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Does attention make the difference? Horses' response to human stimulus after 2 different training strategies

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Abstract We hypothesized that in an open environment, horses cope with a series of challenges in their interactions with human beings. If the horse is not physically constrained and is free to move in a small enclosure, it has additional options regarding its behavioral response to the trainer. The aim of our study was to evaluate the influence of 2 different training strategies on the horse's behavioral response to human stimuli. In all, 12 female ponies were randomly divided into the following 2 groups: group A, wherein horses were trained in a small enclosure (where indicators of the level of attention and behavioral response were used to modulate the training pace and the horse's control over its response to the stimuli provided by the trainer) and group B, wherein horses were trained in a closed environment (in which the trainer's actions left no room for any behavioral response except for the one that was requested). Horses' behavior toward the human subject and their heart rate during 2 standardized behavioral tests were used to compare the responses of the 2 groups. Results indicated that the horses in group A appeared to associate human actions with a positive experience, as highlighted by the greater degree of explorative behavior toward human beings shown by these horses during the tests. The experience of the horses during training may have resulted in different evaluations of the person, as a consequence of the human's actions during training; therefore, it seems that horses evaluate human beings on daily relationship experiences.

Introduction

Horse training methods are generally based on teaching a horse to be subordinate. During training the horse is isolated from the rest of the herd and is often restrained; here it learns that any attempts at avoidance or escape are unsuccessful (Waran and Casey, 2005). Therefore, not surprisingly, most of these training methods use negative reinforcement (Waran and Casey, 2005). In general, horse behavior is considered to be merely driven by conditioned responses (Hanggi, 2005); therefore, the correct administration of stimuli during horse training has been thought to require application of the rules of associative learning (McGreevy and McLean, 2007). It has been suggested, for example, that delays in the release of a stimulus can result in inadvertent punishment (McGreevy and McLean, 2009). Better understanding of horse behavior and their learning processes could benefit training and improve the safety of both horse and rider (Murphy and Arkins,

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2007), as well as contribute to the horses' well-being (McGreevy and McLean, 2007).

Thus, it may be useful to look at horse behavior and learning in a different way. Challenges are an important component of the animal's life, and the ability to cope with challenges effectively plays an important role in an individual's fitness (Meehan and Mench, 2007). To be successful in their lives, animals must solve problems so as to minimize threats to their health, safety, or reproduction, and to do so, they use behavioral strategies and cognitive skills (Meehan and Mench, 2007).

By responding effectively to a challenge, animals express control over their environment through the application of cognitive skills, manifested by the use of attention and explorative behaviors that permit them to understand whether a cue predicts a positive or negative event (Mendl et al., 2009). Attention behavior involves selecting which stimulus to process or which response to carry out (Zentall, 2005). When there is unlimited time for evaluation, the animal focuses selective attention on each aspect of the stimulus, and subsequently determines the kind of behavior and the time when it should be performed (Washburn and Tagliatatela, 2005). Evaluation of attention in animals depends on external behavioral indicators, such as looking or gazing behavior (Emery, 2000), and has been described in a previous study conducted on horses (Seaman et al., 2002; Nicol et al., 2005). Looking behavior has been used to demonstrate cross-modal individual recognition in domestic horses (Proops et al., 2009), and the importance of attention has been underlined in the study of comprehension of human gestures by dogs (Miklósi et al., 2003; Virányi et al., 2008). Comparative research has determined that local stimulus enhancement, attention, and memory could play a role in cue processing (Miklósi and Soproni, 2006).

We hypothesized that in an open environment, the horse copes with a series of challenges it comes across while interacting with human beings. Because the horse is not physically constrained, it has additional choices regarding its behavioral response to the trainer in a small enclosure (if the trainer allows the horse sufficient time and space to choose the behavior). This is worthy of scientific investigation if we accept that for their well-being, animals should have the opportunity to actively participate in their environment and to effect change through their own behavior (Jones and Nicol, 1998; Meehan and Mench, 2007). Thus, a small enclosure could offer a useful framework for studying how horses interact with human beings when allowed some control over the interaction by expressing behaviors of attention and exploration, which are parts of cognitive biases (Mendl et al., 2009).

This preliminary study was aimed to evaluate the influence of 2 different training strategies on the behavioral response of horses to human stimuli. We compared a training strategy in which the horse had some control over its responses to the stimuli provided by the trainer, to a training strategy performed in a smaller environment, where the horse could not retreat from the trainer. When the training ended, behavioral parameters and heart rate were used to compare the responses of the 2 groups to a range of validated tests; these tests simulate everyday situations that the horses might encounter (Lansade and Bouissou, 2008).

We used heart rate as a general psychophysiological indicator in farm animals on the basis of the assumption that increased levels of acute stress are reflected in increased heart rate (Rushen et al., 2001; Visser et al., 2002; Langbein et al., 2004). When taken in isolation, the increase in heart rate might be interpreted as a stronger nonspecific arousal response (Rainville et al., 2006). It is important to remember that heart rate is not only influenced by body movement but also by the psychological stimuli experienced. In fact, it has been suggested that cardiac changes may reflect the "attentional state" of the animal; for example, orientation to novel nonthreatening objects decreases heart rate, whereas a threatening situation is accompanied by acceleration in the heart rate (Maros et al., 2008).

Materials and methods

Animals

The study involved 12 female Esperia ponies (age range, 2.5 ± 0.5 years) to minimize the effects of gender (Wolff and Husberger, 1996) and age (Lindberg et al., 1999) on their learning capacity. The ponies came from a free-range breeding farm (Frosinone, Italy) and the experiment was carried out at the "Il Vivaro" (Rocca di Papa, Rome, Italy) riding center. The horses were handled only lightly before they were made to participate in this study (to reduce the stress of their transport to the experimental site), thus keeping the influence of previous handling to a minimum. Each horse was provided with access to water and hay ad libitum.

The ponies were randomly divided into 2 groups of 6 subjects each: group A and group B. The use of ponies was regulated by the "Italian Animal Care" law (D.L. 116/92, Department reference number 87/3.0.7).

Experimental design

After assigning the horses to their respective groups, they were allowed 5 days to adapt to the new environment before the training began. Each group followed a different training strategy aimed at achieving the sequence of goals mentioned later. The training consisted in ground training and was considered finished when each horse (1) allowed its head, neck, and trunk to be stroked by hands and a brush, (2) lifted its legs for hoof inspection, and (3) accepted the halter, saddle, and bit. When the trainers declared that the horse was ready, each of these actions was checked according to the following criterion: the horse should not make more than 2 steps (back, away, or lateral) when the trainer approached it during the earlier mentioned actions. If the horse took more than 2 steps or showed other avoidance or defensive behavior, the training would start all over again. For lifting the legs, the same criterion of the grooming test was used (discussed later in the article). The time required to achieve the end of training was recorded.

Trainers

Training was carried out by 4 equally experienced staff trainers (2 men for each group). Trainers avoided punishment and coercion other than physically restraining the animal by lunging or stalling (the lead-rope attached to the halter was not tied to a ring or anything else to prevent horse movement, and trainers avoided hitting the horse with hands or other objects). Trainers of each group took turns working with all the horses of the group and spent the same amount of time working with each horse (for about 30 min/d and 5 times per week till the end of the training) to reduce individual influence.

Training strategy of group A

The 2 trainers of group A coordinated their method during a 3-day period working together before the start of the experiment and according to the following guidelines: (a) evaluation of the horse's behavioral response to each stimulus applied, (b) modulation of stimuli offered by the trainer depending on the horse's response so as to focus the animal's attention on the trainer, (c) allowing the horse to perform attention and exploration behaviors without time limits, and (d) refraining from eliciting avoidance or defensive reactions from the horse (except during the initial chase stimulus). The training of group A was carried out in a small circular enclosure (a round pen 16 m in diameter), connected by a corridor and gates to the ponies' paddock. Each horse was individually guided from the paddock to the round pen for training sessions (without the use of halter and rope).

The training strategy for horses in group A started with a stimulus called the chase-away, as described by other authors (Rivera et al., 2002; Krueger, 2007). To perform the chase-away stimulus, the trainers used body position and a raised arm to provoke the horse to gallop or trot around the ring. The chase-away was not repeated while the horse galloped or trotted. This phase ended when the horse spontaneously focused its attention on the trainer, with its neck high, and head, ears, and eyes pointed toward the person (Seaman et al., 2002). When the horse displayed this attention behavior, the trainer no longer applied the chase-away and slowly moved closer to the horse. If the horse appeared that it was about to retreat (backing away or simply turning the head laterally) the trainer stopped approaching; if the horse continued to retreat, the trainer gave the chase-away stimulus again. After the chase-away had been applied between 5 and 15 times (depending on the individual horse's behavior), the frequency and wideness of arm movements were reduced and the horse was allowed to come closer until it explored the trainer and followed him when he moved in any direction, as described by Krueger (2007). When the horse was willing to remain close to the trainer, the chase-away stimulus was no longer used. Subsequent phases led to physical contact, beginning with stroking the forehead, and gradually extending in craniocaudal and dorsoventral directions toward the feet. Proceeding with slow movements and always allowing the horse time to evaluate every action, the trainer put on the halter, which was removed at the end of each session. The horse was also familiarized with objects (brush, harness, saddle, etc.), allowing sufficient time to focus attention on the objects and investigate them (displayed as attention and exploration directed toward the trainer and the stimuli provided).

As long as the horse appeared to accept every action (physical contact or objects), the trainer continued with the stimulus, but as soon as the animal appeared about to retreat, the trainer interrupted his action and allowed the horse to retreat; he then attempted to obtain a new attention behavior without chasing the horse away. This involved actions such as the trainer clicking his fingers or tapping a foot on the ground. The intensity used for those new stimuli was very low at first and was increased if the horse did not pay attention to the trainer, but always without provoking avoidance behavior or a fear reaction in the horse.

Because the chaseaway, which can be considered an aversive stimulus, was not used when the horse carried out the desired behavior (attention toward the trainer), this training method contains elements of negative reinforcement (Waran and Casey, 2005).

Training strategy of group B

The 2 trainers of group B also coordinated their method during a 3-day period working together before the start of the experiment and according to the following guidelines: (a) during training, the horse would remain isolated from other horses, (b) the horse would be restrained in a close environment and/or by a rope during each training session, and (c) the horse needs to learn that attempts at avoidance or escape are unsuccessful. The horses of group B were kept in individual stalls (3×3.5 m^2) located in the riding school. Training was carried out in the stall of each horse. The method and timing of putting on the halter varied between individual horses, but the main action was to confine the horse in the corner of the stall, catch it with a rope, and then to place the halter despite its attempts to retreat. In the subsequent training session, the trainer caught the horse by the halter and attached a lead-rope to the halter; any attempt to flee was prevented by tension on the lead-rope. Physical contact was then initiated, with trainers touching the horse starting from the head and extending in craniocaudal and dorsoventral directions, down to the feet. If the horse refused to be handled, the trainer simply persisted until the animal accepted, forcing it into a corner of the stall or pulling it with the lunge attached to the halter. In this way, the trainers introduced various items (brush, harness, saddle, etc.) to the horse, without giving it time to evaluate the stimuli.

A component of negative reinforcement was also intrinsic to this training method, as pressure imposed by the trainer (e.g., by the lead-rope) was removed when the desired behavior was performed.

Behavioral and physiological evaluations

When the training period was finished, 2 behavioral tests (person test and grooming test, in this order) were performed in sequence, 1 test per day with a 1-day interval between the 2 tests. Tests were recorded with a hidden video camera and analyzed with Observer 5 Software (Noldus, Wageningen, The Netherlands). Latency before displaying a behavior (in seconds) and frequency of the behavior (times/min) were recorded. For sustained behaviors, the percentage of duration of the behavior over the total duration of the test, as well as the average duration (in seconds), were also recorded (Table 1). Videos were analyzed by 3 trained people who were blinded to this study. During each test, heart rate was recorded with a heart rate monitor (Vantage, Polar Electro Oy, Kempele, Finland) secured to the horse using a chest belt.

Person test

This test evaluated the animal's perception of an unfamiliar person who did not interact with the horse, in conditions of isolation from other horses and in a known environment (modified after Seaman et al., 2002). The person test was performed in a 10×15 m^2 fenced testing area within the indoor riding arena. Each horse underwent a 10-minute familiarization period with the testing area on the day before the test. Horses were tested in random order and brought to the testing area by one of the trainers. During the test, there were no people in the indoor riding arena. A circle, 4 m in diameter, was drawn on the ground with chalk in the middle of the testing area. The horse was brought into the circle and freed; after 2 minutes an unfamiliar woman entered the testing area and stood in the middle of the circle in a passive position (erect stance, arms hanging down, hands clasped in front, head down, and looking down) for a further 2 minutes. In addition to the behaviors listed in Table 1, the number of horses entering the central circle with at least 2 feet as well as the time spent in the circle was recorded. The heart rate monitor was put on the horse before its entry into the testing area and the heart rate was recorded every 30 seconds for the 4-minute duration of the test.

Grooming test

This test evaluated the manner in which the horse perceived handling during the standardized actions of grooming performed by a familiar person in a familiar environment (modified after Lansade et al., 2004). For each horse, the grooming test was carried out in the training location (the round pen for group A and the stall for group B) by one of the persons who trained it. The heart rate monitor was put on the horses, and then they were left free for 2 minutes while the trainer remained outside in a position that allowed the horse to see him. At the end of the 2 minutes, the operator entered the round pen or the stall.

The trainer approached the horse to put on the halter, and then began the test procedure (as described later). During the entire test, the trainer kept the lead-rope in 1 hand without tension. The heart rate was recorded every 5 seconds and the heart rate monitor was synchronized with a chronometer permitting us to identify the nearest heart rate value at 6 reference points (with a possible error of ± 2 seconds). The following reference points were identified: (1) trainer's entrance (time recorded when trainer crossed the limits of round pen or stall), (2) putting on the halter (time recorded when trainer fastened the halter), (3) start of grooming that included 1-minute brushing per side and lifting the hooves (time recorded when the brush started), (4) end of grooming (time recorded when last hoof raised), (5) saddling (time recorded when the saddle belt was fastened), and (6) inserting the bit (time recorded when the bit was placed in the mouth). Lifting

Table 1 Behaviors evaluated in the tests

Behavior	Description	Test where evaluated
Exploration of the person[a] (Visser et al., 2001)	Neck horizontal or lower, sniffing with head and ears forward toward the person (also without lowered neck).	Person test and grooming test
Attention to the person[a] (Seaman et al., 2002)	Neck high, head and ears toward person.	Person test and grooming test
Head lowered[a] (Rietmann et al., 2004)	Nose below level of abdomen.	Grooming test
Kinetic behaviors[a](Seaman et al., 2002)	Standing, walk and trot.	Person test
Defensive behaviors[b]	Any direct attempt by horse to threaten operator with legs or mouth.	Grooming test
Avoidance behaviors[b]	Any obvious attempt by horse to retreat from handling by operator.	Grooming test

[a]Behaviors that continued over time (states) for which the following were evaluated: latency (time elapsed from beginning of test to appearance of the behavior, seconds); frequency (number of times behavior was manifested per unit of time, n/min); percentage duration (percentage of time over total duration of test in which behavior was manifested); and average duration (average time desired behavior lasted, seconds).
[b]Focal behaviors (events) for which latency and frequency were evaluated.

Table 2 Latency, frequency, percentage duration, and average duration (mean ± SEM, median and quartile between brackets) of behaviors evaluated during the person test

	Latency (sec)	Frequency (n/min)	Duration (%)	Average duration (sec)
Attention to the person				
Group A	4.4 ± 1.5 (2.3, 1.5)	1.8 ± 0.3 (1.6, 0.9)	29.7 ± 7.9 (30.9, 4.1)	8.1 ± 1.6 (7.4, 3.3)
Group B	16.2 ± 6.8 (9.9, 7.3)	1.6 ± 0.3 (1.2, 0.6)	29.6 ± 8.4 (16.9, 3.9)	11.9 ± 4.3 (5.6, 2.2)
	$z = 2.078$, $P = 0.038$*	$z = 0.540$, $P = 0.589$	$z = 0.027$, $P = 0.978$	$z = 0.180$, $P = 0.857$
Exploration of the person				
Group A	47.0 ± 19.3 (13.5, 4.3)	1.6 ± 0.3 (1.4, 0.9)	18.3 ± 2.0 (18.0, 14.5)	14.1 ± 3.3 (7.6, 5.7)
Group B	114.9 ± 8.8 (121.6, 109.6)	0.4 ± 0.0 (0.4, 0.4)	3.3 ± 0.5 (3.4, 3.1)	2.5 ± 1.3 (1.3, 1.2)
	$z = 0.940$, $P = 0.353$	$z = 2.114$, $P = 0.035$*	$z = 2.003$, $P = 0.045$*	$z = 2.180$, $P = 0.029$*
Standing				
Group A	6.8 ± 2.8 (3.1, 2.0)	2.3 ± 0.3 (2.2, 1.4)	74.7 ± 6.0 (87.2, 62.0)	27.4 ± 4.8 (23.9, 9.7)
Group B	2.5 ± 0.3 (2.9, 1.5)	2.1 ± 0.2 (1.9, 1.4)	79.6 ± 3.8 (84.0, 80.7)	29.3 ± 4.5 (25.7, 16.1)
	$z = 0.890$, $P = 0.373$	$z = 0.434$, $P = 0.664$	$z = 0.416$, $P = 0.678$	$z = 0.343$, $P = 0.731$
Walking				
Group A	8.9 ± 1.7 (10.8, 2.6)	2.2 ± 0.3 (2.0, 1.0)	24.2 ± 5.9 (12.0, 6.6)	5.4 ± 0.8 (5.1, 2.8)
Group B	31 ± 6.7 (24.3, 16.2)	1.6 ± 0.2 (1.4, 0.9)	19.1 ± 3.9 (16.0, 9.5)	7.4 ± 0.9 (8.4, 4.0)
	$z = 3.419$, $P = 0.000$**	$z = 1.067$, $P = 0.286$	$z = 0.343$, $P = 0.731$	$z = 1.555$, $P = 0.120$
Trotting				
Group A	n.s.	n.s.	n.s.	n.s.
Group B	n.s.	n.s.	n.s.	n.s.

Note: n.s., not shown.
*$P < 0.05$.
**$P < 0.01$.

of the hooves was examined in detail. For each test, the trainer's attempts to lift the hoof and hold it in position (for about 5 seconds without the horse trying to retract the hoof) were counted and this allowed us to distinguish between positive (carried out with a maximum of 3 attempts) and negative outcomes (more than 3 attempts, or not carried out for safety reasons) following the criteria of Visser et al. (2001). To minimize differences between trainers during the grooming test, each trainer performed a simulation with horses not involved in the experiment.

Statistics

Behavioral data were analyzed using the nonparametric Mann–Whitney test and the heart rate was analyzed using the 1-way analysis of variance (ANOVA) test. The *t*-test for unpaired data was used to analyze the number of successful attempts to lift the legs in the grooming test. In the person test, the number of horses entering the central circle was compared using the Fisher's test. All tests were carried out with Statistics for Biomedical Subjects 5.0 (Glantz, 2002).

Results

Average time needed to complete the training goals was significantly higher ($F_{1,10} = 7.97$, $P = 0.018$) for group A (mean ± standard error of mean [SEM]: 11.2 ± 2.3 hours) than for group B (3.6 ± 1.4 hours).

One of the horses of group B displayed flight behavior and broke through the testing area fence twice during the familiarization period. This animal was excluded from the subsequent person test for safety reasons. For the person test, data and statistical analysis of behaviors have been reported in detail in Table 2. The heart rate for horses in group B was significantly higher than that among horses in group A in the last 2 points of reference (Figure 1). All 6 horses of group A entered the circle where the person was standing, whereas only one of the horses from group B did so ($P = 0.034$). On an average, group A (6 horses) spent 49.8% of total standing time in the central circle, whereas group B (1 horse) spent 7.7 %.

For the grooming test, data and statistical analyses of behaviors are reported in Table 3. Positive attempts to lift the hooves were significantly higher ($t_{10} = 2.449$, $P = 0.034$) in group A (mean ± SEM: 3.3 ± 0.3) than group B (2.5 ± 0.2). Heart rate was significantly higher in group B than in group A when the trainer fastened the halter and placed saddle and bit (Figure 2). Despite individual differences, the time taken (mean ± SEM, in s) to perform the grooming test did not vary ($t_{10} = 0.796$, $P = 0.445$) between group A (330.5 ± 29.0) and group B (303.7 ± 17.2).

Discussion

Results indicate that horses from group A appeared to associate the human's actions with their own less fearful

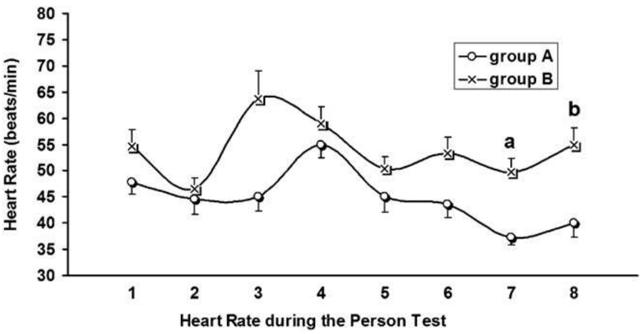

Figure 1 Trend of heart rate (mean ± SEM) during person test. Measurements were recorded every 30 seconds, during the 2 minutes of adaptation (measurements 1-4) and in the 2 minutes after positioning of the person in the central circle of the testing area (measurements 5-8); the figure shows statistically significant differences (a: $F_{1,5} = 15.36$, $P = 0.003$; b: $F_{1,5} = 9.22$, $P = 0.013$).

reactions. This could be a consequence of the training strategy which involves stimulus intensity modulation based on the horse's behavioral responses. The training strategy of group A gives the horse time to evaluate the stimuli, as reflected by the differences in total training time between the 2 training periods.

In both tests, group A also appeared to spend more time exploring people, although the person was unknown to the horses in the person test. Because exploration behavior is associated with a positive emotional state (Boissy et al., 2007), we can state that group A may have acquired a broad positive generalization of the "person" stimulus. This may be the result of having allowed the horses of group A to perform attention and exploration behaviors without any time limit during the training.

Attention behavior displayed by the horses of the 2 groups during the tests appears to have different meanings. In the grooming test, the horses of group B displayed attention behavior earlier with the person, but also displayed more avoidance (including less positive outcomes when the trainer attempted to lift the hooves) and defensive behaviors toward the operator. This may suggest that group B had made a negative assessment of the appearance of the known person (the trainer). Similar attention behavior in a negative situation has previously been described in horses (Nicol et al., 2005). This is in contrast to group A, which during the grooming test displayed more exploration of the trainer, and longer spontaneous lowering of the head, which have been reported to be indicators of relaxation (Rietman et al., 2004). Even the exploration behavior could be influenced by tests order. The hypothesis that horses of group A were more relaxed is also supported by the fact that their heart rate remained at the starting values throughout the test. However, it should be noted that attention behavior is also expressed by animals when faced with neutral stimuli (Paul et al., 2005). It has also been reported that attention (i.e., time taken for looking) is a behavior used when horses, and animals in general, encounter a stimulus that does not coincide with their expectations (Proops et al., 2009). This might explain the reason the horses of group A displayed this behavior earlier during the person test. In this

Table 3 Latency, frequency, percentage duration, and average duration (mean ± SEM, median and quartile between brackets) of behaviors evaluated during the grooming test

	Latency (sec)	Frequency (n/min)	Duration (%)	Average duration (sec)
Attention to the person				
Group A	16.6 ± 2.4 (16.9, 7.7)	1.7 ± 0.2 (1.7, 1.2)	27.8 ± 5.8 (23.7, 9.0)	9.2 ± 2.1 (9.5, 5.2)
Group B	6.9 ± 2.6 (3.8, 3.1)	1.6 ± 0.2 (1.6, 1.3)	29.3 ± 7.1 (16.6, 11.9)	12.2 ± 3.0 (7.8, 6.1)
	$z = 3.800$, $P = 0.000$*	$z = 0.288$, $P = 0.773$	$z = 0.021$, $P = 0.983$	$z = 0.603$, $P = 0.547$
Exploration of the person				
Group A	41.5 ± 12.6 (26.7, 20.7)	0.3 ± 0.1 (0.2, 0.1)	2.7 ± 0.7 (2.2, 0.8)	3.5 ± 0.5 (3.4, 2.6)
Group B	165.0 ± 31.9 (140.5, 104.1)	0.3 ± 0.0 (0.3, 0.2)	0.8 ± 0.3 (0.6, 0.4)	2.0 ± 0.4 (1.8, 1.3)
	$z = 3.224$, $P = 0.001$*	$z = 0.901$, $P = 0.368$	$z = 2.044$, $P = 0.041$**	$z = 1.973$, $P = 0.049$**
Lowered head				
Group A	19.2 ± 8.9 (7.1, 5.9)	0.4 ± 0.0 (0.4, 0.4)	10.4 ± 2.4 (7.4, 6.1)	17.1 ± 3.3 (12.3, 9.8)
Group B	93.0 ± 16.6 (77.6, 67.8)	0.4 ± 0.1 (0.4, 0.3)	3.4 ± 1.0 (2.8, 1.9)	5.5 ± 1.8 (4.0, 2.7)
	$z = 2.003$, $P = 0.045$**	$z = 1.022$, $P = 0.307$	$z = 2.379$, $P = 0.017$**	$z = 2.056$, $P = 0.040$**
Defensive behaviors				
Group A	222.8 ± 0.5 (222.3, 222.3)	0.2 ± 0.0 (0.2, 0.2)	–	–
Group B	117.6 ± 31.2 (129.2, 46.2)	0.4 ± 0.1 (0.4, 0.3)	–	–
	$z = 3.417$, $P = 0.000$*	$z = 3.142$, $P = 0.002$*	–	–
Avoidance behaviors				
Group A	63.6 ± 31.3 (21.0, 14.4)	0.8 ± 0.2 (0.5, 0.4)	–	–
Group B	13.3 ± 3.5 (8.1, 4.1)	2.2 ± 0.4 (1.9, 1.3)	–	–
	$z = 2.072$, $P = 0.038$**	$z = 3.632$, $P = 0.000$*	–	–

*$P < 0.05$.
**$P < 0.01$.

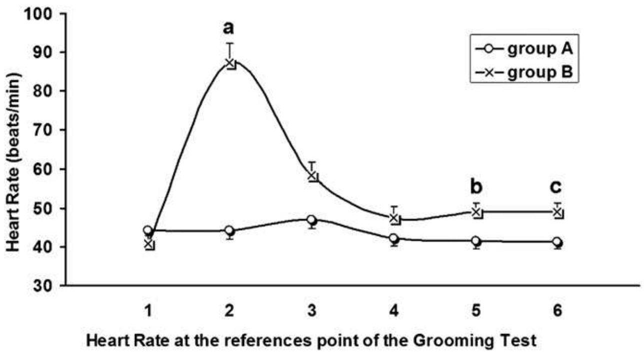

Figure 2 Trend of heart rate (mean ± SEM) during grooming test. Measurements were recorded at reference points of test (1, entry of trainer; 2, Haltering; 3, beginning grooming; 4, end of grooming; 5, Saddling; 6, insertion of bit). The figure shows statistically significant differences (a: $F_{1,6} = 7.96$, $P = 0.037$; b: $F_{1,6} = 6.23$, $P = 0.037$; c: $F_{1,6} = 6.86$, $P = 0.031$).

case, the attention behavior may have been used by group A to make a proper assessment of the person stimulus, which then led them to generalize their earlier experience with the trainer to the unknown person who appeared in this test. In fact, all horses of group A entered the central circle, remaining in close proximity to the person for about half of the total standing time. Regarding the trend of the heart rate in the person test, it cannot be excluded that differences found could be because of differences in the walking behavior at the time, rather the psychological experience of the horse toward the person, although the kinetic behavior did not show quantitative differences between groups for the whole test.

In the training strategy used by group A, the time taken to evaluate a stimulus was determined by the horse, with trainers taking into consideration attention behavior and the individuality of responses in their actions. However, until now attention behavior as a cognitive function has attracted little attention in horse-learning studies. This may be a source of error if we consider that some inconsistency in the research findings on animal learning may be because of experimental designs in which animals are not allowed to adequately use their attentional processes (Zentall, 2005).

The horses' experience during the training may have resulted in different evaluations of the person in these tests, as a consequence of human actions during the training process. This seems to confirm the work of Hausberger and Muller (2002), who stated that horses evaluate human beings on the basis of positive or negative daily relationship experiences.

It should also be noted that the "round pen" in itself may be of little importance and that the training of group A could be carried out in other environmental contexts (including the stall), as the strategy essentially concerns modulating the trainer's actions according to the horse's response.

For example, the training of horses in group A started with the chase-away stimulus because this stimulus had already been described by other authors (Rivera et al., 2002; Krueger, 2007) and used in practice by several trainers. Because the chase-away stimulus is used to activate the horse's attention behavior toward the trainer, we believe that this could also be done with other stimuli of varying intensities, based on the horse's behavior. It seems that it is not the type of stimulus in itself that is important, but rather providing appropriate challenges by exposing animals to environmental stimuli that provoke attention and optimize stress responses (Meehan and Mench, 2007). This could facilitate learning and adaptive behaviors.

It has been shown that the environment influences the perception of a stimulus in animals (Harding et al., 2004) and in our design the environment is an essential part of the training. Greiveldinger et al. (2007) suggest that the appraisal process in animals derives from the animal's needs, and in this way, the human being should be considered as part of the environment. Therefore, differences in the environments in which training was carried out may have influenced our results. However, data regarding the influence of environment on the human–horse relationship appear to be contradictory. Søndergaard et al. (2003) found that horses that were kept in separate stables were able to relate more to human beings than those kept in a group, whereas Rivera et al. (2002) suggest that horses kept in a group have a greater capacity for training and were more easily handled by human beings. These apparently contradictory data may indicate that it might not be the type of environment or management per se that influences the behavior of horses, but rather the way in which horses appraise stimuli (including human beings) in the surrounding environment.

Finally, in both of our study groups, elements of negative reinforcement were evident during training; the differences are essentially in the time needed to evaluate a stimulus, which in group A was left up to the horses. Therefore, we can hypothesize that the important difference between the 2 strategies lies in the opportunity for decision-making, rather than the strategies of reinforcement used.

Conclusions

Both groups of horses were trained using a similar basis of learning theory, but were provided with different opportunities to control their environment. It seems that the ability of human beings to offer the horses a certain degree of control over the trainer and his actions, by imposing no time limits on the evaluation of each stimulus and using attention behavior of horses to determine progression in the stages of training, resulted in a more positive categorization of human beings and handling.

There is a need for new methods for scientific study that allow us to investigate the use of cognitive biases in animals (Mendl et al., 2009), which seems to be an important element in animal well-being (Paul et al., 2005). Therefore, we believe that the results of this study, although preliminary, can provide an outline for new scientific studies.

The use of training strategies in which the horse retains a certain degree of control over its behavioral choices could be useful for investigating the horse's appraisal process toward human beings and the stimuli provided.

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