is one of the most commonly used animal-based metrics in animal welfare assessments (Mench & Mason, 1997). Having a clear definition of specific behavioral terminology is critical to understanding the behaviors being observed. While previous research has attempted to define fear (Forkman et al., 2007; Manteca & Deag, 1993), stress (Martin, 2014; McGrath, 1970) and reactivity (McCall et al., 2006) these terms still are often misinterpreted and misused. Correctly identifying and understanding which specific behavior(s) a horse is expressing is vitally important to understanding their welfare states and intervening appropriately to support positive welfare.

Among recreational horse populations, it has been suggested that a considerable number of the welfare problems related to horses occur because of mismanagement or neglect due to the owner's ignorance as opposed to intentional actions (Leckie, 2001; Pearson, 2004). It is therefore important to consider how individuals obtain their understanding and interpretations of horse behavior and welfare.

Horse welfare is influenced by owners' perceptions and attributes, including the owner's commitment to responsible ownership, demographic factors including age, income, and education levels, their knowledge of horse husbandry and management practices, and their attitudes towards horse husbandry and management practices (Heleski & Zanella, 2006; Leckie, 2001; Pearson, 2004). Perceptions of horses may also influence people's level of commitment to them, and ultimately, their welfare. These perceptions can in turn be influenced by psychographic factors such as horse ownership, industry involvement, use of horses, competition involvement, preferred sources to obtain equine information, and demographic factors such as age, sex, income, and geographical distribution. (Stowe, 2018). In the 2015 American Horse Productions Equine Industry Survey (Stowe, 2015), among 10,662 respondents, most reported they viewed horses as family members (67.4%), companion animals (62.7%), performance partners (57.6%), or best friends (55.9%), while fewer reported that they viewed horses as an investment (22.4%), a livestock animal (21.1%), or an employee (7.8%).

This broad diversity of owner and caretaker characteristics in today's horse industry imply varying levels of understanding of horse behavior, which in turn impacts the welfare of horses. How people obtain their understanding of horse behavior is critical for determining the best strategies to ensure that knowledge impacts human behaviors that support horse welfare. One way to explore how people arrive at their understanding of horse behavior and welfare is to consider their interpretations of learning theory as it applies to horses.

Learning theory in horses as applied to equine training strategies and management practices has been investigated (Doherty et al., 2017; McLean and Christensen, 2017). Correct systematic application of learning theory may strengthen the horse-human relationship and ensure safe interactions for people and horses through improved communication. This in turn may help to improve horse welfare (McGreevy & McLean, 2010). Yet, despite research applying learning theory to training and management practices (McLean, 2013), there has been little exploration of the connection between understanding learning theory and understanding specific behaviors in horses. Similarly, little research has explored the connection between specific human psychographics and understanding specific behaviors in horses.

If an individual who is working with horses is unable to correctly identify the behaviors being expressed by the horse, then they may incorrectly apply a training strategy that could potentially create a problem or worsen an existing one. Similarly, by misunderstanding principles of learning theory, an improper training strategy may be implemented causing similar outcomes. Additional research is needed to further explore the relationships between people's understanding of common horse behavior and welfare terminology and learning theory, and how these factors potentially impact the welfare of the horse.

Therefore, the aim of this study was to explore: 1) students' interpretations of fear, stress, and reactivity in horses; 2) students' interpretations of components of Learning Theory; 3) the relationship between students' psychographics and their interpretations of fear, stress, and reactivity in horses; 4) the extent to which understanding of principles of Learning Theory correlates with students' interpretations of fear, stress, and reactivity in horses; and 5) the extent to which students' ability to define fear, stress, and reactivity correlates to students' ability to identify these specific states in horse-human interaction videos.

3.3 Methods

This exploratory research study utilized a quantitative research design to examine the interpretations and understanding of horse behavior and LT amongst undergraduate students, as well as the relationships between these factors.

3.3.1 Study Participants

A convenience sample of 46 students enrolled in a senior-level horse management at Purdue University was the target population for this study.

3.3.2 Instrument

This online survey instrument was administered using Qualtrics®, a web-based survey software, at the convenience of each participant. The survey was created using a positivist/post-positivist perspective through a deductive approach by the researcher and included a multitude of question designs that reported quantitative and qualitative data.

Survey Sections

This online survey instrument was administered using Qualtrics®, a web-based survey software, at the convenience of each participant. The survey was created using a positivist/post-positivist perspective through a deductive approach by the researcher and included a multitude of question designs that reported quantitative and qualitative data.

The survey included nine sections: a) participant horse psychographics, b) participant companion animal psychographics, c) horse behavior terminology definitions, d) horse behavior video analysis, e) horse heart rate, f) learning theory principles definitions, g) learning theory scenarios, and h) participant demographics.

For section a, participant horse psychographics, participants were asked 13 total questions (see Appendix A), separated into main sections including Horse Ownership, Horse Management, Training Skills, and View of Horses. When participants were asked to report their views of horses, they selected on a 1-4 scale (strongly agree, agree, disagree, strongly disagree) whether they viewed horses as a best friend, companion animal/pet, employee, family member, investment, livestock animal, or performance partner.

For section b, participant companion animal psychographics, participants were asked four total questions. Participants were also asked to select "Yes" or "No" if they owned any of the following animals: dog, cat, fish, bird, reptile/amphibian, rodent or small mammal. If they selected "yes" they were then prompted to report which and how many of these specific animals they currently owned. When participants were asked to report their views of dogs, cats, and other household pets, they selected on a 1-4 scale (strongly agree, agree, disagree, strongly disagree) whether they viewed companion animals as a best friend, companion animal/pet, employee, family member, investment, livestock animal, or performance partner.

For section c, horse behavior terminology definitions, participants were asked in an open-ended question to report what fear, stress, and reactivity meant to them, respectively (what is fear and how can it be identified, what is stress and how can it be identified, what is reactivity and how can it be identified?).

For section d, horse behavior video analysis, five videos were embedded within the survey that showed a variety of horse-human interactions. These were selected to capture specific states (fear, stress, and reactivity) that were expressed by the horse (see Appendix D). Participants were required to watch each video and report their interpretation of the horse's behavior by selecting "Yes" or "No" to Fear, Stress, and Reactivity.

For section e, horse heart rate, the same five videos included corresponding heart rate data for the horses in the video. These videos were already presented to the participants in the previous section. However, this time participants were shown the average heart rate for the horse in each video. In addition to reporting their interpretations of the horse's behavior by selecting "Yes" or

“No” to Fear, Stress, and Reactivity, participants were asked if knowing the average heart rate for the horse in the video changed their interpretations of the behavior(s) being expressed by the horse, and to explain why or why not. These five videos were all recorded by the researcher at Middle Tennessee State University’s Horse Science program, using an iPad. All horses were fitted with a heart rate monitor (Polar RC3 GPS, Polar Electro Inc., Lake Success, NY, USA) to collect their heart rate as each video was recorded. Participants were also asked to report what the average resting heart rate was for an adult horse in beats per minute (bpm).

For section f, learning theory definitions, participants were to define positive reinforcement, negative reinforcement, positive punishment, and negative punishment, in an open-ended format.

For section g, learning theory scenarios, participants were presented with 11 different learning theory scenarios. All scenarios used were reviewed and approved by a content expert with expertise in learning theory. For each scenario, participants were asked on a multiple-choice scale which learning theory principle (positive reinforcement, negative reinforcement, positive punishment, negative punishment) they believed was being described.

Finally, for section h, participant demographics, demographic data collected included gender, age, ethnicity, geographical location, and education level.

3.3.3 Validity

Validity of the survey was determined through a review by content experts with expertise in horse behavior, horse welfare, and social science. The survey was pilot tested with a group of conference participants from The International Society for Equitation Science. Any issues regarding item purpose or clarity were addressed and changed by the researcher.

3.3.4 Statistical analysis

Qualitative statistical analysis for this study was conducted using the IBM Statistical Package for the Social Sciences (SPSS) Statistics 25 for thematic coding. Quantitative statistical analysis for this study was conducted using SAS Ver. 9.4 (SAS Stat Inc., Cary, NC). Interrelationships between variables were examined using cross-tabulations. Statistical differences in cross-tabulations were determined for Video Consistency and Operant Conditioning data by transforming the Yes/No data to numeric values, with Yes=1 and No=0. Percentages of Yes/No data were thematically coded to level of agreement by high (67-100%), medium (33-66%), and low (0-32%). Pearson's Correlation Coefficients were used to examine the relationships between students' definitions of fear, stress, reactivity, students' definitions of positive reinforcement, negative reinforcement, positive punishment, negative punishment, and students' interpretations of various horse-human interaction videos with and without corresponding heart rate data. Intraclass Correlation Coefficients were used to examine the level of agreement between participants for their interpretations of fear, stress, and reactivity within the horse-human interaction videos. Correlation coefficients greater than 0.90 were considered very strong correlations; between 0.75 to 0.90 were strong correlations; 0.50 to 0.75 were moderate correlations; and less than 0.50 were considered weak correlations (Koo and Li, 2016). Level of understanding for fear, stress, reactivity, positive reinforcement, negative reinforcement, positive punishment, and negative punishment was thematically coded by assigning a score of 0 for incomplete or incorrect definitions, a score of 1 for partially correct definitions, or a score of 2 for completely correct definitions (See Appendix C "Terminology Codebook" for details). Similarly, of the seven videos with the corresponding HR data for the horse in each video, level of understanding for fear, stress, and reactivity was thematically coded by assigning a score of 0 for incorrect interpretations, a score of 1 for partially correct interpretations, or a score of 2 for completely correct interpretations (See Appendix B "Interpretations Codebook" for details). A repeated measures analysis was used to examine if understanding HR impacted students' abilities to correctly understand and interpret fear, stress, and reactivity by comparing their abilities to correctly identify a normal resting HR in adult horses to their 0-2 scores of each horse-human interaction video. Statistical significance was considered at $P < 0.05$.

3.4 Results and Discussion

3.4.1 Demographics

The majority of students in this study identified as female (95%) while (5%) identified as male. All students were between 18 to 25 years of age. Of those who chose to identify their race, most identified as White (85%), while 7.5% identified as Hispanic and 5% identified as Black. All students lived in the United States, and most (97%) currently lived in the U.S. state of Indiana. The largest proportion (42%) reported "some college, no degree" as their highest level of education, while fewer reported "high school graduate, diploma, or equivalent" (26%), "bachelor's degree" (19%), and "associates degree" (13%) as their highest level of education. No differences were found between any of participants' demographics to their ability to correctly define fear, stress, reactivity, or any of the learning theory principles (Appendix E).

3.4.2 Psychographics

At the time of this study, most students (70%) did not currently own or work with a horse and 59% had never owned a horse. These results differ from the 2018 AHP Equine Industry Survey results, which reported 98.5% of their respondents were horse owners (Stowe, 2018). The difference is likely due to this study targeting a group of undergraduate students, whereas the AHP survey targeted individuals who were well established within the horse industry. Among the students who currently owned horses, most students (43%) reported their horses resided at either their own home or "other," while few students (14%) kept their horses at a boarding facility. More students (50%) spent two to three times a week with their horse(s), compared to students who spent two to three times a month (21%), once a month (7%), a few times a week (7%), and some who were with their horse(s) daily (14%). Most students were riding or driving their horse(s) once a week (21%), two to three times a week (21%), or two to three times a month (21%) compared to students who were riding or driving their horse(s) daily (14%) or once a month (7%). Of the students who did not currently own horses, most students (53%) were not spending any time with or around horses, compared to those who were spending time with horses two to three times a month (3%), two to three times a week (3%), or once a week (3%). Of the same students who did not currently own horses, more students reported they were actively working with horses two to three times a week (36%), compared to students who reported they were actively working with horses once a week (21%), two to three times a month (14%), or daily (14%). Students' levels of agreement with statements relating to how they viewed horses are represented in Table 1a and Table 1b. When the categories 'strongly agree' and 'agree' were combined, students collectively agreed that horses were viewed as a companion animals/pets (100%), performance partners (90.9%), employees (88.6%), best friends (84.1%), livestock (75.0%), investments (72.7%), and family members (31.8%) (Table 1b). In comparison, dogs, cats, and other household pets were viewed by students as companion animals/pets (100%), family members (97.7%), best friends (92.9%), investments (47.6%), performance partners (23.8%), employees (9.4%), and livestock (4.5%) (Table 2b). These results indicate that as is the case for cats, dogs, and other typical "pet" species, most students viewed horses as companion animals or pets. The views of horses that were reported by students in this study were consistent with those reported in the 2015 AHP study (Stowe, 2015).

3.4.3 Behavioral Terminology

While researchers have attempted to define fear (Forkman et al., 2007; Manteca & Deag, 1993), stress (Martin, 2014; McGrath, 1970) and reactivity (McCall et al., 2006) related to horses, these terms are still often misinterpreted and misused. Further, despite identifying methods to measure the behaviors of interest, behavioral terminology is often used inconsistently. Previous research suggests that fear, stress, and reactivity cannot be directly observed or measured, but can only be determined by the combination of the physical and behavioral condition of the animal (Hemsworth & Coleman, 2011; Manteca & Deag, 1993; Martin, 2014; McCall et al, 2006). With this notion in mind, when students were asked to define fear, stress, and reactivity, only 4.35% of students were able to provide complete definitions for fear and stress by including both physical and psychological measurements within their definitions, and no students were able to provide complete definitions for reactivity (Table 3). A higher number of students was able to partially define stress (58.7%) by including either physical or psychological measurements within their definitions, but fewer students were able to partially define fear (56.5%) and reactivity (28.3%).

Because most students could not completely define these specific terms, concern is raised that many may not have a sound understanding of behavior and/or related terminology, and thus may not be able to correctly define, identify, and differentiate when these states/responses are occurring. Of those who correctly defined the three terms of focus, no significant differences were found between those who currently owned or had ever owned a horse (Appendix E). This suggests that not owning a horse does not necessarily constrain ability to correctly identify horse fear and stress. Similarly, there were no differences between races or genders on ability to define and use the terms of interest (Appendix E). This suggests that these demographic factors do not influence students' abilities to correctly understand specific behaviors and states.

With all five videos combined, students showed a moderate level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.993, $F_{1,21}$=146, p=0.000), and a high level of agreement when asked to indicate the presence of stress (ICC; ICC=0.997, $F_{1,21}$=311, p=0.000) and reactivity (ICC; ICC=0.993, $F_{1,21}$=151, p=0.000) (Table 4), when the horse's hear rate data was not given to them. When the horse's heart rate data was presented to the students, students showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.993, $F_{1,21}$=151, p=0.000), stress (ICC; ICC=0.994, $F_{1,21}$=168, p=0.000), and reactivity (ICC; ICC=0.984, $F_{1,21}$=60.8, p=0.000) (Table 5). Despite demonstrating moderate to high levels of agreement between each other, results indicated the students were unable to correctly define these terms. This raises the concern that even if students are able to agree on which behavior is being expressed by a horse, their inability to correctly define the terms suggests they still may be unable to correctly differentiate and/or understand each behavior individually.

Despite most students being unable to completely define the terms of interest, five main themes emerged when analyzing their definitions: Tautologies, Specific Behavioral Identifiers, Specific Physiological Identifiers, Anthropomorphism, and Use of Another Behavioral or Welfare State Within Their Definition. Tautologies were reported for each of the three states, but most students (62%) used tautologies in their definitions for reactivity (such as "Reactivity is how quickly a horse reacts…", "Reactivity is a reaction to…"). Most students were able to report specific behaviors (such as freezing, tail swishing, or head bobbing) for each state, while others were able to report specific physiological factors (such as increased heart rate or elevated hormone levels) used to identify these behaviors. Students anthropomorphized their definitions of fear, stress, and reactivity, but stress was anthropomorphized the most by students (58%) by including terms such as "irritated", "overwhelmed", "uncomfortable", "depressed", or "unwilling to work" to describe the horse's behavior. Some students mentioned one of the other states within their definition (such as "fear can be identified by stressful behaviors", "stress is when a horse is afraid", or "reactive horses are stressed"). Most students related stress to negative factors, but few students (4%) identified that stress can be positive. This finding agrees with previous research (Borstel, Visser, & Hall, 2017; Munsters et al., 2013), which reported that people recognized the negative aspects of stress but neglected to acknowledge that positive stress also exists. Among the five videos with corresponding heart rate data for the horse in each video, when students were asked to identify whether the horse in each video was expressing fear, stress, and/or reactivity, students' abilities to correctly define fear compared to their abilities to correctly define stress and reactivity were poorly correlated ($r = 0.41$, $p = 0.0052$; $r = 0.22$, $p = 0.147$ respectively). Students' abilities to correctly define stress compared to their abilities to correctly define reactivity were weakly but significantly correlated ($r = 0.37$, $p = <0.0115$). Similar to the concern of most students not being able to correctly define these terms, there is an additional concern due to the low level of agreement among these terms that if students, regardless of their background or level of involvement, are unable to agree on which state is being expressed by the horse, then they may be unable to differentiate these specific states. This in turn could cause students to interact or work with horses improperly, which could worsen the welfare for the horse.

Collectively, the findings suggest that regardless of ownership status all students who interact with horses may require additional education about key horse welfare and behavior concepts. Additionally, the current findings raise a concern because in addition to reflecting poor understanding of specific terms associated with behaviors and states as they pertain to horse welfare, individuals who may go on to work in the horse industry may have some important knowledge gaps that require correction.

3.4.4 Heart Rate

Most students (84%) correctly reported resting heart rate in horses and no significant differences were found between those who currently owned or had ever owned a horse (Appendix E). This suggests that owning a horse is not related to one's ability to correctly report a normal resting heart rate in horses. Students in this study also self-reported that knowing the horse's heart rate did not change their interpretations of behaviors in the seven videos. This finding suggests a lack of understanding by the students of the potential impacts of fear, stress, and reactivity on horses' physiology, including heart rate, as that information should have changed students' responses in several scenarios presented. Understanding behaviors and states in horses and the physical and physiological changes associated with them can be helpful in ensuring safe human-horse interactions and avoiding having horses experience undue distress or insufficient positive stress.

3.4.5 Learning Theory

Previous research suggests that learning theory, as it relates to horses, combines multiple principles (such as operant conditioning, habituation, and desensitization) to aid in the training and learning process for the horse (Doherty et al., 2017; McLean & Christensen, 2017). When asked to define each of the learning theory principles, positive reinforcement was the easiest for students to correctly define, followed by negative punishment and positive punishment, with negative reinforcement being the most difficult to correctly define (Table 6). When asked to select which learning theory principle is being described within different horse-human interaction scenarios, positive reinforcement was the easiest for students to correctly identify, followed by negative reinforcement and positive punishment, with negative punishment (Table 7). These results suggest that even though students may be able to correctly define these principles they may not be able to correctly identify which principle is being described in a given scenario, and vice versa. Similar to all other areas mentioned above, no significant differences were found between students who currently owned or had ever owned a horse (Appendix E) and their ability to correctly identify each of the four learning theory principles. This further suggests that horse ownership did not affect undergraduate student understanding of learning theory principles.

Overall, the main findings of this study, namely that a majority of students inconsistently selected fear, stress, and reactivity to describe a horse's behavior, could not define key terms such as fear, stress, and reactivity, did not connect heart rate to these states and did not connect learning theory principles to specific methods applicable to horse training indicate several areas of need. These include need for additional education in these areas, need to address deficiencies in the existing curricula of these students, and need to understand how students map concepts of behavior, welfare, and learning theory principles to facilitate connecting these to their academic understanding and practical applications. In addition, the findings suggest that horse ownership alone is insufficient to inform students fully and accurately on these topics. As an individual's knowledge in the horse industry is often judged solely by their level of industry/horse experience, these results may appear advantageous to someone who would consider themselves a novice in the industry. Yet the problem remains that the majority may still be incorrectly defining and/or identifying specific horse behavior terminology and learning theory principles.

With the small sample size used for this study, generalizations cannot be made for individuals across the horse industry who may be demographically and psychographically similar to the study participants. Therefore, there is a need for future research to explore these same psychographics and demographics with a random sample from a broader population of undergraduate students. Additionally, future research should explore how individuals outside of the role of student or academician involved in the horse industry interpret specific horse behavior terminology and principles of learning theory. This would help determine if there are additional factors, including industry roles that are related to ability to correctly define and identify these concepts.

3.5 Summary

Students' views of horses reported in the current study were consistent with previous AHP Equine Industry findings. Participants primarily viewed horses as companion animals/pets. Owning a horse or being directly involved in the horse industry did not affect participant ability to correctly interpret and understand fear, stress, and reactivity in horses or learning theory principles. The findings also indicated that many students may not understand the potential impacts of fear, stress and reactivity on horse heart rate, suggesting a failure to connect heart rate with negative welfare states that may need remediation. Students' abilities to correctly and completely define fear and stress were not related to their understanding of learning theory principles. Despite showing an ability to correctly identify fear and stress, some students may lack an understanding of the differentiation between positive and negative parameters of stress and their applications in real life scenarios.

3.6 Figures, Tables and Schemes

Table 1a. Students' (n = 42) Levels of Agreement with Views of Horses Using a Likert Scale

	Strongly Agree		Agree		Disagree		Strongly Disagree	
View	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
Best Friend	26	59.1	11	25.0	6	13.6	1	2.3
Companion Animal	25	56.8	19	43.2	0	0.0	0	0.00
Family Member	2	4.55	12	27.3	21	47.7	9	20.5
Employee	10	22.7	29	65.9	4	9.1	1	2.3
Livestock	7	15.9	26	59.1	9	20.5	2	4.6
Investment	8	18.2	24	54.6	11	25.0	1	2.3
Performance Partner	13	29.6	27	61.4	4	9.1	0	0.0

Table 1b. Students' (n = 42) Combined Levels of Agreement with Views of Horses Using the Likert Scale presented in Table 1a.

	Combined Agreement		Combined Disagreement	
View	n	Percentage (%)	n	Percentage (%)
Best Friend	37	84.1	7	15.9
Companion Animal	44	100	0	0.00
Family Member	14	31.8	30	68.2
Employee	39	88.6	5	11.4
Livestock	33	75.0	11	25.0
Investment	32	72.7	12	27.3
Performance Partner	40	90.9	4	9.1

Table 2a. Students' (n = 42) Levels of Agreement with Views of Dogs, Cats, and Other Household Pets Using a Likert Scale

	Strongly Agree		Agree		Disagree		Strongly Disagree	
View	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
Best Friend	27	64.29	12	28.57	2	4.76	1	2.38
Companion Animal	30	71.43	12	28.57	0	0.00	0	0.00
Family Member	28	66.67	13	30.95	1	2.38	0	0.00
Employee	1	2.27	3	7.14	13	30.95	25	59.52
Livestock	1	2.27	1	2.27	15	35.71	25	59.52
Investment	3	7.14	17	40.48	8	19.05	14	33.33
Performance Partner	2	4.76	8	19.05	20	47.62	12	28.57

Table 2b. Students' (n = 42) Combined Levels of Agreement with Views of Dogs, Cats, and Other Household Pets Using the Likert Scale presented in Table 2a.

	Combined Agreement		Combined Disagreement	
View	n	Percentage (%)	n	Percentage (%)
Best Friend	39	92.9	3	7.1
Companion Animal	42	100	0	0.0
Family Member	41	97.6	1	2.4
Employee	4	9.4	38	90.5
Livestock	2	4.5	40	95.2
Investment	20	47.6	22	52.4
Performance Partner	10	23.8	32	76.2

Table 3. Students (n = 46) Ability to Correctly Define Fear, Stress, and Reactivity Using 0-2 Scale

	Level of Correct/Complete Definition					
	0		1		2	
State	n	Percent (%)	n	Percent (%)	n	Percent (%)
Fear	18	39.1	26	56.5	2	4.4
Stress	17	36.9	27	58.7	2	4.4
Reactivity	33	71.7	13	28.3	0	0.0

*Scoring Scale: 0 – Incorrect/Incomplete, 1 – Partially Correct, 2 – Completely Correct

Table 4. Intraclass Correlation Coefficients of Students' (n = 384) Levels of Agreement Between Each Other When Asked to Identify Presence of Specific States in Horses Without Corresponding Horse Heart Rate Data.

State	**Intraclass Correlation Coefficients**		
	ICC Estimate	**F-value**	**P-value**
Fear	0.678	3.11	0.017
Stress	0.981	52.0	0.000
Reactivity	0.877	8.11	0.000

*Raters showed a moderate level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.993, $F_{1,21}$=146, p=0.000), and a high level of agreement when asked to indicate the presence of stress (ICC; ICC=0.997, $F_{1,21}$=311, p=0.000) and reactivity (ICC; ICC=0.993, $F_{1,21}$=151, p=0.000).

Table 5. Intraclass Correlation Coefficients of Students' (n = 384) Levels of Agreement Between Each Other When Asked to Identify Presence of Specific States in Horses With Corresponding Horse Heart Rate Data.

State	**Intraclass Correlation Coefficients**		
	ICC Estimate	**F-value**	**P-value**
Fear	0.914	11.69	0.000
Stress	0.933	14.8	0.000
Reactivity	0.930	14.3	0.000

*Raters showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.993, $F_{1,21}$=151, p=0.000), stress (ICC; ICC=0.994, $F_{1,21}$=168, p=0.000), and reactivity (ICC; ICC=0.984, $F_{1,21}$=60.8, p=0.000).

Table 6. Student (n = 37) Ability to Correctly Define Positive Reinforcement, Negative Reinforcement, Positive Punishment, Negative Punishment Using 0-2 Scale.

	Level of Correct/Complete Definition					
	0		1		2	
Learning Theory Principle	n	Percent (%)	n	Percent (%)	n	Percent (%)
Positive Reinforcement	11	29.7	21	56.8	5	13.5
Negative Reinforcement	27	72.9	4	10.8	6	16.2
Positive Punishment	17	45.9	19	51.4	1	2.7
Negative Punishment	17	45.9	18	48.7	2	5.4

*Scoring Scale: 0 – Incorrect/Incomplete, 1 – Partially Correct, 2 – Completely Correct

Table 7. Student (n = 37) Ability to Correctly Identify Positive Reinforcement, Negative Reinforcement, Positive Punishment, Negative Punishment Through Horse-Human Interaction Scenarios.

	Correct Answer (%)	
Learning Theory Principle	**Yes**	**No**
Positive Reinforcement	97	3
Negative Reinforcement	58	42
Positive Punishment	50	50
Negative Punishment	44	56

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CHAPTER 4. INTERPRETATION AND APPLICATION OF ANIMAL BEHAVIOR AND WELFARE TERMINOLOGY BY PARTICIPANTS AT THE 2018 INTERNATIONAL SOCIETY FOR EQUITATION SCIENCE CONFERENCE

4.1 Simple Summary

When exploring equine behavior, having a clear understanding of the relevant terminology is important. Addressing different behaviors in horses requires appropriate training methods and confusing behavioral terminology may negatively influence perspectives and practices amongst equestrian communities. This pilot study tested an instrument to explore participants' interpretations and understanding of animal behavior and welfare terminology as it applies to horses at the 2018 International Society for Equitation Science Conference. Results indicated participants were inconsistent in their interpretations and understanding of fear, stress, and reactivity in horses. Data from this study contributed to the development of an instrument that is being used to further explore these topics with other audiences across the horse industry.

4.2 Abstract

Misunderstanding of behavioral terminology may elicit diverse interpretations of horse behavior among equestrians. This may result in use of improper human interventions to modify horse behavior, and negative impact on horse welfare. The purpose of this study was to pilot-test an instrument exploring equestrians' understanding of animal behavior and welfare terminology as it applies to horses. Twenty-five participants at the 2018 International Society for Equitation Science Conference completed an online survey containing 19 videos of human-horse interactions, including seven with horse heart rate information included. Participants defined fear, stress, and reactivity and identified whether they believed the subject horse expressed these states. Data were analyzed with SPSS (Ver. 25) and SAS (Ver. 9.4). Results indicated that even though participants were consistent between each other when identifying whether fear, stress, or reactivity was expressed in each video, they demonstrated an inability to correctly define these terms. Participants were able to report physical identifiers for fear (72%) and stress (68%), but few (12%) for reactivity. Participants also acknowledged physiological indicators of fear (56%) and stress (28%)

and recognized both positive and negative aspects of stress (12%). Most (86%) correctly identified resting heart rate in horses but indicated that knowing the video horse's heart rate did not change their interpretations in six of the videos. This suggests that participants may not connect the relationships between heart rate and fear, stress, and reactivity.
Keywords: Horse behavior; Horse-Human Interaction; welfare

4.3 Introduction

Today, humans interact with horses in a variety of ways and to different degrees, leading to a wide spectrum of horse-human interactions. These range from people owning horses and working with them daily to individuals who may be enthusiastic about horses but who are not responsible for providing their daily care or who are not around them often. Regardless as to the level of interaction, the quality-of-life horses experience under human care depends on the quality of the human-horse relationship. The human-horse relationship is well established, and the quality of this relationship may potentially impact the welfare of horses. When a horse's welfare is compromised there is often a behavioral change accompanied by a related physical or psychological response. Physical metrics which may be used to evaluate horse welfare can include internal measures including cortisol, catecholamines, health, injury, production, heart rate, and heart rate variability (Dawkins, 1998; Keeling & Jensen, 2009). While heart rate is a commonly used measurement in previous horse research, little research has explored the connection between being able to accurately report a normal resting heart rate on an adult horse and understanding how heart rate may be related to specific horse behaviors. In addition to internal physical metrics of horse welfare, external metrics such as behavioral measurements can be useful to identify when a negative impact on the horse's welfare has occurred. Because avoiding subjectivity in interpreting horse behavior is important, it is often necessary to incorporate additional objective metrics that can give further insight into the horse's state as opposed to relying only on subjective behavioral terms (McGreevy & McLean, 2010).

In addition to behavioral metrics, various states are often used to inform assessments of horse welfare. Common states that are incorporated into evaluations of horse welfare includes fear, stress, and reactivity. As is often the case for laypeople, the ability of scientists and lay people to easily identify and understand the affective states of horses can be challenging (Minero et al., 2018). Previous research has defined fear (Forkman et al., 2007; Manteca & Deag, 1993), stress (Martin, 2014; McGrath, 1970) and reactivity (McCall et al., 2006) but these terms are still frequently misused and misinterpreted. It is critical for individuals to be able to correctly interpret and understand which specific behavior(s) are being expressed by a horse to allow them to understand their welfare states. In addition to the importance of being able to correctly interpret and understand specific horse behavioral terminology, there is also a need for individuals to understand proper training and management techniques as used in equitation science.

The discipline of equitation science explores human-horse interactions by combining learning theory and ethology and has shown to be both sustainable and ethical (McGreevy &McLean, 2007). Equitation science aims to improve horse training and management and strengthen horse welfare by utilizing more evidence-based techniques. Many equitation science studies aim to evaluate various situations horses may experience and how these experiences impact their overall welfare. The International Society for Equitation Science (ISES) follows this approach.

Because the quality of life a horse experiences is influenced by the human-horse interactions and relationships, better understanding of how people form perceptions of horses is needed. For a strong human-horse relationship to exist, there must be clear understanding and reasonable expectations of people towards horses as well as knowledge of horses' behaviors and needs. However, how individuals obtain their interpretations and understanding of horse behavior and welfare concepts has not yet been well explored. While previous research has examined principles related to equitation science, there is limited research that focuses solely on the interpretations of equitation scientists. An initial step toward filling these knowledge gaps requires exploring interpretation of principles related to equitation science by individuals directly involved in the discipline. Therefore, the purpose of this study was to pilot-test an instrument exploring equestrians' abilities to interpret and understand animal behavior and welfare terminology as it applies to horses, focusing specifically on participants of the 2018 ISES Conference in Rome, Italy. It was anticipated that participants' specific demographic identifiers such as education level might impact their abilities to correctly understand and interpret behavior and welfare terminology related to horses. Additionally, it was hypothesized that if participants were provided physiological data related to the horse, that additional information might influence their interpretations of horse behavior.

4.4 Materials and Methods

This exploratory research study utilized a quantitative research design to explore the interpretation and understanding of horse behavior amongst participants in the 2018 ISES conference, as well as the relationship between these components.

4.4.1 Participants

Adult individuals who were participants at the 2018 ISES conference were the target population of this study. There were no restrictions on participant form of involvement in the horse industry (e.g. owners, trainers, riders, instructors, educators, students, etc.), but all participants were required to be at least 18 years of age.

4.4.2 Instrument

At the convenience of each participant, the online survey instrument was administered using Qualtrics, a web-based survey software. The survey was created using a positivist/post-positivist perspective through a deductive approach by the researcher and included a multitude of question designs that reported quantitative and qualitative data.

Survey Sections

The survey included four sections: a) horse behavior terminology, b) horse behavior video analysis, c) horse heart rate, and d) demographics.

For section a, horse behavior terminology, participants were asked to report what fear, stress, and reactivity meant to them in an open-ended response format, respectively (what is fear and how can it be identified, what is stress and how can it be identified, what is reactivity and how can it be identified?).

For section b, horse behavior video analysis, the survey included five videos that showed various horse-human interactions which were selected based on specific states (fear, stress, and reactivity) that were expressed by the horse (see Appendix D). Participants watched each video and reported their interpretations of the horse's behavior by selecting "Yes", "No", or "Unsure" as to whether the horse was showing Fear, Stress, or Reactivity.

For section c, horse heart rate, the same five videos included heart rate data for the horses in the video. These five videos were among those previously shown to the participants. However, this time, the average heart rate for the horse in each video was provided to the participants. After participants reported their interpretations of the horse's behavior by selecting "Yes", "No", or "Unsure" to Fear, Stress, and Reactivity, they were then asked if knowing the average heart rate for the horse in the video changed their interpretations of the horse's behavior(s), and to explain why or why not. These five videos were all recorded by the researcher at Middle Tennessee State University's Horse Science program, using an iPad. During video recording, all horses were fitted with a heart rate monitor (Polar RC3 GPS, Polar Electro Inc., Lake Success, NY, USA) to collect their heart rate's. Additionally, as a knowledge check, participants were asked to report the average resting heart rate was for an adult horse in beats per minute (bpm).

4.4.3 Validity

Survey validity was completed through a review by content experts with expertise in horse behavior, welfare, and social science. Any issues regarding item purpose or clarity were addressed by the researcher and were used to refine pilot-testing of the instrument with other audiences.

4.4.4 Statistical analysis

Qualitative statistical analysis for this study was conducted using the IBM Statistical Package for the Social Sciences (SPSS) Statistics 25 for thematic coding. Quantitative statistical analysis for this study was conducted using SAS Ver. 9.4 (SAS Stat Inc., Cary, NC). For video consistency data, statistical differences were determined by transforming the Yes/No/Unsure data to numeric values, with Yes=1, Unsure=0.5, No=0. Intraclass Correlation Coefficients were used to examine the level of agreement between participants for their interpretations of fear, stress, and reactivity within the horse-human interaction videos. Correlation coefficients greater than 0.90 were considered very strong correlations; between 0.75 to 0.90 were strong correlations; 0.50 to 0.75 were moderate correlations; and less than 0.50 were considered weak correlations (Koo and

Li, 2016). Participants' definitions of fear, stress, and reactivity were thematically analyzed by assigning a score of 0 for incomplete or incorrect definitions, a score of 1 for partially correct definitions, or a score of 2 for completely correct definitions (See Appendix B "Terminology Codebook" for details). Likewise, of the seven videos with the corresponding heart rate data for the horse in each video, level of understanding for fear, stress, and reactivity was thematically coded by assigning a score of 0 for incorrect interpretations, a score of 1 for partially correct interpretations, or a score of 2 for completely correct interpretations (See Appendix D "Video Interpretations Codebook" for details). A repeated measures analysis was used to examine if understanding heart rate impacted participant ability to correctly understand and interpret fear, stress, and reactivity by comparing participants' abilities to correctly identify a normal resting heart rate in adult horses to their 0-2 scores of each horse-human interaction video. Statistical significance was considered at $P < 0.05$.

4.5 Results

4.5.1 Demographics

All participants identified as white and female. The majority of participants were in the age range of 26-35 years of age (36%). Other age ranges reported were 18-25 years (14%), 36-45 years (21%), 46-55 years (7%), 56-65 years (14%), and greater than 65 years (7%). Most participants (71%) lived outside of the United States with represented countries including New Zealand (14%), Australia (14%), United Kingdom (14%), South Africa (7%), Germany (7%), Poland (7%), and the Netherlands (7%). A majority of participants reported some level of collegiate degree as their highest received education level (86%), while fewer reported receiving a high school level degree or diploma (14%). No differences were found in participants' abilities to correctly understand fear, stress, reactivity, or heart rate based on their age, race, level of education, or if they currently lived in the United States (Appendix F).

4.5.2 Horse Behavior Terminology

When participants were asked to define fear, stress, and reactivity, few participants were able to provide complete definitions of stress (30%) and fear (10%) by including both physical and physiological measurements within their definitions (Table 1). No participants were able to provide complete definitions for reactivity. More participants (80%) were able to partially define fear by including either physical or physiological measurements within their definitions, but less participants were able to partially define stress (60%) and reactivity (35%).

As a collective sample, participants were inconsistent when determining if fear, stress, or reactivity were being expressed by the horse in each video. More participants related stimulus responses to reactivity (44%) and fear (32%), but less so to stress (16%). Most participants reported specific physical identifiers for fear (72%) and stress (76%), but fewer (28%) were recognized for reactivity. Participants may have acknowledged the difficulty in distinguishing fear and stress based on observable behaviors as several identifiers overlapped between these behaviors (such as teeth grinding, widened eyes, snorting, muscle tension, and widened nostrils). Participants acknowledged using physiological factors such as heart rate and cortisol levels to identify only fear (56%) and stress (28%), but not for reactivity. Some participants included tautologies for each of the three states (such as "fearful", "afraid", "stressful", "reactive", or "responsive"), and most participants (48%) included tautologies in their definition of reactivity. Most participants anthropomorphized their definitions of fear (36%), stress (24%), and reactivity (40%) by mentioning aspects such as horses' "lack of confidence", "lack of comfort", or "concerned condition" within their definitions. Participants occasionally mentioned one or both of the other two states within their respective definitions of fear (8%), stress (12%), and reactivity (28%), such as "fear is when the horse is stressed", "stress can be identified by fear behaviors", and "horses are reactive to fearful and stressful situations". Few participants (12%) recognized both positive and negative aspects of stress.

4.5.3 Video Consistency

Across all videos, when the participants evaluated the horse's behavior in the videos without knowing the horse's HR data, participants showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.852, $F_{1,21}=6.75$, $p=0.000$) and stress (ICC; ICC=0.921, $F_{1,21}$=12.7, p=0.000), but a low level of agreement for reactivity (ICC; ICC=0.271, $F_{1,21}$=1.37, p=0.255) (Table 2). Similarly, when participants were presented with the horse's HR data, participants showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.892, $F_{1,21}$=9.30, p=0.000) and stress (ICC; ICC=0.931, $F_{1,21}$=14.6, p=0.000), but a moderate level of agreement for reactivity (ICC; ICC=0.596, $F_{1,21}$=2.48, p=0.051) (Table 3).

4.5.4 Heart Rate

Most of the participants (86%) correctly reported the normal resting heart rate for an adult horse. Also, most participants (67%) indicated that knowing the heart rate of the horse in the video did not influence their interpretations of the horse's behavior as demonstrated in six of the seven total heart rate videos. For the seventh video, most participants (64%) agreed that knowing the heart rate for the horse in the video did change their overall interpretation of the horse's behavior. Being able to correctly understand heart rate impacted participants' ability to correctly identify fear, stress, and reactivity as they apply to horses. Participants who could correctly identify a normal resting heart rate in horses were more correct in their ability to identify if the horse in each video was expressing fear, stress, or reactivity when observing the behavior of the horse in each video.

4.6 Figures, Tables and Schemes

Table 1. Participants' Abilities to Correctly Define Fear, Stress, and Reactivity

	Level of Correct/Complete Definition					
	0		1		2	
State	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Fear	2	10.00	16	80.00	2	10.00
Stress	2	10.00	12	60.00	6	30.00
Reactivity	13	65.00	7	35.00	0	00.00

*Scoring Scale: 0 – Incorrect/Incomplete, 1 – Partially Correct, 2 – Completely Correct

Table 2. Intraclass Correlation Coefficients of Participants' (n = 384) Level of Agreement Between Each Other When Asked to Identify if Specific States are Present in Horses When Observing Various Human-Horse Interaction Videos Without Corresponding Horse Heart Rate Data.

State	Intraclass Correlation Coefficients		
	ICC Estimate	**F-value**	**P-value**
Fear	0.852	6.75	0.000
Stress	0.921	12.7	0.000
Reactivity	0.271	1.37	0.255

*Raters showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.852, $F_{1,21}$=6.75, p=0.000) and stress (ICC; ICC=0.921, $F_{1,21}$=12.7, p=0.000), but a low level of agreement for reactivity (ICC; ICC=0.271, $F_{1,21}$=1.37, p=0.255).

Table 3. Intraclass Correlation Coefficients of Participants' (n = 384) Level of Agreement Between Each Other When Asked to Identify if Specific States are Present in Horses When Observing Various Human-Horse Interaction Videos With Corresponding Horse Heart Rate Data.

State	Intraclass Correlation Coefficients		
	ICC Estimate	**F-value**	**P-value**
Fear	0.892	9.30	0.000
Stress	0.931	14.6	0.000
Reactivity	0.596	2.48	0.051

*Raters showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.892, $F_{1,21}$=9.30, p=0.000) and stress (ICC; ICC=0.931, $F_{1,21}$=14.6, p=0.000), but a moderate level of agreement for reactivity (ICC; ICC=0.596, $F_{1,21}$=2.48, p=0.051).

4.7 Discussion

Despite previous research attempting to define fear (Forkman et al., 2007; Manteca and Deag, 1993), stress (Martin, 2014; McGrath, 1970) and reactivity (McCall et al., 2006) as they relate to horses, these terms are commonly misinterpreted and misused. Additionally, although previous research has identified various methods to measure these specific states, these terms are commonly used inconsistently within the equine industry. When asked to report their interpretations of fear, stress, and reactivity after watching various horse videos, participants in this study demonstrated a lack of agreement among these states. Across all videos, when the participants evaluated the horse's behavior in the videos without knowing the horse's heart rate data, participants showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.852, $F_{1,21}$=6.75, p=0.000) and stress (ICC; ICC=0.921, $F_{1,21}$=12.7, p=0.000), but a low level of agreement for reactivity (ICC; ICC=0.271, $F_{1,21}$=1.37, p=0.255) (Table 2). Similarly, when participants were presented with the horse's heart rate data, participants showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.892, $F_{1,21}$=9.30, p=0.000) and stress (ICC; ICC=0.931, $F_{1,21}$=14.6, p=0.000), but a moderate level of agreement for reactivity (ICC; ICC=0.596, $F_{1,21}$=2.48, p=0.051) (Table 3). These findings raise the concern that if individuals in the industry, particularly those directly involved in equitation science, are not able to agree on which behavior or state is being expressed by the horse, they may not be able to correctly differentiate between and act on these specific states. Of the three states of interest, participants showed the most consistency when interpreting fear, followed by stress and reactivity.

Previous research has suggested that fear, stress, and reactivity cannot be measured or observed directly, but can only be identified using a combination of physical and psychological factors (Manteca and Deag, 1993; Martin, 2014; McCall et al, 2006). When participants were asked to define fear, stress, and reactivity, few participants were able to provide complete definitions of stress (30%) and fear (10%) by including both physical and physiological measurements within their definitions (Table 1). No participants were able to provide complete definitions for reactivity. More participants (80%) were able to partially define fear by including either physical or physiological measurements within their definitions, but fewer participants were able to partially define stress (60%) and reactivity (35%). As the majority of the participants were not able to completely and correctly define these specific terms, this raises a concern that participants may not have a sound understanding of behavior and/or related terminology, and thus may not be able to correctly define, identify, and differentiate when these states/responses are occurring. This is even more concerning as the target audience for this pilot study consisted of individuals directly involved in the field of equitation science, which suggests that even individuals who could be considered experts in the field of equitation science were unable to correctly define and differentiate these specific terms.

Participants in this study reported specific observable identifiers for fear and stress (such as teeth grinding, widened eyes, snorting, muscle tension, and widened nostrils), but were unable to provide many identifiers for reactivity. Participants acknowledged physiological factors such as heart rate and cortisol levels to identify fear and stress, but not for reactivity. This suggests that participants may not grasp the connection between physiological indicators and measurement of reactivity in horses. While participants were able to identify some physical and physiological components of these specific states, few participants articulated that physical and psychological components were both needed in combination to accurately identify the specific state. This raises the concern that these participants may not be able to accurately identify when these states are occurring in interactions with horses, which in turn could compromise horse welfare, especially if they are also misinterpreting horse's overall behaviors. Some participants included tautologies for each of the three states (such as "fearful", "afraid", "stressful", "reactive", or "responsive"), and many participants (48%) included tautologies in their definitions of reactivity. Using the term itself within its definition suggests that participants may not have a complete understanding of these states. Many participants anthropomorphized their definitions of fear (36%), stress (24%), and reactivity (40%). This was evident in their use of aspects such as horses' "lack of confidence", "lack of comfortability", or "concerned appearance" within their definitions. As is the case for those using tautologies, concerns arise if participants are using anthropomorphic terms or phrases within their definitions, as this may indicate that they do not have a complete understanding of the individual states. Lack of understanding may negatively influence their ability to correctly identify if or when these states are occurring in horses. Participants sometimes included one or both of the other two states within their respective definitions of fear (8%), stress (12%), and reactivity (28%), such as "fear is when the horse is stressed", "stress can be identified by fear behaviors", and "horses are reactive to fearful and stressful situations". This, again, may suggest the lack of understanding participants have related to these specific states. Few participants indicated recognition of both positive and negative aspects of stress. This finding agrees with previous studies (Borstel, Visser, & Hall, 2017; Munsters et al., 2013), which reported that the negative aspects of stress were recognized by individuals but not the positive aspects. This raises an additional concern about the lack of consistency among these terms; namely that if individuals are unable to recognize both positive and negative aspects of stress, then they may not have a complete understanding of these terms and may not respond to them properly.

Although the majority of the participants in this study correctly reported the normal resting heart rate for an adult horse, most participants indicated that knowing the heart rate of the horse did not influence their interpretations of the horses' behaviors demonstrated in six of the seven total heart rate videos. This finding suggests that participants may not completely understand the potential impacts that fear, stress, and reactivity may have on a horse's physiology, including heart rate. Furthermore, this may suggest that participants were unable to make the connection between outward behavior, which is more easily observed, and internal changes in horses' physiological states. This mistake could compromise horse welfare because participants' interpretations of the horse's physical and physiological states could potentially be incorrect, leading to human behaviors that potentially compromise their own safety as well as horse welfare. Participants who correctly reported a normal resting heart rate in horses were more correct in their ability to report if the horse in each video was expressing fear, stress, or reactivity when observing the behavior of the horse in each video. This finding suggests that participants were able to make the connection between observable behavior demonstrated by the horse and changes in their underlying physiological states, which in turn could lead to more positive welfare of horses.

Overall, the main results from this study suggest that participants were inconsistent between each other when interpreting fear, stress, and reactivity to describe a horse's behavior, could not demonstrate clear understandings of fear, stress, and reactivity related to horses. They also could not make the connection between these states to important physiological factors (i.e., heart rate), when identifying these states. Further, no differences were found in the demographic groups studied, suggesting that all of these should be targeted for improved education relating to equine behavior and welfare. However, some limitations to the study exist that require cautious interpretation for the findings. First, it is important to consider the small, convenience sample size utilized for this study. As the aim of this study was only to pilot-test the instrument used, the goal was not to obtain a large enough sample to be able to generalize across the diverse equine audiences within the horse industry. It is possible that the audience used for this study caused skewed data as the participants were all attending the same international academic conference. Future research should use this or similar instruments to explore the same components of horse behavior and welfare reported on here using a larger sample size. Utilizing a larger sample size with a more representative audience within the horse industry may demonstrate differences among additional psychographic factors, such as one's role, niche in the industry, or their horse ownership history.

4.8 Conclusion

Results from this study suggest that even individuals who are directly involved with equitation science may still be unable to correctly interpret and understand specific states related to horse behavior. Participants were inconsistent amongst each other in their interpretations of fear, stress, and reactivity and were unable to provide a clear understanding of these terms individually. Participants were also unable to recognize both positive and negative aspects of stress. Further, the findings indicated that although most equitation science participants were able to correctly report the average resting heart rate for an adult horse, they were unable to demonstrate a clear understanding of the impacts of fear, stress, and reactivity on physiological factors such as heart rate. Results from this study suggest that additional education on clearly defining specific states such as fear, stress, and reactivity may be necessary for this specific population. Future research is needed using a larger, more diverse sample size that better represents the equine industry population.

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CHAPTER 5. HORSE INDUSTRY ADULTS VARY IN ABILITY TO INTERPRET AND APPLY ANIMAL BEHAVIOR AND WELFARE TERMINOLOGY

5.1 Simple Summary

Across the horse industry, it is crucial to establish clear understandings and interpretations of appropriate terminology. When evaluating different behaviors in horses, appropriate training methods are unique for every horse-human interaction and confusing the respective terminology may impact human perceptions of the interactions, which in turn could compromise horse welfare. This study explored interpretations and understandings of behavior and welfare terminology, as applied to horses, among adults within the horse industry. Results suggested while participants were consistent in their interpretations of fear, stress, and reactivity in horses, in addition to LT principles, their ability to understand these terms was low. Further education relative to these specific concepts is important to improve general horse-human interactions, and to positively promote horse welfare.

5.2 Abstract

Misinterpreting behavior and welfare terminology, as applied to horses, may result in inappropriate interventions that compromise horse welfare. The purpose of this study was to explore interpretations and understanding of animal behavior and welfare terminology, and learning theory, as applied to horses among adult participants within the horse industry. Participants (n = 1,145) completed an online survey containing psychographic questions related to horse industry involvement, 5 videos of horse-human interactions (each with corresponding heart rate data, and 11 learning theory scenarios. When asked to define fear, stress, and reactivity, only 34.2% of participants were able to provide complete definitions for stress, followed by fear (13.7%) and reactivity (0.90%). Most participants (80%) were able to correctly identify the normal resting heart rate for an adult horse. Also, a majority of the participants (83%) indicated that knowing the heart rate of the horse in each video did not influence their interpretation of the horse's behavior as demonstrated in any of the five videos. This suggests

participants may possess a lack of understanding of the potential impacts of fear, stress, and reactivity on horse HR. Most psychographics, such as horse ownership and/or frequency of interaction with horses, did not affect the ability of participants to correctly define the selected states or learning theory terminology. When asked to define each of the learning theory principles, few participants were able to provide completely correct definitions for positive punishment (11.6%), positive reinforcement (8.6%), negative punishment (8.0%), and negative reinforcement (7.1%). No differences were found between participants' abilities to correctly define fear, stress, or reactivity, or any of the learning theory principles, based on most participant demographics (age, gender, education) and psychographics (horse ownership and level of involvement). These findings suggest that these demographic factors or psychographic factors did not affect ability to correctly identify key horse behaviors related to fear, stress, and reactivity, or understanding of learning theory principles. Collectively, the findings indicate the existence of knowledge gaps that suggest that education pertaining to these concepts is vitally important for individuals who interact with horses whether or not they own or interact with them.
Keywords: Horse behavior; Horse-Human Interaction; welfare.

5.3 Introduction

Humans who interact with horses can do so in a variety of ways; from petting the horse at the local barn, to taking occasional trail rides, to riding for sport or work nearly every day. Some people own horses, house them on their own property, and have daily interactions while providing daily care. Others may own horses but are not responsible for their day-to-day care. When exploring a sample of undergraduate students enrolled in a horse management course, Wires (2021a) found the majority of students did not currently own or work with a horse and were not currently spending any time with or around horses. The study found that horse ownership status or level of interaction with horses among these participants did not influence their abilities to correctly identify and define specific horse behavior and welfare concepts. Previous research has also focused on various characteristics of an individual that may influence their perspectives regarding horses. The characteristics studied have included age, gender, personality traits of "agreeableness", political status, socioeconomic status, and education (Furnham et al., 2003; Heleski et al., 2004; Heleski & Zanella, 2006; Mazas et al., 2013). Within the same sample of horse-management undergraduate participants mentioned before, neither demographic factors (such as age, gender, and race), nor psychographic factors (such as how these participants viewed horses), did not impacted their abilities to correctly identify and define specific horse behavior and welfare concepts (Wires, 2021a). Despite these findings, the level of interaction an individual has with horses may still impact their overall perception and understanding of horses which could, in turn, impact the horses' welfare and quality of life.

In addition to an individual's perception of horses, the extent to which the horse's welfare needs are met and understood depends on the ability of the individual to understand horse welfare concepts. Animal welfare is typically assessed based on either physical or behavioral metrics. Physical metrics that may be used to evaluate horse welfare can include internal measures such as cortisol levels, catecholamine levels, health, injury, production, heart rate variability, and heart rate (Dawkins, 1998; Keeling and Jensen, 2009). Previous research has explored the connection between being able to accurately report a normal resting heart rate on an adult horse and how understanding factors that affect heart rate may be related to individuals' abilities to correctly define and identify specific states, as related to horses. Wires (2021a) indicate most collegiate horse management students (84%) correctly identified resting heart rate in horses, and students who could correctly identify a normal resting heart rate in horses were more able to correctly identify when specific states were being expressed by horses. Similarly, when exploring a sample of individuals within the field of equitation science, Wires (2021b) indicate that most equitation science participants (86%) correctly identified the normal resting heart rate for an adult horse, and participants who could correctly identify a normal resting heart rate in horses were more correct in their abilities to identify when specific states were being expressed by horses. These findings may indicate that equitation science individuals were able to make the connection between observable behaviors demonstrated by the horse and changes in their underlying physiological states. Awareness of this connection could improve horse welfare.

In addition to behavioral metrics, common states used to evaluate the welfare of horses include fear, stress, and reactivity. The ability of individuals to easily identify and define the affective states of horses can be challenging (Minero et al., 2018). While previous research has to defined fear (Forkman et al., 2007; Manteca & Deag, 1993), stress (Martin, 2014; McGrath, 1970) and reactivity (McCall et al., 2006), these terms are often still misused and misinterpreted. Wires (2021a, 2021b) indicate that most participants were unable to provide complete definitions of all three states. This raises the concern that participants not only do not understand these terms, but also may not be able to correctly define, identify, and differentiate when these states/responses are occurring in horses. It is critical for individuals to be able to correctly interpret and understand which specific behavior(s) are being expressed by a horse to allow them to understand their welfare states.

When there is a strong human-horse relationship there is potentially an increased desire to improve horse welfare. For a strong human-horse relationship to exist, people must have both a solid understanding of horses and reasonable expectations for them. If an individual has unclear expectations and/or interpretations of a horse, it could be due to a lack of understanding of what the horse needs or wants. Since the human-horse bond is important to improving horse welfare, it is necessary to understand how humans obtain their perceptions, interpretations, and understanding of horse behavior and welfare terminology. Learning theory and schema theory could provide some insights to improve this understanding.

The impact of learning theory in horses when applied to horse training and management practices has been explored (Doherty et al., 2017; McLean & Christensen, 2017). Additionally, Wires (2021a) explored the connection between undergraduate students' abilities to understand learning theory concepts and their abilities to understand specific behaviors in horses. While most students were able to correctly define and identify learning theory principles, students did not connect learning theory principles to specific methods applicable to horse training. This raises concern for the impact concepts of learning theory have on horse welfare. While correct understanding and application of learning theory concepts as applied to horses may be useful for individuals to gain a better understanding of overall horse welfare, schema theory may help to clarify how people understand and interpret concepts related to horse behavior, horse welfare, and learning theory. Despite the extensive amount of research utilizing schema theory across different subject areas such as education, cultural studies, and psychology medicine (An, 2013; Bem, 1981; Hu, 2012; Pichert & Anderson, 1977; Young et. al, 2003), there is little research that relates schema theory to equitation science. Schema theory has been used to explain how individuals obtain and interpret knowledge in a variety of subjects, so it is equally possible it could be used in the horse industry to further explore how individuals acquire their overall interpretations, understanding, and knowledge related to horse behavior and welfare terminology.

Confusing behavior and welfare terminology, as applied to horses, may impact an individual's interpretation and understanding of horse behavior and welfare. This can potentially result in improper application of horse training principles and human intervention, when appropriate. If an individual who is working with horses is unable to correctly identify the behaviors being expressed by the horse, then the individual may incorrectly apply a training strategy that could potentially worsen the behavior or situation. Likewise, by misunderstanding learning theory concepts, an improper training strategy may be applied to the horse, which could lead not only to poor learning outcomes, but also to unnecessary welfare problems. Integrating how individuals interpret and understand horse behavior, welfare terminology, and learning theory principles with schema theory regarding development of their perceptions of horses and their needs, may offer unique insights into how to better support horse welfare. Therefore, the purpose of this study was to explore: 1) individuals' interpretations of fear, stress, and reactivity in horses; 2) individuals' interpretations of components of learning theory; 3) the relationship between individuals' psychographics and their interpretations of fear, stress, and reactivity in horses; 4) the extent to which understanding of principles of learning theory relates to individuals' interpretations of fear, stress, and reactivity in horses; and 5) the extent to which individuals' ability to define fear, stress, and reactivity relates to their ability to identify these specific states in horse-human interaction videos.

5.4 Materials and Methods

This exploratory research study utilized a quantitative research design to examine the interpretations and understanding of horse behavior and LT amongst adults involved within the horse industry, as well as the relationships between these factors.

5.4.1 Participants

Adults within the horse industry were the target population for this research study. There were no restrictions on participant level of involvement within the horse industry (i.e. owners, trainers, riders, instructors, educators, participants, etc.). All participants were required to be at least 18 years of age.

5.4.2 Instrument

At the convenience of each participant, the online survey instrument was administered using Qualtrics®, a web-based survey software. The survey was created using a positivist/post-positivist perspective through a deductive approach by the researcher and included a multitude of question designs that reported quantitative and qualitative data.

Survey Sections

The survey included seven sections: a) participant horse psychographics, b) horse behavior terminology definitions, c) horse behavior video analysis, d) horse heart rate, e) learning theory principles definitions, f) learning theory scenarios, and g) participant demographics.

For section a, participant horse psychographics, participants were asked 9 total questions (see Appendix A), separated into sections including Horse Ownership, Horse Management, and Training Skills.

For section b, horse behavior terminology definitions, open-ended questions were used to ask participants to define fear, stress, and reactivity respectively and how each state could be identified in the context of horses (what is fear and how can it be identified, what is stress and how can it be identified, what is reactivity and how can it be identified?).

For section c, horse behavior video analysis, five videos were embedded within the survey that showed a variety of horse-human interactions. Each of these videos were recorded by the researcher to capture specific states (fear, stress, and reactivity) that were expressed by the horse (see Appendix D). Participants were required to watch each video and report their interpretation of the horse's behavior by selecting "Yes", "No", or "Unsure" to Fear, Stress, and Reactivity respectively.

For section d, horse heart rate, the same five videos included corresponding heart rate (HR) data for the horses in each video, were presented to the participants. Despite these videos being presented to the participants in the previous section, this time participants were shown the average HR for the horse in each video. In addition to reporting their interpretations of the horse's behavior by selecting "Yes", "No", or "Unsure" to Fear, Stress, and Reactivity respectively, participants were asked if knowing the average HR for the horse in the video changed their interpretations of the state(s) being expressed by the horse, and to explain why or why not. These five videos were all recorded by the researcher at Middle Tennessee State University's Horse Science program, using an iPad. All horses were fitted with a heart rate monitor (Polar RC3 GPS, Polar Electro Inc., Lake Success, NY, USA) to collect their HR as each video was recorded. Participants were also asked to report what they believed the average resting HR was for an adult horse in beats per minute (bpm).

For section e, learning theory definitions, participants were asked to define positive reinforcement, negative reinforcement, positive punishment, and negative punishment, in an open-ended format.

For section f, learning theory scenarios, participants were presented with 11 different learning theory scenarios. Each individual scenario was reviewed and approved by a content expert with expertise in learning theory. For each scenario, on a multiple-choice scale, participants were asked which learning theory principle (positive reinforcement, negative reinforcement, positive punishment, negative punishment) they felt was being described.

Finally, for section g, participant demographics, demographic data was collected, including gender, age, race, and geographical location.

5.4.3 Validity

Validity of the survey was determined through a review by content experts with expertise in horse behavior, horse welfare, and social science. The survey was pilot tested with a group of conference participants from The International Society for Equitation Science as well as a group of undergraduate participants completing a horse management course at Purdue University. Any issues regarding item purpose or clarity were addressed and changed by the researcher.

5.4.4 Statistical analysis

The survey data were exported from the Qualtrics software using the IBM Statistical Package for the Social Sciences (SPSS) Statistics 25. Level of participants' understanding for fear, stress, reactivity, positive reinforcement, negative reinforcement, positive punishment, and negative punishment was thematically coded by assigning a score of 0 for incomplete or incorrect definitions, a score of 1 for partially correct definitions, or a score of 2 for completely correct definitions (See Appendix B and Appendix C for details).

Relationships between demographic variables and ability to correctly identify and define fear, stress, reactivity, positive reinforcement, negative reinforcement, positive punishment, and negative punishment were examined using cross-tabulation tables and a chi-square test of independence (SAS Ver. 9.4, SAS Stat Inc., Cary, NC). Statistical significance was considered at $P < 0.05$.

Pearson's correlation coefficients were used to examine relationships between each participant's definitions of fear, stress, reactivity, and their ability to identify these sates from horse-human interaction videos with and without corresponding heart rate data as well as relationships to ability to define positive reinforcement, negative reinforcement, positive punishment, and negative punishment. Intraclass Correlation Coefficients (ICCs) were used to examine the levels of agreement between participants for their interpretations of fear, stress, and reactivity within the horse-human interaction videos. Correlation coefficients <0.5 were poor, ≥ 0.5 to <0.75 were moderate, ≥ 0.75 and <0.9 were good, and ≥ 0.9 were excellent (Koo and Li, 2016).

Five horse-human interaction videos with corresponding heart rate data for the horse in each video were evaluated by three researchers experienced in interpreting horse fear, stress, and reactivity, and these same videos were shown to survey participants. Videos were evaluated twice by both researchers and participants; first without the inclusion of heart rate data, and then with horse heart rate included. Using the experienced researchers' interpretations as the standard for states exhibited by horses in each video before and after heart rate was revealed, the participants' evaluations of horse fear, stress, and reactivity exhibited in the same videos were then thematically coded. Participants were assigned a score of 0 for incorrect interpretations, a score of 1 for partially correct interpretations, or a score of 2 for completely correct interpretations (See Appendix D for details).

5.5 Results

5.5.1 Demographics

A large majority of participants in this study identified as female (93%), while few participants identified as male (4%), gender variant non-conforming (1%), or preferred not to say (2%). Most participants identified as White (94%), while fewer participants identified as other (2%), Asian (1%), Native American (0.3%), or preferred not to say (3%). Most participants were in the age range of 56-65 years (26%), while others were in the age range of 46-55 years (20%), 36-45 years (18%), 26-35 years (18%), 18-25 years (9%), older than 65 years (7%), and 2% preferred not to say. At the time of the study, most participants (63%) reported that they lived in the United States. There were no effects of gender or age on ability of participants to correctly define fear, stress, reactivity, or any of the learning theory principles. There were no differences between participants' race and their abilities to correctly define stress (X^2 (8, N = 326) = 6.73, p = 0.57) or reactivity (X^2 (8, N = 325) = 4.18, p = 0.84), but there were differences for their abilities to correctly define fear (X^2 (8, N = 326) = 20.84, p = 0.008) (Table 1). Individuals who identified as other or preferred not to say were more correct in their abilities to correctly define fear (100%, 100% respectively) compared to individuals who identified as White (88%) or Asian (0%). There were also differences between participants who did or did not live in the United States at the time of the study for their abilities to correctly define fear (X^2 (2, N = 326) = 10.03, p = 0.007), stress (X^2 (2, N = 326) = 11.01, p = 0.004), and reactivity (X^2 (2, N = 325) = 7.74, p = 0.02) (Table 2). Individuals who did not live in the United States were more correct in their abilities to define fear (80%), but individuals who did currently live in the United States were more correct in their abilities to define stress (87%) and reactivity (38%). There were no differences between participants who did or did not live in the United States at the time of the study for their abilities to correctly define positive reinforcement (X^2 (2, N = 326) = 2.04, p = 0.36), but there were differences for participants who did or did not live in the United States at the time of the study for their abilities to correctly define negative reinforcement (X^2 (2, N = 326) = 20.15, p < 0.0001), positive punishment (X^2 (8, N = 326) = 26.34, p < 0.0001), and negative punishment (X^2 (2, N = 326) = 10.21, p = 0.006) (Table 3). Individuals who did not live in the Unites States at the time of the study were more correct in their abilities to correctly define negative reinforcement (54%), positive punishment (48%), and negative punishment (47%).

5.5.2 Psychographics

At the time of this study, most participants (86%) owned a horse and (84%) reported this was not the first one they had owned. Most participants (96%) had owned a horse at some point in their lifetime; few (4%) reported that they had never owned a horse. Among the participants who currently owned horses, most participants (84%) reported their currently owned horse(s) was/were not their first. Among the participants who currently owned horses, more (47%) reported that their horses resided at their own homes, while fewer (39%) kept their horses at a boarding facility. Most participants (77%) were with their horses daily, compared to participants who were with their horses two-to-three-times a week (19%), once a week (2%), or once a month (1%). Most participants were riding or driving their horse(s) two-to-three-times a week (40%), compared to participants who were riding or driving their horses daily (17%), a few times a week (10%), two-to-three times a month (10%), once a week (10%), or once a month (3%). Few participants (11%) reported they were not currently riding or driving their horses at all. Of the participants who did not currently own horses, most spent time with horses two to three times a week (35%) or daily (21%), compared to participants who were only spending time with horses two-to-three times a month (13%), once a week (11%), or once a month (1%). Few participants (8%) reported they were not spending any time with horses. Of the participants who did not own horses, more reported actively working with horses daily (37%) or two to three times a week (30%), compared to participants who were actively working with horses two to three times a month (13%), once a week (10%), or once a month (4%). There were no differences between participants if they did or did not currently own horses for their abilities to correctly define fear (X^2 (2, N = 556) = 4.45, p = 0.11) or stress (X^2 (2, N = 556) = 4.277, p = 0.12), but there were differences for participants' abilities to correctly define reactivity (X^2 (2, N = 555) = 8.28, p = 0.02) (Table 4). Participants who did currently own horses were more correct in their abilities to correctly define reactivity (31%). There were no differences between whether participants currently worked with horses and their abilities to correctly define fear (X^2 (2, N = 556) = 0.467, p = 0.79) or reactivity (X^2 (2, N = 555) = 2.45, p = 0.29), but there were differences for their abilities to correctly define stress (X^2 (2, N = 556) =

11.48, p = 0.003) (Table 5). Participants who currently worked with horses were more correct in their abilities to correctly define stress (81%). There were no differences between whether participants currently worked with horses and their abilities to correctly define positive reinforcement (X^2 (2, N = 336) = 3.09, p = 0.21), positive punishment (X^2 (2, N = 336) = 2.57, p = 0.28), or negative punishment (X^2 (2, N = 336) = 4.79, p = 0.09), but there were differences for their abilities to correctly define negative reinforcement (X^2 (2, N = 336) = 7.99, p = 0.02) (Table 6). Participants who currently worked with horses were more correct in their abilities to correctly define negative reinforcement (41%). There were also differences between the amount of time participants spent with unowned horses for their abilities to correctly report the normal resting heart rate for an adult horse (X^2 (5, N = 271) = 12.14, p = 0.03) (Table 7). Participants who were spending time with unowned horses daily or once per week were more correct in their abilities to correctly report the normal resting heart rate for an adult horse (87%, 83% respectively).

5.5.3 Horse Behavior Terminology

When participants were asked to define fear, stress, and reactivity in the context of horses, few could provide complete definitions (stress = 34.2%, fear =13.7%, reactivity = 0.90%) by including both physical and physiological metrics (Table 8). More participants were able to partially define fear (62.9%) and stress (43.2%) by including either physical or physiological metrics, but only a few participants (28.8%) were able to partially define reactivity. Reactivity was the most difficult for participants to define as the majority of participants (70.3%) provided completely incorrect or incomplete definitions of reactivity. Results suggested a weak positive correlation between participants' abilities to correctly define fear compared to their abilities to correctly define stress (r = 0.29, p = <0.0001). Additionally, participants' abilities to correctly define fear compared to their abilities to correctly define reactivity was weakly correlated (r = 0.12, p = 0.006). Likewise, results suggest a weak correlation between participants' abilities to correctly define stress compared to their abilities to correctly define reactivity (r = 0.28, p = <0.0001) (Table 9).

5.5.4 Video Consistency

Across all videos, participants showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.993, $F_{1,21}$=146, p=0.000), stress (ICC; ICC=0.997, $F_{1,21}$=311, p=0.000), and reactivity (ICC; ICC=0.993, $F_{1,21}$=151, p=0.000) within the videos when the corresponding HR data was not present (Table 10). Likewise, when the corresponding horse HR data was presented to the participants, participants again showed a high level of agreement (Koo & Li, 2016) when asked to indicate the presence of fear (ICC; ICC=0.993, $F_{1,21}$=151, p=0.000), stress (ICC; ICC=0.994, $F_{1,21}$=168, p=0.000), and reactivity (ICC; ICC=0.984, $F_{1,21}$=60.8, p=0.000) (Table 11).

5.5.5 Heart Rate

Most participants (80%) were able to correctly identify the normal resting heart rate for an adult horse. Also, a majority (83%) indicated that knowing the heart rate of the horse in each video did not influence their interpretation of the horse's behavior as demonstrated in any of the five videos. No differences were found between participants' abilities to correctly report heart rate and their abilities to correctly define and identify fear, stress, reactivity, or any of the learning theory principles. Likewise, no differences were found between participants' abilities to correctly report heart rate based on their demographics, or most of the' psychographics. There were, however, differences between time spent with unowned horses for participants' ability to correctly report the average resting heart rate for an adult horse (X^2 (5, N = 271) = 12.14, p = 0.03) (Table 7). Participants who were spending time with unowned horses daily or once per week were more correct in their abilities to correctly report the normal resting heart rate for an adult horse (87%, 83% respectively).

5.5.6 Learning Theory

When asked to define each of the learning theory principles, few participants were able to provide completely correct definitions. More participants were able to completely define positive punishment (11.6%), than positive reinforcement (8.6%), negative punishment (8.0%), and negative reinforcement (7.1%) (Table 12). Most participants were able to partially define positive reinforcement (55.1%), fewer correctly defined negative reinforcement (30.1%), negative punishment (28.3%), and positive punishment (20.2%). Weak correlations were observed between participants' abilities to correctly define positive reinforcement compared to their abilities to correctly define negative reinforcement (r = 0.36, p = <0.0001), positive punishment (r = 0.48, p = <0.0001), and negative punishment (r = 0.41, p = <0.0001; Table 13). Moderate correlations were observed between participants' abilities to correctly define negative reinforcement compared to their abilities to correctly define positive punishment (r = 0.55, p = <0.0001) and negative punishment (r = 0.61, p = <0.0001 respectively). Participants' ability to correctly define positive punishment compared to their ability to correctly define negative punishment was also moderately correlated (r = 0.71, p = <0.0001). When asked to select which learning theory principle was being described within different horse-human interaction scenarios, positive reinforcement was the easiest for participants to correctly identify (28.1%), followed by negative punishment (15.8%), negative reinforcement (15.5%), and positive punishment (12.8%) (Table 14). No differences were found between participants' abilities to correctly define any of the learning theory principles, based on most of the participants' demographics or psychographics. There were no differences between participants based on where participants lived at the time of the study for their abilities to correctly define positive reinforcement (X^2 (2, N = 326) = 2.04, p = 0.360). However, there were differences between participants who did or did not live in the United States at the time of the study for their abilities to correctly define negative reinforcement (X^2 (2, N = 326) = 20.15, p < 0.0001), positive punishment (X^2 (8, N = 326) = 26.34, p < 0.0001), and negative punishment (X^2 (2, N = 326) = 10.21, p = 0.006) (Table 3). Individuals who did not live in the Unites States at the time of the study were more correct in their abilities to correctly define negative reinforcement (54%), positive punishment (48%), and negative punishment (47%). There were no differences between whether participants currently worked with horses and their abilities to correctly define positive reinforcement (X^2 (2, N = 336) = 3.09, p = 0.214), positive punishment (X^2 (2, N = 336) = 2.57, p = 0.276), or negative punishment (X^2 (2, N = 336) = 4.79, p = 0.091), but there were differences for their abilities to correctly define negative reinforcement (X^2 (2, N = 336) = 7.99, p = 0.018) (Table 6). Participants who currently worked with horses were more correct in their abilities to correctly define negative reinforcement (41%).

5.6 Figures, Tables and Schemes

Table 1. Percentage of participants' abilities to correctly define fear, stress, and reactivity based on self-reported racial identity (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a completely correct definition.

Race	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
White	18% 55	66% 202	16% 49	17% 52	44% 135	39% 119	66% 202	33% 100	1% 4
Asian	100% 2	0% 0	0% 0	50% 1	50% 1	0% 0	50% 1	50% 1	0% 0
Native American	0% 0	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0
Other	0% 0	63% 5	38% 3	38% 3	38% 3	25% 2	86% 6	14% 1	0% 0
Prefer not to Say	0% 0	67% 6	33% 3	11% 1	33% 3	56% 5	78% 7	22% 2	0% 0

*There were no differences between participants' race for stress (X^2 (8, N = 326) = 6.73, p = 0.57) or reactivity (X^2 (8, N = 325) = 4.18, p = 0.84), but there were differences for fear (X^2 (8, N = 326) = 20.84, p = 0.008).

Table 2. Percentage of participants' abilities to correctly define fear, stress, and reactivity based on residency (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a completely correct definition.

Lived in the United States	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	16% 33	71% 146	13% 26	13% 26	49% 101	38% 78	62% 128	37% 76	1% 1
No	20% 24	55% 67	25% 30	25% 31	35% 42	40% 48	73% 88	24% 29	3% 3

*There were differences between if participants lived in the United States for fear (X^2 (2, N = 326) = 10.03, p = 0.007), stress (X^2 (2, N = 326) = 11.01, p = 0.004), or reactivity (X^2 (2, N = 325) = 7.74, p = 0.021).

Table 3. Percentage of participants' abilities to correctly define learning theory principles based on residency (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a completely correct definition.

Lived in the United States	**Positive Reinforcement**			**Negative Reinforcement**			**Positive Punishment**			**Negative Punishment**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	37% 75	57% 117	6% 13	71% 146	23% 47	6% 12	79% 161	13% 27	85 17	70% 143	24% 50	6% 12
No	34% 41	55% 67	11% 13	46% 56	44% 53	10% 12	51% 62	31% 38	17% 21	53% 64	35% 42	12 %1 5

*There were no differences between participants who did or did not live in the United States for positive reinforcement (X^2 (2, N = 326) = 2.04, p = 0.36), but there were differences for negative reinforcement (X^2 (2, N = 326) = 20.15, p < 0.0001), positive punishment (X^2 (8, N = 326) = 26.34, p < 0.0001), and negative punishment (X^2 (2, N = 326) = 10.21, p = 0.006).

Table 4. Percentage of participants' abilities to correctly define fear, stress, and reactivity based on horse ownership (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a completely correct definition.

Currently Owned Horses	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	23% 113	63% 313	15% 73	21% 107	44% 220	34% 172	69% 345	30% 150	1% 3
No	30% 17	65% 37	5% 3	33% 19	35% 20	32% 18	79% 45	17% 10	4% 2

*There were no differences between participants if they did or did not currently own horses for their abilities to correctly define fear (X^2 (2, N = 556) = 4.45, p = 0.11) or stress (X^2 (2, N = 556) = 4.277, p = 0.12), but there were differences for their abilities to correctly define reactivity (X^2 (2, N = 555) = 8.28, p = 0.02).

Table 5. Percentage of participants' abilities to correctly define fear, stress, and reactivity based on working with horses (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a completely correct definition.

Currently Worked With Horses	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	23% 90	63% 249	14% 56	19% 75	44% 174	37% 146	68% 270	31% 121	1% 4
No	25% 40	63% 101	12% 20	32% 51	41% 66	27% 44	75% 120	24% 39	1% 1

*There were no differences between if participants currently worked with horses for their abilities to correctly define fear (X^2 (2, N = 556) = 0.467, p = 0.79) or reactivity (X^2 (2, N = 555) = 2.45, p = 0.29), but there were differences for their abilities to correctly define stress (X^2 (2, N = 556) = 11.48, p = 0.003).

Table 6. Percentage of participants' abilities to correctly define learning theory principles based on working with horses (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a completely correct definition.

Currently Worked With Horses	**Positive Reinforcement**			**Negative Reinforcement**			**Positive Punishment**			**Negative Punishment**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	34% 84	56% 140	10% 24	58% 145	33% 82	8% 21	66% 163	22% 54	13% 31	61% 151	29% 73	10 % 24
No	43% 38	51% 45	6% 5	75% 66	19% 22%	3% 3	75% 66	16% 14	9% 8	72% 63	25% 22	3% 3

*There were no differences between whether participants currently worked with horses for their abilities to correctly define positive reinforcement (X^2 (2, N = 336) = 3.09, p = 0.21), positive punishment (X^2 (2, N = 336) = 2.57, p = 0.28), or negative punishment (X^2 (2, N = 336) = 4.79, p = 0.09), but there were differences for their abilities to correctly define negative reinforcement (X^2 (2, N = 336) = 7.99, p = 0.02).

Table 7. Percentage of participants' abilities to correctly report the average resting heart rate for an adult horse based on time spent with unowned horses (row % for reporting heart rate and n). Yes represents their ability to correctly report heart rate, No represents their inability to correctly report heart rate.

Amount of Time Spent	**Heart Rate**	
	Yes	**No**
Daily	87% 95	13% 14
Once per week	83% 20	17% 4
2 to 3 times per week	68% 52	32% 25
Once a month	75% 9	25% 3
Few times per year	69% 9	31% 4

*There were differences between time spent with unowned horses for participants' abilities to correctly report the average resting heart rate for an adult horse (X^2 (5, N = 271) = 12.14, p = 0.03).

Table 8. Participants' (n = 556) Abilities to Correctly Define Fear, Stress, and Reactivity.

	Level of Correct/Complete Definition					
	0		**1**		**2**	
State	n	Percent (%)	n	Percent (%)	n	Percent (%)
Fear	130	23.4	350	62.9	76	13.7
Stress	126	22.7	240	43.2	190	34.2
Reactivity	390	70.3	160	28.8	5	0.90

*Scoring Scale: 0 – Incorrect/Incomplete, 1 – Partially Correct, 2 – Completely Correct

Table 9. Pearson's Correlations Comparing Participants' (n = 556) Abilities to Correctly Define Fear, Stress, and Reactivity.

	Definition of Fear	Definition of Stress	Definition of Reactivity
Definition of Fear			
r value	1	0.29	0.12
p value		**<.0001**	**0.0064**
n	556	556	555
Definition of Stress			
r value	0.29	1	0.28
p value	**<.0001**		**<.0001**
n	556	556	555
Definition of Reactivity			
r value	0.12	0.28	1
p value	**0.0064**	**<.0001**	
n	555	555	555

Bolded values in the table indicate statistically significant differences of P < 0.05.

Table 10. Intraclass Correlation Coefficients of Participants' (n = 384) Level of Agreement Between Each Other When Asked to Identify Presence of Specific States in Horses from Videos Without Corresponding Horse Heart Rate Data.

State	**Intraclass Correlation Coefficients**		
	ICC Estimate	**F-value**	**P-value**
Fear	0.993	146	<0.001
Stress	0.997	311	<0.001
Reactivity	0.993	151	<0.001

Table 11. Intraclass Correlation Coefficients of Participants' (n = 384) Level of Agreement Between Each Other When Asked to Identify Presence of Specific States in Horses from Videos With Corresponding Horse Heart Rate Data.

State	**Intraclass Correlation Coefficients**		
	ICC Estimate	**F-value**	**P-value**
Fear	0.993	151	<0.001
Stress	0.994	168	<0.001
Reactivity	0.984	60.8	<0.001

Table 12. Participants' (n = 336) Abilities to Correctly Define Positive Reinforcement, Negative Reinforcement, Positive Punishment, Negative Punishment.

	Level of Correct/Complete Definition					
	0		**1**		**2**	
Learning Theory Principle	n	Percent (%)	n	Percent (%)	n	Percent (%)
Positive Reinforcement	122	36.3	185	55.1	29	8.6
Negative Reinforcement	211	62.8	101	30.1	24	7.1
Positive Punishment	229	68.1	68	20.2	39	11.6
Negative Punishment	214	63.7	95	28.2	27	8.0

*Scoring Scale: 0 – Incorrect/Incomplete, 1 – Partially Correct, 2 – Completely Correct

Table 13. Correlations of Participants' (n = 336) Abilities to Correctly Define Positive Reinforcement, Negative Reinforcement, Positive Punishment, Negative Punishment Compared to Their Abilities to Correctly Define Positive Reinforcement, Negative Reinforcement, Positive Punishment, Negative Punishment.

	Definition of Positive Reinforcement	Definition of Negative Reinforcement	Definition of Positive Punishment	Definition of Negative Punishment
Definition of Positive Reinforcement				
r value	1	0.36	0.48	0.41
p value		**<0.0001**	**<0.0001**	**<0.0001**
n	336	336	336	336
Definition of Negative Reinforcement				
r value	0.36	1	0.55	0.61
p value	**<0.0001**		**<0.0001**	**<0.0001**
n	336	336	336	336
Definition of Positive Punishment				
r value	0.48	0.55	1	0.71
p value	**<0.0001**	**<0.0001**		**<0.0001**
n	336	336	336	336
Definition of Negative Punishment				
r value	0.41	0.61	0.71	1
p value	**<0.0001**	**<0.0001**	**<0.0001**	
n	336	336	336	336

Bolded values in the table indicate statistically significant differences as noted.

Table 14. Participants' (n = 336) Abilities to Correctly Identify Positive Reinforcement, Negative Reinforcement, Positive Punishment, Negative Punishment Through Horse-Human Interaction Scenarios.

	Correct Answer (%)	
Learning Theory Principle	Yes	No
Positive Reinforcement	28.1	71.9
Negative Reinforcement	15.5	84.4
Positive Punishment	12.8	87.2
Negative Punishment	15.8	84.2

5.7 Discussion

Typically, horse training is based on knowledge passed on through generations and the 'art of horsemanship' is frequently discussed with little research to back it up (Pearson, 2015). How an individual obtains knowledge can be further explained by schema theory, which is how schemata are represented suggested to be an interactive process, utilizing the idea that background knowledge influences future comprehension (Driscoll, 2004). Within the horse industry, an individual's knowledge level is often judged based on their level of industry/horse experience. A common assumption within the horse industry is that people who are more involved within the industry may be more knowledgeable about horses overall, compared to those who are less involved within the industry, as more experience may equate to increased knowledge and understanding. In addition to an individual's level of involvement within the industry, it is possible that other psychographics (such as if an individual owns a horse, has ever owned a horse, or their frequency of time spent with or around horses), or certain demographics (such as age, race, or residence), may influence their overall knowledge and understanding of horse behavior and welfare concepts.

Most participants at the time of this study identified as White (94%), while fewer identified as other (2%), Asian (1%), Native American (0.3%), or preferred not to say (3%). No differences were found between participants' race and their abilities to correctly define stress or reactivity, but results from this study suggest that individuals who identified as other or those who preferred not to say were more correct in their abilities to define fear) compared to individuals who identified as White (88%) or Asian (0%). These results disagree with other findings in this laboratory (Chapters 3 and 4), which indicated no effect of self-reported racial identity on participants' abilities to correctly define fear, stress, or reactivity. It is important to note that even though results from this study suggest individuals who identified as "other" or those who did not identify their race were more correct in their abilities to define fear, the numbers in these categories were small (eight and none, respectively). These results are not robust enough to generalize across all such individuals. In this study, individuals who did not live in the United States were more correct in their abilities to define fear (80%), but individuals who did currently live in the United States were more correct in their abilities to define stress (87%) and reactivity (38%). These results disagree previous findings in this laboratory (Chapters 3 and 4), which indicated no differences among participants' abilities to correctly define these states regardless of their current residence. This may simply reflect an ability to detect differences due to the increased sample size in the current study.

At the time of this study, most participants (86%) owned a horse. In a similar audience of adults within the horse industry, Hotzel et al. (2019) found that 81% of survey participants identified themselves as horse owners. In contrast, this laboratory (Chapter 3) reported that only 30% of their respondents were horse owners. The difference is likely due to this study targeting a more representative group of individuals across the horse industry whereas the pilot study in this laboratory targeted only a small sample of undergraduate animal science students. Previous research has linked greater attribution of cognitive and emotional states in animals to animal ownership (Walker et al., 2014). Hotzel et al. (2019) suggests that individuals who identify as horse owners have more opportunities to learn about their horse's cognitive abilities through routine contact with horses, which in turn may impact owners' beliefs and attitudes towards emotionality in horses. In this study, no differences were found between participants' abilities to correctly define fear, stress, reactivity, based on most of participants' horse psychographics, although horse owners were more correct in their abilities to correctly define reactivity (31%). Results from the current study disagree with results from Chapter 3 which did not find an effect of horse ownership status on participants' abilities to correctly define any of the three states. It is possible that individuals who own horses may be more correct in their abilities to define reactivity if they have more exposure to horses demonstrating related behaviors in various situations, but level of horse ownership varies from person to person. For example, individuals who are horse owners never interact with their horse(s), e.g., individuals who own racehorses. In contrast, an individual that is a horse owner could potentially spend more time with or around horses (i.e. stable hands, veterinarians, trainers, etc.). Therefore, simply being classified as a "horse owner" may not provide a complete evaluation of an individual's ability to correctly define and/or identify specific concepts related to horse behavior and welfare. With that in mind, participants were asked to report if they currently worked with or around horses. Even though participants who reported they did currently work with horses were more correct in their abilities to correctly define stress, similar to the suggestion about level of horse ownership, how an individual works with horses varies across multiple people. Similar to the diversity of horse ownership, an individual who reports they currently work with horses may have different skillsets based on the kind of work they are actively involved in with horses. For example, individuals who take riding lessons, farriers who focus on the general hoof care of horses, judges in competition, or individuals who haul horses between multiple locations, are all individuals who work directly with horses, yet the work they do, and subsequently the interactions they have with horses, varies greatly.

Previous research has suggested as readers use various processes interchangeably when reading, consciously or unconsciously, to facilitate comprehension, they are able to make predictions regarding what they may expect to experience in any given context (An, 2013). Likewise, it has been suggested that students' past experiences and knowledge dictates their comprehension of future opportunities to foster educational growth (Fahrianv, 2015). Differences between experienced and inexperienced participants (Gronqvist et al., 2017) have been explored to assess how experience influences interpretations. For example, the ability of first-year veterinary science, veterinary technology, and undergraduate equine science students to perceive and interpret certain expressive horse behaviors was affected by their level of horse-experience (Gronqvist et al., 2017). Therefore, it should be expected that diverse horse-human interactions may frame an individual's unique schema of horses differently, enhancing their personal knowledge base and skillsets, which in turn could influence their abilities to correctly define and identify specific states used to assess horse behavior differently. It is important to mention that even though several horse-related psychographic characteristics were explored among the participants within this study, most of them only scratched the surface and failed to be dissected in more detail. How someone works with horses, and what they do with them, may also vary across different roles and niches within the industry, which in turn should be further explored in future studies.

Previous research has attempted to define fear (Forkman et al., 2007; Manteca & Deag, 1993), stress (Martin, 2014; McGrath, 1970) and reactivity (McCall et al., 2006) as they relate to horses, but these terms are frequently misunderstood and used incorrectly. Research has also identified multiple metrics that can be used to measure these specific states, yet these terms are still commonly misinterpreted and used inconsistently. Because the majority of participants could only provide partial definitions, this raises the concern that participants may not understand the relationship between physical and physiological metrics needed to identify these individual states. These results suggest that participants were not able to accurately identify if and when these states may be occurring in horses, which could subsequently compromise the welfare of a horse and human safety. Overall, participants in this study showed a high level of agreement between each other (Koo & Li, 2016) when asked to indicate the presence of fear, stress, and reactivity when the corresponding heart rate data was not present. Likewise, when the corresponding horse heart rate data was presented to the participants, participants again showed a high level of agreement between each other (Koo & Li, 2016) when asked to indicate the presence of fear, stress, and reactivity. When analyzing animal behavior, it is critical to have a clear understanding of behavioral terminology. States, such as stress, fear, and reactivity, are often confused, which may create diverse perspectives on behaviors being expressed. Despite the high level of agreement between the participants, ability for participants to be able to correctly define one state did not suggest they could correctly define the other two states, as ability for participants to correctly define these terms was weakly correlated. These results suggest that participants may not have a complete understanding of each of these terms separately, but also the difference among each term individually. As these terms are often used not only incorrectly but interchangeably, the ways in which these terms are being taught to individuals may need to change in order to resolve the issue of people not being able to correctly define and identify these states. Education may not be enough, though, to change the way individuals within the industry manage horses. A sample of participants across the Canadian equine industry strongly believe that horses are capable of experiencing affective states, such as pain and fear, and welfare issues that may be present within the industry are not a result of lack of motivation, but rather a lack of knowledge of the welfare concerns themselves (DuBois et al., 2018). Pearson (2004) reported that owners of horses that elicited welfare concerns had less knowledge about horse management practices but they did not take active measures seek to enhance their knowledge or skillset. As most participants in the current study have demonstrated they are not able to correctly define these terms, there is an additional concern that individuals involved in the horse industry, regardless of their background or level of involvement, may not be able to correctly differentiate if and when these states are occurring. As scientists and lay people are equally challenged with the ability to easily recognize the affective state of horses (Minero et al., 2018), even if participants are able to correctly define and identify these states, they aren't making the connection between these states to important physiological factors (i.e., heart rate), when identifying these states. This disconnect could be a product of how their individual schemas for horses are shaped based on their unique demographic and/or psychographic factors. This in turn could cause participants to have a lack of understanding of horse behavior, which could worsen the welfare for the horse.

Heart rate has been identified as a measure to indicate stress and/or fear in horses (Borstel et al 2010, Leiner and Fendt 2011, Munsters et al. 2013, Wires et al. 2017), but little research has been done to explore the ability for individual's within the horse industry to accurately report the normal resting heart rate in an adult horse, not to mention if there are any demographic or psychographic characteristics that may put certain individuals at a greater advantage over others for being able to correctly report this common physiological metric. In the current study, most participants (80%) were able to correctly identify the normal resting heart rate for an adult horse. Also, a majority (83%) indicated that knowing the heart rate of the horse in each video did not influence their interpretation of the horse's behavior as demonstrated in any of the five videos. These findings are similar to previous work in this laboratory (Chapters 3 and 4), which also found that most participants were able to correctly identify the normal resting heart rate for an adult horse (84%, 86% respectively). In this study, no differences were found between participants' abilities to correctly report heart rate and their abilities to correctly define and identify fear, stress, reactivity, or any of the learning theory principles. Likewise, no differences were found between participants' abilities to correctly report heart rate based on their demographics, or most of the' psychographics, although participants who were spending time with unowned horses daily or once per week were more correct in their abilities to report the normal resting heart rate for an adult horse (87%, 83% respectively). It is possible that an individual who spends more time with horses, whether they own the horses or not, might have greater knowledge about general physiological measures of horses. However, this would disagree with other results from this study, which suggest that the amount of time an individual spends with horses does not influence their abilities to correctly define specific states used to assess horse behavior. Overall, these findings suggest that despite participants being able to correctly identify a normal resting heart rate for an adult horse, they may not grasp the connection between a horse's physiological response (such as heart rate) to their expression of fear, stress, or reactivity. Furthermore, if participants are more focused on physical, outward behavior as opposed to physiological, internal behavior, they may be missing this connection. This mistake could additionally compromise a horse's welfare due to the potential for participants' interpretations of the horse's physical and physiological to be incorrect. Despite this concern, no differences were found between participants' abilities to correctly report the normal resting heart rate of an adult horse and abilities to correctly identify and define fear, stress, reactivity, or any of the learning theory principles.

Learning theory utilizes an application of changes in behavior produced by mental and/or physical practice, as opposed to other physiological development factors, and incorporates non-associative learning, such as habituation and desensitization, and associative learning, such as classical and operant conditioning. The use of learning theory principles in horses has been previously explored when applied to horse training and management practices (Doherty et al., 2017; McLean and Christensen, 2017), but little research has been done demonstrating the relationship between an individual's ability to correctly define and apply these principles, as they apply to horses. When asked to define each of the learning theory principles few participants were able to provide completely correct definitions of each learning theory principle. Among those who were able to provide completely correct definitions, however, more participants (11.6%) were able to completely define positive punishment, compared to those who completely defined positive reinforcement (8.6%), negative punishment (8.0%), and negative reinforcement (7.1%). When asked to select which learning theory principle is being described within different horse-human interaction scenarios, positive reinforcement was the easiest for participants to correctly identify (28.1%), followed by negative punishment (15.8%), negative reinforcement (15.5%), and positive punishment (12.8%). Even if participants can define these principles, if they cannot correctly identify them, horse welfare may be compromised. For example, participants might be misinterpreting which learning theory principle is necessary to apply during training to elicit the desired response from a horse. If participants apply the incorrect principle, then they may make the situation worse for the horse and hinder the training process, which in turn could compromise the horse's overall welfare.

Participants' abilities to correctly define positive reinforcement compared to their abilities to correctly define negative reinforcement, positive punishment, and negative punishment was weakly significantly correlated. However, participants' abilities to correctly define negative reinforcement compared to their abilities to correctly define positive punishment and negative punishment were moderately correlated. Similarly, participants' abilities to correctly define positive punishment compared to their abilities to correctly define negative punishment were moderately significantly correlated. Participant demographics and psychographics, had little effect on their abilities to correctly define any of the learning theory principles. These results agree with Wires (2021a) who also found that animal science students' demographic and psychographic characteristics did not affect their abilities to correctly define any of the learning theory principles.

In the current study, individuals who did not live in the Unites States at the time of the study were more correct in their abilities to correctly define negative reinforcement (54%), positive punishment (48%), and negative punishment (47%). These results disagree with previous findings in this laboratory (Chapter 3), which indicated no differences between participants' residency on their abilities to correctly define any of the learning theory principles. This effect may be due to international participants being exposed to the learning theory principles outlined by experts from The International Society of Equitation Science to help clarify these concepts. Participants in this study who currently worked with horses were more correct in their abilities to correctly define negative reinforcement (41%). Similar to the concern raised by the finding that participants who were currently working with horses were more correct in their abilities to correctly define stress, how an individual works with horses and what is considered "work" with horses varies greatly person to person.

Overall, participants in this study demonstrated that just because one can correctly identify a concept does not mean they can equally define the same concept, and vise-versa. Results from this study suggest that specific demographic and horse-related psychographic characteristics explored within this study may not be enough to frame an individual's unique schema of horse behavior and welfare terminology. Future research should use this or similar instruments to explore the same components of horse behavior and welfare reported on here using a more representative sample of the horse industry. A different sample of participants with a more representative audience within the horse industry might yield more diverse psychographic factors (e.g., participant role, niche in the industry, horse ownership history or view of horses) that might be examined relative to knowledge of the terms and concepts explored here. Understanding the potential effects of these additional, distinct psychographic characteristics might also help to clarify how an individual's schema of horses might be created and applied in their interpretations and understandings of horse behavior and welfare.

5.8 Conclusion

Results from this study suggest that regardless of whether an individual owns a horse, has ever owned a horse, or an individuals' level of involvement with horses, they may still be unable to correctly define and identify specific states related to horse welfare. Participants demonstrated a high level of agreement between each other when asked to identify if fear, stress, or reactivity was present in a horse's behavior by watching various horse-human interaction videos. However, they were unsuccessful in reporting a clear understanding of these terms individually, as they failed to correctly define and identify these states. The findings showed that even though the majority of participants was able to correctly report the normal resting heart rate for an adult horse, they were unable to demonstrate a clear understanding of the influences of fear, stress, and reactivity on physiological factors such as heart rate. Results from this study indicate that additional education and intervention on key behavior and welfare terminology and ability to identify corresponding behaviors and states in horses is necessary for individuals involved within the horse industry. Utilizing a more diverse audience and evaluating psychographic factors, such as role or niche in the industry, may provide greater insights into how individuals learn and should be further explored.

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CHAPTER 6. CONCLUSIONS

Improving the quality-of-life horses experience under human care depends on the quality of the human-horse relationship. The quality and frequency of human-horse interactions influence the relationship between the human and the horse. Further, science has demonstrated that the overall quality of life for the horse is impacted by the quality of the human-horse relationship.

In addition to an individual's perceptions of horses, the extent to which the horse's welfare needs are met and understood, depends on the quality of the human-horse relationship. A strong human-horse relationship leads to potentially more desire to improve horse welfare. For a strong human-horse relationship to exist, solid understanding and reasonable human expectations of horses must exist. Without clear expectations and understanding about horses, people may fail to meet horses' needs or wants. How individuals obtain their interpretations and understandings of horse behavior and welfare concepts may be influenced by their demographic or psychographic characteristics. Additionally, how humans acquire their interpretations and understandings of horse behavior and welfare concepts could potentially be explained by exploring principles of learning theory and schema theory.

Focusing on a small sample of the horse industry, a group of undergraduate students enrolled in a horse management course was studied. Results indicated that horses were most commonly viewed by students as companion animals/pets as their top choice. Current horse ownership status, or level of involvement within the horse industry, did not impact ability to correctly define and identify fear, stress, and reactivity in horses, or learning theory principles. Additionally, results from this study suggested that many students may not understand how fear, stress and reactivity potentially impact horse HR, suggesting an inability to connect HR with negative welfare states. Despite students demonstrating a high level of agreement between each other when identifying fear, stress, and reactivity in recordings of horse-human interactions, their abilities to correctly define fear and stress were not related to their abilities to correctly define any of the learning theory principles. The majority of students struggled to correctly define fear, stress, and reactivity, and some students appeared to lack an understanding of the differentiation between positive and negative parameters of stress and their applications in real life scenarios. This lack of differentiation raises concerns that individuals may not understand if the horse's needs or wants are being met, which in turn could potentially erode the human-horse relationship.

Study two suggested that even individuals who are directly involved within the field of equitation science may demonstrate an inability to correctly define and identify specific states related to horse behavior. Similar to the sample of horse-management undergraduate students, participants showed a high level of agreement between each other in their abilities to identify fear, stress, and reactivity in horses, but were unable to clearly and completely define these states. Also, similar to the sample of horse-management undergraduate students, participants were unable to recognize both positive and negative aspects of stress. Furthermore, the results suggest that although most participants could correctly report the average resting HR for an adult horse, they were unable to demonstrate a clear understanding of the impacts of fear, stress, and reactivity on physiological factors such as HR.

Expanding the scope to a broader audience of individuals across the horse industry, similar results were found. In agreement with both pilot studies, participants in the final study demonstrated a high level of agreement between each other in their abilities to identify fear, stress, and reactivity, and were unsuccessful in their abilities to clearly define any of these terms. Just as both pilot studies suggested, results across the broader audience showed that even though the majority of participants was able to correctly report the average resting HR for an adult horse, they did not seem to connect HR to the presence of fear, stress, and reactivity in horses.

While it may seem logical that individuals who own a horse or are directly involved within the horse industry may have a more developed schema of horses, potentially providing an advantage in ability to identify and define specific behavior and welfare concepts as applied to horses, results from this dissertation did not agree with that assumption. Despite popular belief, the current findings suggest that individuals who own or directly work with horses may not necessarily be more successful at correctly identifying and defining specific states related to horse behavior, or principles of LT. The same may be true for individuals who are specifically involved in a unique niche within the horse industry. Overall, results from this dissertation suggest additional education and intervention could be beneficial when it comes to clearly defining specific states such as fear, stress, and reactivity, or principles of learning theory, for individuals involved across the horse industry. Exploring additional psychographic factors, such as one's specific role or niche in the industry, or their overall views of horses, may help to identify more differences between participants knowledge and may provide greater insight into schema formation in a more representative audience.

APPENDIX A. HORSE PSYCHOGRAPHIC SECTIONS AND QUESTIONS FOR SURVEY PARTICIPANTS

Table A.1

Section	Question
Horse Ownership	• Do you own a horse? • Have you ever owned a horse? • How many horses do you currently own? • How many horses have you owned in your lifetime?
Horse Management	• Do you board your horse? • Does your horse live in your back yard? • Do you currently work with horses?
Training Skills	• How often do you spend time with your horse? • How often do you ride or drive your horse?
View of Horses	(Possible Views to Select) • Companion Animal/Pet • Employee • Family Member • Investment • Livestock Animal • Performance Partner

APPENDIX B. BEHAVIOR TERMINOLOGY CODEBOOK

Table B.1
Fear:

Score	Response	Example
0	Nonsense response – Incorrect, absent, impossible to interpret. Not specific enough – Too vague. Tautologies – Using the specific term within the definition, without any further clarification or detail.	“Fear is a fear of the unknown.” “Fear can be identified by visual signs in the horse.”
1	Includes specific external behavioral identifiers OR specific internal physiological identifiers within definition	“Fear for horses is when they spook over something from a prey instinct it can be identified from shying sideways or rearing.”
2	Includes specific external behavioral identifiers AND specific internal physiological identifiers within definition	“Fear is a reaction to an uncomfortable or unfamiliar experience where the horse feels threatened. Fear can be measured by behaviors, such as bolting, and hormones levels.”

Table B.1
Stress:

Score	Response	Example
0	Nonsense response – Incorrect, absent, impossible to interpret. Not specific enough – Too vague. Tautologies – Using the specific term within the definition, without any further clarification or detail.	"Stress is being placed in a situation that makes you uncomfortable."
1	Includes specific external/behavioral identifiers OR specific internal/physiological identifiers within definition	"Stress can be identified by hormone tests in the horse."
2	Includes specific external/behavioral identifiers AND specific internal/physiological identifiers within definition	"Stress is a physiological response to any form of overwhelming experience and can be measured by behavior, such as freezing, and hormone levels."

Table B.3
Reactivity:

Score	Response	Example
0	Nonsense response – Incorrect, absent, impossible to interpret. Not specific enough – Too vague. Tautologies – Using the specific term within the definition, without any further clarification or detail.	“Reactivity is what happens after a stimulus is identified.” “When a horse reacts to a stimulus. It can be identified by the horses behavior towards a certain object/sound/pressure and other stimulus. If a horse does not like an object, you will notice the behavior change.”
1	Includes specific external/behavioral identifiers OR specific internal/physiological identifiers within definition	“Reactivity is how well a horse responds to any external stimuli. It can be identified by the horse expressing behaviors such as fight or flight.”
2	Includes specific external/behavioral identifiers AND specific internal/physiological identifiers within definition	“Reactivity is the outward signs of a prey instinct. It can be identified by the horse jumping sideways or rearing in reaction as well as physiologic changes such as increased heart rate.”

APPENDIX C. LEARNING THEORY PRINCIPLES CODEBOOK

Table C.1
Positive Reinforcement:

Score	Response	Example
0	<u>Nonsense response</u> – Incorrect, absent, impossible to interpret. <u>Not specific enough</u> – Too vague. <u>Tautologies</u> – Using the specific term within the definition, without any further clarification or detail.	“To positively reinforce something.” “When you add something to the environment to reinforce a behavior.” “Rewarding horses in a positive way for unwanted behaviors.”
1	Includes <u>PARTIAL DEFINITION</u> – addition of stimulus/treat/interaction/objection/etc. <u>OR</u> increase the likelihood of the behavior/response to occur again … without making the definition incorrect Not specific enough – Definition includes the use of “something” instead of the use of stimulus/activity/reaction/etc.	“Giving a treat with a positive action.” “Adding a good stimulus to the environment.” “Positive reinforcement is giving the horse something so that it will repeat a behavior.”
2	Includes <u>FULL DEFINITION</u> – addition of stimulus/treat/interaction/objection/etc. <u>AND</u> to increase the likelihood of the behavior/response to occur again	“Positive reinforcement is when a reward is given to the horse which increases the likelihood of a behavior to occur.”

Table C.2
Negative Reinforcement:

Score	Response	Example
0	<u>Nonsense response</u> – Incorrect, absent, impossible to interpret. <u>Not specific enough</u> – Too vague. <u>Tautologies</u> – Using the specific term within the definition, without any further clarification or detail.	"The absence of positive reinforcement." "Stopping the undesired behavior." "Negative reinforcement is taking something away so the horse won't repeat a behavior." "The taking away of stimuli to reinforce the desired behavior."
1	Includes <u>PARTIAL DEFINITION</u> – reduction/removal of stimulus/treat/interaction/objection/etc. <u>OR</u> increase the likelihood of the behavior/response to occur again … without making the definition incorrect Not specific enough – Definition includes the use of "something" instead of the use of stimulus/treat/interaction/objection/etc.	"Taking something away that shows the horse that the behavior was correct and is a good thing to do." "Taking away something to make behavior happen more often."
2	Includes <u>FULL DEFINITION</u> – reduction/removal of stimulus/treat/interaction/objection/etc. <u>AND</u> to increase the likelihood of the behavior/response to occur again	"Negative reinforcement is a method of encouraging a behavior by taking away something, like removing pressure." "Removing an adverse stimulus to enhance behavior."

Table C.3

Positive Punishment:

Score	Response	Example
0	Nonsense response – Incorrect, absent, impossible to interpret. Not specific enough – Too vague. Tautologies – Using the specific term within the definition, without any further clarification or detail.	"Desensitization of something that once scared/displeased the horse." "Adding punishment to change behavior."
1	Includes PARTIAL DEFINITION – addition of stimulus/treat/interaction/objection/etc. OR decrease the likelihood of the behavior/response to occur again … without making the definition incorrect Not specific enough – Definition includes the use of "something" instead of the use of stimulus/treat/interaction/objection/etc.	"Decreasing the undesired behavior." "Giving something to the horse to discourage the behavior."
2	Includes FULL DEFINITION – addition of stimulus/treat/interaction/objection/etc. AND to decrease the likelihood of the behavior/response to occur again	"Adding adverse stimulus to deter behaviors."

Table C.4
Negative Punishment:

Score	Response	Example
0	Nonsense response – Incorrect, absent, impossible to interpret. Not specific enough – Too vague. Tautologies – Using the specific term within the definition, without any further clarification or detail.	"Punishing horses." "Punishment with taking something away."
1	Includes PARTIAL DEFINITION – reduction/removal of stimulus/treat/interaction/objection/etc. OR decrease the likelihood of the behavior/response to occur again … without making the definition incorrect Not specific enough – Definition includes the use of "something" instead of the use of stimulus/treat/interaction/objection/etc.	"Negative punishment is when you take away something which decreases the likelihood of a behavior from occurring." "Taking something away that a horse wants."
2	Includes FULL DEFINITION – reduction/removal of stimulus/treat/interaction/objection/etc. AND to decrease the likelihood of the behavior/response to occur again	"Taking a positive stimulus away from the horse to discourage the behavior." "Removing pleasant stimulus to deter behaviors."

APPENDIX D. VIDEO INTERPRETATIONS CODEBOOK

Table D.1
Video Interpretations

	State Being Expressed by Horse in Video		
Video	Fear	Stress	Reactivity
1 w/o HR	No	No	Yes
1 with HR	No	Yes	Yes
2 w/o HR	No	No	No
2 with HR	No	No	No
3 w/o HR	No	No	No
3 with HR	No	Yes	No
4 w/o HR	No	No	No
4 with HR	No	Yes	No
5 w/o HR	Yes	Yes	Yes
5 with HR	Yes	Yes	Yes

*Correct answers for each horse-human interaction video were identified using three observers experienced in animal behaviors associated with fear, stress, and reactivity.
*Scores of 0-2 were determined based on which state(s) students selected were being expressed by the horse in each video.
*Scoring Scale: 0 – Incorrect/Incomplete, 1 – Partially Correct, 2 – Completely Correct

Table D.2
Video Descriptions

Video	Description
1	Horse turned loose in a 60-ft diameter round pen reacts to a fog machine stimulus by facing the machine and lowering its head into the fog; heavy inhalation and breathing of the fog is evident. Average HR = 171 bpm.
2	A handler walks a haltered horse on a lead in a pattern in an open, paved area; horse is asked to walk forward and backwards, and turn directions. Average HR = 59 bpm.
3	Horse standing on an activated vibrating plate (EquiVibe) in a 12x12 stall; lead tied to the stall bars to prevent the horse from stepping off the plate. Average HR = 73 bpm.
4	A handler walks a horse haltered and on a lead to a pasture, opens the gate, and releases the horse. Average HR = 127 bpm.
5	Horse turned loose in a 60-ft diameter round pen trots back and forth at the pen gate, tossing its head. Average HR = 116 bpm.

APPENDIX E. CROSS-TABULATIONS OF UNDERGRADUATE STUDENTS' ABILITY TO CORRECTLY DEFINE AND IDENTIFY FEAR, STRESS, REACTIVITY, AND LEARNING THEORY PRINCIPLES

Table E.1

Percentage of students' correct definitions of fear, stress or reactivity based on age (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Age (years)	Fear			Stress			Reactivity		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
18 to 25	37% 15	60% 24	3% 1	40% 16	57% 23	3% 1	75% 30	25% 10	0% 0

*n too small for valid chi-square analysis. All students were 18 to 25 years of age.

Table E.2

Percentage of students' correct definitions of learning theory principles based on age (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Age (Years)	Positive Reinforcement			Negative Reinforcement			Positive Punishment			Negative Punishment		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
18 to 25	30% 11	57% 21	14% 5	73% 27	11% 4	16% 6	46% 17	51% 19	3% 1	46% 17	49% 18	5% 2

*n was too small for valid chi-square analysis based on age comparisons. All students were 18 to 25 years of age.

Table E.3

Percentage of students' correct understanding of heart rate based on age (row % for understanding HR and n). Yes represents their ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Age (Years)	Heart Rate	
	Yes	No
18 to 25	84% 31	16% 6

*n too small for valid chi-square analysis based on age. All students were 18 to 25 years of age.

Table E.4

Percentage of students' correct definitions of fear, stress or reactivity based on gender (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Gender	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
Male	50% 1	50% 1	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0	0% 0
Female	37% 14	61% 23	3% 1	37% 14	61% 23	3% 1	74% 28	26% 10	0% 0

*There were no differences between students' gender and ability to define fear (X^2 (2, N = 40) = 0.17, p = 0.92), stress (X^2 (2, N = 40) = 3.16, p = 0.21), or reactivity (X^2 (1, N = 40) = 0.70, p = 0.40).

Table E.5

Percentage of students' correct definitions of learning theory principles based on gender (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Gender	Positive Reinforcement			Negative Reinforcement			Positive Punishment			Negative Punishment		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Male	0% 0	100% 2	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0	0% 0	50% 1	50 % 1	0% 0
Female	31% 11	54% 19	14% 5	71% 25	11% 4	17% 6	43% 15	54% 19	3% 1	46% 16	495 17	6% 2

*There were no statistically significant differences between students' gender and ability to define positive reinforcement (X^2 (2, N = 37) = 1.61, p = 0.45), negative reinforcement (X^2 (2, N = 37) = 0.78, p = 0.68), positive punishment (X^2 (2, N = 37) = 2.49, p = 0.29), or negative punishment (X^2 (2, N = 37) = 0.12, p = 0.94).

Table E.6

Percentage of students' correct understanding of heart rate based on gender (row % for understanding HR and n). Yes represents ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Gender	Heart Rate	
	Yes	**No**
Male	50% 1	50% 1
Female	86% 30	14% 5

*There were no differences between students' gender for understanding heart rate (X^2 (1, N = 37) = 1.78, p = 0.18).

Table E.7

Percentage of students' correct definitions of fear, stress or reactivity based on race (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Race	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
White	41% 14	56% 19	3% 1	35% 12	62% 21	3% 1	74% 25	26% 9	0% 0
Black	0% 0	100% 2	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0	0% 0
Hispanic	33% 1	67% 2	0% 0	33% 1	67% 2	0% 0	100% 3	0% 0	0% 0
Prefer not to Say	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	0% 0	100% 1	0% 0

*There were no differences between students' race and ability to define fear (X^2 (6, N = 40) = 2.36, p = 0.88), stress X^2 (6, N = 40) = 4.97, p = 0.55), or reactivity X^2 (3, N = 40) = 4.71, p = 0.20).

Table E.8

Percentage of students' correct definitions of learning theory principles based on race (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Race	Positive Reinforcement			Negative Reinforcement			Positive Punishment			Negative Punishment		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
White	29% 9	58% 18	13% 4	74% 23	10% 3	16% 5	52% 16	45% 14	3% 1	48% 15	45% 14	6% 2
Black	50% 1	50% 1	0% 0	50% 1	50% 1	0% 0	0% 0	100% 2	0% 0	50% 1	50% 1	0% 0
Hispanic	33% 1	33% 1	33% 1	67% 2	0% 0	33% 1	0% 0	100% 3	0% 0	0% 0	100% 3	0% 0
Prefer not to Say	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0

*There were no differences between students' race for positive reinforcement (X^2 (6, N = 37) = 2.52, p = 0.87), negative reinforcement (X^2 (6, N = 37) = 4.61, p = 0.60), positive punishment (X^2 (6, N = 37) = 6.39, p = 0.38), or negative punishment (X^2 (6, N = 37) = 4.64, p = 0.59).

Table E.9

Percentage of students' correct understanding of horse heart rate based on students' race (row % for understanding HR and n). Yes represents their ability to correctly understand resting heart rate, No represents their inability to correctly understand resting heart rate.

Race	**Heart Rate**	
	Yes	**No**
White	81% 25	19% 6
Black	100% 2	0% 0
Hispanic	100% 3	0% 0
Prefer not to Say	100% 1	0% 0

*There were no differences between students' race for understanding heart rate (X^2 (3, N = 37) = 1.39, p = 0.71).

Table E.10

Percentage of students' correct definitions of fear, stress or reactivity states based on if they currently owned horses (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Currently Owned Horses	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	29% 4	64% 9	7% 1	21% 3	64% 9	14% 2	57% 8	43% 6	0% 0
No	44% 14	53% 17	3% 1	44% 14	56% 18	0% 0	78% 25	22% 7	0% 0

*There were no differences between students if they did or did not currently own horses for fear (X^2 (2, N = 46) = 1.15, p = 0.56) or stress (X^2 (2, N = 46) = 5.99, p = 0.05), or reactivity (X^2 (1, N = 46) = 2.11, p = 0.15).

Table E.11

Percent of students' correct definitions of learning theory principles based on if they currently owned horses (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Currently Owned Horses	**Positive Reinforcement**			**Negative Reinforcement**			**Positive Punishment**			**Negative Punishment**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	36% 4	54% 6	9% 1	73% 19	9% 1	18% 2	45% 5	55% 6	0% 0	45% 5	55% 6	0% 0
No	27% 7	58% 15	15% 4	73% 19	12% 3	15% 4	46% 12	50% 13	4% 1	46% 12	46% 12	8% 2

*There were no differences between students if they did or did not currently own horses for positive reinforcement (X^2 (2, N = 37) = 0.472, p = 0.79), negative reinforcement (X^2 (2, N = 37) = 0.08, p = 0.96), positive punishment (X^2 (2, N = 37) = 0.455, p = 0.80), or negative punishment (X^2 (2, N = 37) = 0.959, p = 0.62).

Table E.12

Percentage of students' correct understanding of heart rate based on if they currently owned horses (row % for understanding HR and n). Yes represents their ability to correctly understand resting heart rate, No represents their inability to correctly understand resting heart rate.

Currently Owned Horses	Heart Rate	
	Yes	No
Yes	91% 10	9% 1
No	81% 21	19% 5

*There were no differences between if students did or did not currently own horses for understanding heart rate (X^2 (1, N = 37) = 0.585, p = 0.444).

Table E.13

Percentage of students' correct definitions of fear, stress or reactivity states based on the residence of their currently owned horses (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Residence	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
Boarding Facility	100% 2	0% 0	0% 0	0% 0	100% 2	0% 0	50% 1	50% 1	0% 0
Home	33% 2	67% 4	0% 0	33% 2	50% 3	17% 1	83% 5	17% 1	0% 0
Other	0% 0	83% 5	17% 1	17% 1	67% 4	17% 1	33% 2	67% 4	0% 0

*There were no differences between the residence of students' currently owned horses for fear (X^2 (4, N = 14) = 8.30, p = 0.08), stress (X^2 (4, N = 14) = 1.81, p = 0.77), or reactivity (X^2 (2, N = 14) = 3.11, p = 0.21).

Table E.14

Percentage of students' correct definitions of learning theory principles based on the residence of their currently owned horses (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Residence	**Positive Reinforcement**			**Negative Reinforcement**			**Positive Punishment**			**Negative Punishment**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Boarding	0% 0	50% 1	50% 1	50% 1	0% 0	50% 1	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0
Home	40% 2	60% 3	0% 0	100% 5	0% 0	0% 0	60% 3	40% 2	0% 0	60% 3	40% 2	0% 0
Other	50% 2	50% 2	0% 0	50% 2	25% 1	25% 1	50% 2	50% 2	0% 0	50% 2	50% 2	0% 0

*There were no differences between the residence of students' currently owned horses for positive reinforcement (X^2 (4, N = 11) = 5.50, p = 0.24), negative reinforcement (X^2 (4, N = 11) = 4.81, p = 0.31), positive punishment (X^2 (2, N = 11) = 2.13, p = 0.35), or negative punishment (X^2 (2, N = 11) = 2.13, p = 0.35).

Table E.15

Percentage of students' correct understanding of heart rate based on the residence of their currently owned horses (row % for understanding HR and n). Yes represents their ability to correctly understand resting heart rate, No represents their inability to correctly understand resting heart rate.

Residence	**Heart Rate**	
	Yes	**No**
Boarding	100% 2	0% 0
Home	100% 5	0% 0
Other	75% 3	25% 1

*There were no differences between the residence of students' currently owned horses for understanding heart rate (X^2 (2, N = 11) = 1.93, p = 0.382).

Table E.16

Percentage of students' correct definitions of fear, stress or reactivity states based on if they ever owned horses (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Ever Owned Horses	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	39% 7	56% 10	6% 1	22% 4	67% 12	11% 2	56% 10	44% 8	0% 0
No	37% 10	59% 16	4% 1	44% 12	56% 15	0% 0	81% 22	19% 5	0% 0

*There were no differences between if students ever owned horses for fear (X^2 (4, N = 46) = 1.71, p = 0.79), stress (X^2 (4, N = 46) = 6.48, p = 0.17), or reactivity (X^2 (2, N = 46) = 3.98, p = 0.14).

Table E.17

Percentage of students' correct definitions of learning theory principles based on if they ever owned horses (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Ever Owned Horses	Positive Reinforcement			Negative Reinforcement			Positive Punishment			Negative Punishment		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Yes	29% 4	64% 9	7% 1	79% 11	7% 1	14% 2	50% 7	50% 7	0% 0	50% 7	50% 7	0% 0
No	27% 6	55% 12	18% 4	68% 15	14% 3	18% 4	41% 9	55% 12	5% 1	41% 9	50% 11	9% 2

*There were no differences between if students ever owned horses for positive reinforcement (X^2 (4, N = 37) = 3.35, p = 0.50), negative reinforcement (X^2 (4, N = 37) = 0.92, p = 0.92), positive punishment (X^2 (4, N = 37) = 2.05, p = 0.73), or negative punishment (X^2 (4, N = 37) = 2.67, p = 0.61).

Table E.18

Percentage of students' correct understanding of heart rate based on if they ever owned horses (row % for understanding HR and n). Yes represents their ability to correctly understand resting heart rate, No represents their inability to correctly understand resting heart rate.

Ever Owned Horses	Heart Rate	
	Yes	**No**
Yes	86% 12	14% 2
No	82% 18	18% 4

*There were no differences between if they ever owned horses for understanding heart rate (X^2 (2, N = 37) = 0.29, p = 0.86).

Table E.19

Percentage of students' correct definitions of fear, stress or reactivity states based on time spent with currently owned horses (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Amount of Time Spent	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
Daily	50% 1	50% 1	0% 0	0% 0	100% 2	0% 0	50% 1	50% 1	0% 0
2 to 3 times per week	29% 2	57% 4	14% 1	14% 1	57% 4	29% 2	71% 5	29% 2	0% 0
2 to 3 times per month	33% 1	67% 2	0% 0	33% 1	67% 2	0% 0	33% 1	67% 2	0% 0
Once a month	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0
Few times per year	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0

*There were no differences between time spent with currently owned horses for fear (X^2 (8, N = 14) = 2.44, p = 0.97), stress (X^2 (8, N = 14) = 7.18, p = 0.52), or reactivity (X^2 (4, N = 14) = 3.40, p = 0.49).

Table E.20

Percentage of students' correct definitions of learning theory principles based on time spent with currently owned horses (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Amount of Time Spent	**Positive Reinforcement**			**Negative Reinforcement**			**Positive Punishment**			**Negative Punishment**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Daily	50% 1	0% 0	50% 1	100% 2	0% 0	0% 0	50% 1	50% 1	0% 0	50% 1	50% 1	0% 0
2 to 3 times per week	40% 2	60% 3	0% 0	60% 3	20% 1	20% 1	60% 3	40% 2	0% 0	80% 4	20% 1	0% 0
2 to 3 times per month	50% 1	50% 1	0% 0	100% 2	0% 0	0% 0	50% 1	50% 1	0% 0	0% 0	100% 2	0% 0
Once a month	0% 0	100% 1	0% 0	0% 0	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0
Few times per year	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0

*There were no differences between time spent with currently owned horses for positive reinforcement (X^2 (8, N = 11) = 7.33, p = 0.50), negative reinforcement (X^2 (8, N = 11) = 7.15, p = 0.52), positive punishment (X^2 (4, N = 11) = 2.13, p = 0.71), or negative punishment (X^2 (4, N = 11) = 5.76, p = 0.22).

Table E.21

Percentage of students' correct understanding of heart rate based on time spent with currently owned horses (row % for understanding HR and n). Yes represents their ability to correctly understand resting heart rate, No represents their inability to correctly understand resting heart rate.

Amount of Time Spent	Heart Rate	
	Yes	No
Daily	100% 2	0% 0
2 to 3 times per week	80% 4	20% 1
2 to 3 times per month	100% 2	0% 0
Once a month	100% 1	0% 0
Few times per year	100% 1	0% 0

*There were no differences between time spent with currently owned horses for understanding heart rate (X^2 (4, N = 11) = 1.32, p = 0.86).

Table E.22

Percentage of students’ correct definitions of fear, stress or reactivity states based on time spent with unowned horses (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Amount of Time Spent	**Fear**			**Stress**			**Reactivity**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Not at all	35% 6	65% 11	0% 0	41% 7	59% 10	0% 0	76% 13	24% 4	0% 0
Once per week	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0
2 to 3 times per week	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0
2 to 3 times a month	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0
Few times per year	50% 6	42% 5	8% 1	42% 5	58% 7	0% 0	75% 9	25% 3	0% 0

*There were no differences between time spent with unowned horses for fear (X^2 (8, N = 32) = 6.14, p = 0.63), stress (X^2 (4, N = 32) = 3.42, p = 0.49), or reactivity (X^2 (4, N = 32) = 0.94, p = 0.92).

Table E.23

Percentage of students' correct definitions of learning theory principles based on time spent with unowned horses (row % within each learning theory principle and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Amount of Time Spent	**Positive Reinforcement**			**Negative Reinforcement**			**Positive Punishment**			**Negative Punishment**		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
Not at all	20% 3	60% 9	20% 3	67% 10	20% 3	13% 2	33% 5	60% 9	7% 1	40% 6	53% 8	7% 1
Once per week	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0
2 to 3 times per week	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0
2 to 3 times a month	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0
Few times per year	25% 2	63% 5	12% 1	75% 6	0% 0	25% 2	63% 5	37% 3	0% 0	50% 4	37% 3	13% 1

*There were no differences between time spent with unowned horses for positive reinforcement (X^2 (8, N = 26) = 6.74, p = 0.57), negative reinforcement (X^2 (8, N = 26) = 3.57, p = 0.89), positive punishment (X^2 (8, N = 26) = 5.49, p = 0.70), or negative punishment (X^2 (8, N = 26) = 4.21, p = 0.84).

Table E.24

Percentage of students' correct understanding of heart rate based on time spent with unowned horses (row % for understanding HR and n). Yes represents their ability to correctly understand resting heart rate, No represents their inability to correctly understand resting heart rate.

Amount of Time Spent	Heart Rate	
	Yes	**No**
Not at all	87% 13	13% 2
Once per week	100% 1	0% 0
2 to 3 times per week	100% 1	0% 0
2 to 3 times a month	100% 1	0% 0
Few times per year	63% 5	37% 3

*There were no differences between time spent with unowned horses for understanding heart rate (X^2 (4, N = 26) = 2.77, p = 0.60).

APPENDIX F. CROSS-TABULATIONS OF THE 2018 ISES CONFERENCE PARTICIPANTS' ABILITY TO CORRECTLY DEFINE AND IDENTIFY FEAR, STRESS, AND REACTIVITY

Table F.1

Percentage of participants' correct definitions of fear, stress or reactivity states based on participants' age (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Age (years)	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
18 to 25	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0	50% 1	50% 1	0% 0
26 to 35	0% 0	80% 4	20% 1	20% 1	40% 2	40% 2	80% 4	20% 1	0% 0
36 to 45	0% 0	100% 3	0% 0	0% 0	33% 1	67% 2	33% 1	675 2	0% 0
46 to 55	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0
56 to 65	50% 1	50% 1	0% 0	50% 1	50% 1	0% 0	50% 1	50% 1	0% 0
Older than 65	0% 0	100% 1	0% 0	0% 0	0% 0	100% 1	100% 1	0% 0	0% 0

*There were no differences between participants' age for fear (X^2 (10, N = 14) = 8.28, p = 0.60), stress (X^2 (10, N = 14) = 8.94, p = 0.54), or reactivity (X^2 (5, N = 14) = 3.93, p = 0.56).

Table F.2

Percentage of participants' correct understanding of heart rate based on participants' age (row % for understanding HR and n). Yes represents their ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Age (Years)	Heart Rate	
	Yes	No
18 to 25	100% 2	0% 0
26 to 35	100% 5	0% 0
36 to 45	100% 3	0% 0
46 to 55	100% 1	0% 0
56 to 65	100% 2	0% 0
Older than 65	100% 1	0% 0

*There were no differences between participants' age for understanding heart rate (X^2 (5, N = 14) = 6.87, p = 0.23).

Table F.3

Percentage of participants' correct definitions of fear, stress or reactivity states based on participants' gender (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Gender	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
Female	7% 1	85% 12	7% 1	14% 2	50% 7	36% 5	57% 8	43% 6	0% 0

*n too small for valid chi-square analysis. All participants were female.

Table F.4

Percentage of participants' correct understanding of heart rate based on participants' gender (row % for understanding HR and n). Yes represents their ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Gender	Heart Rate	
	Yes	No
Female	100% 14	0% 0

*n too small for valid chi-square analysis. All participants were female.

Table F.5

Percentage of participants' correct definitions of fear, stress or reactivity states based on participants' race (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Race	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
White	7% 1	86% 12	7% 1	14% 2	50% 7	36% 5	57% 8	43% 6	0% 0

*n too small for valid chi-square analysis. All participants were white.

Table F.6

Percentage of participants' correct understanding of heart rate based on participants' race (row % for understanding HR and n). Yes represents their ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Race	Heart Rate	
	Yes	No
White	100% 14	0% 0

*n too small for valid chi-square analysis. All participants were white.

Table F.7

Percentage of participants' correct definitions of fear, stress or reactivity states based on if participants live in the United States (row % within each state and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Lived in the United States	Fear			Stress			Reactivity		
	0	1	2	0	1	2	0	1	2
Yes	25% 1	75% 3	0% 0	25% 1	25% 1	50% 2	50% 2	50% 2	0% 0
No	0% 0	90% 9	10% 1	10% 1	60% 6	30% 3	60% 6	40% 4	0% 0

*There were no differences between if participants lived in the United States for fear (X^2 (2, N = 14) = 2.98, p = 0.23), stress (X^2 (2, N = 14) = 1.47, p = 0.48), or reactivity (X^2 (1, N = 14) = 0.12, p = 0.73).

Table F.8

Percentage of participants' correct understanding of heart rate based on if participants lived in the United States (row % for understanding HR and n). Yes represents their ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Lived in the United States	Heart Rate	
	Yes	No
Yes	100% 4	0% 0
No	100% 10	0% 0

*There were no differences between participants who did or did not live in the United States for understanding heart rate (X^2 (1, N = 14) = 0.0.042, p = 0.84).

Table F.9

Percentage of participants' correct definitions of fear, stress or reactivity states based on participants' education level (row % within each State and n). A score of 0 represents a completely incorrect definition; 1 represents a partially correct definition, and 2 represents a correct definition.

Education Level	Fear			Stress			Reactivity		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
High School	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0	0% 0	100% 2	0% 0
BS	0% 0	100% 5	0% 0	0% 0	20% 1	80% 4	40% 2	60% 3	0% 0
MS	0% 0	100% 1	0% 0	0% 0	100% 1	0% 0	100% 1	0% 0	0% 0
PhD	25% 1	75% 3	0% 0	50% 2	25% 1	25% 1	75% 3	25% 1	0% 0
Other	0% 0	50% 1	50% 1	0% 0	100% 1	0% 0	100% 2	0% 0	0% 0

*There were no differences between participants' education level for fear (X^2 (8, N = 14) = 9.04, p = 0.34), stress (X^2 (8, N = 14) = 13.56, p = 0.09), or reactivity (X^2 (4, N = 14) = 6.04, p = 0.20).

Table F.10

Percentage of participants' correct understanding of heart rate based on participants' education level (row % for understanding HR and n). Yes represents their ability to correctly understand heart rate, No represents their inability to correctly understand heart rate.

Education Level	Heart Rate	
	Yes	No
High School	100% 2	0% 0
BS	100% 5	0% 0
MS	100% 1	0% 0
PhD	100% 4	0% 0
Other	100% 2	0% 0

*There were no differences between participants' education level for understanding heart rate (X^2 (4, N = 14) = 3.31, p = 0.51).

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