Positive Reinforcement Training for School Horses: Its Use as Enrichment and Its Effect on the Human-Horse Relationship

Emily Armentrout Sanders

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science
In
Applied Animal Behavior and Welfare
Agriculture and Life Sciences

Erica Feuerbacher, PhD (Chair)
Robin Foster, PhD
Leonie Jacobs, PhD

August 8, 2023

Positive Reinforcement Training as Enrichment for School Horses

Emily Armentrout Sanders

ABSTRACT

The use of positive reinforcement training has been shown to improve the human-horse relationships, but the equestrian community has been slow to replace traditional techniques with positive reinforcement training. Horse owners and trainers might be willing to add positive reinforcement training sessions to their routine, even if they are unwilling to change their primary training methods. For this study, we examined whether the addition of positive reinforcement training, in an otherwise unchanged routine, would have behavioral effects on a group of school horses. The implementation of positive reinforcement sessions increased contact seeking behavior (both proximity to and physical touch) with the trainer, but not a stranger. Horses showed similar perception in value of positive reinforcement sessions and food-toy enrichment sessions through increased anticipatory behavior, measured by behavior transition rate, compared to a control group. Providing school horses access to regular food-toy sessions is a good way to provide enrichment, but it does not increase the bond between the horse and trainer like regular positive reinforcement training sessions.

ACKNOWLEDGEMENTS

My husband. Thank you for your unwavering support throughout graduate school and this thesis project. It would have been impossible without you.

Dr. Robin Foster, Dr. Erica Feuerbacher, and Dr. Leonie Jacobs. Thank you for serving as my committee. Your ideas, knowledge, and insights pushed me to be a better scientist and writer.

Elise Lestz, Dawn Smith, and Keira Smith. Thank you for being enthusiastic research assistants.

Bekah Rowan. Thank you for your help in coding the behavioral observation videos.

River Chase Farm and horse owners. Thank you for volunteering the use of your school horses and facilities for this project.

Lastly, thank you to every school horse I have had the pleasure of riding, especially my dear **Jeffrey.** You all inspired my passion for improving the school horse experience.

TABLE OF CONTENTS

INTRODUCTION

The use of positive reinforcement training, a form of associative learning in which the horse performs a response and is then presented with a type of primary or secondary reinforcer, has been shown to improve the human-animal relationship in horses in addition to showing benefits such as faster learning, less distress, increased participation, and better welfare (Cooper, 1998; Larssen & Roth, 2022; Lundberg et al., 2020; Sankey et al., 2010a; Sankey et al., 2010b; Hendriksen et al., 2011; Innes & McBride, 2008; Briefer Freymond et al., 2014). Despite the promising science on positive reinforcement training, the equestrian community has been slow to replace traditional techniques with positive reinforcement training (Waran et al., 2006 p. 179).

Horse owners and trainers might be willing to add positive reinforcement training sessions to their routine, even if they are unwilling to change their primary training methods. For this study, we examined whether the addition of positive reinforcement training in an otherwise unchanged routine would have behavioral effects on a group of horses used in a lesson program, commonly referred to as school horses. Of the many potential facets that could be affected by the addition of positive reinforcement training, this study aimed to look at changes to human-animal relationship with both the trainer and strangers and the perceived value of the training sessions to the horse.

Negative and positive reinforcement training in equines

Xenophon of Athens, largely credited as the father of traditional horsemanship, wrote *On Horsemanship* over 2,000 years ago. In it, he repeatedly relies on the principles of negative reinforcement to describe proper horse training. Negative reinforcement, which involves first applying and then removing of an aversive stimulus (in horses, generally pressure) following the performance of the correct response by the horse, has long been considered the norm and has a proven history of effectiveness in equine training (McLean, 2005). However, the use of negative reinforcement has drawn criticism based on the culture of aversive control of behavior. In his book, *A Matter of Consequences,* B. F. Skinner noted the exclusively aversive handling of horses and reluctance of individuals handling horses to "spoil" them, citing "There is definitely something wrong with the way horses are handled", and "There seems to be a belief that you must *not* be nice to a horse" (1983, p. 82, p.83).

Negative reinforcement has been proven effective in training horses, but regarding the criticism of the use of aversive stimuli, it is important to remember that the range of severity of aversive stimuli can make one negative reinforcement training regimen radically different from another (Fenner et al., 2019; Warren-Smith et al., 2005). Training with negative reinforcement in horses can range from light pressure from the hand or a simple bit to the use of more severe tools such as saw-chain bits, tie-downs, and spurs (McLean, 2005; McGreevy, 2007). Negative reinforcement training can cause unnecessary stress and create conflict behaviors if there are inconsistent or opposing signals or if there is continued use of heavy pressure or tools (McLean, 2005).

Most horse trainers rely on the basic principles of negative reinforcement with different nomenclature or implementation, but the underlying learning rules are rarely discussed or understood (Waran & Casey, 2005). Many riders and trainers believe horses to have an inherent understanding of equitation principles or that certain body movements will automatically elicit a certain response from a horse, but it has been shown that only 12% of naïve horses move forward off of leg pressure, the most basic of ridden commands (McLean, 2005). It is therefore unlikely that horses have an innate understanding of more complicated maneuvers in equitation, and the simplest answer is that horses learn these maneuvers through trial and error, according to the principles of learning theory. In a survey of equestrian coaches in Australia, only 2.8% of respondents were able to correctly explain negative reinforcement's use (Warren-Smith & McGreevy, 2008). Similar results were found in a more recent survey in which only 23% of adults in the horse industry were able to correctly identify negative reinforcement, while 42% of adults were able to identify positive reinforcement (Wires et al., 2022). These surveys assessed the individuals' written understanding of behavior science terms rather than their implementation in practice, so it is possible that their techniques follow learning theory but that they use different words to describe their procedures.

Scientists have studied learning principles and positive reinforcement training with horses dating back to the 1930s, although the terminology used and understanding of underlying mechanisms was not what it is today (Gardner, 1933). Although the adoption of positive reinforcement techniques by the world of horse training has lagged behind other species, it has been used successfully for training horses on a variety of commonly taught behaviors: trailer loading, general handling, including feet handling, and problem behaviors such as pawing, biting, and chewing (McLean & Christensen, 2017; Ferguson & Rosales-Ruiz, 2001; Hendriksen et al., 2011; Slater & Dymond, 2011; Dai et al., 2019; Fox & Belding 2015; Fox et al., 2012). Some owners and trainers are reluctant to utilize food for positive reinforcement techniques due to a misconception that it promotes biting and creates a "mugging" or nipping response in horses (Waran et el., 2006 p. 173). However, no association has been found between clicker training and oral investigative behaviors (Hockenhull & Creighton, 2010).

Positive reinforcement training shows advantages in performance and willingness to participate in training sessions (Hendriksen et al., 2011; Innes & McBride, 2008; Briefer Freymond et al., 2014). This is important because increased performance is something that trainers are interested in, and it might convince them to switch their training style. For example, in a study with horses with a history of trailer-loading problems, horses trained with positive reinforcement learned to load faster and with less stress than those trained with negative reinforcement (Hendriksen et al., 2011). In this case, positive reinforcement both decreased the amount of time a trainer needed to spend training and improved the experience for the horse.

Two other studies have shown benefits of positive reinforcement over negative reinforcement in horses. Innes and McBride (2008) found that in a population of rescued ponies, those trained with positive reinforcement were more motivated to participate and showed more exploratory behavior in novel environments. Briefer Freymond et al. (2014) found that positively reinforced horses showed lower body tension and more motivation than those trained with negative reinforcement. It seems clear that positive reinforcement increases motivation and creates a less stressful experience for horses.

Negative reinforcement training creates task-related stress and an increased emotional state, which can impact learning (Sankey et al., 2010b; Valenchon et al., 2017). Horses showed reduced performance in a learning test trained with negative reinforcement in a novel environment compared to a learning test trained with positive reinforcement, measured by criterion reached in a shaping procedure (Christensen et al., 2012). However, these same horses showed no difference in performance between the negative and positive reinforcement tests in the home environment. Valenchon et al. (2017) also found that in the absence of environmental stressors, horses trained with positive and those trained with negative reinforcement seemed to learn equivalently. When the horses were in the presence of environmental stressors, however, those trained with negative reinforcement showed a smaller learning deficit than those trained with positive reinforcement. This indicates that horses trained with negative reinforcement might be less susceptible to environmental stressors. This study also found that personality interacted with performance for both training styles: fearfulness improved performance in negative reinforcement contingencies and decreased performance in positive reinforcement contingencies. Given the conflicting results on learning performance, more research is needed to understand how the stress created by negative reinforcement translates to learning performance.

Adding positive reinforcement sessions into an otherwise unchanged training regimen may create a generalized change in the horse's willingness to participate in all training sessions, but this has not been systematically studied in horses. There is some support of positive reinforcement training creating generalized behavioral effects in other species. For example, in a population of zoo-housed chimpanzees, adding positive reinforcement training sessions worked in an enrichment capacity, but it also affected the chimps' behavior outside of their training sessions, with the chimps showing generalized decreased stress-related behaviors and increased affiliative behaviors (Pomerantz & Terkel, 2009).

The effect of training style on equine welfare

Horses experience welfare issues related to nutrition, management, behavior, training, riding, and transport (Minero & Canali, 2009). Welfare assessments vary widely; they can be subjective or objective, assess individuals or populations, assess the animal or the resources provided to the animal, and vary in the time frame covered (Hockenhull & Whay, 2014). In the past, welfare assessments have focused on the negative effects and welfare compromise, but in recent years models such as the Five Domains model have shifted to promoting positive welfare states (Mellor & Beausoleil, 2015). Equine welfare has been assessed through a variety of animal-based measures: the presence of stereotypic behaviors, time budget analyses, health and physiological responses, behavioral repertoire, cognitive bias, and reaction to humans (Arena et al., 2021; Auer et al., 2021; Lesimple, 2020).

When it comes to how training impacts welfare, the use of negative reinforcement training can decrease welfare. Aversive-based training methods, negative reinforcement specifically, adversely affect the welfare of companion dogs as shown by increased stress-related behaviors and increased tension, both during and outside of training (Vieira de Castro et al., 2020). This likely extends to horses, as negative reinforcement training has been associated with negative emotions (Hausberger et al., 2019; Briefer Freymond et al., 2014). However, when comparing the two reinforcement strategies together, it seems that positive reinforcement training can actively improve horses' welfare rather than negative reinforcement training compromising welfare in horses (Innes & McBride, 2008).

Different riding disciplines have been shown to have large effects on horses' welfare. One study showed that horses had significant differences in the prevalence and types of stereotypies based on the type of riding they were used for, despite being housed identically with just one hour of ridden work daily (Hausberger et al., 2009). Additionally, horses who are ridden by beginner riders may be at increased risk of compromised welfare due to lack of knowledge and experience with the equipment, such as bits, nosebands, spurs, and whips, which can quickly become increasingly aversive in unskilled hands (Holmes & Brown, 2022). School horses are subjected to a variety of riders at different skill levels, and their welfare is especially important to monitor given the increased risk of interacting with humans with little knowledge of horses' needs and the training tools used. Interestingly, horses that were groomed and ridden by more than one person showed fewer behavioral problems than those ridden by a single rider (Normando et al., 2002). This is possibly a product of selection bias – typically school horses are selected for their ability to be safely ridden by a large variety of humans (McKenzie et al., 2021). A sample of school horses was chosen specifically for this study, as they have much to gain from added enrichment to their daily routine.

Human-horse relationship

Horses are perceptive of humans and have a high level of discrimination of individual interactions, which can build into lasting associations with certain people based on how they have interacted with them in the past (Fureix et al., 2009; Sankey et al., 2010a). They can discriminate between identical twins (Stone, 2010); and they can discriminate between passive and active humans, responding to them differently depending on the context, and generalize their perception based on repeated interactions (Sankey et al., 2010a). Negative prior experiences have a bigger impact than positive ones, an important finding as it relates to human perception and training style (Fureix et al., 2009).

The way humans present themselves, especially audibly, can affect how horses perceive them. Studies show that horses discriminate between different human vocalizations, freezing more with negative sounds (Smith et al., 2018). Studies have also shown that horses are sensitive to pet-directed speech, showing more affiliative behaviors and better task completion than those that are spoken to with adult-directed speech (Lansade et al., 2021). In another study, though, no differences were found in task completion, calmness, or heart rate when using soothing versus harsh vocal cues. The tasks in this study were trained through negative reinforcement, so it is possible that the training style overshadowed any differences in the use of differing vocal cues (Heleski et al., 2015).

Despite their ability to discriminate individual humans, repeated interactions with the same human or similar training styles can lead to generalization in horses' perceptions of humans. The daily caretaker may be an important factor in how horses perceive humans, and one study found it to be a factor in how horses react to the sudden appearance of a human at their stall door (Hausberger & Muller, 2002). Unfortunately, no information about the handling methods of each caretaker was reported in this study, but nonetheless the horses showed significant differences, ranging from a friendly approach to a threatening approach. Breed was found to be a factor in reaction as well, with French saddlebreds showing more friendly behavior than Angloarabs and Thoroughbreds showing more indifferent responses (no change in behavior with the appearance of the human) than Angloarabs or French saddlebreds. Another study tested yearlings with a motionless human and suggested that their daily caretaker interactions with humans influence their perception of humans (Hausberger et al., 2004, as cited in Hausberger et al. 2008). These studies point to how important the role of caretaker is in the overall training and welfare of horses.

The Motionless Human Test

Our study utilized a common method of testing human-horse approach behavior: the Motionless Human Test (MHT), in which horses are turned loose in an area with a motionless human and the latency to approach or time spent in proximity to or touching the person is recorded (Waiblinger et al., 2006). MHTs can be designed such that different people serve as the motionless human, depending on the focus of the study: handlers, owners, trainers, strangers, etc. For this study, we tested both the trainer and a stranger. We anticipated that the horses' perception of the trainer would change after several weeks of positive reinforcement training, as the use of food in positive reinforcement training creates a positive association with humans (Hausberger et al., 2008). We included an MHT with a stranger to see if this positive association which the trainer would create a generalized effect with strangers.

Several studies have looked at how positive reinforcement training affects the outcomes of MHTs with both familiar and unfamiliar humans (Sankey et al., 2010a; Sankey et al., 2010b; Larssen & Roth, 2022). All studies found increased contact seeking behavior with a stranger following the implementation of positive reinforcement training. Both studies that conducted an MHT with the trainer also found increased contact seeking behavior (Sankey et al., 2010a; Sankey et al., 2010b).

Sankey et al. (2010b) found that ponies trained with positive reinforcement increased contact seeking behavior with the experimenter (approaching the human both quicker and for longer) after five days of training sessions that lasted for 1 to 3 minutes. They also found that the ponies also showed increased contact seeking behavior (again, both approaching the human quicker and spending more time with) in a test five months later with an unknown person. This could suggest generalization of the positive association with humans in this specific context (the MHT) or might suggest a broader generalization to all humans (Sankey et al., 2010b). This study is particularly interesting because of the drastic results after just five days of training that seemed to persist for months.

Sankey et al. (2010a) also found that compared to horses in the control group, yearlings trained with positive reinforcement spent much more time in proximity of the experimenter after completing a positive reinforcement training regimen. In this study, the training regimen was 5 minutes per day, 5 days per week until the 41-step program was completed (length was variable for each horse). The horses were tested pre-training regimen and again with the experimenter six months after the completion of the program. They were also tested with an unfamiliar human eight months after the completion of the program. They found that the horses trained with positive reinforcement had half the latency to approach and four times the amount of time spent in proximity with the human in both delayed tests – with the experimenter and an unfamiliar human – compared to the control group. The horses in this study had limited contact with any other humans during the time between the training regimen and the follow up tests six and eight months later, so it is possible that this explains why their results persisted so strongly. This limited experience with humans differs substantially from the school horses used in our study who interact with a variety of individuals daily.

Most recently, Larssen and Roth (2022) conducted a study examining horses that participated in a positive reinforcement training routine added to their current training regimen against a control group. The horses resided at different locations throughout southeast Sweden and the training program was designed by the researchers but performed by the owners with the horses. The positive reinforcement training program was nine-weeks long and consisted of four sessions each week for at least 5 minutes in each session. The training program focused on exercises related to targeting (nose touch, generalizing targeting to other objects, following a target, following a target over obstacles, stationary target). In this study, horses were tested in a MHT before and after the training regimen with the researcher, an unfamiliar human to the horses. The positive reinforcement training group horses showed an increase in physical touch with the unfamiliar human after they received the positive reinforcement training, compared both to their pre-training scores and the control horses' scores. There was no significant difference in their proximity scores after the training. An important limitation to note in this study was the repeated use of the same "novel" human, such that they might not be considered novel by the horses for the post-test (Larssen & Roth, 2022). This study did not test the horses in an MHT with the positive reinforcement trainer (in this case, their owner). The horses in this study had the most similar training experience to our design – the horses continued with their regular training routine with the addition of positive reinforcement training sessions.

It is important to proceed with caution when interpreting the results of studies using MHT, as the procedures are often not well-defined or are different from one another (Hausberger et al., 2008). What appear to be small changes in setup or implementation could be important variables that are affecting results. Recent studies have used MHTs to examine the effect of adding positive reinforcement training regiments to naïve horses' routines, but the horses' age, positive reinforcement training regimen, daily (outside of the experiment) training regimen, and MHT protocol have differed (Sankey et al., 2010a; Sankey et al., 2010b, Larssen & Roth, 2022). More duplicative studies on MHTs can help to narrow down which variables are contributing to any differences. For the present study, we duplicated the Larssen and Roth MHT protocol as much as possible and added a trainer test, like both Sankey et al. studies included (2010a; 2010b). We expanded on the stranger condition to include a second stranger, so the human was novel each time, a noted limitation in the Larssen and Roth study. The horses continued with their daily training and received positive reinforcement training as a supplement, like the horses in Larssen and Roth (2022). The training regimen in our study was shorter (four weeks rather than nine), but it was of a similar cadence and taught similar behaviors.

Enrichment in equines

Enrichment has long been studied in captive wild animals but is also of interest among pet owners, including horses. Environmental enrichment is particularly relevant to ridden horses, as they are often kept in housing conditions that compromise their well-being, such as individual stalls with few opportunities for voluntary exercise or social interactions (Lansade et al., 2014). When housed with an environmental enrichment program that included physical activity, sensory stimuli, and social contacts, horses showed improved welfare, better learning performance, and beneficial biological effects (changes to cortisol levels and gene expression) compared to a control group (Lansade et al., 2014). Different components have been studied individually to determine their enrichment effect, including novel objects, forage-based enrichment, food toys, and social interaction.

The addition of novel objects that are not food-based into horses' environments does not seem to have a strong enrichment effect, compared to edible items (Jørgensen et al., 2011; Bulens et al., 2015). These items might elicit item-directed behaviors, especially in individually stalled horses, but it could be attributed to boredom and does not increase desirable behaviors like foraging or decrease passive behaviors like standing (Jørgensen et al., 2011; Bulens et al., 2013). It seems that when horses are housed in appropriate conditions and receive sufficient forage, non-food based environmental enrichment toys are not needed or useful (Bulens, et al., 2015).

When access to different types or quantities of forage are provided beyond the standard feeding routine, forage can be considered a type of food-based enrichment. Horses fed a multiple forage diet show significantly more foraging behavior and less stereotypy compared to a single forage diet (Thorne et al., 2005; Goodwin et al., 2002). Forage-based enrichment is relatively inexpensive and simple to implement and can have a large impact on welfare, so it is an attractive option for providing enrichment for stabled horses (Goodwin et al., 2002).

Food toys have been studied mainly as enrichment tools to reduce the incidence of abnormal oral behaviors, such as crib-biting and wood-chewing, which are of concern to owners and caretakers (Stanley et al., 2015; Nichol, 1999). The Equiball, a popular equine-specific ball that releases food as horses move it around on the floor, has been found to extend foraging time, changing horses' time budgets to be more comparable to wild horses, and reduce stereotypy (Winskill et al., 1996; Henderson & Waran, 2001). However, horses' interactions with the ball were reinforcement-dependent, and the horses had little interest in interacting with the item unless it was filled with grain (Henderson & Waran, 2001). A tongue-activated liquid dispenser filled with corn syrup and a flavoring agent was not found to be effective at reducing stereotypic behavior, perhaps because it did not contain any source of fiber (Stanley et al., 2015). Similarly, in a presentation of rotating stall toys produced by Talisker Bay International Ltd. (Snak-a-Ball, Likit, Tongue Twister, and the Boredom Breaker), only the Tongue Twister was found to reduce oral stereotypy incidence, but only slightly (Whisher et al., 2011). The Likit, Tongue Twister, and Boredom Breaker included a sugar gelatin mixture while the Snak-a-Ball filled with pellets. It seems that food toys that provide access to a food source with fiber are the most effective enrichment options, at least when compared by their ability to reduce incidence of stereotypy.

Interactions with humans is a commonly studied enrichment intervention in dogs, however most studies on human-horse interactions have focused on the benefit to humans and little is known about how the interactions impact horses or whether horses can form attachment bonds the ways dogs can (Gunter et al., 2021; Kelly et al., 2021; Payne et al., 2016). Positive reinforcement training sessions offer an opportunity for social interactions with humans, additional food including sometimes novel foods or high value food that is fed infrequently, and the opportunity to express new behaviors. As zoos began incorporating positive reinforcement training in a variety of species for veterinary purposes, they quickly found secondary enrichment benefits: generalized stress reduction, better group cohesion and cooperation, reduced stereotypy, better and safer relationships with their keepers, and exploration of new behaviors (Kobert, 1998; Pomerantz & Terkel, 2009; Laule et al., 2003; Yamanashi & Hayashi, 2011; Hambrecht et al., 2021; Laule & Desmond, 1998). Although not explicitly studied in equines to the author's knowledge, it is likely that positive reinforcement training sessions can also act as enrichment for equines and might even improve upon food-toy enrichment options by providing a social component. For this study, we set out to see if that was true by comparing horses' anticipatory response to positive reinforcement training sessions to a food-toy enrichment session and a control group.

Anticipatory behaviors are behavioral responses that occur between a stimulus that acts as an announcement of an appetitive stimulus and the actual presentation of the appetitive stimulus, and the number of behavioral transitions is a commonly used measure of excitement for impending enrichment across species (van der Harst & Spruijt, 2007; Anderson et al., 2020). In domesticated horses specifically, number of behavioral transitions has been found to correlate with a physiological measure (heart rate) in the positive anticipation of a food reward (Peters et al., 2020). Anticipation in the horses has also been demonstrated through an increase in the duration and frequency of standing, locomotion, and arousal and investigation behaviors and a decrease in maintenance behaviors (Peters et al., 2012). To evaluate equine anticipatory behavior for this study, we measured behavioral transitions and created a modified version of the Peters et al. (2012) ethogram to measure behaviors in the categories of standing, locomotion, arousal and investigation, and maintenance categories for horses across the three conditions: food enrichment, positive reinforcement training, and a control group.

It is important to recognize that anticipation can have a positive or negative valence, which changes the interpretation of anticipatory responses (van der Harst et al., 2003). For events in which a high level of participation is elicited following an anticipatory response, anticipation can be interpreted as excitement, or as having a positive valence (Clegg et al., 2018). For this study, as both the FE and R+ interventions were designed to be rewarding, anticipatory behavior was assumed to be positive in valence.

Study Overview

The purpose of this study was to assess the effect of positive reinforcement training sessions on human-horse relationships and to compare the horses' perceived value of positive reinforcement training sessions to food toy enrichment sessions. Because positive reinforcement training provides an opportunity for horses to receive additional, varied, and high-value foods in addition to social interaction with a human, a comparison group that received a food enrichment device and no additional human interaction was used to understand any differences in simply providing additional food enrichment and the social and learning components of the training sessions. A standard control group was also used to compare any enrichment effects. Behavioral transitions and anticipatory behaviors were evaluated and compared across conditions. Human-animal relationship was evaluated through a pre- and post-intervention Motionless Human Test, with both the positive reinforcement trainer and a stranger. This allowed for evaluation of any generalization of the effects of the positive reinforcement training on the human animal relationship.

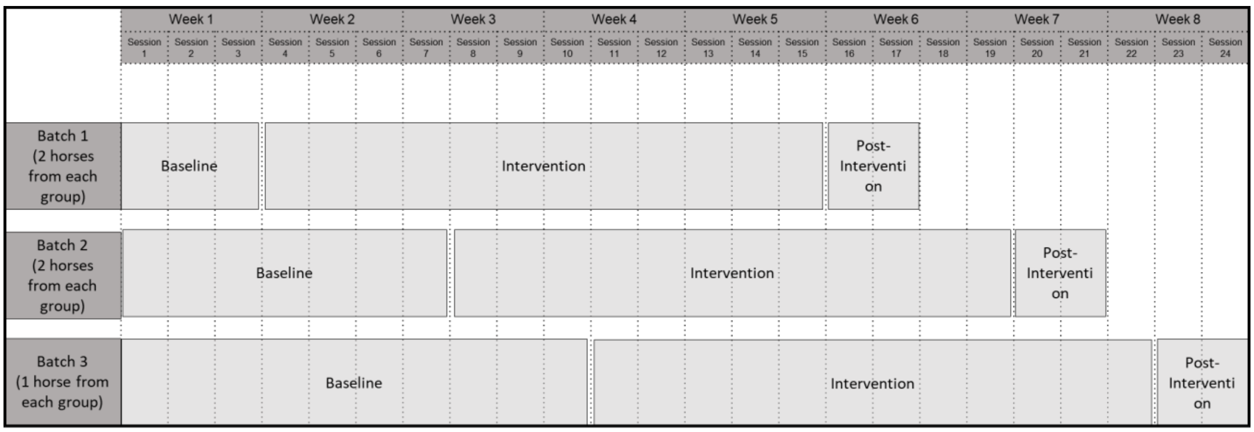
METHODS

General Overview

The design had three intervention conditions, with five horses in each group: a Food Enrichment (FE) group, a Positive Reinforcement Training (R+) group, and a Control (C) group. The study was a Multiple Baseline Design: all horses started Baseline sessions at the same time, but the five horses of each experimental group were dispersed across three batches. All the horses in one batch started intervention on the same day. The first batch included six horses (two from each experimental group), the second batch was also six horses (two from each experimental group), and the last batch included three horses (one from each experimental group) (see Figure 1).

Figure 1

Batch Setup



This design was chosen because of the small group size, to avoid putting the FE and R+ groups on extinction, and to account for the likely irreversible nature of positive associations with humans created by positive reinforcement training (Sankey et al. 2009). Horses participated in the study three days per week, with each testing day at least one and no more than three days apart. In addition to the baseline and intervention sessions, horses participated in an acclimation session, two Motionless Human Tests (MHTs), and a preference assessment. For a chart showing the experimental design including group assignments, batch assignments, and schedule see Appendix A.

Participants

Sixteen horses were evaluated for use in this project, with 15 selected as participants. All horses were boarded at the same facility where the experiment took place. There were no restrictions on breed, sex, size, or age. To be eligible for the study, horses had to be enrolled in at least three riding lessons per week with at least two different riders. Additionally, horses must have passed an acclimation phase which involved being released into the round pen where the research project would be occurring.

Equine participants included eight mares and seven geldings of varying breeds, ranging from 7 to an estimated 30 years old, and ranging in size from 12 to 17.3 hands. Information on participant demographics and lesson use can be found in Table 1. All participants continued participating in their regular riding lessons for the duration of the study, which were primarily negative reinforcement based. Over the course of the study, two horses (Cupid and Gigi) experienced health issues which did not impact their participation in the study but did lead to a lower number of weekly riding lessons for these subjects.

Table 1

Participant Information

Name	Breed	Sex	Age	Size	Average riding lessons per week	Average level of lesson
Barbie	Quarter Horse	Mare	14	15 hh	4	Flat Only
Buddy	Appendix	Gelding	19	16 hh	9	Beginner – Intermediate, Flat Only
Cupid	Quarter Horse	Gelding	Aged	14.2 hh	2	Beginner
Flint	Welsh pony	Gelding	25	13 hh	9	Learn to Ride – Low Level Jumping
Gabby	Quarter Horse Cross	Mare	12	14.1 hh	10	Beginner
Gigi	Pony cross	Mare	Aged	12 hh	2	Beginner – Intermediate

Lily	Welsh cross	Mare	13	12.2 hh	8	Intermediate – Advanced, Jumping
Max	Thoroughbred	Gelding	17	16 hh	8	Beginner – Intermediate, Jumping
Rosa	Thoroughbred	Mare	7	16.2 hh	9	Beginner – Intermediate, Jumping
Saint	Grade	Gelding	9	15.1 hh	8	Beginner, Flat Only
Scarlet	Thoroughbred	Mare	Aged	16 hh	7	Beginner – Intermediate
Sterling	Quarter Horse	Gelding	14	14.2 hh	8	Beginner – Intermediate, Jumping
Titan	Quarter horse	Gelding	9	16.2 hh	10	Beginner – Intermediate, Flat Only
Valeria	Selle Francais	Mare	14	17.3 hh	4	Flat Only
Wheezy	Arab / Morgan	Mare	14	14.3 hh	12	Intermediate, Jumping

Procedures

Pre-Intervention

Prior to beginning data collection in baseline conditions, the researcher worked with the owner to complete a temperament assessment for each horse. All horses also experienced an acclimation session, which was also used as a selection criterion. At the end of their baseline period but before their intervention conditions started, horses experienced a preference assessment and two MHTs.

Temperament Assessment

The researcher met with the owner of each horse prior to the start of the study and completed a commonly used equine temperament assessment for each horse (Momozawa et al., 2005). This assessment contained 20 Likert scale questions related to the horse's trainability, anxiety, and affability. Results from this assessment were used to assign horses to each group, so that equine temperament was balanced across conditions to control for any temperament effect.

Acclimation Session

Each horse experienced one acclimation session on the first day of the baseline phase, no more than 30 minutes prior to their first baseline session. The researcher released the horse into the empty round pen to be by themselves for 10 minutes. The researcher stood within 10 meters of the round pen to monitor the horses' behavior but did not make eye contact with or speak to the horse. If the horses exhibited no excessive or increasing stress-related behaviors during this time, they were considered acclimated to the space and were returned to their stalls for a short break (15 – 30 minutes) before their first baseline session began. If the horse exhibited excessive or increasing stress-related behaviors, the researcher immediately removed the horse from the round pen, returned the horse to their stall, and excluded them from the study.

Baseline Sessions

Baseline sessions occurred during daylight hours when the horses were not participating in lessons. Session timing was not consistent every day, as the horses' lesson schedule varied every day. Baseline sessions were video recorded using one GoPro mounted on the top board of the round pen over the entrance gate and one phone that was on a tripod outside of the round pen.

On the first day of the study, following a successful acclimation session earlier that day, horses began baseline sessions. For each baseline session, the researcher released the horse into the round pen and left them alone for 12 minutes. During the sessions, the researcher sat in a chair 1.5 meters away that was below where the horses could see out of the round pen. The researcher did not talk to or touch the horses during the session and avoided eye contact. Occasionally individuals from the barn staff or riders would walk by the round pen and the researcher asked them to ignore the horses. At the end of the 12 minutes, the researcher caught the horse and returned it to its stall.

Horses participated in a maximum of one baseline session per day, and no more than three baseline sessions per week. The horses all started the baseline phase within one day of each other, but because the implementation of intervention was staggered into three batches due to the multiple baseline design, some horses experienced more baseline sessions than others. Batch 1 horses completed three baseline sessions, Batch 2 horses completed six baseline sessions, and Batch 3 horses completed eight baseline sessions (see Appendix A for the schedule for each batch of horses). On the last two days of baseline sessions each horse also participated in an MHT after their baseline session. On the day of their last baseline session, horses also participated in a preference assessment as the last activity for the day.

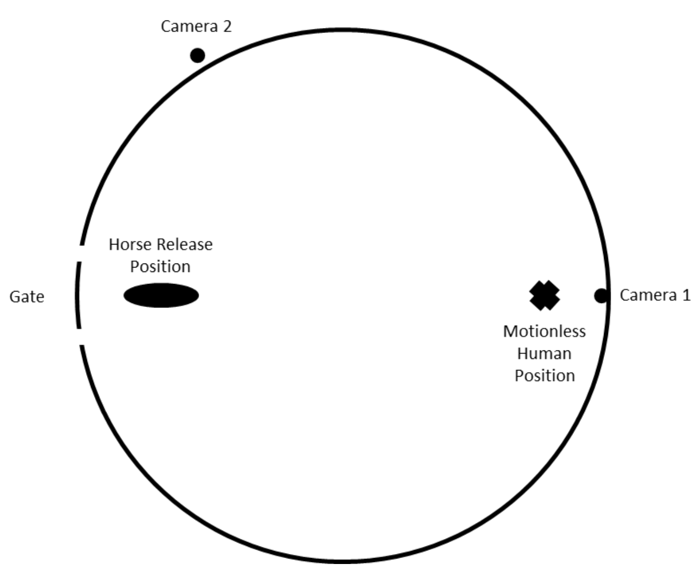
Pre-Intervention Motionless Human Tests

Each horse experienced four MHTs: two tests with the familiar trainer (researcher) and two tests with a stranger. One trainer and one stranger test were completed in the baseline phase, and one trainer and one stranger test were completed in the post-intervention phase. The trainer handled the horses during the baseline period, so the trainer was not a novel human for the first MHT. To ensure novelty of the stranger, horses were tested with two individuals, one during the baseline test and another during the post-intervention test. The order of tests and order in which the horses encountered the strangers were counterbalanced. Baseline MHTs were on the same days as the horses' last two baseline sessions (one MHT on each day). Horses had a break in their stall for at least 10 minutes and no more than 4 hours between their baseline session and their MHT. After their second MHT in the baseline phase, horses experienced a preference assessment.

The MHT procedure was performed as described by Larssen and Roth (2022) with the addition of a novel stranger condition. The human (trainer or stranger) stood motionless on a marked spot in the back quadrant of the round pen, facing the gate (Figure 2). A research assistant led the horse into the round pen and released it by unclipping the lead rope when its hindquarters cleared the gate. The research assistant then exited the round pen, closed the gate, and started a stopwatch. The research assistant remained within view of the round pen but stood approximately 15 meters away during the test to limit distraction. The motionless human stayed as still as possible and looked straight ahead maintaining a neutral face. If the horse knocked the human off balance, the person regained their footing and resumed standing motionless. After 2 minutes, the research assistant opened the gate, caught the horse, and returned them to their stall. The MHT was video recorded using two cameras at different angles (Figure 2).

Figure 2

Motionless Human Test Setup



Preference Assessment

A preference assessment was completed by all 15 horses with various food items. This preference assessment procedure was modeled after the protocol used by Cameron et al. (2021). The preference assessment occurred once for each horse, as the last activity on the last day of baseline sessions for each horse (with a break of at least 15 minutes in their stall after their MHT). Results from the preference assessment were used to identify putative reinforcers for the positive reinforcement training condition intervention sessions.

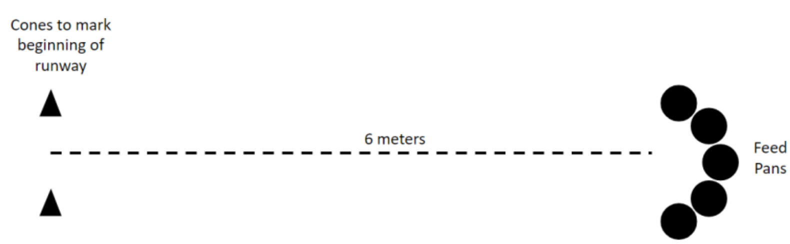
The preference assessment occurred in another area on the farm's property, approximately 23 meters away from the round pen to prevent any association between the two. An array of five food items was offered simultaneously in five black round food pans (3-quart Manna Pro Feed Pan) on the ground in a semicircle, 6 meters from the starting point. To account for size differences, a similar volume of each type of food item was offered. Food items offered were: two carrot pieces, two Purina Nicker Makers (molasses flavored treats), two DuMOR Baked Apple & Honey Flavor Baker's Bites, three Manna Pro Start to Finish Peppermint Horse Snacks, two rounded tablespoons of Triple Crown Senior Feed grain. The same type of food item was presented in a given pan for each session to avoid odor contamination. One horse (Titan) had a corn allergy, so his preference assessment excluded options with corn (Purina Nicker Makers, Manna Pro Start to Finish Peppermint Horse Snacks, Triple Crown Senior Feed grain) and instead each trial included two DuMOR Peppermint Flavor Baker's Bites, two DuMOR Baked Molasses Flavor Baker's Bites, two DuMOR Baked Apple & Honey Flavor Baker's Bites, two apple pieces, and two carrot pieces. Titan's preference assessment utilized identical but separate pans to prevent odor contamination.

The starting order of the food items was chosen by a random number generator for the first trial of each session. In the subsequent trials, the starting position was rotated to the left by one position, such that each food item was in each possible position. The horses were not exposed to the food items by the researcher prior to the first trial of the preference assessment. It is possible that the horses' owners or riders had given the same type of treats to the horse at some point during the horses' lives.

Each trial began when the research assistant walked the horse from the starting point to the semicircle of food item options and ended when the horse chose a food item to consume (Figure 3). When the horse consumed a food item, the researcher quickly covered the other food pans with a paper plate to prevent the horse from accessing the other alternatives. The research assistant always walked on the left side of the horse, per tradition. The lead rope was 2 meters long and when the horse approached the array of feed pans, the research assistant stayed out of the way of all pans, stood at the horse's shoulder level about 1.5 meters to the side, and held the rope with no tension to avoid any unintentional cueing.

Figure 3

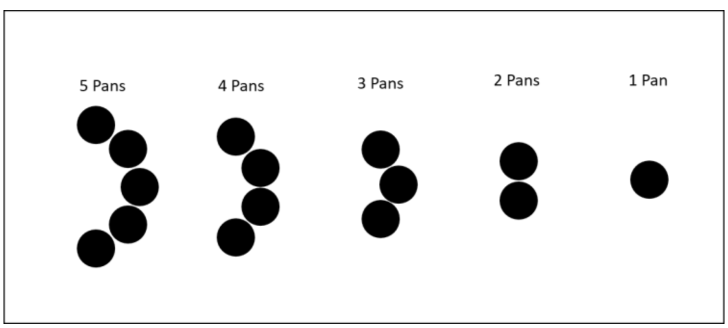
Preference Assessment Setup



Once the horse chose a food item by taking it in their mouth, the research assistant walked the horse back to the starting point while the researcher recorded the results. Then the researcher removed the empty food pan, removed the paper plates on the remaining food options, and adjusted the remaining bins in a semi-circle configuration (Figure 4), keeping the food items in the same order less the one chosen. Trials continued until there were no food items left or the horse spent over 30 seconds standing in proximity of the food bins without choosing anything to consume. This task was replicated five times for each horse with an approximately 2-minute break between each replication to allow the researcher to reset the pans using the same randomized sequence from the previous trial, with the starting position moved one spot to the left.

Figure 4

Preference Assessment Food Pan Configuration



For each trial, the researcher recorded the item selected and its position. Items chosen were ranked from 1-5 depending on trial order (item chosen in first trial were assigned 1). Items that the horse chose but subsequently spit out were assigned to rank 5. If the trial ended and an item was not chosen by the horse, the item was assigned to rank 5.

Item scores were summed across all five replications for each horse. The item with the lowest score was deemed the most preferred item, and the item with the highest score was deemed the least preferred item. Other items were considered moderately preferred. If scores differed by two or fewer points, the items were considered equivalently preferred. The scoring sheet was used from Chazin and Ledford (2016) (see Appendix C). The results from the preference assessment informed the blend of food items used as a putative reinforcer for horses participating in positive reinforcement training sessions during the Intervention phase.

Intervention

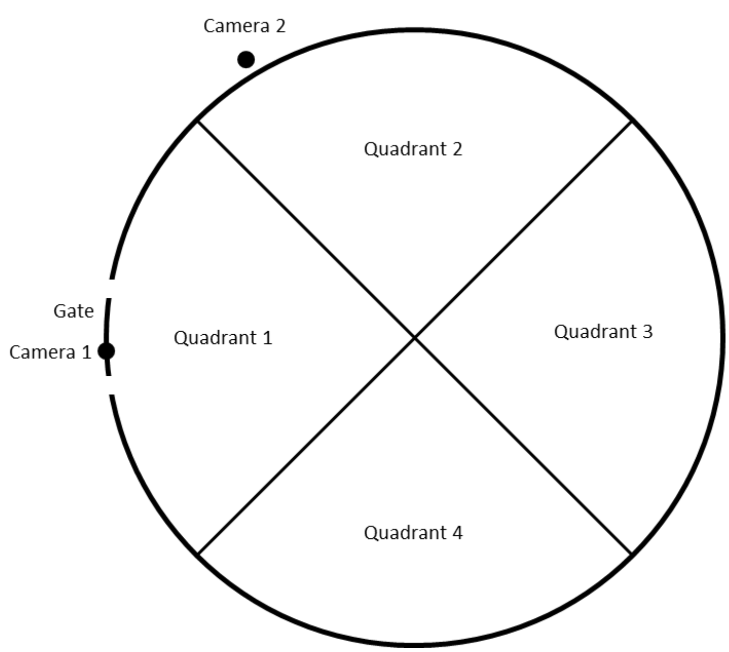
The intervention phase consisted solely of the intervention sessions. Each horse participated in 12 intervention sessions that lasted 12 minutes each: three per week for four weeks. All experimental sessions were video recorded with one GoPro mounted on the round pen above the entrance gate and one phone on a tripod outside the round pen. After each intervention session, the primary removed any fecal matter left by the horse and raked over any urine spots or excessive droppings from the FE food toy.

Positive Reinforcement (R+) Training Condition

In the R+ training condition, the researcher released the horse into the round pen for 2 minutes by themselves. At the end of the 2 minutes, the researcher entered the round pen with the horse and trained with them, reinforcing target behavior with a food-based item. The researcher utilized food items as the putative reinforcer, as it is preferred by horses and more effective than other human interaction-based reinforcers (patting, withers scratching, etc.) (Kieson, 2017; Takahashi et al., 2016; Kieson et al., 2020). The type of food utilized for each horse was a mixture of the foods they found highly or moderately preferred, as determined by the preference assessment. Target behaviors included standing still, touching a handheld target, moving with the researcher (walking and trotting), backing, and stepping on a mat. The researcher then worked with the horse through shaping plans, training no more than three behaviors per session. The researcher trained a behavior until the horse successfully completed a step in the shaping plan for that behavior or the horse became disengaged with training, at which point the researcher moved to training one of the other two behaviors selected for that day (See Appendix D). The researcher always started each session in quadrant 4 (see Figure 5). Some target behaviors involved movement (liberty leading and backing on cue), so the researcher and horse moved throughout the round pen during the sessions. After 10 minutes of training, the session ended, and the horse was returned to their stall.

Figure 5

Intervention Session Round Pen Locations



Food Enrichment (FE) Condition

In the FE condition, the researcher released the horse into the round pen for 2 minutes by themselves. At the end of the 2 minutes, the researcher entered, placed the food enrichment device in quadrant 2 (Figure 5), and then exited the round pen. During the FE session, the researcher sat in the same place as during the Baseline sessions. The horse remained in the round pen for a further 10 minutes, after which the researcher caught and removed the horse from the round pen and returned them to their stall.

Two food enrichment devices were used in this experiment. From the first day of FE (Session 4) to Session 11, Uncle Jimmy's Hanging Balls (molasses flavored, each horse had their own ball) were hung from the top rail of the round pen at head height. The Uncle Jimmy's Hanging Balls attracted bees that disturbed the horses, so on Session 12 a new enrichment toy was used. This toy was a large yoga ball wrapped in a hay net, with a variety of foods stuffed in the slots of the hay net (Figure 6). Carrots, apples, romaine lettuce, and alfalfa were used in the net, in a variety of combinations on each day. The toy was refreshed between each horse. One horse in the FE group (Cupid) refused to eat carrots during the Preference Assessment, so carrots were omitted from his food-enrichment toy mixture. All FE groups horses experienced Uncle Jimmy's Hanging Balls and the new food toy, with the number of sessions with each toy dependent on the horses' assigned batch. Batch 1 horses had the Hanging Ball for eight sessions and the yoga ball toy for four sessions, Batch 2 horses had the Hanging Ball for four sessions and the yoga ball toy for eight sessions, and Batch 3 horses had the Hanging Ball for one session and the yoga ball toy for 11 sessions.

Figure 6

Yoga Ball Food Toy

Control Condition

In the Control Group, horses participated in sessions that were identical to the Baseline sessions. For each Control session, the researcher released the horse into the round pen and left them alone for 12 minutes. During the sessions, the researcher sat in a chair 1.5 meters away that was below where the horses could see out of the round pen. The researcher did not talk to or touch the horses during the session and avoided eye contact. Occasionally individuals from the barn staff or riders would walk by the round pen and the researcher asked them to ignore the horses. At the end of the 12 minutes, the researcher caught the horse and returned it to its stall.

Post-Intervention

After the Intervention phase, there was a short post-Intervention phase that consisted of two mock baseline sessions and two MHTs. One mock baseline session and one MHT occurred on each day, and the horses had at least one and no more than three days between each grouping of mock baseline session and MHT.

Mock Baseline Sessions

To replicate the MHT tests in the baseline phase, horses participated in mock baseline sessions prior to but on the same day as each post-intervention MHT. The mock baseline sessions were identical to the baseline sessions. For each session, the researcher released the horse into the round pen and left them alone for 12 minutes. During the sessions, the researcher sat in a chair 1.5 meters away that was below where the horses could see out of the round pen. The researcher did not talk to or touch the horses during the session and avoided eye contact. Occasionally individuals from the barn staff or riders would walk by the round pen and the researcher asked them to ignore the horses. At the end of the 12 minutes, the researcher caught the horse and returned it to its stall. Horses had a break of at least 10 minutes and no more than 4 hours between the mock baseline session and the MHT.

Post-Intervention Motionless Human Tests

Horses participated in two post-intervention MHTs, one with the trainer and one with a stranger. To replicate the horses' experience prior to the baseline MHT tests, the two post-intervention MHTs both followed a mock baseline session. Horses had one mock baseline session and one MHT on two separate days, at least one day but not more than three days apart. Horses had a break in their stall for at least 10 minutes and no more than 4 hours between their baseline session and their MHT. For the MHT with a stranger, horses were tested with a different human than they were tested with in the baseline phase, to ensure novelty of the stranger. The order of tests and order in which the horses encountered the strangers were counterbalanced. Post-intervention MHTs followed the same procedure as pre-intervention MHTs (see section above).

Study Measures

Motionless Human Tests

Video recordings were coded and analyzed with the MHT ethogram (Table 2).

Table 2

Motionless Human Test Ethogram

Behavior	Definition
Proximity	Any part of the horse is less than 1 meter from the Motionless Human
Physical Contact	Any part of the horse is touching the Motionless Human

Behavioral Coding

To assess horses' perceived value of their assigned intervention, their behavior in the baseline and intervention sessions was coded during the first 2 minutes of each session during which the horses were alone in the pen without any enrichment items. The videos were coded for potential anticipatory behaviors using Behavioral Observation Research Interactive Software (BORIS) version 8.13 (Table 3; Friard & Gamba, 2016; Peters et al., 2012). Behaviors were not recorded or coded for the post-intervention sessions, as they were meant only to mock the baseline sessions for repetition purposes for the MHTs.

Table 3

Behavioral Observation Session Ethogram

Category	Behavior	Definition	Behavior Type
Maintenance	Elimination	Urination or defecation	Event
	Rubbing	Rubbing any part of the body against an exterior surface, such as the round pen wall	State
	Rolling	Buckling on knees, lying down to lateral position, and rolling over on back, and standing back up including	State

		a full body shake	
	Standing Rest	Standing with head in neutral position, with eyes half or fully closed and no other movement	State
Standing	Stand Normal	Standing in neutral position with head at or below the withers, eyes fully open	State
	Stand Alert	Standing with head above the withers, with rigid body and ears perked	State
Locomotion	Walk	A slow four beat gait moving in a forward or sideways direction	State
Arousal & Investigation (Movement)	Trot	A two-beat gait in which diagonal pairs hit the ground at the same time	State
	Canter	A three-beat gait in which one hind leg strikes off, the diagonal pair moves together, and then the remaining front hoof moves forward	State
	Tail swishing	Rapid, repeated movement of the tail to either side of the body, counted in bouts if less than 1 second apart	Event
	Stamp	Rapidly lifting and returning one leg to the ground with considerable force, more so than if moving in another gait	Event
Arousal & Investigation (Investigation)	Smell object	Placing nose in proximity of object and breathing in and out in a manner more rapid or exaggerated than normal breathing breath pattern	State
	Wood chewing	Using teeth to grab on to the round pen wall or removal of chunks of wood and chewing of them, without the characteristic neck arch or grunt of cribbing	State
Audible Sounds	Whinny	Long loud high-pitched vocalization	Event
	Nicker	Soft low-pitched vocalization	Event
	Snort	Short loud sound made by expelling breath rapidly through nose	Event
Other	Other	Other category used to catch behaviors that might not fit into the	Event

		other categories	
Out of View	Out of View	Horse is out of all camera ranges, behavior is unknown	State

Counts of each behavior were recorded, as were durations for the state behaviors. Behavioral Transitions rates (behaviors/minute) were calculated for the first two minutes of each intervention session, before any type of intervention was deployed to horses in the FE or R+ groups. This was done by summing the total number of state behaviors (except the "Out of View" category) and dividing them by the total time. The rates were adjusted for any time the horse spent out of view of the camera during those two minutes.

Statistical Treatment of Data

Statistical analyses were performed using Excel, JMP 17, and an online Tau U calculator (Vannest et al., 2016). We used non-parametric tests as the data were not normally distributed. MHT data were analyzed by a one-way ANOVA on the pre-test/post-test difference scores of the three groups (R+, FE, and C). Post hoc Tukey-Kramer HSDs were run for pairwise comparisons between groups. Behavioral Transition data were analyzed via visual trends and supported by the Tau-U statistic. Two observers coded the videos and inter-rater reliability was scored for 15% of the videos, for both behavioral transitions and behavior durations ($\alpha_{transitions} = 0.9319$, $\alpha_{durations} = 0.9905$).

RESULTS

Horse Enrollment

Temperament Assessment

Horses were assigned to their experimental group through a temperament test assessment (Momozawa et al., 2005). Horses were matched in groups of three based on their Anxiety and

Trainability temperament scores; Affability did not play a role in creating matched groups (see Table 4). One horse from each matched group was randomly assigned to each experimental condition using a random number generator.

For a full list of the horses and their temperament results, please see Appendix B.

Table 4

Matched Groups

Matched Group	Horses	Trainability	Anxiety	Affability
High Trainability, Low Anxiety 1	Cupid, Gabby, Gigi	High	Low	High
High Trainability, Low Anxiety 2	Lily, Max, Scarlet	High	Low	High
High Trainability, Low Anxiety 3	Flint, Saint, Wheezy	High	Low	Medium – High
Medium Anxiety	Buddy, Rosa, Valeria	Medium – High	Medium	Medium – High
Medium Trainability	Barbie, Sterling, Titan	Medium	Low	Medium – High

Acclimation Session

During this acclimation phase, one horse exhibited excessive stress-related behaviors (frequent whinnying and frantic pacing, indicative of separation anxiety) and was excluded from the study (McDonnell, 2003). All other horses passed the acclimation phase with little to no stress-related behaviors upon being released alone in the round pen.

Preference Assessment

All horses completed the preference assessment as the last step of their pre-intervention phase. Results for each horse are reported below (Table 5).

Table 5

Preference Assessment Individual Results

	Item Score Possible range: 5 (highest preferred) – 25 (lowest preferred) Bolded results indicate the highest preferred item				
Horse	**Grain**	**Nicker Maker**	**Apple Treat**	**Peppermint Treat**	**Carrot**
Barbie	15	17	15	**13**	15
Buddy	**12**	14	15	17	17
Cupid	**10**	13	16	11	25
Flint	**9**	16	14	15	25
Gabby	14	**11**	21	15	14
Gigi	**8**	15	14	16	22
Lily	**11**	14	16	16	18
Max	**9**	15	17	23	11
Rosa	13	**12**	16	18	16
Saint	**8**	16	17	20	14
Scarlet	**12**	15	13	18	17
Sterling	**8**	19	16	18	14
Valeria	**10**	13	14	21	17
Wheezy	14	14	17	18	**12**
Titan *Denotes substituted item due to corn allergy	*Apple Pieces 14	*DuMOR Baked Molasses Baker's Bites 18	16	*DuMOR Peppermint Flavor Baker's Bites **11**	16

For horses participating in positive reinforcement training sessions, the horses' behavior was reinforced using a blend of items that was a roughly equal mixture of their highest and moderately preferred items and included none of their least preferred item(s). See Table 6 for individual mixtures.

Table 6

Putative Reinforcer Mixtures

Horse	Items Included in Putative Reinforcer Mixture
Buddy	Grain, Nicker Makers, Apple Treat
Gigi	Grain, Apple Treat, Nicker Maker, Peppermint Treat *After the first day, only grain was used as Gigi exhibited

	difficulty chewing the other items
Lily	Grain, Nicker Makers, Peppermint Treat, Apple Treat
Sterling	Grain, Carrots, Apple Treat
Wheezy	Carrot, Grain, Nicker Maker, Apple Treat

During the Preference Assessment, one horse (Cupid) repeatedly refused to eat carrots after he had trouble chewing them. Because of this, carrots were not included when he was offered the yoga ball food enrichment toy during intervention sessions.

Motionless Human Test

Group results for the total duration of time horses spent in proximity of and touching the human are reported below (Table 7). A one-way ANOVA on the pre-test results confirmed that neither proximity nor touch was different for the stranger or trainer condition across groups (n = 5 each group, $p_{\text{pre- trainer proximity}} = 0.3340$, $p_{\text{pre- stranger proximity}} = 0.1530$, $p_{\text{pre- trainer touch}} = 0.1148$, $p_{\text{pre- stranger touch}} = 0.4285$).

Table 7

Motionless Human Test Pre-Test Duration Spent in Proximity of and Touching the Motionless Human (Trainer and Stanger Conditions)

	Trainer		**Stranger**	
	Average Pre-Test Duration (mean seconds ± standard deviation)			
Group	**Proximity**	**Touch**	**Proximity**	**Touch**
R+ Group	0 ± 0	0 ± 0	37.89 ± 41.60	5.46 ± 6.05

FE Group	29.65 ± 31.50	5.52 ± 5.44	13.06 ± 22.98	7.20 ± 13.36
C Group	27.75 ± 49.43	2.09 ± 3.88	2.16 ± 4.83	0.25 ± 0.56
	Average Post-Test Duration (mean seconds ± standard deviation)			
R+ Group	48.63 ± 39.78	9.36 ± 8.45	46.64 ± 39.87	8.70 ± 7.28
FE Group	5.35 ± 8.61	1.93 ± 3.54	9.30 ± 14.98	1.06 ± 2.02
C Group	10.95 ± 10.08	2.45 ± 3.68	29.95 ± 46.47	10.11 ± 18.65
	Average Difference (Post-Test minus Pre-Test) (mean seconds ± standard deviation)			
R+ Group	48.63 ± 39.78	9.36 ± 8.45	8.75 ± 46.73	3.24 ± 10.61
FE Group	-24.30 ± 31.64	-3.59 ± 3.67	-3.76 ± 11.50	-6.14 ± 11.42
C Group	-16.80 ± 44.63	0.36 ± 5.23	27.79 ± 47.55	9.86 ± 18.70

We found that the Pre-Test and Post-Test values were significantly different for the groups for both proximity ($F(2,12) = 5.2755$, $p = 0.0227$, $\eta^2 = 0.467$) and touch ($F(2,12) = 5.8830$, $p = 0.0166$, $\eta^2 = 0.500$) in the trainer condition. Pre-Test and Post-Test values were not significantly different for any groups for proximity ($p = 0.4608$) nor touch ($p = 0.2356$) in the stranger condition.

A post hoc Tukey-Kramer HSD test revealed that horses in the R+ group spent significantly more time in proximity of the trainer than those in the FE group ($p = 0.0302$, 95% CI = 7.03, 38.83). Horses in the R+ group also spent more time with the trainer than those horses in the C group, but the result was not significant ($p = 0.0517$). No differences were found between time spent in proximity of the trainer for the C and FE group horses ($p = 0.9507$).

A post hoc Tukey-Kramer HSD test showed that horses in the R+ group touched the trainer significantly more than horses in the FE group ($p = 0.0149$, 95% CI = 2.63, 23.27).

Horses in the R+ group also touched the trainer more than the horses in the C group, but this difference was not statistically significant (p = 0.0903, 95% CI = -1.32, 19.32). Touches by horses in the FE and C groups were not different (p = 0.5789).

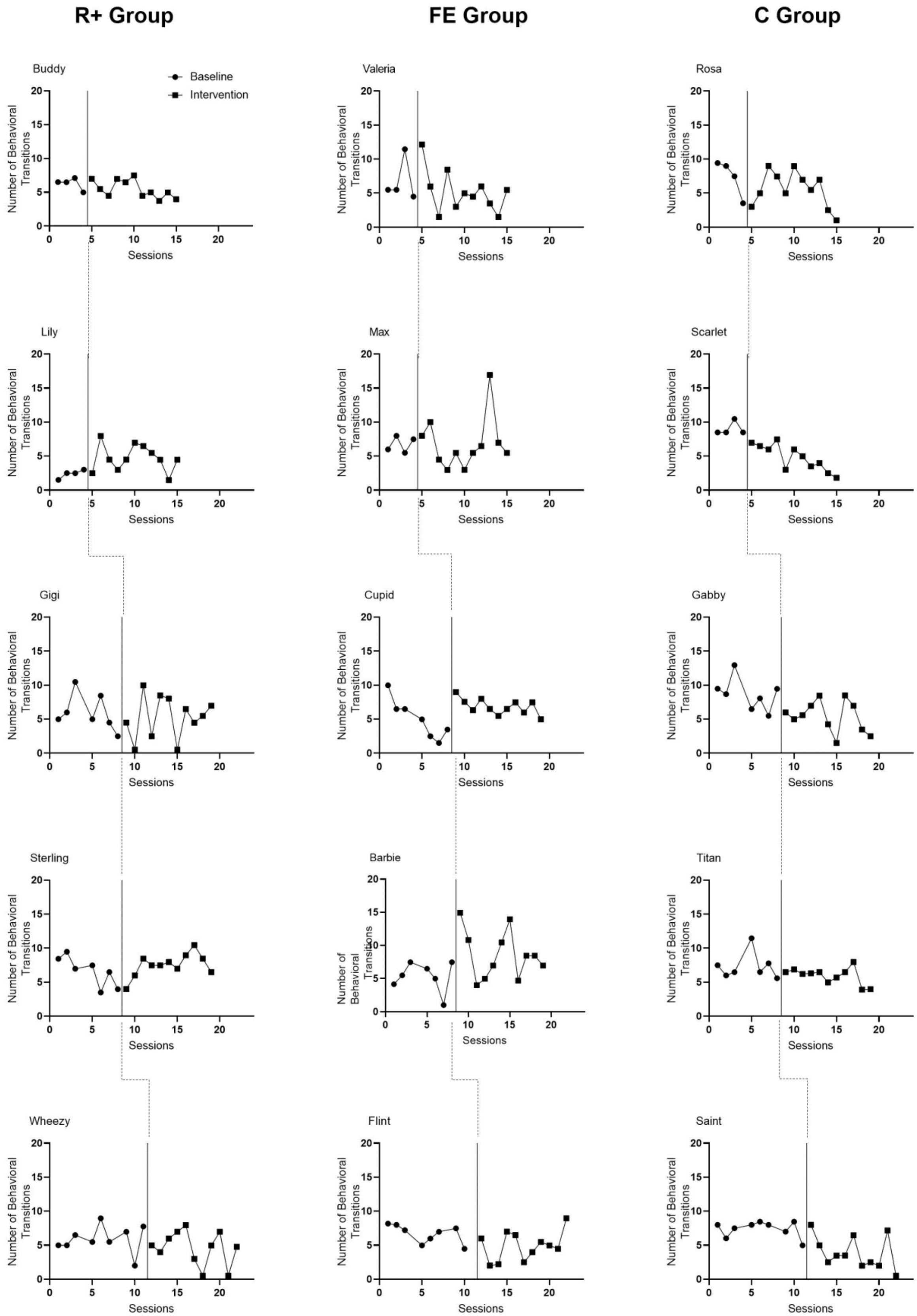
Behavioral Coding

Behavioral Transitions

Individual results were plotted to reveal trends in behavior transition rates across conditions (see Figure 7).

Figure 7

Behavioral Transition Rates


R+ Group
FE Group
C Group
Buddy
Baseline
Intervention
Valeria
Rosa
Lily
Max
Scarlet
Gigi
Cupid
Gabby
Sterling
Barbie
Titan
Wheezy
Flint
Saint
Number of Behavioral Transitions
Sessions

The graphs indicate that horses in the C group, but not the R+ or E groups, showed a steady decrease in the number of behavioral transitions throughout the study. As a whole, the R+ group horses showed a slight decrease in behavioral transitions during the baseline phase, but then maintained the same number of behavioral transitions throughout their intervention phase. The decreasing trend from baseline did not continue into intervention as it did for the C group horses. The two horses with the shortest baseline phase, Buddy and Lily, did not show a downward trend in baseline. Individual horses in the R+ group showed slight trends in the intervention phase: Wheezy showed a very small decrease in behavioral transitions throughout the intervention phase whereas Sterling and Lily showed slight increases in behavioral transitions in the intervention phase compared to the baseline. Buddy and Gigi maintained roughly the same number of behavioral transitions throughout the whole study.

FE Group horses showed similar graphs to the R+ group horses, with an overall decreasing baseline trend that was stronger in horses with a longer baseline (Cupid, Barbie, and Flint). After implementation of intervention, Cupid and Barbie showed a considerable increase in behavioral transitions. Max and Flint roughly maintained the average behavioral transition rate from baseline, not continuing the trend of decreasing behavioral transitions. Similar to horses in the control condition, Valeria showed a continued downward trend in behavioral transitions from the baseline phase to the intervention phase.

Tau U statistics were run to confirm the individual and group graphical analysis; individual and group results are reported below (Table 8, Table 9). A baseline correction was applied for baseline slopes greater than 0.35 or less than -0.35, based on the 0.4 and 0.33 values used in recent practice (Parker et al., 2011; Lee & Cherney, 2018). The Tau U statistics confirmed the visual trend analysis: Tau U yielded a significant effect size for the C group (τ = -

0.6504, Z = -4.7056, p < 0.0001), but not the R+ (τ = -0.031, Z = 0.2244, p = 0.8224) or FE group (τ=-0.0574, Z = 0.4131,p=0.6795). This is reflected in the individual results: three C group horses (Gabby (τ = -0.6883, Z = -2.4000, p = 0.0164), Saint (τ = -0.7677, Z = -2.887, p = 0.0039), and Scarlet (τ = -1.000, Z = -2.8723, p = 0.0041)) showed a statistically significant effect size indicating significantly less transitions in the intervention phase than the baseline, while only one horse from the FE group (Cupid (τ = 0.6494, Z = 2.2642, p = 0.0236)) showed a significant change, which was in the opposite direction. No horses from the R+ group showed a statistically significant change.

Table 8

Individual Tau U Results

Group	Horse	Tau	Z	p value
R+	Buddy	-0.4318	-1.2403	0.2149
R+	Wheezy	-0.3535	-1.3295	0.1837
R+	Gigi	-0.013	-0.0453	0.9639
R+	Lily	0.5682	1.632	0.1027
R+	Sterling	0.4286	1.4944	0.1351
FE	Barbie	0.4805	1.6755	0.0938
FE	Max	-0.2955	-0.8486	0.3961
FE	Valeria	-0.3182	-0.9139	0.3608
FE	Cupid	0.6494	2.2642	0.0236
FE	Flint	-0.3409	-1.2386	0.2155
C	Gabby	-0.6883	-2.4000	0.0164
C	Rosa	-0.3864	-1.1097	0.2671
C	Saint	-0.7677	-2.887	0.0039
C	Scarlet	-1.000	-2.8723	0.0041
C	Titan	-0.4156	-1.4491	0.1473

Table 9

Group Tau U Weighted Averages

Group	Tau	Z	p value
R+	0.031	0.2244	0.8224
FE	0.0574	0.4131	0.6795
C	-0.6504	-4.7056	<0.0001

Behavioral Categories

The percentage of time each horse spent in the five behavioral categories (Maintenance, Standing, Locomotion, Arousal & Investigation – Movement, and Arousal & Investigation – Investigation) was calculated for the first two minutes of each intervention session, before any type of intervention was deployed to horses in the FE or R+ groups. This was compared to the first two minutes of each baseline session and the first two minutes of each intervention session for the C group horses. Duration in each behavioral category was averaged by group for the Baseline and Intervention phases. See Table 10 for the results.

On average, horses spent the most time standing both in the Baseline and Intervention phases. The remaining time was, on average, split between the Locomotion and Arousal & Investigation (Investigation) category, with very little time being devoted to Maintenance or Arousal & Investigation (Movement) behaviors. Individual differences in behaviors displayed were variable. Most horses spent the most time standing normally or standing alert (Standing category), but a few horses spent most of the time walking (Locomotion category) and smelling objects (Arousal & Investigation (Investigative) category). Individual results were plotted to reveal any trends (see Figure 8). See below for graphs for each individual.

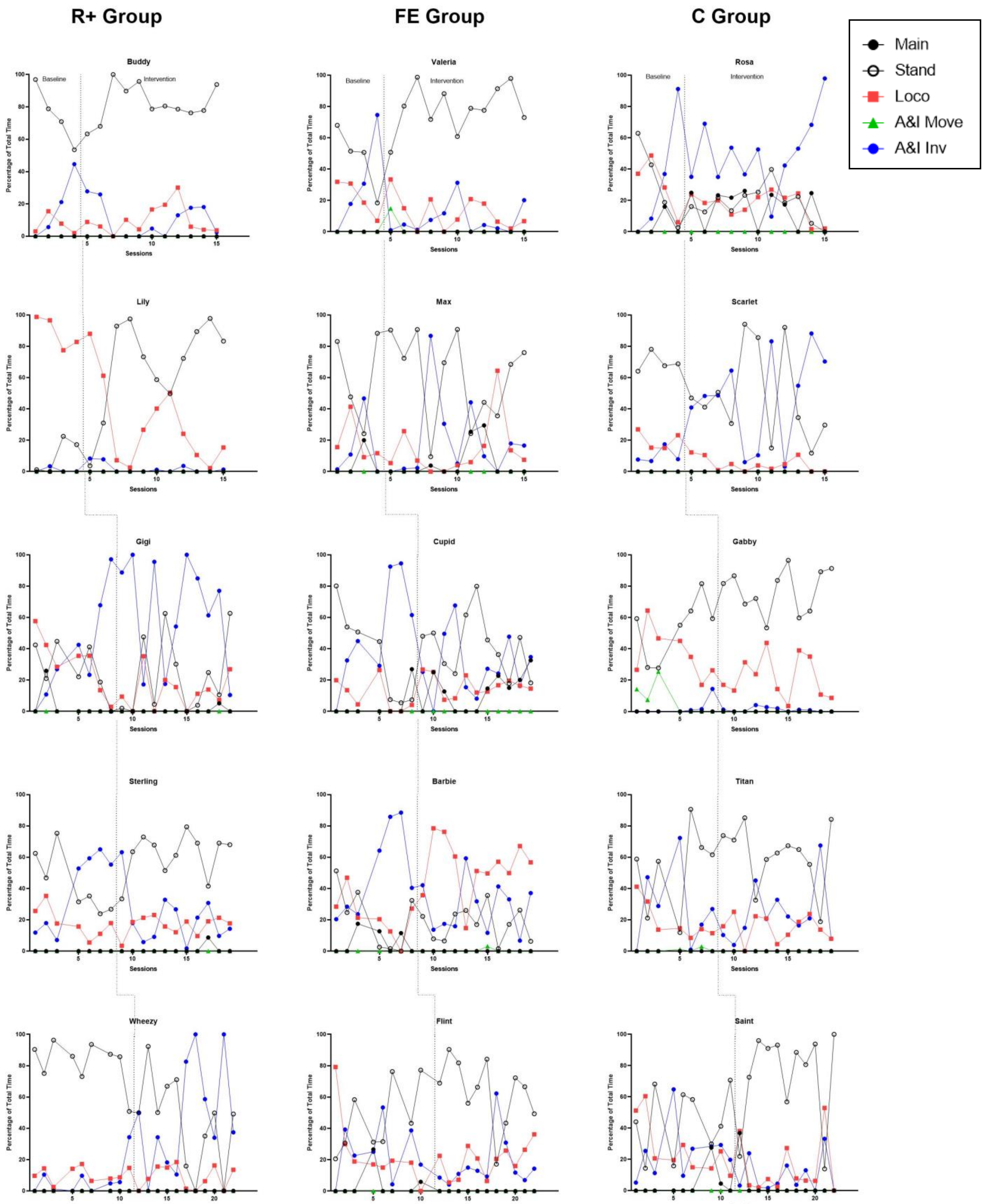
Table 10

Average Percentage of Time (mean ± standard deviation) Spent in Each Behavioral Category during Baseline and Intervention Phases, and Difference Scores

Group	Maintenance	Standing	Locomotion	A&I-Movement	A&I - Investigation
			Baseline		
R+	0.7% ± 1.7%	47.5% ± 30.7%	31.2% ± 33.5%	0.0% ± 0.0%	20.6% ± 17.4%
E	3.8% ± 2.3%	42.3% ± 14.7%	19.7% ± 5.8%	0.0% ± 0.0%	34.3% ± 15.8%
C	1.5% ± 2.1%	50.5% ± 13.8%	26.8% ± 7.5%	1.5% ± 23.0%	19.7% ± 13.1%
			Intervention		
R+	0.3% ± 0.4%	57.0% ± 25.2%	15.5% ± 8.6%	0.0% ± 0.0%	29.1% ± 26.2%
E	3.7% ± 6.0%	52.5% ± 23.7%	23.2% ± 17.6%	0.3% ± 0.6%	20.2% ± 8.7%
C	3.6% ± 6.4%	55.7% ± 23.8%	14.4% ± 6.3%	0.0% ± 0.0%	26.3% ± 22.0%
			Difference Scores		
R+	-0.5% ± 1.6%	9.5% ± 35.1%	-15.7% ± 25.5%	0.0% ± 0.0%	8.5% ± 24.0%
E	-0.1% ± 5.8%	10.2% ± 14.5%	3.5% ± 17.1%	0.3% ± 0.6%	-14.1% ± 12.3%
C	2.1% ± 4.8%	5.2% ± 22.1%	-12.4% ± 4.6%	-1.5% ± 3.0%	6.6% ± 20.5%

Figure 8

Percentage of Time Spent in Each Behavioral Category by Day by Horse


R+ Group
FE Group
C Group
Main
Stand
Loco
A&I Move
A&I Inv
Buddy
Valeria
Rosa
Lily
Max
Scarlet
Gigi
Cupid
Gabby
Sterling
Barbie
Titan
Wheezy
Flint
Saint
Baseline
Intervention
Percentage of Total Time
Sessions

Some horses showed a change in behavior that occurred close to their given intervention, but there was no overall pattern that provided compelling evidence of a change related to any specific intervention. This was confirmed by the one-way ANOVA on the baseline and intervention difference scores across groups. No groups showed significant differences for any of the behavioral categories (n = 5 each group, $p_{maintenance} = 0.6226$, $p_{standing} = 0.9434$, $p_{locomotion} = 0.2340$, $p_{A\&I\ Movement} = 0.2623$, $p_{A\&I\ Investigation} = 0.1714$).

DISCUSSION

We set out to observe how the addition of positive reinforcement training sessions to an otherwise unchanged training and riding routine affected the behavior of school horses, in comparison to food-toy enrichment sessions and a no intervention control. We specifically looked for changes in the human-animal relationship to both the positive reinforcement trainer and strangers. We found that horses that received three 10-minute training sessions per week for four weeks increased contact seeking behavior towards the trainer in a MHT, but not towards a stranger. Contact seeking behavior towards the trainer decreased in horses in the other groups in the post-test.

We also examined the horses' perceived value of the training and food-toy enrichment sessions by measuring their anticipatory behaviors prior to their enrichment session. We found that food-toy and positive reinforcement training horses either maintained or showed an increase in behavioral transitions, indicative of anticipation, compared to the control group, which showed a steady decline in behavioral transitions throughout the study (Peters et al., 2012). The food-toy enrichment and training groups did not differ significantly, indicating that the horses perceived the sessions to be of similar value.

Motionless Human Test

The implementation of positive reinforcement sessions increased contact seeking behavior (both proximity to and physical touch) with the trainer, but not a stranger. The FE group showed a decrease in contact seeking behavior with the trainer and no changes with a stranger, whereas the C group showed a decrease in contact seeking behavior with the trainer but an increase in contact seeking behavior with a stranger. This increase in contact seeking behavior with the trainer in the R+ group was significantly different than the FE group horses, and trending significantly for the C group horses. Even with a small sample size in each group (n = 5), it was clear that the positive reinforcement training sessions impacted how horses performed in the MHT with the trainer but not with a stranger. This result is not surprising, since horses can readily discriminate between people (Stone 2010).

Increased contact seeking with a positive reinforcement trainer aligns with previous research in this area (Sankey et al., 2010a; Sankey et al., 2010b). After the implementation of a positive reinforcement training regimen, horses spend more time in proximity of the trainer and show lower latencies to approach the positive reinforcement trainer (Sankey et al., 2010a; Sankey et al., 2010b). The use of food in positive reinforcement training creates a positive association with humans, which is reflected in these increased contact seeking behaviors (Hausberger et al., 2008)

In this study we found no evidence of a generalized response of increased contact seeking behavior toward a stranger after the implementation of positive reinforcement training sessions. This is in contrast to recent studies, which found that positive reinforcement sessions increased contact seeking behavior with an unfamiliar person. (Sankey et al, 2010a; Sankey et al., 2010b, Larssen & Roth, 2022).

One possible explanation for the differing results is that different types of horses were used in these studies. Sankey et al. (2010b) studied horses that had limited contact with any other humans during the time between the training regimen and the follow up tests six and eight months later, only receiving hay from caretakers twice daily and having no other training. In this case, it seems more likely that the results of the training regimen would have a longer carry-over effect, as the horses had far fewer opportunities to interact with and create associations with humans in the time between tests. Larssen and Roth (2022) studied a group of privately owned horses who were visited by the owner at least five days per week. Because the horses were privately owned and consistently handled by their owners, it could create differences in how they generalize their perception of humans as compared to school horses who are exposed to and trained or ridden by many more people. The horses studied by Sankey et al. (2010b) were a part of a riding school, but it was noted that riding sticks were never used in these riding centers. It is possible that although the horses in that study and the horses in our study were a part of a lesson program, the daily training and experience of these horses was different enough to create differences in how they generalized their perception of humans. In this study, the school horses continued participating in their daily lessons throughout the intervention period. It is possible that the effects and associations of continuing with school horse lessons, which are primarily negative reinforcement but also sometimes punishment based, might have prevented the generalization of any positive associations created by the addition of positive reinforcement training sessions in our population of school horses.

Another potential explanation for the difference in results is the differing positive reinforcement training regimens. It is possible that the implementation of positive reinforcement differed between the trainers in each study. Our study and two others (Sankey et al., 2010a;

Sankey et al., 2010b) utilized the primary researcher as the trainer, whereas Larssen and Roth (2022) relied on individual owners to conduct the training sessions. Additionally, the training regimens in recent literature ranged in length from just five days to nine weeks, which might have impacted results (Sankey et al., 2010b; Larssen & Roth, 2022). In the most recent comparable study, owners followed a nine-week positive reinforcement training program that had four sessions per week for at least five minutes whereas our study was four weeks in length and had three sessions per week for 10 minutes (Larssen & Roth, 2022). If the horses in our study had been trained for longer, the increased contact seeking behavior might have generalized to a stranger. However, given the high level of discrimination horses achieve with humans, it is more likely that further repetitions of positive reinforcement training occurring with the trainer would further strengthen the discrimination conditions for these horses. Future studies on the generalization of perception to humans could help identify the specific factors that contribute and how often the interactions must occur for the effect to be maintained.

There are other variables that might have contributed to whether horses generalize their perception of humans to strangers after positive reinforcement training sessions. Differences in training context, testing context, or the horses' daily care might explain the differences. Although commonly used, the MHT is not a well-defined or standardized measure (Hausberger et al., 2008). Efforts to standardize MHT protocols would help isolate variables that might be influencing variations in MHT results across the current literature.

Behavioral Transitions

C group horses showed a clear downward trend in behavioral transitions throughout the study, whereas FE and R+ horses did not show the same clear trend. This downward trend throughout the study is likely a result of habituation to the round pen context predicting the lack of any food or social reinforcers. The graphs do not show a clear plateau, so it is difficult to say whether there is a lower limit to this trend. It is notable that the only group that showed this continued decreasing trend into intervention is the control group.

R+ and FE group horses showed a maintained or slightly increased behavioral transition rate post-intervention implementation. This contrast to the decreasing trend in C group indicates greater anticipatory behavior in the R+ and FE group horses, compared to C group horses (Peters et al., 2012). Although we hypothesized that the social component of positive reinforcement training might create additional benefit to the horses compared to the delivery of a food toy, we observed no significant difference between the behavioral transition rate for R+ and FE group horses. It seems that the horses generally equally anticipated positive reinforcement sessions and food-toy enrichment sessions. Human contact has been shown to reduce stress in dogs, but there is little evidence that horses view interactions with humans as social bonding or as a reward in the way that dogs do (Coppola et al., 2006; Hunt et al., 2022; Kieson et al., 2020; Payne et al., 2016). It seems the horses perceive similar value whether the food is delivered as a ‘work to eat’ toy or as a part of a training session, which is important because it shows that the relatively simple act of providing a food toy was as positively anticipated a positive reinforcement training session. Food-toy enrichment can be implemented easily and does not require the caretaker to spend extra time learning positive reinforcement training techniques or interacting with the horse during the enrichment sessions. In general, for a busy school barn environment it might be better to allocate the limited resources towards providing food-based enrichment.

We observed individual differences in these responses, indicating that individual horses differ in how they anticipate different types of enrichment. For example, two FE group horses (Barbie and Cupid), and two R+ group horses (Lily and Sterling), showed a marked increase in behavioral transition rate after intervention implementation. One horse in the FE group (Valeria) and one horse in the R+ group (Wheezy) showed a continued decrease in behavioral transition rate throughout implementation. Understanding the factors that contributed to these individual variations was beyond the scope of this project, but could include variables such as breed, age, prior training history, etc. Future research could compare anticipatory behavior in individual horses for different types of enrichment through a within groups design.

Behavioral Categories

Unlike the Peters et al. study (2012), we found no significant changes to the average amount of time any group spent in any specific behavioral category after intervention, nor any differences between the groups. Several reasons might account for the difference between the studies. First, the context was different: horses in the Peters et al. study were observed in their stall during feeding time whereas horses in this study were observed in a round pen and during different types of interventions. This was intentional, as horses have good spatial awareness, and it is likely that their being in the round pen was a signal of the upcoming intervention which helped evoke the anticipatory behaviors we were looking to study by serving as a clear discriminative stimulus for R+ and FE horses. Second, increased investigative behavior was expected after R+ and FE group horses encountered food in the round pen, but it is possible that the C group horses also started exhibiting increased investigative behaviors after the first R+ and FE group horses were introduced to their intervention and unavoidably left small bits of food in the sand in the round pen. Measures were taken to reduce this (i.e., regular dragging of the round pen), but its effect cannot be ignored. Future research might include identical but different round pens for each group, C group horses going first each day, and stricter cleaning protocols to help mitigate any effect this had. Thirdly, two minutes may not have been long enough to detect differences in individual behaviors. Finally, one of the largest maintenance category behaviors in the Peters et al. study, foraging, was not present in this study. The horses in this study did not have access to any forage in the round pen, and thus it was eliminated from the ethogram. It is possible that if the horses were given access to forage in the round pen, their behaviors would have differed. Future studies should consider including forage as an option for horses to express this maintenance behavior.

CONCLUSIONS

Ridden horses' welfare can be compromised through common management practices such as isolating and confined housing systems, limited grazing opportunities, and concentrate feeding (Mills & Clarke, 2006). School horses, who are often ridden by beginner riders, are at an increased risk of compromised welfare due to riders' lack of knowledge and experience (Holmes & Brown, 2022). Enrichment can improve welfare, learning performance, and even gene expression, and should be a consideration for all horse owners, especially for those that own school horses (Lansade et al., 2014). In our study comparing food-toy enrichment sessions to positive reinforcement training sessions for a group of school horses, we found that both types of sessions were positively anticipated compared to a control group. There were no differences between groups in anticipatory behavior for the food-toy and positive reinforcement sessions, indicating an equivalent perception of value.

Horses can discriminate humans and can build lasting associations with certain people based on how they have interacted with them in the past, but their daily interactions with caretakers and other people can cause them to create a generalized perception of humans (Fureix et al., 2009; Sankey et al., 2010a; Hausberger & Muller, 2002). Positive reinforcement training has been shown to create a generalized positive association with humans in horses (Sankey et al., 2010a; Sankey et al., 2010b; Larssen & Roth, 2022). We used a Motionless Human Test to evaluate changes to the perception of a positive reinforcement trainer and a stranger for a group of school horses. We found that school horses who received supplemental positive reinforcement training sessions increased contact seeking behavior with the trainer compared to horses who received a food-toy enrichment session and a control group. We found no evidence that this positive association extended to a stranger. School horses interact with and are ridden by more people than privately owned horses, which might explain why the horses' perception did not generalize. More research is needed to understand the conflicting results and to standardize the Motionless Human Test protocol.

Adding positive reinforcement training sessions to ridden horses' regular training regimen provides valuable enrichment and can increase the relationship between the horse and person who trains with the horse. Providing regular food-toy sessions is a good way to provide equally valuable enrichment to school horses with less resources than positive reinforcement training, but it does not provide the same benefits to the human-animal relationship seen with the positive reinforcement trainer.

LITERATURE CITED

Anderson, C., Von Keyserlingk, M., Lidfors, L., & Weary, D. (02020). Anticipatory behaviour in animals: A critical review. *Animal Welfare*, *29*(3), 231–238. https://doi.org/10.7120/09627286.29.3.231

Arena, I., Marliani, G., Sabioni, S., Gabai, G., Bucci, D., & Accorsi, P. A. (2021). Assessment of horses' welfare: Behavioral, hormonal, and husbandry aspects. *Journal of Veterinary Behavior*, *41*, 82–90. https://doi.org/10.1016/j.jveb.2021.01.006

Auer, U., Kelemen, Z., Engl, V., & Jenner, F. (2021). Activity time budgets—A potential tool to monitor equine welfare? *Animals, 11*(3), 850. https://doi.org/10.3390/ani11030850

Briefer Freymond, S., Briefer, E. F., Zollinger, A., Gindrat-von Allmen, Y., Wyss, C., & Bachmann, I. (2014). Behaviour of horses in a judgment bias test associated with positive or negative reinforcement. *Applied Animal Behaviour Science*, *158*, 34–45. https://doi.org/10.1016/j.applanim.2014.06.006

Bulens, A., Dams, A., Van Beirendonck, S., Van Thielen, J., & Driessen, B. (2015). A preliminary study on the long-term interest of horses in ropes and Jolly Balls. *Journal of Veterinary Behavior*, *10*(1), 83–86. https://doi.org/10.1016/j.jveb.2014.08.003

Bulens, A., Van Beirendonck, S., Van Thielen, J., & Driessen, B. (2013). The enriching effect of non-commercial items in stabled horses. *Applied Animal Behaviour Science*, *143*, 46–51. https://doi.org/10.1016/j.applanim.2012.11.012

Cameron, K. E., Siddall, A., & Bizo, L. A. (2021). Comparison of paired- and multiple-stimulus preference assessments using a runway task by dogs. *International Journal of Comparative Psychology*, *34*, 14.

Chazin, K. T., & Ledford, J. R. (2016). *Multiple stimulus without replacement (MSWO) preference assessment*. Evidence-Based Instructional Practices for Young Children with Autism and Other Disabilities. http://ebip.vkcsites.org/multiple-stimulus-without-replacement

Christensen, J. W., Ahrendt, L. P., Lintrup, R., Gaillard, C., Palme, R., & Malmkvist, J. (2012). Does learning performance in horses relate to fearfulness, baseline stress hormone, and social rank? *Applied Animal Behaviour Science*, *140*, 44–52. https://doi.org/10.1016/j.applanim.2012.05.003

Clegg, I. L. K., Rödel, H. G., Boivin, X., & Delfour, F. (2018). Looking forward to interacting with their caretakers: Dolphins' anticipatory behaviour indicates motivation to participate in specific events. *Applied Animal Behaviour Science*, *202*, 85–93. https://doi.org/10.1016/j.applanim.2018.01.015

Cooper, J. J. (1998). Comparative learning theory and its application in the training of horses. *Equine Veterinary Journal*, *30*(S27), 39–43. https://doi.org/10.1111/j.2042-3306.1998.tb05144.x

Coppola, C. L., Grandin, T., & Enns, R. M. (2006). Human interaction and cortisol: Can human contact reduce stress for shelter dogs? *Physiology & Behavior*, *87*(3), 537–541. https://doi.org/10.1016/j.physbeh.2005.12.001

Dai, F., Dalla Costa, A., Bonfanti, L., Caucci, C., Di Martino, G., Lucarelli, R., Padalino, B., & Minero, M. (2019). Positive reinforcement-based training for self-loading of meat horses reduces loading time and stress-related behavior. *Frontiers in Veterinary Science*, *6*. https://www.frontiersin.org/articles/10.3389/fvets.2019.00350

Farm Animal Welfare in Great Britain: Past, Present, and Future. (2009). Farm Animal Welfare Council. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/319292/Farm_Animal_Welfare_in_Great_Britain_-_Past__Present_and_Future.pdf

Fenner, K., Freire, R., McLean, A., & McGreevy, P. (2019). Behavioral, demographic, and management influences on equine responses to negative reinforcement. *Journal of Veterinary Behavior*, *29*, 11–17. https://doi.org/10.1016/j.jveb.2018.08.007

Ferguson, D. L., & Rosales-Ruiz, J. (2001). Loading the problem loader: The effects of target training and shaping on trailer-loading behavior of horses. *Journal of Applied Behavior Analysis*, *34*(4), 409–423. https://doi.org/10.1901/jaba.2001.34-409

Fox, A. E., Bailey, S. R., Hall, E. G., & St. Peter, C. C. (2012). Reduction of biting and chewing of horses using differential reinforcement of other behavior. *Behavioural Processes, 91*, 125–128. https://doi.org/10.1016/j.beproc.2012.05.001

Fox, A. E., & Belding, D. L. (2015). Reducing pawing in horses using positive reinforcement. *Journal of Applied Behavior Analysis*, *48*(4), 936–940. https://doi.org/10.1002/jaba.241

Friard, O. & Gamba, M. (2016) BORIS: a free, versatile open-source event-logging software for video/audio coding and live observations. Methods in Ecology and Evolution, 7(11), 1324-1330 DOI: 10.1111/2041-210X.12584

Fureix, C., Jego, P., Sankey, C., & Hausberger, M. (2009). How horses (Equus caballus) see the world: Humans as significant "objects." *Animal Cognition*, *12*, 643–654. https://doi.org/10.1007/s10071-009-0223-2

Gardner, L. P. (1933). The responses of horses to the situation of a closed feed box. *Journal of Comparative Psychology*, *15*(3), 445–467. https://doi.org/10.1037/h0074308

Goodwin, D., Davidson, H. P. B., & Harris, P. (2002). Foraging enrichment for stabled horses: Effects on behaviour and selection. *Equine Veterinary Journal*, *34*(7), 686–691. https://doi.org/10.2746/042516402776250450

Gunter, L. M., Gilchrist, R. J., Blade, E. M., Barber, R. T., Feuerbacher, E. N., Platzer, J. M., & Wynne, C. D. L. (2021). Investigating the Impact of Brief Outings on the Welfare of Dogs Living in US Shelters. *Animals*, *11*(2), Article 2. https://doi.org/10.3390/ani11020548

Hambrecht, S., Oerke, A. K., Heistermann, M., Hartig, J., & Dierkes, P. W. (2021). Effects of positive reinforcement training and novel object exposure on salivary cortisol levels under consideration of individual variation in captive african elephants (Loxodonta africana). *Animals*, *11*, Article 12. https://doi.org/10.3390/ani11123525

Hausberger, M., Gautier, E., Biquand, V., Lunel, C., & Jégo, P. (2009). Could work be a source of behavioural disorders? A study in horses. *PLoS ONE*, *4*(10), e7625. https://doi.org/10.1371/journal.pone.0007625

Hausberger, M., & Muller, C. (2002). A brief note on some possible factors involved in the reactions of horses to humans. *Applied Animal Behaviour Science*, *76*, 339–344. https://doi.org/10.1016/S0168-1591(02)00016-3

Hausberger, M., Roche, H., Henry, S., & Visser, E. K. (2008). A review of the human–horse relationship. *Applied Animal Behaviour Science, 109*, 1–24. https://doi.org/10.1016/j.applanim.2007.04.015

Hausberger, M., Stomp, M., Sankey, C., Brajon, S., Lunel, C., & Henry, S. (2019). Mutual interactions between cognition and welfare: The horse as an animal model. *Neuroscience and Biobehavioral Reviews, Elsevier, 107*, 540–559. https://doi.org/10.1016/j.neubiorev.2019.08.022

Heleski, C. R., & Anthony, R. (2012). Science alone is not always enough: The importance of ethical assessment for a more comprehensive view of equine welfare. *Journal of Veterinary Behavior, 7*(3), 169–178. https://doi.org/10.1016/j.jveb.2011.08.003

Henderson, V., & Waran, N. K. (2001). Reducing equine stereotypies using an equiball. *Animal Welfare*, *10*, 73–80. https://doi.org/10.1017/S0962728600023277

Hendriksen, P., Elmgreen, K., & Ladewig, J. (2011). Trailer-loading of horses: Is there a difference between positive and negative reinforcement concerning effectiveness and stress-related signs? *Journal of Veterinary Behavior*, *6*, 261–266. https://doi.org/10.1016/j.jveb.2011.02.007

Hockenhull, J., & Creighton, E. (2010). Unwanted oral investigative behaviour in horses: A note on the relationship between mugging behaviour, hand-feeding titbits and clicker training. *Applied Animal Behaviour Science*, *127*, 104–107. https://doi.org/10.1016/j.applanim.2010.08.008

Hockenhull, J., & Whay, H. R. (2014). A review of approaches to assessing equine welfare. *Equine Veterinary Education*, *26*(3), 159–166. https://doi.org/10.1111/eve.12129

Holmes, T. Q., & Brown, A. F. (2022). Champing at the bit for improvements: A review of equine welfare in equestrian sports in the United Kingdom. *Animals*, *12*, Article 9. https://doi.org/10.3390/ani12091186

Hunt, R. L., Whiteside, H., & Prankel, S. (2022). Effects of Environmental Enrichment on Dog Behaviour: Pilot Study. *Animals*, *12*(2), Article 2. https://doi.org/10.3390/ani12020141

Innes, L., & McBride, S. (2008). Negative versus positive reinforcement: An evaluation of training strategies for rehabilitated horses. *Applied Animal Behaviour Science*, *112*, 357–368. https://doi.org/10.1016/j.applanim.2007.08.011

Jørgensen, G. H. M., Liestøl, S. H.-O., & Bøe, K. E. (2011). Effects of enrichment items on activity and social interactions in domestic horses (Equus caballus). *Applied Animal Behaviour Science*, *129*, 100–110. https://doi.org/10.1016/j.applanim.2010.11.004

Kelly, K. J., McDuffee, L. A., & Mears, K. (2021). The effect of human–horse interactions on equine behaviour, physiology, and welfare: A scoping review. *Animals*, *11*, Article 10. https://doi.org/10.3390/ani11102782

Kieson, E. (2017). *Equine preferences for food rewards versus human contact and implications for interspecies social bonding.* Oklahoma State University.

Kieson, E., Felix, C., Webb, S., & Abramson, C. I. (2020). The effects of a choice test between food rewards and human interaction in a herd of domestic horses of varying breeds and experiences. *Applied Animal Behaviour Science*, *231*, 105075. https://doi.org/10.1016/j.applanim.2020.105075

Kobert, M. G. (1998). *Operant conditioning as an enrichment strategy at the San Diego Zoo*. International Conference on Environmental Enrichment.

Lansade, L., Trösch, M., Parias, C., Blanchard, A., Gorosurreta, E., & Calandreau, L. (2021). Horses are sensitive to baby talk: Pet-directed speech facilitates communication with humans in a pointing task and during grooming. *Animal Cognition*, *24*, 999–1006. https://doi.org/10.1007/s10071-021-01487-3

Lansade, L., Valenchon, M., Foury, A., Neveux, C., Cole, S. W., Layé, S., Cardinaud, B., Lévy, F., & Moisan, M. P. (2014). Behavioral and Transcriptomic Fingerprints of an Enriched Environment in Horses (Equus caballus). *PLoS ONE*, *9*(12), e114384. https://doi.org/10.1371/journal.pone.0114384

Larssen, R., & Roth, L. S. V. (2022). Regular positive reinforcement training increases contact-seeking behaviour in horses. *Applied Animal Behaviour Science*, *252*, 105651. https://doi.org/10.1016/j.applanim.2022.105651

Laule, G., Bloomsmith, M. A., & Schapiro, S. (2003). The use of positive reinforcement training techniques to enhance the care, management, and welfare of primates in the laboratory. *Journal of Applied Animal Welfare Science*, *6*(3), 163–173. https://doi.org/10.1207/S15327604JAWS0603_02

Laule, G., & Desmond, T. (1998). Positive reinforcement training as an enrichment strategy. In *Second nature: Environmental enrichment for captive animals* (pp. 302–313). https://vt.hosts.atlas-sys.com/illiad/illiad.dll?Action=10&Form=75&Value=1671580

Laule, G. E., Bloomsmith, M. A., & Schapiro, S. J. (2003). The use of positive reinforcement training techniques to enhance the care, management, and welfare of primates in the laboratory. *Journal* *of Applied Animal Welfare Science: JAAWS*, *6*(3), 163–173. https://doi.org/10.1207/S15327604JAWS0603_02

Lee, J. B., & Cherney, L. R. (2018). Tau-U: A Quantitative Approach for Analysis of Single-Case Experimental Data in Aphasia. *American Journal of Speech-Language Pathology*, *27*(1S), 495–503. https://doi.org/10.1044/2017_AJSLP-16-0197

Lesimple, C. (2020). Indicators of horse welfare: State-of-the-Art. *Animals : An Open Access Journal from MDPI*, *10*(2), 294. https://doi.org/10.3390/ani10020294

Lundberg, P., Hartmann, E., & Roth, L. S. V. (2020). Does training style affect the human-horse relationship? Asking the horse in a separation–reunion experiment with the owner and a stranger. *Applied Animal Behaviour Science*, *233*, 105144. https://doi.org/10.1016/j.applanim.2020.105144

McDonnell, S. M. (2003). *The equid ethogram: A practical field guide to horse behavior* (First). Eclipse Press.

McGreevy, P. D. (2007). The advent of equitation science. *The Veterinary Journal*, *174*, 492–500. https://doi.org/10.1016/j.tvjl.2006.09.008

McKenzie, J., Fenner, K., Hyde, M., Anzulewicz, A., Burattini, B., Romness, N., Wilson, B., & McGreevy, P. (2021). Equine responses to acceleration and deceleration cues may reflect their exposure to multiple riders. *Animals*, *11*(1), Article 1. https://doi.org/10.3390/ani11010066

McLean, A. N. (2005). The positive aspects of correct negative reinforcement. *Anthrozoös*, *18*(3), 245–254. https://doi.org/10.2752/089279305785594072

McLean, A. N., & Christensen, J. W. (2017). The application of learning theory in horse training. *Applied Animal Behaviour Science*, *190*, 18–27. https://doi.org/10.1016/j.applanim.2017.02.020

Mellor, D. J., & Beausoleil, N. (2015). Extending the "Five Domains" model for animal welfare assessment to incorporate positive welfare states. *Animal Welfare*, *24*. https://doi.org/10.7120/09627286.24.3.241

Mills, D. S., & Clarke, A. (2006). Housing, Management and Welfare. In *The welfare of horses* (Vol. 1, pp. 77–97). Kluwer Academic Publishers. https://doi.org/10.1007/0-306-48215-0_5

Minero, M., & Canali, E. (2009). Welfare issues of horses: An overview and practical recommendations. *Italian Journal of Animal Science*, *8*(sup1), 219–230. https://doi.org/10.4081/ijas.2009.s1.219

Momozawa, Y., Kusunose, R., Kikusui, T., Takeuchi, Y., & Mori, Y. (2005). Assessment of equine temperament questionnaire by comparing factor structure between two separate surveys. *Applied Animal Behaviour Science*, *92*(1–2), 77–84. https://doi.org/10.1016/j.applanim.2004.11.006

Nicol, C. (1999). Understanding equine stereotypies. *Equine Veterinary Journal*, *31*(S28), 20–25. https://doi.org/10.1111/j.2042-3306.1999.tb05151.x

Normando, S., Canali, E., Ferrante, V., & Verga, M. (2002). Behavioral problems in Italian saddle horses. *Journal of Equine Veterinary Science*, *22*(3), 117–120. https://doi.org/10.1016/S0737-0806(02)70123-8

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy*, *42*(2), 284–299. https://doi.org/10.1016/j.beth.2010.08.006

Payne, E., DeAraugo, J., Bennett, P., & McGreevy, P. (2016). Exploring the existence and potential underpinnings of dog–human and horse–human attachment bonds. Behavioural Processes, 125, 114–121. https://doi.org/10.1016/j.beproc.2015.10.004

Peters, S. M., Bleijenberg, E. H., van Dierendonck, M. C., van der Harst, J. E., & Spruijt, B. M. (2012). Characterization of anticipatory behaviour in domesticated horses (Equus caballus). *Applied Animal Behaviour Science*, *138*, 60–69. https://doi.org/10.1016/j.applanim.2012.01.018

Pomerantz, O., & Terkel, J. (2009). Effects of positive reinforcement training techniques on the psychological welfare of zoo-housed chimpanzees (Pan troglodytes). *American Journal of Primatology*, *71*(8), 687–695. https://doi.org/10.1002/ajp.20703

Sankey, C., Richard-Yris, M.-A., Henry, S., Fureix, C., Nassur, F., & Hausberger, M. (2010b). Reinforcement as a mediator of the perception of humans by horses (Equus caballus). *Animal Cognition*, *13*, 753–764. https://doi.org/10.1007/s10071-010-0326-9

Sankey, C., Richard-Yris, M.-A., Leroy, H., Henry, S., & Hausberger, M. (2010a). Positive interactions lead to lasting positive memories in horses, Equus caballus. *Animal Behaviour*, *79*, 869–875. https://doi.org/10.1016/j.anbehav.2009.12.037

Skinner, B. F. (1983). *A matter of consequences: Part three of an autobiography*. https://vt.hosts.atlas-sys.com/illiad/illiad.dll?Action=10&Form=75&Value=1671658

Slater, C., & Dymond, S. (2011). Using differential reinforcement to improve equine welfare: Shaping appropriate truck loading and feet handling. *Behavioural Processes*, *86*, 329–339. https://doi.org/10.1016/j.beproc.2011.02.001

Smith, A., Proops, L., Grounds, K., Wathan, J., Scott, S., & McComb, K. (2018). Domestic horses (Equus caballus) discriminate between negative and positive human nonverbal vocalisations. *Scientific Reports*, *8*, 13052. https://doi.org/10.1038/s41598-018-30777-z

Stanley, S. O., Cant, J. P., & Osborne, V. R. (2015). A pilot study to determine whether a tongue-activated liquid dispenser would mitigate abnormal behavior in pasture-restricted horses. *Journal of Equine Veterinary Science*, *35*(11–12), 973–976. https://doi.org/10.1016/j.jevs.2015.08.016

Stone, S. M. (2010). Human facial discrimination in horses: Can they tell us apart? *Animal Cognition*, *13*, 51–61. https://doi.org/10.1007/s10071-009-0244-x

Takahashi, A., Nishiyama, K., Ohkita, M., & Sawa, K. (2016). Failure to find reinforcement effect of neck patting in horses (Equus caballus). *Psychologia*, *59*, 91–99.

Thorne, J. B., Goodwin, D., Kennedy, M. J., Davidson, H. P. B., & Harris, P. (2005). Foraging enrichment for individually housed horses: Practicality and effects on behaviour. *Applied Animal Behaviour Science*, *94*, 149–164. https://doi.org/10.1016/j.applanim.2005.02.002

Valenchon, M., Lévy, F., Moussu, C., & Lansade, L. (2017). Stress affects instrumental learning based on positive or negative reinforcement in interaction with personality in domestic horses. *PLoS ONE*, *12*(5), 0170783. https://doi.org/10.1371/journal.pone.0170783

van der Harst, J. E., Fermont, P. C. J., Bilstra, A. E., & Spruijt, B. M. (2003). Access to enriched housing is rewarding to rats as reflected by their anticipatory behaviour. *Animal Behaviour*, *66*, 493–504. https://doi.org/10.1006/anbe.2003.2201

van der Harst, J. E., & Spruijt, B. (2007). Tools to measure and improve animal welfare: Reward-related behaviour. *Anim Welfare*, *16*. https://doi.org/10.1017/S0962728600031742

Vannest, K.J., Parker, R.I., Gonen, O., & Adiguzel, T. (2016). Single Case Research: web based calculators for SCR analysis. (Version 2.0) [Web-based application]. College Station, TX: Texas A&M University. Retrieved Wednesday 19th July 2023. Available from singlecaseresearch.org

Vieira de Castro, A. C., Fuchs, D., Morello, G. M., Pastur, S., Sousa, L. de, & Olsson, I. A. S. (2020). Does training method matter? Evidence for the negative impact of aversive-based methods on companion dog welfare. *PLOS ONE*, *15*(12), e0225023. https://doi.org/10.1371/journal.pone.0225023

Waiblinger, S., Boivin, X., Pedersen, V., Tosi, M.-V., Janczarek, A., Visser, E. K., & Jones, R. B. (2006). Assessing the human–animal relationship in farmed species: A critical review. *Applied Animal Behaviour Science*, 185–242. https://doi.org/10.1016/j.applanim.2006.02.001

Waran, N., & Casey, R. (2005). Horse training. In *The domestic horse: The origins, development, and management of its behaviour* (1st ed., pp. 184–195). Cambridge University Press. https://vt.hosts.atlas-sys.com/illiad/illiad.dll?Action=10&Form=75&Value=1664231

Waran, N., McGreevy, P., & Casey, R. (2006). Training methods and horse welfare. In *The welfare of horses* (Vol. 1, pp. 151–180). Kluwer Academic Publishers. https://doi.org/10.1007/0-306-48215-0_5

Warren-Smith, A. K., & McGreevy, P. D. (2008). Equestrian coaches' understanding and application of learning theory in horse training. *Anthrozoos*, *21*(2), 153–163.

Warren-Smith, A. K., McLean, A. N., Nicol, H. I., & McGreevy, P. D. (2005). Variations in the timing of reinforcement as a training technique for foals (Equus caballus). *Anthrozoös*, *18*(3), 255–272. https://doi.org/10.2752/089279305785594117

Whisher, L., Raum, M., Pina, L., Pérez, L., Erb, H., Houpt, C., & Houpt, K. (2011). Effects of environmental factors on cribbing activity by horses. *Applied Animal Behaviour Science - APPL ANIM BEHAV SCI*, *135*. https://doi.org/10.1016/j.applanim.2011.09.001

Winskill, L. C., Waran, N. K., & Young, R. J. (1996). The effect of a foraging device (a modified 'Edinburgh Foodball') on the behaviour of the stabled horse. *Applied Animal Behaviour Science*, *48*(1–2), 25–35. https://doi.org/10.1016/0168-1591(95)01021-1

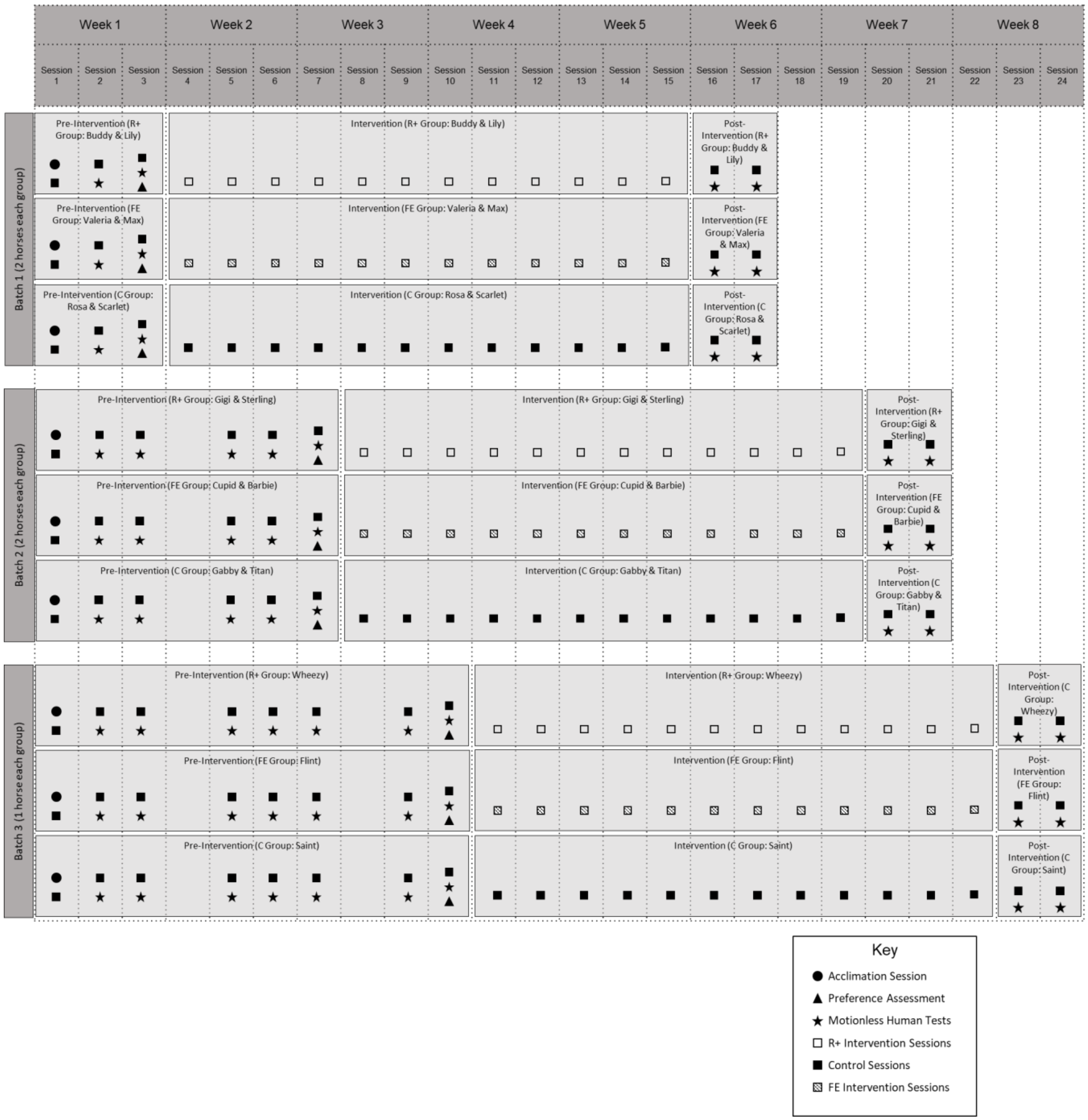
Wires, C., Hoffman, R., Talbert, A., Brady, C., O'Haire, M., & Croney, C. (2022). 111 Ability to interpret and apply animal behavior and welfare terminology by adults within the horse industry. *Journal of Equine Veterinary Science*, *100*, 103574. https://doi.org/10.1016/j.jevs.2021.103574

Xenophon. (n.d.). *On Horsemanship, by Xenophon*. Retrieved June 19, 2023, from https://www.gutenberg.org/files/1176/1176-h/1176-h.htm

Yamanashi, Y., & Hayashi, M. (2011). Assessing the effects of cognitive experiments on the welfare of captive chimpanzees (Pan troglodytes) by direct comparison of activity budget between wild and captive chimpanzees. *American Journal of Primatology*, *73*, 1231–1238. https://doi.org/10.1002/ajp.20995

APPENDICES

Appendix A: Design with Group and Batch Assignments



Appendix B: Temperament Assessment Results

	Horse														
Question	**Barbie**	**Buddy**	**Cupid**	**Flint**	**Gigi**	**Kip**	**Lily**	**Max**	**Rosa**	**Saint**	**Scarlet**	**Sterling**	**Titan**	**Valeria**	**Wheezy**
- become nervous about insects, noises, etc.	2	5	1	1	1	3	1	1	1	1	1	1	1	7	1
- be trainable and undisturbed by the environment	2	4	9	9	9	4	9	9	8	9	9	2	7	3	8
- be at ease if left alone away from other horses or the herd	2	7	9	8	9	8	9	9	7	8	9	2	9	8	2
- be trained easily and promptly	2	6	9	9	9	3	9	9	8	7	9	3	4	5	6
- get excited easily	5	4	1	3	1	4	1	1	5	1	1	2	2	5	3
- be aggressive or fearful	2	2	1	1	1	3	1	1	1	1	1	2	1	5	6
- be aggressive or fearful (reverse scored)	8	8	9	9	9	7	9	9	9	9	9	8	9	5	4
- be interested in novel objects and approaches them	5	5	1	1	1	2	1	1	5	7	1	2	9	2	2
- memorize what it learned or was trained	8	7	9	9	9	7	9	9	7	7	9	7	5	7	8
- get excited to an abnormal extent	3	2	1	2	1	2	1	1	4	1	1	1	1	2	2
- be cooperative with a caretaker when handled	9	9	9	9	9	3	9	9	7	9	9	8	8	8	5
- be unpredictable from day to day	6	2	1	1	1	3	1	1	2	1	1	1	2	4	5
- be obstinate once it resists a command	5	3	1	1	1	6	1	1	2	6	1	2	3	5	3
- be docile in general	5	8	9	9	9	6	9	9	9	9	9	7	2	7	2
- be vigilant (watchful) about its surroundings	5	6	1	9	1	2	1	1	6	8	1	2	2	9	2
- be patient with various stimuli	5	6	9	9	9	4	9	9	8	9	9	2	2	5	8
- interact with other horses in a friendly manner	5	7	9	7	9	8	9	9	8	9	9	4	5	4	6

Question	Barbie	Buddy	Cupid	Flint	Gigi	Kip	Lily	Max	Rosa	Saint	Scarlet	Sterling	Titan	Valeria	Wheezy
- be dominant in antagonistic encounters with other horses	8	6	1	3	1	2	1	1	1	5	1	2	2	7	2
- get surprised easily	5	7	1	1	1	4	1	1	2	2	1	2	2	7	2
- be timid in a novel environment	3	5	1	1	1	1	1	1	5	1	1	2	4	6	2
- go easily through a [starting] gate	8	8	9	9	9	N/A	9	9	9	N/A	9	8	1	8	N/A

	Horse														
Trait Totals	**Barbie**	**Buddy**	**Cupid**	**Flint**	**Gigi**	**Kip**	**Lily**	**Max**	**Rosa**	**Saint**	**Scarlet**	**Sterling**	**Titan**	**Valeria**	**Wheezy**
Anxiety Score	29	31	7	18	7	19	7	7	25	15	7	11	14	40	17
Anxiety Bin	Medium	Medium	Low	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Medium	Low
Trainability Score	17	23	36	36	36	18	36	36	31	32	36	14	18	20	30
Trainability Bin	Medium	Medium	High	High	High	Medium	High	High	High	High	High	Medium	Medium	Medium	High
Affability Score	27	32	36	34	36	24	36	36	33	36	36	27	24	24	17
Affability Bin	High	High	High	High	High	Medium	High	High	High	High	High	High	Medium	Medium	Medium

Appendix C: Preference Assessment Scoring Sheet

MSWO 5-item data sheet.pdf

Appendix D: Shaping Plans

Goal Behavior	Standing Still
Starting Behavior	Horse can stand in a neutral position for one second
Steps	**Notes**
Standing Still (Head Away) for the Reinforcer	
1. No criteria for horse - mark and feed treats to begin conditioning of marker	Once it's established that the horse receives a food reinforcer (treat) after each mark, the horse may become increasingly muggy. Feed the treat on the opposite side of the horse, under the neck away from the trainer, to encourage their head to stay away in anticipation of treats. Continue for about 10 repetitions before beginning operant protocol.
2. Horse stands with head either in neutral position or to the side away from the trainer	In the beginning, accept any position that is out of the trainer's space. Begin to discriminate a more neutral position: if the horse's head is all the way to the side, wait until it moves a few inches closer to neutral position. Continue for a few trials and then increase criteria to a more neutral position until Step 3 is achieved.
3. Horse stands in neutral position (head generally same height as withers and not stretched out to either side, all four feet on the ground, excepting movement to remove bugs or a hip camped out to the side) for one second	Once it is established that the horse can stand with head in appropriate position, the exercise can move to building duration with a stand / stay.
Criteria for Advancement	
• Increase after 3/3 successful repetitions at distance, location, time duration, or when next behavior is captured organically • Keep criteria the same if achieving 2/3 successful repetitions at distance, location, or time duration • Drop criteria to last successful distance is only achieving 1/3 successful repetitions at distance, location, or time duration	
Goal Behavior	
Horse stands still for 10 seconds in a neutral position.	

Goal Behavior	Nose Target
Starting Behavior	Horse stands in neutral position while target is presented about 6 inches in front of nose
Steps	**Notes**
1. Horse attends to target (perks ears, makes brief motion toward the presentation of it, etc.)	Typically, horse will jump to step 3 on presentation of novel target, but steps 1 and 2 can be used if necessary.
2. Horse moves nose toward target a. Horse moves nose toward target, with decreasing space between nose and target (6 inches, 5 inches, 4 inches. etc. until touching target)	
3. Horse touches nose to target and removes	
4. Horse touches nose to target on verbal cue	
5. Horse holds nose to target for duration a. Horse holds nose to target for increasing time criteria (1 second, 2 seconds, 3 seconds, 5 seconds, 7 seconds, etc. up to 30 seconds)	
6. Horse touches nose to target in a variety of positions a. Location to vary from 6 inches in front of nose to different locations in same plane (2 inches to the right or left, up or down)	
7. Location to vary from 6 inches in front of nose to different distances from face (8 inches from nose, 10 inches from nose, etc.)	
8. Location to vary through other dimensions, including stretching to the side, down towards the ground, higher in the air, etc.	
Criteria for Advancement	
• Increase after 3/3 successful repetitions at distance, location, time duration, or when next behavior is captured organically • Keep criteria the same if achieving 2/3 successful repetitions at distance, location, or time duration • Drop criteria to last successful distance is only achieving 1/3 successful repetitions at distance, location, or time duration	
Goal Behavior	
Horse holds nose to target in varied positions for 30 seconds.	

Goal Behavior	Liberty Leading
Starting Behavior	Horse can stand still for food reinforcer; horse can touch nose to target
Steps	**Notes**
1. Standing next to the horse (on their left side), with the trainer's shoulder next to middle of neck, mark and feed	
2. Trainer takes a small step forward and presents the target so that the horse must stretch head up to a position that places the trainer in the center of the horse's neck to touch its nose to the target	
3. Trainer adjusts target position so that it is slightly out of horse's reach, reinforcing: a. Weight shift forward b. Leg lift to move forward c. Forward step	After several successful repetitions of the trainer taking a step forward and the horse taking a step forward to reach the target, fade the target, reinforcing any forward movement that happens before the target is presented and only using it when horse does not offer any forward movement after 3 tries.
4. Add a verbal cue ("Let's go") before the trainer takes a step forward	
5. Increase the distance the trainer walks forward with horse stepping beside a. 2 steps b. 3 steps c. 5 steps, etc.	
6. Add a left turn, having trainer take one step to the left, reinforcing: a. Weight shift to the left b. Lifting of foot to move sideways c. Sideways step	
7. Increase duration/distance of left turn, having trainer take increasing number of steps diagonally from the horse	Continue to sprinkle in trials of forward movement, rather than only taking left turns
8. Add a right turn, having trainer take one step towards the horse, reinforcing: a. Weight shift to the right b. Lifting of foot to move sideways c. Sideways step	Trainer's body position here can be helpful, as stepping directly into the horse's space can create some natural momentum in the right direction.
9. Increase duration/distance of right turn, having trainer take increasing number of steps diagonally from the horse	Continue to sprinkle in trials of forward movement and left turns, rather than only taking right turns
10. Increase duration of horse walking beside trainer, including left and right turns a. 5 seconds b. 10 seconds c. 15 seconds d. 20 seconds	

e. 25 seconds f. 30 seconds	

Criteria for Advancement
• Increase after 3/3 successful repetitions at distance, location, time duration or when next behavior is captured organically • Keep criteria the same if achieving 2/3 successful repetitions at distance, location, or time duration • Drop criteria to last successful distance is only achieving 1/3 successful repetitions at distance, location, or time duration

Goal Behavior
Horse walks with trainer, staying shoulder to shoulder for 30 seconds.

<table>
<tr><th>Goal Behavior</th><td>Standing Still (“Stay”)</td></tr>
<tr><th>Starting Behavior</th><td>Horse can stand still for food reinforcer; horse can touch nose to target</td></tr>
<tr><th>Steps</th><th>Notes</th></tr>
<tr><td>1. Horse stands in neutral position (head generally same height as withers and not stretched out to either side, all four feet on the ground, excepting movement to remove bugs or a hip camped out to the side) for one second.
a. Add a verbal cue (“Stand” or “Stay”) or tactile cue (two hands touched to neck or shoulder) for the behavior</td><td>This is the end criteria for the Standing Still (For Reinforcer) plan.</td></tr>
<tr><td>2. Build duration on the stay, with the horse standing in neutral position for increasing duration
a. 2 seconds
b. 3 seconds
c. 5 seconds
d. 7 seconds
e. 10 seconds
f. 15 seconds
g. 20 seconds
h. 25 seconds
i. 30 seconds</td><td></td></tr>
<tr><td>3. Begin building duration with trainer’s movement.
a. Take one step away and return
b. Take two steps away and return, etc.
c. Vary direction in which the trainer steps away</td><td></td></tr>
<tr><th colspan="2">Criteria for Advancement</th></tr>
<tr><td colspan="2">• Increase after 3/3 successful repetitions at distance, location, time duration, or when next behavior is captured organically
• Keep criteria the same if achieving 2/3 successful repetitions at distance, location, or time duration
• Drop criteria to last successful distance is only achieving 1/3 successful repetitions at distance, location, or time duration</td></tr>
<tr><th colspan="2">Goal Behavior</th></tr>
<tr><td colspan="2">Horse stands still for 30 seconds while trainer walks around.</td></tr>
</table>

Goal Behavior	Backing on verbal cue
Starting Behavior	Horse can touch nose to target.
Steps	**Notes**
1. Horse touches target when placed directly under nose	
2. Horse touches target with increasing distance towards chest (markers: throatlatch, 6 inches from throatlatch, 6 inches from chest)	
3. Horse shifts weight back to reach target	
4. Horse shifts weight back and lifts leg to step back to reach target	
5. Horse takes steps back to reach target, in increasing steps (1 step, 2 steps, 3 steps, 4 steps) (keep target moving with horse until desired criteria is met)	
6. Introduce verbal cue before target is presented on each trial, lengthening time between verbal cue and target presentation until horse is reliably beginning to back before presentation of the target	
Criteria for Advancement	
• Increase after 3/3 successful repetitions at distance or when next behavior is captured organically • Keep criteria the same if achieving 2/3 successful repetitions at distance, location, or time duration • Drop criteria to last successful distance is only achieving 1/3 successful repetitions at distance, location, or time duration	
Goal Behavior	
Horse backs up 4 steps when trainer gives a verbal cue.	

Goal Behavior	Hoof to mat
Starting Behavior	Horse can stand quietly for food delivery, Knows how to Liberty Lead or back on cue
Steps	**Notes**
1. Trainer places mat on the ground a few feet in front of the horse and reinforces any movement towards the mat, such as: a. Orientation towards b. Weight shift towards c. Step towards	
2. Sniff mat	
3. Paw at mat	To begin, mark and reinforce the first touch of the mat with the foot. If the horse paws repeatedly at the mat, move to marking for the end of the pawing, when the horse's foot rests on the mat.
4. Places one front hoof on mat (without pawing)	Between trials, the horse's hoof must move off the mat. This can be done through Liberty Leading or a Backing cue.
5. Places both front hooves on mat	Start gradually with the second foot, going through same process as first hoof. Reinforce for weight shift of second hoof, step up of second hoof, and eventually move to second hoof stepping fully on to mat.
6. Places both front hooves on mat for duration while standing within stepping distance: a. 1 second b. 2 seconds c. Etc.	
7. Add a verbal cue ("Mat")	
8. Increase the distance the horse must move to place paw on the mat: a. 2 steps b. 3 steps c. 5 steps d. Etc., up to 10 steps	If desired, at this point the trainer can vary where they are when they ask the horse to move to the mat.
Criteria for Advancement	
• Increase after 3/3 successful repetitions at distance or when next behavior is captured organically • Keep criteria the same if achieving 2/3 successful repetitions at distance, location, or time duration • Drop criteria to last successful distance is only achieving 1/3 successful repetitions at distance, location, or time duration	

Goal Behavior
Horse walks 10 feet and places both front hooves on mat on verbal cue.