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Interspecific Communication From People To Horses Is Influenced By Different Horsemanship Training Styles

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Abstract

The ability of many domesticated animals to follow human pointing gestures to locate hidden food has led to scientific debate on the relative importance of domestication and individual experience on the origins and development of this capacity. To further explore this question we examined the influence of different prior training histories/methods on the ability of horses (*Equus ferus caballus*) to follow a momentary distal point. Ten horses previously trained using one of two methods (Parelli Natural Horsemanship or traditional horse training) were tested using a standard object choice task. The results show that neither group of horses was able to follow the momentary distal point initially. However, after more experience with the point, horses previously trained using Parelli's Natural Horsemanship method learned to follow momentary distal points significantly faster than those previously trained with traditional methods. The poor initial performance of horses on distal pointing tasks, coupled with the finding that prior training history and experimental experience can lead to success on this task, fails to support the predictions of the Domestication Hypothesis, and instead lends support to the Two-Stage Hypothesis.

Keywords: Equus ferus caballus, object-choice task, momentary distal point, ParelliNatural Horsemanship, traditional horse training, social cognition, learning

Interspecific Communication From People To Horses Is Influenced By Different Horsemanship Training Styles

Domestic dogs living as pets have been found to be very skilful at following a variety of different human pointing gestures (for reviews see Miklósi & Soproni, 2006 and Udell & Wynne, 2008). However the origins of this ability have been heavily debated. Some have argued that the ability to follow human gestures evolved as a consequence or byproduct of selection during domestication (Hare et al., 2010; Hare & Tomasello, 2005; Miklósi, Polgardi, Topal & Csanyi, 1998). Consequently, proponents of the domestication hypothesis predicted that domesticated animals would have a natural sensitivity to human gestures independent of environment or lifetime experience. Furthermore, non-domesticated counterparts should not share this sensitivity. However, in recent years, it has been demonstrated that environment and individual experience play an important role in the ability of a wide range of species to follow human gestures (for a review see Udell, Dorey, & Wynne, 2010b). As a result, greater attention has been given to the importance of individual lifetime experiences in the development of this sensitivity, culminating in the two stage hypothesis (Udell et al., 2010b). According to the two stage hypothesis, an individual's ability to follow human gestures depends on an animal's lifetime, as well as its evolutionary, history including the acceptance of humans as social companions in early life and conditioning to follow human limbs to obtain desired consequences (Udell et al., 2010b). Thus, according to the two stage hypothesis, differences in gesture responsiveness within or between species may develop based on different styles of interaction or methods of training used throughout an individual life. Such differences would not be predicted by the domestication hypothesis.

Horses (*Equus ferus caballus*), like dogs, are domesticated animals. However, unlike dogs horses do not typically live inside human homes and typically have very different training experiences and thus may not get the same kind or quantity of exposure to human gestures that dogs experience. To date only three studies have investigated the ability of horses to follow human gestures using the object-choice task. In the object-choice task, a human uses a pointing gesture to indicate which of two identical containers the animal will be rewarded for approaching. McKinley and Sambrook (2000) reported that horses were significantly less successful in following two types of human gestures than were dogs tested under similar conditions. Only two of the four horses tested successfully followed a touch gesture (where the experimenter switched from a neutral position to touching the container until the horse made its choice) and only one of the four horses successfully used a more complex dynamic pointing cue (where the experimenter stood approximately .75 m back from the container and alternated between a pointing position and a neutral position until the horse made its choice). McKinley and Sambrook (2000) concluded that the differences in performance between dogs and horses might be explained by different social experiences among individual horses and/or different selective pressures during domestication.

In another study, Maros, Gàsci and Miklósi (2008) tested twenty horses on four different types of human pointing gestures. On average the subjects were able to follow all of the points given except the momentary distal point (where the experimenter's finger was > 50 cm from the target and returned to a neutral position before the horse was released). Because horses appeared to preferentially follow points made close to the container and held in place, Maros et al. (2008) suggested that the horses could have been using stimulus or local enhancement to guide their choices –which would not require them to understand the referential meaning of the pointing gesture.

To further investigate the role of stimulus enhancement, Proops, Walton and McComb (2010) compared cues that remained in place while the horse was making its choice with cues that were removed before the horse could make its choice. Proops et al. (2010) found their subjects were able to use the sustained point and markers that were kept in place while the horse was making its choice, but not the momentary tapping cue, in which the experimenter taps the side of the correct bucket three times with large movements of the arm and returns to a standing posture until a choice is made. The authors concluded that the horses in their study used stimulus enhancement (see Whiten & Ham, 1992) to choose the correct bucket in the object choice task. Thus the question remains whether there are conditions under which horses will follow more challenging gesture types, such as those that dogs have successfully used, including the momentary distal point.

No study to date has explicitly compared the performance of groups of horses trained with different methods or those living in substantially different environments. This is important because several studies have demonstrated that dogs with certain training histories (e.g. agility training) exhibit more social sensitivity towards humans on socio-cognitive tasks than those with more independently oriented training histories (e.g. search and rescue) (Marshall-Pescini, Passalacqua, Barnard, Valsecchi, & Prato-Previde, 2009) . Currently there are a wide range of methods used to train horses. Two of the most widely used methods are traditional training and Parelli™ Natural Horsemanship Training (Skipper, 2007). These methods vary greatly in how the handler interacts with the horse.

For the purpose of this paper, traditional horse training will be defined as training involving the use of tools that serve as supplements to or extensions of the human body (e.g. leads, bits, spurs, martingales, etc) with the majority of training occurring on the horse's back (low emphasis on human-gestures as visual training cues). In contrast, trainers using the Parelli Natural Horsemanship method (Parelli Natural Horsemanship, Inc., Pagosa Springs, CO, Miller & Lamb, 2005) primarily use the movement of their body (arms, hands, legs, feet and facial expressions) to remotely control the movement of the horse. These gestures are presented while the human is on the ground in the horse's direct view (Parelli, 1993). While this method does use some tools (i.e., special halter) their use is explicitly paired with human gestures and then faded out as training continues (strong emphasis on human-gestures as visual training cues).

The purpose of this study is to compare the point-following performance of Parelli Natural Horsemanship™ trained horses with traditionally trained horses in a human-guided object choice task. Because these horse training methods differ in their emphasis on gestural communication, we predicted that if individual lifetime experience was important to the development of point following behavior in horses (as the two stage hypothesis predicts), then these different training histories should influence a horse's ability to use, or learn to use, human gestures as has been previously demonstrated in dogs (Marshall-Pescini et al., 2009). However if, through domestication, horses were equally prepared to respond to human gestures independent of lifetime experience (as predicted by the domestication hypothesis), then horses from both groups should succeed on the task without additional training, independent of their different histories.

Method

Subjects

Twenty horses, nine males and 11 females, participated in this experiment (See Table 1). All horses were unfamiliar to the experimenters and had not participated in previous experiments. All horses lived in private stables, but were let out periodically for riding and grazing. Horses were kept on their regular diets, but were not fed for 4hrs before testing to ensure sufficient food motivation.

Ten horses had been trained using traditional methods and the other ten had been trained using Parelli Natural Horsemanship by official trainers. Parelli Natural Horsemanship horses were tested at the Florida Parelli Center in Ocala, Florida. Traditional horses were tested at their current owner's ranch in Ocala, Florida. All horses had been living with, and cared for by, their current owner for a minimum of 3 years. The caretaker of the horses confirmed each horse's training history was consistent with one of the two defined experimental training categories before inclusion in the study.

Materials and Procedures

All horses were tested individually in a fenced area (approximatly18.29 m in diameter with fence height of 1.83 m) on the property where they were being housed. Two identical feed buckets hung on either side of an experimenter, 2 m apart from each other and 3 m from the subject (Figure 1). Carrots, apples, or horse treats were used to reinforce correct responses depending on the preference of the subject.

---Insert Figure 1 About Here---

In both the testing and control conditions an experimental assistant noted on each trial whether the horse selected the correct or incorrect bucket. A correct choice was defined as the subject's nose coming within 10 cm of the correct feed bucket (before visiting the other bucket) within 2 minutes of the experimenter completing the pointing gesture. Location of the correct bucket was randomized for each subject with the constraint that neither side was correct more than twice in a row and that both sides were correct equally often.

There were three phases + control trials in this experiment:

Phase 1: Pre-training

With the participants located as shown in Figure 1, pre-training began with the experimenter approaching and feeding the horse a piece of food. Once the experimenter returned to her starting point (mid way between the two buckets) she gained the horse's attention by calling its name or making a clucking sound. She then placed a piece of food in one of the buckets, making sure the horse was watching. Once the experimenter was back in a neutral position between the buckets the horse was released by the assistant, allowing it to approach the buckets and make its choice. If the horse chose the correct bucket, it was allowed to consume the piece of food. If the incorrect bucket was chosen, the experimenter removed the food from the correct bucket and showed it to the horse. However, the horse was not allowed to consume the food. This procedure was repeated three times per side, totaling six trials, with the sides being randomized across the trials. Pre-training trials were repeated during testing if the horse made three incorrect responses in a row, to test for motivation when the horse knew the location of food.

Phase 2

Phase 2 trials began immediately after the pre-training trials from phase 1 were completed. The experimenter began each trial with both hands in a fist at her chest and her head oriented forward. Once she obtained the horse's attention (by clucking or calling its name), she gave a momentary distal point for one second. This consisted of the extension of the ipsilateral arm toward the target container with the tip of her finger at least 78 cm from the edge of the bucket. A momentary distal point was chosen because successful performance with this form of point cannot be explained by stimulus/local enhancement i.e., the point is not in place when the horse makes its choice. Once the experimenter's arm returned to the neutral starting position, the horse was released by the assistant and allowed to approach/choose a bucket. If a correct choice was made, the horse was allowed to eat a piece of food, which was dropped into the bucket after a choice was made. If an incorrect choice was made (the horse approached the other bucket within 10cm or approached neither bucket within 2 minutes) the horse received no food and was escorted back to the starting position by the assistant to begin the next trial. A total of ten experimental trials were presented to each horse in phase 2.

Phase 3

If a horse failed to choose correctly on at least eight of the ten trials (reaching binomial significance/above chance performance) in phase 2, the horse moved on to phase 3. The purpose of phase 3 was to see if the horses could learn to follow the point if given additional trials. Trials in phase 3 were identical to those in phase 2 and continued, one right after the other, until a horse choose correctly on eight out of the last 10 trials or completed a total of 60 trials, whichever came first.

Control trials

The purpose of the control trials was to test for extraneous cueing that could have been present in the environment during experimental trials, i.e., the Clever Hans effect. Five control trials were presented during phase 2 and five more during phase 3; one control trial after every 2 experimental trials (for a total of 10 control trials per horse). For control trials, the experimenter began each trial in a neutral position (with her head and eyes orientated forward and both hands in a fist at her chest), just as in experimental trials. Once she obtained the horse's attention (by clucking or calling its name), the horse was released. However, now, instead of pointing, she remained in this neutral position until the horse made its choice. Although a point was not given, one bucket was still predetermined as the correct choice. As with experimental trials, the experimenter knew which bucket was the correct target. If the horse chose this bucket it was rewarded with food just as in the experimental condition. If the horse chose the incorrect bucket, it was escorted back to the start position without consuming a reward. Above chance performance during controls trials would suggest that the subjects were using extraneous/unintentional cues to identify the correct target (Clever Hans effect), as opposed to the independent variable under test: The momentary distal point. However, chance performance on control trials would indicate that the experimenter's knowledge of the correct target did not result in unintentional cuing sufficient to guide the horse's behavior in the absence of the pointing gesture.

Statistical Analysis

In phase 2, a Mann-Whitney *U* test was used to compare the mean number of correct choices out of ten for each group (Parelli Natural Horsemanship and traditionally trained horses). The performance of individual subjects was assessed with a binomial test (performance was considered significantly above chance when a horse choose correctly at least 8 or more trials out of 10, $p \leq .05$).

In phase 3, a Mann-Whitney *U* test was used to compare the total number of additional trials it took initially unsuccessful horses from each group to reach the success criterion or eight out of ten consecutive trials correct. Horses that failed to reach criterion were given a value of 60 trials, the maximum number of trials presented in that phase.

An alpha level of .05 was used for all statistical analyses.

Results

In phase 2, Parelli Natural Horsemanship trained horses followed the experimenter's point to the target more often than traditionally trained horses; however, this difference was not statistically significant ($U = 26$, $N_1 = 10$, $N_2 = 10$, $p = .07$, see Fig. 2). Only one horse from the Parelli Natural Horsemanship trained group and no horses from the traditionally trained group performed significantly above chance at the individual level (binomial test $p > .05$). Performance of individual horses is shown in Table 1.

---Insert Table 1 About Here---

---Insert Figure 2 About Here---

In Phase 3 we observed a significant difference in the number of trials required to reach success criterion between the two groups of horses ($U = 81$, N 1 = 10, N 2 = 10, $p < 0.02$, see Fig. 3), with Parelli Natural Horsemanship horses requiring significantly fewer additional trials to reliably follow the human point. Furthermore, significantly more individual Parelli Natural Horsemanship horses learned to follow the experimenter's point to the target at above chance levels during this phase (Fishers Exact Test, $p = .03$, see Fig. 4).

---Insert Figure 3 About Here---

---Insert Figure 4 About Here---

Each horse also received a total of 10 control trials over the course of testing. No horse scored significantly above chance on control trials ($p \geq .05$, best individual performance $p = .31$). On average, horses choose correctly 40% of the time.

Discussion

In the current study Parelli Natural Horsemanship trained horses initially followed the experimenter's point more often than traditionally trained horses, however a significant difference between the groups was not found. As in prior studies (e.g. Maros et al., 2008), most of the horses from both groups failed to reliably follow the experimenter's momentary distal point within the first 10 trials (phase 2), the exception being a single horse from the Parelli Natural Horsemanship trained group.

However in phase 3, individual horses from each group learned to follow the point to the target container at above chance levels. As predicted, based on their long history of gesture based training, Parelli Natural Horsemanship horses learned to follow the momentary distal point significantly faster than traditionally trained horses. By the end of testing 90% of the Parelli Natural Horsemanship horses reliably followed the experimenter's point compared to 40% of the traditionally trained horses.

Although this is the first study to directly test whether the prior training history of horses would predict their ability to follow human gestures, at least one other study has noted the possibility of such a relationship. McKinley and Sambrook (2000) noted that in their study horses trained using a co-operative training method (described as the caregiver eliciting desired behaviors from the horse by mimicking the horse's natural body language) appeared to be more successful at following points than those with different training histories. Prior training histories that emphasize the use of human gestures (i.e., agility training) have also been found to positively influence the performance of dogs on socio-cognitive tasks (Marshall-Pescini et al., 2009).

Past research has suggested that pet dogs follow a variety of point types (for reviews see Miklósi & Soproni, 2006 and Udell & Wynne, 2008) and often learn to follow the simplest points by about 4 months of age (Dorey, Udell, & Wynne, 2010). Investigators have also found that other domesticated animals have the ability to follow human gestures when tested with an object choice task. For example, Miklósi, Pongracz, Lakatos, Topal, and Csanyi (2005) found that cats were able to follow four different point types (proximal dynamic, proximal momentary, dynamic distal and distal momentary) with no significant difference in their performance from that of dogs. In another study, goats were able to use three human gestures to locate hidden food - proximal dynamic touch, dynamic distal point and head turn with gaze (Kaminski, Riedel, Call, & Tomasello, 2005). This coupled with the finding that some subjects from non-domesticated species, including wolves, were initially less successful in human guided tasks (Kubinyi, Virányi, & Miklósi, 2007; Hare, Brown, Williamson, & Tomasello, 2002) led to the domestication hypothesis, which predicted that the process of domestication provided special preparation to respond to human gestures independent of life experience (Hare et al., 2002; Riedel, Schumann, Kaminski, Call, & Tomasello, 2008; Hare et al., 2010).

However, genetic domestication often goes hand-in-hand with increased proximity to- and experience with - humans (Price, 1984), thus it has been difficult to separate the effects of genetic domestication from lifetime experience (or the interaction between the two) on pointing tasks. The current study, along with others, now provide evidence that not all domesticated individuals spontaneously use human gestures in object choice tasks suggesting that domestication alone is not sufficient to explain point following behavior. Horses in this and in prior studies (Maros et al., 2008) have had initial difficulty following distal human points to a target. They have instead relied heavily on stimulus enhancement to guide their choices when possible (e.g., Proops et al., 2010). However, with experience, horses can learn to successfully use human points in object choice tasks. This finding is similar to that of dogs living outside the human home. For example, dogs living in a shelter also tend to fail initial tests requiring the use of a human momentary distal point (Udell, Dorey, & Wynne, 2010a), but can learn to follow points with additional experience similar to phase 3 of the current study. Furthermore, it appears that a horse's prior training history/rearing environment can in some cases predict the ease with which they can come to follow human points. Training methods, like the Parelli Natural Horsemanship method, that use visible human movements and gestures to guide a horse's behavior from the ground might better prepare horses to succeed on certain socio-cognitive tasks, like the pointing task, than more traditional horse training methods. In fact, even non-domesticated animals living in socially enriched environments or environments with increased human interactions of this type have proven capable of succeeding on human-guided object choice tasks in recent years- in many cases without explicit training. Successful non-domesticated species include: Wolves (Gacsi et al., 2009; Udell, Spencer, Dorey, & Wynne, 2012; Udell, Dorey, & Wynne, 2008), parrots (Giret, Miklósi, Kreutzer, & Bovet, 2008), bats (Hall, Udell, Dorey, Walsh, & Wynne, 2011), jackdaws (von Bayern & Emery, 2009), ravens (Schloegl, Kotrschal, & Bugnyar, 2007), dolphins (Pack & Herman, 2004), seals (Scheumann & Call, 2004) and recently elephants (Smet & Byrne, R. (2013). Such findings correspond with the predictions of the two stage hypothesis (see Udell et al., 2010a) and suggest that genetic domestication is not required for responsiveness to human actions.

Future research should investigate the socio-cognitive abilities of horses with a broader range of experiences and developmental histories. For example, other forms of training, such as clicker training, might also be studied- the use of audible stimuli like clicks, word commands or tongue pops, might lead to horses more prone to respond to human cues in that dimension. In general, a more thorough understanding of how training history influences human-animal interactions, especially responsiveness to human body language, may have a wide range of important applications from improved training and welfare to enhanced preparation of animals intended for specific working roles.

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FIGURE LEGENDS

Figure 1:

Sketch of testing layout.

Figure 2:

Median number of trials correct out of 10 on an object choice task utilizing a momentary distal point during phase 2. Data points indicate individual performance. Dashed line shows chance level (5/10).

Figure 3:

Median number of trials completed out of 60 before reaching criterion (binomial test p = .05) during the phase 3. Data points indicate individual performance. Horses not reaching criterion are scored as 60 trials. *$p < .05$

Figure 4:

The number of horses in each training group to reach criterion in following a momentary distal point as a function of trial number.

Figure 1

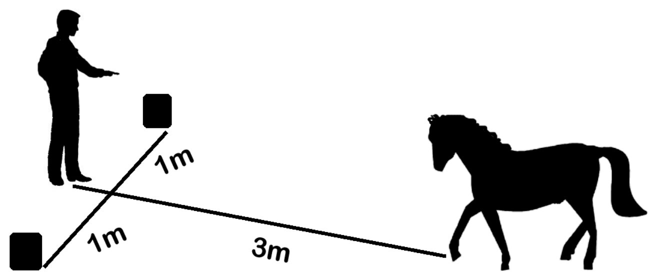

Figure 2

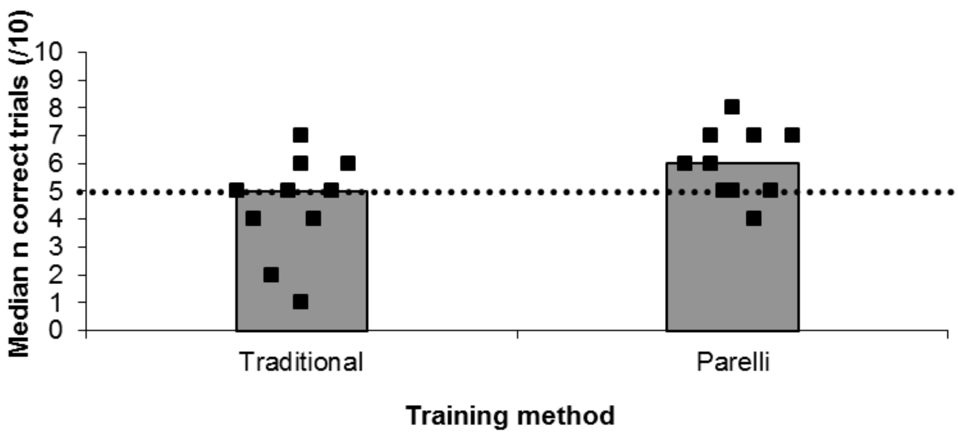
Median n correct trials (/10)
10
9
8
7
6
5
4
3
2
1
0
Traditional
Parelli
Training method

Figure 3

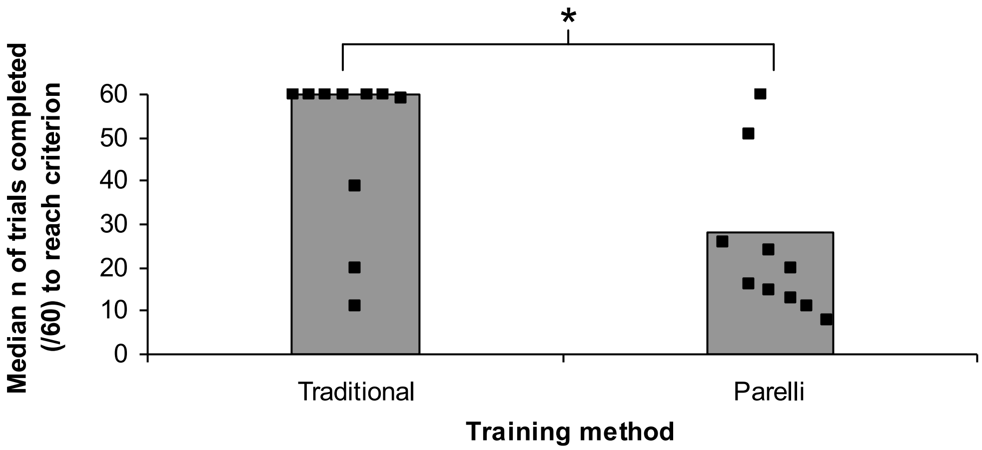
*
Median n of trials completed (/60) to reach criterion
60
50
40
30
20
10
0
Traditional
Parelli
Training method

Figure 4

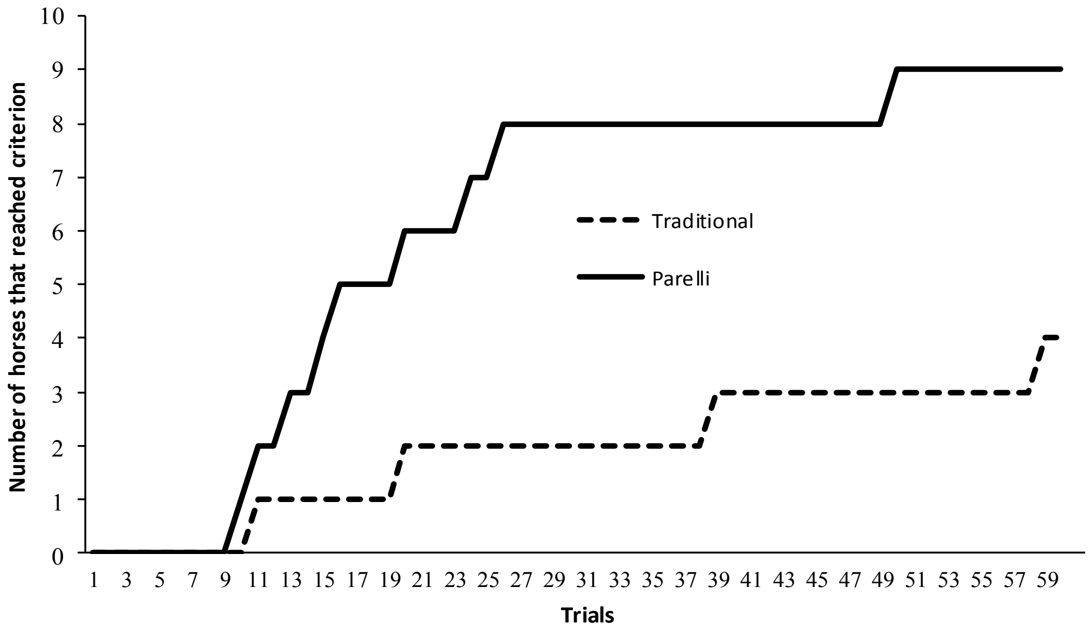
10
9
8
7
6
5
4
3
2
1
0
Number of horses that reached criterion
Traditional
Parelli
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59
Trials

Table 1: Number of trials correct during both testing conditions. N/A indicates a horse did not reach criterion within 60 trials. * indicates that the horse met criterion during the phase 2 and did not proceed to phase 3.

Subject's name	Age (years)	Sex	Training method	Total correct responses in Phase 2 (out of 10)	Total number of trials in Phase 3 until 8/10 correct (out of 60)
Genie	3	F	Traditional	2	N/A
Strider	3	M	Parelli	7	13
Lola	4	F	Parelli	5	51
TT	4	M	Traditional	6	59
Merry Legs	5	F	Traditional	4	N/A
Cajun	5	M	Traditional	6	39
Clyde	5	M	Parelli	5	15
Bob	5	M	Parelli	4	N/A
Salsita	5	F	Parelli	7	26
B	6	F	Parelli	7	11
Melody	6	F	Parelli	6	20
Phantom	6	F	Traditional	4	N/A
Annie	7	F	Traditional	2	20
Luna	7	F	Traditional	5	N/A
Glow	8	M	Parelli	6	16
George	9	M	Traditional	5	N/A
Georgia	10	F	Parelli	8	*
Wyatt	11	M	Traditional	5	N/A
Nick	13	M	Traditional	7	11
Sassy	13	F	Parelli	5	24