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Effects of three non-confrontational handling techniques on the behavior of horses during a simulated mildly aversive veterinary procedure

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ABSTRACT

In a randomized between-subjects design, we evaluated the effectiveness of each of three non-confrontational handling interventions compared to no intervention control on the behavior of horses during a single-trial simulated mildly aversive health care scenario. These handling interventions included withers scratching (WITHERS, n = 12), face and eye rubbing (EYES, n = 12), and feeding (FEED, n = 12) for comparison with no intervention control (CON, n = 12). The simulated health care scenario included confinement in a novel clinical environment away from pasture mates, along with a 3-min exposure to a mildly aversive auditory stimulus (electric sheep shears hand held at a standard 3 m from the horse, 85 dB at ear level of horse). Sessions were video recorded for subsequent detailed quantitative evaluation of avoidance/stress behavior responses during the 3-min auditory stimulus. Additionally, heart rate was telemetrically recorded at 5-s intervals during the 3-min auditory stimulus. Mean (+/− SE) avoidance/stress response frequency was 13.7 (3.2) for FEED, 26.9 (2.7) for EYES, 30.4 (5.2) for WITHERS, and 44.2 (5.3) for CON. FEED, EYES and WITHERS each differed significantly from CON ($P < 0.05$). Mean (+/−SE) average and ending heart rates, respectively, were: 73.7 (4.8) and 68.8 (5.7) for EYES, 75.3 (5.4) and 71.7 (5.9) for FEED, 84.7 (9.2) and 80.3 (10.2) for CON, 92.5 (8.1) and 80.8 (10.1) for WITHERS. For both average and ending heart rate, differences from control were not significant. We conclude that compared to no intervention, each of the three handling interventions was effective in reducing avoidance/stress responses compared in this model. These results provide evidence for recommending non-confrontational handling methods to increase the comfort of horses, as well as improve safety for horses and handlers, during mildly aversive health care procedures.

1. Introduction

When restrained for veterinary examinations and mildly aversive routine or emergency health care procedures, equine patients often exhibit behaviors indicating mild to moderate fear- and/or physical discomfort-related stress, including defecation, vocalizing to other horses, escape or avoidance movements, or general anxious behaviors such as pawing, stamping, tail and head movements. These behaviors not only interrupt and prolong the procedure, but some may also increase risk of injury to the patient and handlers. The traditional horse handling intervention in such situations typically includes increasing the level of physical restraint and/or attempting to verbally or even physically reprimand the patient. These interventions in most instances amount to positive punishment that is not only ineffective at calming a patient, but can escalate dangerous avoidance/escape behaviors (McGreevy and McLean, 2009; Mills, 1998). Additionally, whether or not effective, traditional intense restraint and/or punishment of fearful or physically uncomfortable animals is no longer considered humane, and so particularly inappropriate for use in a veterinary care setting (AVSAB, 2007). While veterinarians have the option for use of sedative agents, there are circumstances where sedation may be contra-indicated.

One of the long-term goals of our veterinary school equine behavior program is to develop evidence-based recommendations for non-confrontational handling interventions for improving comfort and compliance of horses during mildly aversive health care or management procedures. For example, our clinic has introduced the use of food treats, which, in many instances, appear to effectively distract nervous patients, and when appropriately applied in a behavior modification strategy, reward the patient's relaxation and tolerance. In instances where feeding is not convenient, allowed, or effective, it would be useful to have alternative positive options. Potential additional positive interventions include certain types of tactile stimulation, anecdotally believed to distract or comfort horses. One common tactile technique is

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Fig. 1. Three handling interventions: FEED, scratching WITHERS, rubbing EYES, compared with no intervention CONTROL used with horses during exposure to a simulated mildly aversive health care scenario.

scratching at the withers, or at other preferred mutual grooming sites of horses (chest, neck, or rump). Tactile stimulation in the form of scratching or massage at the withers has been shown to reduce heart rate (Feh and Mazières, 1993; Normando et al., 2003; McBride et al., 2004). Another technique involves rubbing of the face, particularly around the eyes and forehead, in a manner meant to be distracting and/or soothing. Neither of these tactile stimulation techniques, nor administration of food treats have been critically evaluated in a veterinary restraint and procedure situation.

The general design of the work reported here included a randomized between-subjects comparison of the effect of each of three positive handling interventions (feeding, scratching withers, rubbing eyes) and control (handler standing calmly at shoulder without interacting with the horse) on the number of avoidance/stress responses as well as average and ending heart rates during exposure to a standard mildly aversive auditory stimulus in a simulated veterinary care scenario. Our hypothesis was that each of the three interventions would result in fewer avoidance/stress behavior responses and lower heart rate measures compare to control.

2. Methods

2.1. Subjects

Forty-eight horses (29 mares, 1 gelding of various breeds) and ponies (13 mares, 5 geldings of various breeds and sizes), ranging in age from 2 to 23 years, served as subjects. These animals had been resident for variable durations, from less than one month to as long as several years, at the University of Pennsylvania School of Veterinary Medicine, New Bolton Center, for teaching and research purposes. The horses and one pony had been acquired as donations to the University for use as veterinary school teaching animals or as embryo transfer recipients. The remaining ponies had been resident since birth. All were kept in pasture herds with free-access to water, and natural forage and/or hay provided as needed. All animal procedures were approved by the University of Pennsylvania Institutional Animal Care and Use Committee, following federal animal care and use guidelines.

2.2. Simulated veterinary procedure

Personnel included one technician (JCW) who did all of the animal handling and one assistant (SMM) who operated the video recording and auditory stimulus devices. Each subject was hand-led individually by the technician from its pasture enclosure to a clinical or examination room or area. An elastic girth band with heart rate monitor (Polar™ Equine Heart Rate Monitor with ProTrainer 5™ Equine Software, Polar Electro Oy, Kempele, Finland) was snugly fitted just caudal to the withers. Electrode gel (Spectra ® 360 Electrogel, Parker Laboratories, Inc., Fairfield, New Jersey, USA) was liberally applied to the hair coat under each of the two heart rate sensors. In some instances of heavy winter hair coat, water was applied before the gel in order to establish adequate conductivity. Depending upon the animal's experience and comfort with examination, it was then either placed in an examination stocks (n = 40), tethered (n = 4), or hand-held using the lead as a sliding tether (n = 4). These restraint conditions were balanced across intervention assignments. Immediately thereafter, the subject was exposed for a period of 3 min to a novel loud sharp sounding (85 dB at ear level of the horse) electric sheep shears (Sunbeam® Stewart Clipmaster®, Model 510A Head, Sunbeam Corporation Chicago, Illinois, USA) hand-held at a standard location at a distance of 3 m from the horse's head. This auditory stimulus was chosen because it was novel, mildly noxious, and could be presented in a controlled and consistent manner to all subjects. In preliminary trials, exposure of several other horses and ponies to this scenario resulted in behavior reaction and heart rate increase similar to that seen with mildly aversive healthcare procedures.

2.3. Handling interventions

Each of the 48 subjects was assigned to one of four handling interventions (illustrated in Fig. 1), which included withers scratching (WITHERS, n = 12), face and eye rubbing (EYES, n = 12), feeding (FEED, n = 12), and no intervention control (CON, n = 12). The animal work was done in a series of occasions over a period of four months. On each occasion, the subjects to be evaluated that day were each randomly assigned to one of the four groups, balancing across for order of evaluation, horses and ponies, mares and geldings.

During the 3-min auditory stimulus, the technician stood at the head or shoulder area of the animal holding the lead shank in one hand while performing the assigned intervention with the other. The auditory stimulus and the intervention started simultaneously.

For EYES, the technician stood quietly at the front and slightly to one side of the subject's head. Gently placing the hand just to the right of the midline of the face, with palm at approximately 7–8 o'clock below the right eye, the technician rubbed the fingers and palm over the eye, following the direction of the hair growth if possible, as if closing the eyelid. This was repeated slowly and rhythmically in a soothing manner several times on the right eye, before similarly rubbing the left eye, starting with palm at 4–5 o'clock below the left eye. This pattern of moving back and forth between, around, and over the eyes continued for the duration of the auditory stimulus.

For WITHERS, the technician stood to one side near the subject's shoulder, while using the finger nails of one hand to firmly scratch at the withers at a rate of approximately one 10-centimeter dorso-ventral stroke per second, attempting to simulate the rhythm and intensity of mutual grooming among herd mates (McDonnell, 2003).

For FEED, the technician stood at the head of the subject slightly to one side while feeding a palatable pelleted complete feed (Purina ® Equine Senior ®, Land O' Lakes Inc., Arden Hills, MN, USA) from a small rubber feed pan held with both hands, except when using one hand to replenish grain from a nearby source container.

For CON, the technician simply stood at the shoulder/head area of the subject with no intentional interaction with the subject.

2.4. Heart rate measures

Heart rate estimates (beats per minute, bpm) included (1) *average heart rate* over the 3-min auditory stimulus (using 5-s interval averages obtained using the Polar ProTrainer 5™ Equine Software) as well as (2) *ending heart rate* (first 5-s reading after cessation of auditory stimulus).

2.5. Subjective assessments at the time of each session

At the completion of each subject's session, the technician and assistant each independently assessed the subject using a numeric scale for relaxation (1 = relaxed versus 5 = tense, with 0.5 increments) and for movement (1 = standing still versus 5 = moving, with 0.5 increments). These impressions based on direct observations while handling or assisting were compared with similar subjective ratings subsequently derived from video recordings of the sessions. The purpose of these comparisons was to assess whether the handler and/or observer could appreciate in the moment whether or not the intervention was effective.

2.6. Behavior measures derived from video recordings

Video recordings were viewed at real time by the technician, for as many repetitions as necessary to obtain the following measures. In preliminary trials this technician's intra-rater reliability for these measures exceeded our laboratory standard of r or rho > 0.85.

2.6.1. Avoidance/stress response frequency

Total number of avoidance/stress responses occurring during the 3-min auditory stimulus. Responses included head movements (toss, shake, pull away, nod, turn to either side or back), body movements (move forward, move backward, attempt to rear, buck, or turn around), lip licking/chewing (other than FEED), snorting, defecation, tail movements (slap against perineum, swish side-to-side), stomping or kicking, pawing, vocalizing (whinny), whole-body freezing (McDonnell, 2003; Young et al., 2012).

2.6.2. Relaxation rating

Subjective numeric rating scale,1 to 5 with 0.5 increments, with 1 = relaxed versus 5 = tense (rigid posture, tense muscles, tense facial muscles expression).

2.6.3. Movement rating

Subjective numeric rating scale, 1–5 with 0.5 increments, with 1 = standing still versus 5 = moving (anxious fidgeting, problematic avoidance or escape movements).

2.7. Statistical analysis

Statistix 10 statistical software (Analytical Software, Tallahassee, Florida, USA) was used. For total avoidance/stress response frequencies, as well as for average and ending heart rates, one-way ANOVA with Dunnett's 2-sided multiple comparison procedures were used to evaluate differences between each intervention and CON. Homogeneity of variance was evaluated using Brown and Forsythe test procedures. Welch's Test for Mean Differences was applied when homogeneity of variance was suspected (for average and ending heart rates). Results are presented as mean +/− SE. For relaxation and movement rating scores from video evaluation, Kruskal-Wallis procedures were used to compare each of the handling intervention groups with control. A probability of less than 0.05 ($P < 0.05$) was considered significant. Spearman rank order correlation procedures were used to evaluate association of the technician's and the assistant's ratings scored immediately following each session, as well as to evaluate the association of the technician's ratings scored immediately following each session with those scored during the subsequent quantitative evaluation from the video recorded session. Results are presented as median.

3. Results

3.1. Avoidance stress response frequency

Mean (+/− SE) avoidance/stress response frequency was 13.7 (3.2) for FEED, 26.9 (2.7) for EYES, 30.4 (5.2) for WITHERS, and 44.2 (5.3) for CON. Each of the three interventions differed significantly from CON (1-way ANOVA, $F_{df3,44} = 8.72$, $p < 0.0001$, Dunnett's 2-sided follow-up multiple comparisons with CON, $P < 0.01$ for FEED and for EYES, $P < 0.05$ for WITHERS).

3.2. Heart rate measures

Mean (+/−SE) average and ending heart rates, respectively, were 73.7 (4.8) and 68.8 (5.7) for WITHERS, 75.3 (5.4) and 71.7 (5.9) for FEED, 84.7 (9.2) and 80.3 (10.2) for CON, and 92.5 (8.1) and 80.8 (10.1) for EYES. Differences among groups were not significant ($P > 0.10$ for each).

3.3. Relaxation and movement ratings

Median relaxation and movement rating scores obtained from the video evaluation were 3.0 and 2.75 for EYES, 3.0 and 3.0 for WITHERS, 1.75 and 1.75 for FEED, and 4.0 and 3.5 for CON. For both ratings, EYES and FEED differed significantly from CON (Kruskal-Wallis = 7.71 and 9.95, df 23, $P < 0.05$).

Median relaxation and movement rating scores recorded by the technician immediately following each session were 4.0 and 3.5 for EYES, 2.5 and 2.25 for WITHERS, 1.75 and 1.75 for FEED, and 3.75 and 3 for CON. For relaxation, FEED differed significantly from CON (Kruskal-Wallis = 12.03, df 23, $P < 0.05$). Values were correlated with the corresponding rating scores obtained during subsequent video evaluation, both for relaxation (rho = 0.85, $p < 0.001$) and for movement (rho = 0.73, $P < 0.001$).

Median relaxation and movement rating scores recorded by the assistant immediately following each session were 2.5 and 2.0 for EYES, 2.0 and 1.75 for WITHERS, 1.25 and 1.0 for FEED, and 3.75 and 2.75 for CON. FEED differed significantly from CON (Kruskal-Wallis = 14.54 and 12.86, DF = 23, $P < 0.01$).

The assistant's and the technician's rating scores recorded immediately following the sessions were positively correlated, both for relaxation (rho = 0.80, $P < 0.001$) and for movement (rho = 0.74, $P < 0.001$).

4. Discussion

In this model veterinary care scenario, each of three simple handling interventions resulted in fewer avoidance/stress responses. Feeding resulted in the lowest mean avoidance/stress response frequency, followed by eye rubbing and withers scratching.

Unexpectedly, in spite of these lower avoidance/stress response frequencies, none of the three interventions resulted in significantly lower average or ending heart rates than control. Heart rates at the start of recording were higher than expected, likely in response to entering the novel clinical area, application of the heart rate monitor girth, and confinement in stocks or cross-ties immediately before the start of heart rate recording. Variation in heart rates among subjects was also greater than expected based on preliminary trials. With this variation, and only 12 subjects per group, statistical power was insufficient to detect mild to moderate differences in heart rate. Our results contrast with those of previous studies showing that grooming by a human at a mutual grooming site lowered heart rates (Feh and Mazières, 1993; Normando et al., 2003). However, several differences in design of these studies could explain the discrepant results. In the Feh and Mazières study, horse heart rates were near resting values and less variable among subjects (mean approximately 35 bpm with SE of approximately +/−1 bpm) at the onset of their 3-min grooming and heart rate recording whereas they were higher in our study (79.0 +/− SE 4.4 bpm). Additionally, Feh and Mazières did not expose the horses to an aversive challenge. The Normando et al. (2003) study protocol was more similar to our study in that the simulated mutual grooming was done with each subject isolated in a clinical room where they had previously experienced injections, which can be a source of stress. Their subjects were also fitted with a novel heart rate monitoring girth that emitted an audible signal every 5 s. Heart rates in their study were higher than normal resting rates, with an average of 52 bpm for control subjects, but still not as high as initial heart rates in our study.

By design, our handling intervention commenced simultaneously with the onset of the mildly aversive auditory stimulus, immediately after subjects were led from their pasture group into the clinical facility and fitted with heart rate girth. Our aim was to simulate the typical equine patient handling scenario, where the earliest that any handling intervention begins is at the start of the potentially aversive procedure. Most often, handling interventions are not applied until the horse begins to exhibit behaviors that are hindering performance of the procedure. It is reasonable to expect that additional benefit may result if the handling intervention was started in advance of a potentially aversive procedure, or even before entering the clinical setting, with the goal of achieving a near-resting heart rate and relaxation before imposing another procedure. In many instances, this would require outpatients to have a period of rest in a holding stall in order to recover from the arousal of transport and arrival at a clinical facility. In reality, this may not be practical. Ideally, for frequent, routine mildly aversive procedures, horses can be acclimated with positive reinforcement techniques. Of course, for the uncommon urgent care situations and aversive procedures, it would not be practical to train in advance of the need to perform such procedures.

Acceptance and implementation of alternate handling protocols likely depends heavily on recognition of effectiveness by personnel involved. For withers scratching and for feeding, the subjective impression at the time, for both the handling technician and the assistant, were consistent with the quantitative results obtained from video evaluation. This suggests that personnel will likely readily appreciate the effectiveness of those two interventions. For face and eye rubbing, it was our impression that a few individuals were bothered rather than soothed, at least initially. As the session progressed, some of these appeared less bothered and some eventually soothed, as if perhaps initially unfamiliar with the technique and/or sensitive to touching of the face. For feeding, while all appeared effectively distracted, some responded with anxious eating, aggressively "punching" their muzzle into the feed pan and bolting the feed, with head, neck and sometimes whole body movements that may complicate certain health care procedures. Based on this impression of individual variation in response to interventions, we speculate that for any particular horse a best technique may be identified empirically. With these observations in mind, it may be useful for horse caretakers to acclimate their horses to these and other positive handling interventions, and to evaluate relative effectiveness. Further work is planned to evaluate these and other techniques within individual horses for various specific types of procedures, and to evaluate benefit of acclimating individuals to each of the interventions to establish in advance which may appear most effective for the individual and the particular procedure.

Unfortunately, a common handling intervention with horses, both for routine care as well as veterinary care scenarios, involves application of restraint and/or verbal or physical reprimand. In rare instances severe restraint or punishment may be perceived as effective in the moment, but often heighten fear that can easily reach the level of "rigid freeze" or imminent "explosive escape" (Foster, 2017; McDonnell, 2017; McGreevy and McLean, 2009). For obvious humane ethical and safety reasons, our design did not include comparison with those confrontational/punitive strategies. For similar reasons, our design did not include comparison with negative reinforcement or overshadowing strategies (Foster, 2017).

In conclusion, these results provide evidence supporting recommendation of feeding, eye rubbing, and withers scratching for increasing comfort and compliance of horses during mildly aversive health care procedures. Feeding consistently resulted in fewer problematic avoidance/stress responses, and was consistently recognized by the technician and the assistance as an effective distractor. Whenever possible, it would be recommended to offer feed during mildly aversive procedures. Further work should be done to evaluate additional non-confrontational handling options.

Conflict of interest

The authors of this research declare no conflicts of interest, financial or otherwise.

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