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Case report

Case series report: Systematic rehabilitation of specific health care procedure aversions in 5 ponies

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ABSTRACT

Five Shetland-type ponies (3 geldings and 2 mares), ranging in age from 2 to 3 years, were presented for behavior evaluation and rehabilitation of specific health care aversions. Their history included the use as subjects in an equine surgery course for veterinary students, during which each pony had developed specific aversion to 1 or more handling and health care procedures for which they had been compliant before use in the course. Initial assessment consisted of exposing each pony to the same battery of handling and health care procedures to which they had reached compliance before use in the course. These included (1) approach of a handler; (2) haltering; (3) oral examination; (4) simulated application of eye medications; (5) ear manipulation; (6) auscultation (cardiac, thoracic, and gastrointestinal); (7) inguinal palpation; (8) rectal thermometer insertion; (9) limb lifting with hoof picking; (10) intramuscular needle stick; (11) jugular (intravenous) needle stick; (12) simulated clipping of the jugular groove, face, and ears; and (13) oral dosing. Each pony was scored for each procedure using an informal subjective 10-point numerical rating scale, and specific avoidance responses were noted. The general behavior modification approach was positive reinforcement–based systematic desensitization and counterconditioning done in a series of once-daily sessions over a period of 2 weeks. Daily sessions averaged 13.9 minutes of contact time. Criterion for successful rehabilitation was defined as scoring 9.5-10 for each procedure, with no more than 2 procedures scoring 9.5. Maintenance was assessed and reinforced for 3 additional daily sessions, followed by a final assessment session with a second, highly experienced clinician. Rehabilitation of these 5 ponies with a total of 31 mild-to-significant aversions proceeded efficiently. Four of the 5 ponies reached criterion by the eighth daily session; the remaining pony by the ninth session. The total contact time to reach criterion ranged among ponies from 107 to 123 minutes, with a mean of 115 (standard deviation 6.65) minutes. All maintained criterion levels of compliance for the subsequent 3 daily reinforcement sessions, and all scored at or above criterion on the final assessment by the second clinician as well as on follow-up assessments at 2-week intervals for 6-10 weeks until rehomed.

Case presentation

Five Shetland-type ponies (3 geldings and 2 mares), ranging in age from 2 to 3 years, were presented for behavior evaluation and rehabilitation after use as subjects in a equine surgery course for third-year veterinary students at the University of Pennsylvania School of Veterinary Medicine. Before their use in the course, the ponies had been acclimated to be tolerant of a battery of handling and health care procedures. After the course, these ponies were no longer comfortably tolerating all these procedures. The 5 ponies were presented for evaluation and behavior modification to restore their comfort with these procedures before rehoming.

History

All 5 ponies had been born into and lived continuously in the University of Pennsylvania semiferal herd managed by the Havemeyer Equine Behavior Program at New Bolton Center. This herd

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has been maintained as a closed population since 1994 as a model for study of the behavior of horses living under natural social and environmental conditions. In the fall of 2016, these 5 ponies along with 5 others had been removed from the herd to be gradually introduced to domestic husbandry, handling, and health care procedures, in preparation for subsequent use as teaching animals in a course for veterinary students during January and February 2017. After the course, the ponies were to be rehomed or assigned to other University teaching or behavior research projects. In advance of their use in the course, all ponies had been acclimated to a battery of basic domestic handling and health care procedures. These included (1) approach of a handler; (2) haltering; (3) oral examination; (4) simulated application of eye medications; (5) ear manipulation; (6) auscultation (cardiac, thoracic, and gastrointestinal tract); (7) inguinal palpation; (8) rectal thermometer insertion; (9) limb lifting with hoof picking; (10) intramuscular needle stick; (11) jugular (intravenous) needle stick; (12) simulated clipping of neck, head, and ears; and (13) oral dosing. This acclimation had been performed by a senior clinician (MA psychology, PhD physiology and behavior, Animal Behavior Society Certified Applied Animal Behaviorist) and a senior veterinary technician of the Equine Behavior Program. Both have advanced animal behavior modification training, excellent equine veterinary technical skills, and over 20 years of experience introducing previously unhandled horses and ponies to domestic husbandry and health care procedures. Ten initial once-daily sessions were conducted with each pony while they were still living in the semiferal herd. These daily sessions ranged in duration from approximately 5 to 10 minutes of contact time, generally decreasing in duration as the pony became more comfortable with procedures. For each session, the ponies were separated into subenclosures with herd mates nearby. The general approach to systematic acclimation to these novel and mildly aversive procedures was positive reinforcement–based habituation and operant shaping of relaxation and tolerance of each procedure (McGreevy, 2004; Mills and Nankervis, 1999). Primary positive reinforcement consisted of a combination of grain (approximately 50 pellets, 5-7 g per delivery, Purina Equine Senior Original; Land O'Lakes, Shoreview, MN) and scratching at mutual grooming sites (Feh and de Maziéres, 1993; Normando et al., 2003; Watson and McDonnell, 2018). Grain was also used at times as a positive enticement and/or distractor. Daily progress was informally tracked using a simple subjective 10-point numerical scale based on the technician's impression of the pony's comfort and compliance with the procedure. This method of assessing patients' comfort and compliance with health care procedures is used for assessing and monitoring progress in our routine clinical behavior work. It is a less formal version of a similar rating scale developed for use in research (McDonnell et al., 2014). For assessment of clinical behavior modification cases, a score of 10 (the behavioral target) indicates relatively comfortable, relaxed compliance with minimal avoidance response, or resulting delay in completing the procedure. A score of 5 or less indicates relative difficulty, such that the procedure is not completed. Intermediate values reflect the handler's judgment of relative comfort and severity of any escape avoidance responses. Over the course of these 10 sessions, all ponies reached target scores of 10 for all procedures. Within a week after completion of this initial 10-day introduction to handling, ponies were transported from the semiferal herd enclosure to a University farm facility 1 mile away. This facility included pastures, as well as outdoor stall–sized pens and indoor stalls, where ponies were gradually acclimated to indoor housing, individual stalls, watering (automatic waterers and buckets), and grooming, as well as husbandry implements and procedures similar to those to be used during the course. On reassessment before the start of the course in January 2017, all ponies again scored 10 for all the handling and health care procedures. Ponies were then transferred to the hospital facility where, for the 6-week course, they were housed in individual stalls together in 1 barn, within sight and/or sound of the other ponies. They were individually hand-walked outside the stall in the barn aisle once or twice daily for approximately 5 to 15 minutes, typically in groups of 2 to 5, during which they often had closer social interactions with one another.

For the duration of the course, each pony was assigned to a team of 3 third-year veterinary students. The ponies were handled and physically examined at least twice daily Monday through Friday by their assigned team members, with additional interactions with a variety of rotating clinicians and veterinary technicians. On weekends, ponies were handled and examined at least once daily, typically by students other than their assigned team. At the start of the course, almost all students had minimal or no experience handling ponies or performing physical examinations and health care procedures. During the course, with coaching and supervision by skilled equine veterinary educators, students learned how to perform all the handling and health care procedures listed previously. In addition, the ponies were groomed daily, and on 3 separate occasions, at 1-week intervals, jugular catheters were placed by students with supervision of the teaching hospital equine anesthetist/anesthesiologist clinicians and technicians. Procedures were typically done in the stalls using a nonconfrontational halter and lead restraint. These procedures were supervised by the same behavior laboratory clinician and technician who had initially acclimated these ponies, as described previously.

During the course, 5 of the 10 ponies developed aversions to 1 or more health care procedures. At the completion of the course, these 5 ponies were returned to the care of the Equine Behavior Program for evaluation and rehabilitation in advance of eventual rehoming. They were kept together at pasture with minimal handling for 4 months before the start of evaluation and rehabilitation.

Behavior assessment

Initial assessment consisted of exposing each pony to the same battery of handling and health care procedures to which they had reached comfortable compliance before use in the course. Each pony was scored for each procedure on the same 10-point numerical rating scale used during their initial acclimation. Specific avoidance responses and apparent conditioned negative stimuli were noted. Individual pony scores and avoidance responses for each procedure are summarized in Table 1. Within the context of this initial assessment, each pony was physically examined by an equine veterinarian to identify any potential sources of physical discomfort that may affect behavior (Fureix et al., 2010; Hothersall and Casey, 2012; Jonckheer-Sheehy et al., 2012; McDonnell, 2005).

Diagnosis

Based on the behavior evaluation, these procedure aversions were judged to represent specific learned avoidance responses. An assessment score of 6.5 or lower was considered a significant aversion, 7 to 9 considered a moderate aversion, and 9.5 considered minor. The specific avoidance responses appeared to have been inadvertently conditioned by negative reinforcement, similar to handling or performance behaviors purposefully taught to horses using negative reinforcement (leading, backing, holding head up, yielding to pressure). For example, if a pony moved slightly when being approached by a naïve student handler, and the handler then

Table 1
Behavior assessment results

Handling/health care procedure	Zola Jesus 2-year-old filly	Do Re Me 3-year-old filly	Ziggy 3-year-old gelding	Rolf Gruber 3-year-old gelding	Austria 3-year-old gelding
Approach	10	10	9.5[a]	10	10
Haltering	10	9.5[a]	10	10	10
Oral examination	10	9.5[a,d]	9.5[e]	9.5[e,g]	10
Simulated eye medication	10	10	10	10	10
Ear manipulation	9.5[a,d]	9.5[a,e]	7[f]	8[a,e]	9.5[k]
Auscultation	10	6.5[a,h,i]	9[a]	10	10
Inguinal palpation	10	4[a,h,i]	10	10	10
Rectal thermometer insertion	10	6[a,l]	10	10	10
Lift limbs/pick hooves	10	6[a,h,j]	9[a,j]	7[a,j]	7.5[a,j]
Intramuscular needle stick	1[b,c]	8[a,e]	9.5[k]	3[b,c]	10
Intravenous (jugular) needle stick	1[b,c]	7.5[a,e]	9.5[k]	3[b,c]	10
Clipper: neck, head, ears	9.5[a,d]	9.5[a,e]	6[a,d]	5[a,d]	9[d]
Oral dosing	10	10	10	10	10

Avoidance responses: [a]Move away, [b]rear, [c]bolt backward, [d]lift head, [e]toss head (vertically), [f]shake head (rotationally), [g]push head against handler, [h]threaten to kick, [i]kick toward handler, [j]pull limb away from hand, [k]flinch, [l]clamp tail.
Different scores for the same avoidance responses reflected differences in severity/danger of the response (e.g., Zola Jesus and Rolf Gruber rear and bolt backward for needle stick).

retreated, after 1 or 2 replicates, the pony just calmly moved away in response to approach. Similarly, during insertion of a rectal thermometer, if a pony moved its hindquarters away causing inadvertent loss of contact of the hand and thermometer, cessation of anal stimulation negatively reinforced that movement. These ponies remained relatively relaxed and positively interested in interacting with the handler, with little or no perceivable indication of conditioned fear. Indications of fear in horses include fear facial expression (wide-eye, tense facial muscles, flared nostrils, pursed lips, ears pulled caudally), as well as fear head and body posture (raised head, flexed neck, rigid muscle tension, tucked hindquarters) (McDonnell, 2003; Waring, 2003).

Treatment

The 5 ponies were kept together at pasture where they had lived during the 4 months since the completion of their use in the course. Behavior modification sessions were conducted once daily (Monday through Friday). The behavior modification work was done primarily by a recent veterinary graduate in postgraduate training for equine behavior modification (C.T.). Supervision and occasional assistance were provided by the same behavior clinician who had initially handled these ponies during transition from semiferal to domestic management and who had supervised the veterinary student handling of ponies during the course (S.M.M.).

For each session, the pony was separated into a smaller fenced enclosure (9.7 × 4.4 m) adjacent to their familiar pasture (Figure 1). This allowed visual contact with herd mates who remained nearby, but limited social distraction or competition for food reinforcement. In 1 corner of this enclosure, a 1.2-m high, 6-rail aluminum gate attached to the fence was available to create a small triangular subenclosure (2.4 × 2.1 × 1 m) that was used as needed for closer confinement. The pony was enticed with grain in a small rubber feed pan to walk behind the gate facing the apex of the triangle, eating the grain while the gate was secured to the adjacent fence using cotton lead ropes that formed a soft, quiet backstop (Figure 2). For some ponies whose avoidance response was to back up and then to rush backward or rear in response to inadvertent poll pressure of the halter, this subenclosure limited backing without use of the halter and lead. The handler reached through the rails of the gate to interact with the pony.

The general behavior modification approach was positive reinforcement–based systematic desensitization and counterconditioning (McGreevy, 2004; Mills and Nankervis, 1999). Each session consisted of progressing through the entire battery of health care procedures detailed in Table 2 and illustrated in Figures 3-13, in the order listed. Session length varied as determined by the handler based on pony tolerance and progress, with the aim to end each session with 1 or more replicates of reinforcement for a well-tolerated procedure. Session duration (animal contact time)

Figure 1. Enclosure used for behavior modification sessions.

Figure 2. Stocks-like subenclosure.

Table 2
Details of procedures and compliance targets

Procedure	Description of procedure and compliance target behavior
Approach	Upon entry of the handler into the enclosure, the pony either voluntarily approaches the handler or stands calmly as the handler approaches the left side of the pony.
Haltering	Pony stands calmly with neutral head position while handler stands at the left shoulder, reaches over the neck, sliding the noseband of a standard nylon or leather pony halter over the muzzle and the crown piece over the poll to buckle on the near side.
Oral examination	Pony stands calmly with neutral head position while handler stands at the left shoulder, running the fingers of 1 hand over the noseband using the thumb to lift the upper lip to expose the mucous membranes.
Simulated eye medication	Pony stands calmly with neutral head position while the handler stands at the left shoulder stabilizing the fingers of 1 hand at about the level of the noseband and then firmly touching the medial canthus to simulate application of eye ointment into the medial canthus.
Ear manipulation	Pony stands calmly with neutral head position while handler stands at left shoulder running 1 hand up the neck to the base of the ear, cupping and gently rubbing the left ear and then the right ear.
Auscultation	Pony stands calmly while handler stands at the shoulder placing the stethoscope over the cardiac, thoracic, and gastrointestinal auscultation sites, first on the left and then on the right side of the pony.
Inguinal palpation	Pony stands calmly while the handler stands just behind the left shoulder running 1 hand along the ventral abdomen to palpate the udder or scrotal area.
Rectal thermometer insertion	Pony stands calmly with relaxed tail while the handler stands at the left hip, rubbing lateral to the tail head. The target response to this prompt is to voluntarily relax and lift the tail and relax the anus for insertion of the rectal thermometer. An acceptable alternative is to allow the handler to gently push the tail to the offside to enable insertion.
Lift limbs/pick hooves	Pony stands calmly while handler stands at the shoulder (fore) or hip (hind) facing the hind end, running a hand down the limb while saying the verbal prompt "lift." The pony should respond by lifting the limb and allowing the limb to be held a few inches above the ground for picking out the hoof.
Intramuscular needle stick	Pony stands calmly with neutral head position while handler stands at left shoulder with the syringe in the right hand first rubbing or scratching the injection site (cranial to the shoulder, ventral to the nuchal ligament, dorsal to the cervical spine) before stabilizing the hand against the neck and rotating the syringe to insert the needle.
Intravenous (jugular) needle stick	Pony stands calmly with neutral head position while handler stands at left shoulder with the syringe in the right hand stabilized against the jugular, occluding the vessel for a few seconds before inserting the needle.
Clipper: neck, head, ears	Pony stands calmly with neutral head position while handler stands at the left shoulder placing the running (vibration and sound) clipper on the jugular groove (blade up rather than against body), progressing up the neck to cheek, the face, and then the ears.
Oral dosing	Pony stands calmly while handler stands at left shoulder with the right hand on the lead or halter and the 60 cc dose syringe in the left hand stabilized against the cheek piece of the halter, then advancing the tip of the syringe to touch the crease of the lip before rotating the syringe placing the tip onto the tongue to administer liquid (syrup thinned with water).

averaged 13.9 minutes, with session duration generally decreasing as rehabilitation progressed.

As during their initial acclimation to domestic handling, successive approximations of standing relaxed and tolerating the procedure (as described for each procedure in Table 2) were positively reinforced with grain and/or scratching at the withers as shown in Figure 14. Scratching at the withers, a common site of mutual grooming among herd mates (McDonnell, 2003), has been found to reduce heart rate (Feh and de Mazieres, 1993; Normando et al., 2003) and escape avoidance behavior during a mildly aversive simulated health care procedure (Watson and McDonnell, 2018). Primary positive reinforcement (innately positive) was paired continuously with the spoken word "good" as a secondary reinforcer (acquired positive value as the result of pairing with primary reinforcement). The "good" was delivered to mark the desired response in a manner similar to use of a clicker in clicker training, with the primary reinforcement delivered simultaneously or with minimal delay (usually within less than a second). For early

Figure 3. Approach and haltering.

Figure 4. Oral examination.

sessions, grain reinforcement was given on a continuous schedule. As tolerance of the procedures progressed, grain was given on an intermittent variable ratio to effect (Schwartz, 1978). For some horses and ponies, reinforcement with highly palatable food may lead to anticipatory behavior (Peters et al., 2012), which at times may be directed toward the handler (nudging or nipping). Care was taken to deliver grain reinforcement only when the pony was not nudging or otherwise gesturing to the handler in anticipation. For those with the tendency to nudge or nip in anticipation, the grain was purposefully delivered to the offside by reaching under the muzzle (Figure 15) as counterconditioning to turn away rather than toward the handler in anticipation of reinforcement (response substitution). In spite of these efforts, with 2 ponies (Do Re Me and Rolf Gruber), grain reinforcement elicited problematic anticipatory responses (head butting, nipping). For these 2, scratching was substituted as the principal primary reinforcement on a continuous schedule. Grain or scratching was used as a positive distractor (Figure 16) as needed during the most uncomfortable part of certain

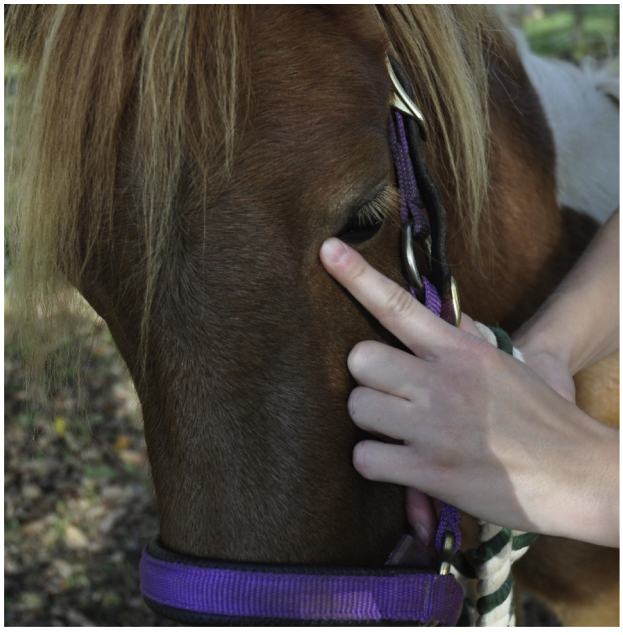

Figure 5. Simulated application of eye medication to medial canthus.

Figure 6. Ear manipulation.

procedures (e.g., penetration of the skin during needle sticks). To avoid inadvertent negative reinforcement of avoidance responses, the handler took care to position the pony such that contact was maintained. For example, if a pony had a tendency to toss its head during oral examination, the handler attempted to maintain continued light contact of the hand over the noseband with the arm relaxed, calmly waiting for the pony to cease tossing the head proceeding to lift the lip while saying the word “good” and then immediately giving grain.

For the 2 ponies that had significant needle stick aversions that included animated avoidance responses (Zola Jesus and Rolf Gruber), the subenclosure with the lead rope backstop was used for the initial 3 (Zola Jesus) or 4 (Rolf Gruber) sessions, and then just the gate without the backstop was used for the next 3 (Rolf Gruber) or 4 (Zola Jesus) sessions. In addition, the plastic cap of the needle

Figure 7. Auscultation.

Figure 8. Inguinal palpation.

was used initially to desensitize to pressure at the injection site. Once the pony stood calmly tolerating pressure of the cap for approximately 3 to 4 seconds, the site was scratched and then primary reinforcement was given, paired with the secondary reinforcer "good." This was repeated 5 to 10 times for both intramuscular (neck) and intravenous (jugular) sites, on both the left and right. Once comfortable with the needle cap (near the end of the second session in each case), a 30-gauge needle and then a 25-gauge needle were used for the third through seventh sessions. Once comfortable with multiple 25-gauge needle sticks per session using the gate of the subenclosure, 25-gauge needle sticks were done in the open area of the enclosure (eighth and ninth sessions). A 22-gauge needle was used for the remaining sessions.

In early sessions, 3 ponies (Do Re Me, Austria, and Ziggy) had a tendency to step forward, back, or laterally away from the handler when working in the open area of the enclosure. Do Re Me also tended to turn her head into the handler, sometimes threatening to bite. These movements were effectively limited by strategically positioning the pony along a fence line or near a corner of the enclosure and/or by looping the lead rope through the fence to form a loose "sliding tether" to guide and limit head movement. For 4 sessions, Do Re Me was positioned in the corner with the gate (without backstop) used to discourage her lateral movement.

Figure 9. Rectal thermometer insertion.

For limb lifting, a common cause of avoidance behaviors is physical discomfort or difficulty maintaining balance if the limb is lifted high or out laterally. This is particularly the case with animals of shorter, narrower conformation. For these ponies, care was taken to keep the limb squarely under the body and to lift only as high as necessary to pick the hoof. One of the ponies (Rolf Gruber) had a history of intermittent upward fixation of the patella bilaterally that had developed in association with markedly reduced exercise during his stall confinement during the course (Walmsley, 2011). In his case, after the third session, attempts to lift hind limbs were discontinued because of obvious discomfort. When lifting his forelimbs, he also appeared to have difficulty maintaining his balance and transferring weight onto his hind limbs. His continued escape avoidance behaviors appeared to be related to physical discomfort. For that reason, after the eighth session, forelimb lifting was also discontinued.

During initial acclimation in preparation for the course, clippers had been gradually introduced by teaching the pony on/off control of the clippers in a classical and operant conditioning paradigm, as illustrated in Figure 17 and in Video 1. The nonrunning clipper was presented to the pony, and when the pony touched it with the muzzle, grain was given from a small rubber feed pan as primary reinforcement along with the spoken secondary reinforcer "good." While the pony was still eating grain as a positive distractor/reinforcer for a few seconds, the clipper was kept near or touching the face. After 1 or 2 replicates, while the pony was eating the grain, the nonrunning clipper was rubbed against the face, neck and up to the poll, and ears as tolerated. After 1 or 2 replicates (depending on tolerance), the clipper was turned on and then presented. When the pony touched the muzzle to the running clipper, it was turned off and reinforcement was given. The next step included presenting the clipper in the off position, turning it on as the pony touched it, again simultaneously reinforcing. With each of a few subsequent presentations with touches to the clipper, the clipper was alternately turned off or on and the touching action reinforced. In our experience, this procedure of reinforcing the pony's interaction and "control" of the clippers increases positive interest and general tolerance of clipping. During rehabilitation, each session's simulated clipping procedure commenced with 1 or 2 on/off replicates of this procedure.

Criterion for successful rehabilitation sufficient to recommend rehoming was defined as reaching 9.5 or 10 on our informal scoring system for each procedure, with no more than 2 procedures scoring 9.5. On reaching this criterion, maintenance was monitored and reinforced for 3 additional daily sessions, followed by a final assessment session with a second, more experienced clinician (S.M.M.).

Four of the 5 ponies reached criterion by the eighth session; the remaining pony (Ziggy) by the ninth session. The total contact time to reach criterion ranged from 107 to 123 minutes, with a mean of 115 minutes (standard deviation 6.65). All maintained criterion levels of compliance for the subsequent 3 daily reinforcement sessions, and all scored at or above criterion on the final assessment by the second clinician.

Follow-up

Follow-up assessments were conducted at 2-week intervals for 10 weeks for all ponies except Do Re Me, who was rehomed at

Figure 10. Limb lifting with hoof picking.

6 weeks (after the third follow-up assessment). All 5 ponies maintained at or above criterion for each follow-up assessment.

Summary and discussion

Health care procedure aversions, both simple learned avoidance or conditioned fear, are a common equine behavior problem (Foster, 2017; Grogan and McDonnell, 2005; McDonnell, 2017). In recent work in our laboratory, 26 horse mares of various light horse breeds and training history that had been donated to the University for use as teaching and embryo transfer recipients were systematically evaluated to identify procedure aversions requiring rehabilitation. Of the 26, 21 (80.7%) were judged to have moderate-to-severe aversion (scoring 7 or less out of 10 on our informal rating scale) to 1 to 7 of the 12 health care procedures evaluated (McDonnell et al., 2014).

Rehabilitation of these 5 ponies with a total of 31 specific mild-to-significant health care procedure aversions proceeded efficiently and safely for both handler and ponies. This illustrates the value of implementing positive methods based on well-tested learning

Figure 11. Intramuscular and intravenous needle sticks.

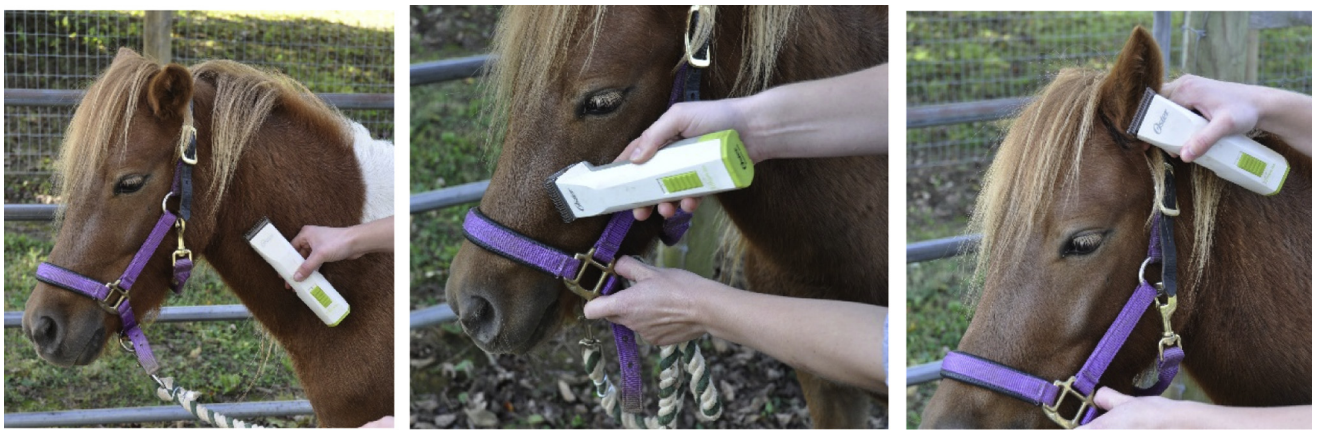

Figure 12. Simulated clipping of the jugular groove, face, and ears.

principles when rehabilitating animals with aversions to handling and health care procedures, as reviewed for horses and other species (Foster, 2017; Hanggi, 2005; Landsberg et al., 2003; McDonnell, 2000; McDonnell, 2017; Overall, 1997).

The schedule of once-daily behavior modification sessions used for rehabilitation of these treatment aversions was chosen based on trainer availability as well as our clinical experience of effectiveness. Similarly, continuing for 3 additional daily reinforcement sessions on reaching criterion was based on previous clinical success with similar treatment aversion rehabilitation. Little research has addressed efficacy of various training schedules for learning of this type in horses. McCall et al. (1993) and Rubin et al. (1980) both evaluated training schedules of horses and ponies, both in escape avoidance learning paradigms.

Low-stress, low-fear handling methods are becoming more commonly applied by small animal health care professionals, both for the prevention and rehabilitation of procedure aversions (Yin, 2009). These techniques and particularly the use of positive reinforcement are not yet widely practiced with large animals. A key challenge is nonconfrontational restraint to limit potentially dangerous escape and learned avoidance behavior. The relatively simple solution in this case series with ponies was the use of the subenclosure created with an aluminum rail gate in the corner of the training enclosure. Based on the successful use of the subenclosure for Zola Jesus and Rolf Gruber to limit backing up during needle sticks, the subenclosure with slight modifications was useful for 1 or more aversions in each of the other ponies. The configuration was slightly modified for each depending on their specific avoidance responses. We find that creative arrangements such as this is particularly helpful to provide a safe and more relaxed environment for handlers and to efficiently interrupt the cycle of avoidance. It is our impression of the horse population at large that most are not introduced to health care procedures with methodical positive reinforcement techniques and so may be at a higher risk of fear conditioning that logically complicates and reduces efficiency of rehabilitation. With increased education of equine caretakers and veterinary health care professionals on learning principles and techniques, we expect a reduction in the incidence of serious equine health care aversions.

In dogs and cats, psychotropic medications are often prescribed as an adjunct to training for behavior modification in cases of anxiety, aggression, or other select behavior problems (Hart et al., 2006). Few published data are available on the efficacy of psychotropic medications in horses. There is research evidence for the use of psychotropic medications as an aid to behavior modification in stallions suffering from psychogenic sexual dysfunction and to horses with locomotor stereotypies (McDonnell et al., 1985; McDonnell, 2011), but to our knowledge, no data have been published on the use of such medications as an aid for behavior modification of health care aversions. Crowell-Davis (2009) reported clinical use of tricyclic antidepressants and selective serotonin reuptake inhibitors as effective adjuncts to behavior modifications of horses with human-directed aggression. As noted by Crowell-Davis, long-term (4-6 weeks) treatment with tricyclic

Figure 13. Oral dosing.

Figure 14. Scratching withers as positive reinforcement.

Figure 16. Grain as a distractor/reinforcer.

antidepressants and selective serotonin reuptake inhibitors is required to reach maximum effectiveness, so these medications may be cost-prohibitive for horses.

The supplement alpha-casozepine (Zylkene) has been found to be an effective aid to behavior modification when introducing ponies to handling and health care procedures during transition from semiferal to domestic handling (McDonnell et al., 2013), as well as of modest benefit for horses with specific health care procedure aversions (McDonnell et al., 2014). Alpha-casozepine is a modified milk protein for which evidence indicates that its calming effects are mediated by interaction with the benzodiazepine receptor (Lecouvey et al. 1997a, 1997b).

Ponies are known anecdotally and in limited research as particularly efficient learners. In previous work in our program, pony foals demonstrated retention of learning after only a single positive reinforcement–based operant conditioning task training session (Martinez deAndino and McDonnell, 2017). Although there is evidence that genetics, age, and sex contribute to learning efficiency in ponies (Bonnell and McDonnell, 2016), fewer than 10 training sessions are usually required to rehabilitate procedure aversions (McDonnell, 2000). In management of horses and ponies, efficient classical and operant learning have both practical advantages and disadvantages. Just as desirable behaviors can typically be acquired in 1 or 2 replicates of positive or negative reinforcement or association, undesirable avoidance responses can be similarly acquired in as few as 1 or 2 replicates of inadvertent reinforcement. Unfortunately, the traditional human response to escape behavior of horses during novel and/or mildly aversive procedures is to increase restraint and/or to add positive punishment. Because horses are large and strong enough to continue to escape or avoid, persisting with this technique typically continues to shape an increasingly animated response. When restraint or punishment is taken to extremes, as is often the case, fear and panic can quickly become conditioned (Maren, 2001). In the case of these ponies, their avoidance behavior had emerged during the veterinary school course. One of the specific goals of the course is to introduce low-fear, low-stress handling to veterinary students and to model its effectiveness to staff, clinicians, and clients. Traditional methods of increased restraint and or positive punishment are specifically discouraged in favor of positive, nonconfrontational methods based on learning science principles. Accordingly, these ponies, for the most part, did not appear to have become fearful during the course and their specific procedure aversions, although well organized, did not appear to have advanced to conditioned fear.

Figure 15. Grain fed to the offside.

Our many years' experience of using these once semiferal ponies as "patients" in a veterinary course has emphasized the factors contributing to the development of aversions to health care procedures, even for animals that start out compliant. In this teaching hospital environment, obvious risk factors include a variety of different people (staff and students) interacting with the ponies and performing mildly aversive procedures. These people have varying skill levels, confidence with the procedures, and styles of human-animal interactions. The general stress inherent to a 6-week hospitalization, particularly for animals recently introduced to domestic care, likely exacerbates the risk. These factors are often difficult to control and so must be managed as much as possible. Students are encouraged to recognize escape avoidance behavior early and to seek coaching by experienced technicians from the Equine Behavior Program, who are regularly present during the course to provide support. In most instances, with instructions, students are able to successfully implement basic behavior modification methods to avoid development of significant aversions.

Figure 17. Clipper acclimation procedure: Left panel illustrates pony reaching to touch muzzle to clipper when presented at various locations. Handler says "good" as the muzzle touches and then immediately offers grain (right panel).

It is important to recognize that physical discomfort may contribute to attempted avoidance of health care procedures that are typically tolerated by most horses. For example, when lifting limbs, especially in ponies, physical discomfort and loss of balance are factors to be considered. Horses, particularly small horses and ponies, may have difficulty learning how to maintain their balance when their limbs are lifted. Holding a limb, particularly a hind limb, in a position that is ergonomically comfortable for the handler (high and out to the side) can be painful to the horse's limb joints. When the technique is modified to keep the horse's comfort in mind, avoidance behaviors conspicuously decrease. For example, Rolf Gruber's discomfort due to bilateral upward fixation of the patella was judged to be such that continuing to attempt limb lifting was detrimental to his rehabilitation overall. When limb lifting was discontinued, Rolf Gruber appeared more relaxed for all other procedures.

In our experience, rehabilitated horses and ponies appear especially at risk of relapse. Maintenance of tolerance often depends on the technical procedure skills of the health care professional and the handler. The ability to efficiently complete the procedure as comfortably as possible and to avoid the cycle of negatively reinforced escape and avoidance is important to continued compliance. Relapse is less likely if generous positive reinforcement is continued. For example, we recommend continued routine use of grain as a positive distractor/reinforcer for every needle stick. This is a practical and inexpensive technique to maintain comfortable compliance with annual vaccinations and blood sampling for Coggins testing. Similarly, offering a small pan of grain as distraction and reinforcement during clipping, eye treatments, or limb lifting is a simple and practical aid for maintaining compliance. With this in mind, in the case of these rehabilitated ponies that will be rehomed, we recommend consideration of a best-fit environment. This includes full disclosure of past aversions along with discussion of recommended handling techniques for maintaining comfortable compliance.

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Ethical considerations

The 5 ponies were evaluated for specific aversions, and an individual behavior modification plan was designed and carried out for each. All work was approved by the University Institutional Animal Care and Use Committee, following applicable equine care and use guidelines.

Conflict of interest

The authors declare no conflicts of interest related to this work.

Authorship statement

The idea for the clinical rehabilitation as a group case report was conceived by Sue McDonnell as a training exercise for Catherine Torcivia. The case rehabilitation protocols were designed collaboratively by Sue McDonnell and Catherine Torcivia. The animal

work was performed primarily by Catherine Torcivia. The evaluation and rehabilitation results were summarized by Catherine Torcivia. The article was written by Catherine Torcivia and Sue McDonnell.

Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jveb.2018.02.003.

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