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Is There Evidence of Learned Helplessness in Horses?

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Learned helplessness is a psychological condition whereby individuals learn that they have no control over unpleasant or harmful conditions, that their actions are futile, and that they are helpless. In a series of experiments in which dogs were exposed to inescapable shocks, this lack of control subsequently interfered with the ability to learn an avoidance task. There is evidence that both neural adaptations and behavioral despair occur in response to uncontrollable aversive experiences in rodents, although this has yet to be demonstrated in other species such as horses. However, certain traditional methods of horse training and some behavioral modification techniques—it has been suggested—may involve aversive conditions over which the horse has little or no control. When training and management procedures are repeatedly unpleasant for the horse and there is no clear association between behavior and outcome, this is likely to interfere with learning and performance—in addition to compromising welfare. This article reviews published literature and anecdotal evidence to explore the possibility that the phenomenon, learned helplessness, occurs in the horse.

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One of the major events that initiated concern over equine welfare was the publication in 1877 of the book *Black Beauty* by Anna Sewell. In this book, there are several descriptions of what could be described as a learned helplessness response and the events that caused it. For example, in chapter 3, the breaking-in process is described as requiring the horse to

> never start at what he sees ... nor have any will of his own, but always do his master's will even though he may be very tired or hungry, but worst of all is, when his harness is once on, he may neither jump for joy nor lie down for weariness....

In chapter 40, Ginger was seen to have a "hopeless look in the dull eye." Although this was a work of fiction, it signifies early concern about the welfare of working horses and provides anecdotal evidence for the possibility that learned helplessness may occur in horses. It is clear that horses suffering from extreme cruelty, debilitation, and/or depression are easy to identify. The challenge for equitation scientists is to provide objective measures of welfare related to the training and riding methods currently utilized and to identify the situations, practices, and events that lead to extreme conditions such as learned helplessness.

The term "learned helplessness" was originally used to explain the findings of a series of studies in which dogs were exposed to inescapable shocks and then failed to learn a subsequent avoidance task (Overmier & Seligman, 1967; Seligman & Maier, 1967). These investigations into avoidance learning resulted in the discovery that the experience of having no control over the outcome of an aversive situation interfered with future learning. Once nonhuman animals had experienced a situation whereby the outcome was independent of their response, they learned to be helpless in similar situations. Such studies, in which animals are subjected to extreme forms of pain and distress, attracted much criticism from animal advocates—particularly in the United States, where much of this original work was carried out. In a thought-provoking and disturbing book (Pratt, 1980), the extent of suffering imposed on animals in the name of "science" is discussed in great detail. It has been suggested that parallels with the learned helplessness experiments can be drawn in relation to a range of situations experienced by horses when subjected to different training methods. To determine whether the horse is suffering as a consequence, it is imperative that we determine whether there is evidence of learned helplessness in the horse.

The main aim of traditional training techniques is often stated as gaining control over the behavior of the horse. If successful from the trainer's point of view, the process will inevitably result in a loss of control for the horse. Whether the experience is unpleasant for the horse will depend upon the methods used. Many of the more traditional approaches involve generating compliance from the horse through the application of unpleasant stimuli (Waran, McGreevy, & Casey, 2002). The term "horse breaking" was traditionally applied to describe

this initial training; this frequently involved extreme forms of restraint such as hobbles to prevent the horse from escaping from the procedure that was being carried out. The horse was deemed to be ready to ride once it had ceased to resist and learned helplessness had been achieved (Farmer-Dougan & Dougan, 1999).

The possibility that ridden horses may exhibit features of the learned helplessness response was raised at least 20 years ago (Ödberg, 1987). It is clear that inappropriate training and riding can result in horses who are uncooperative and aggressive, with some becoming dangerous and unrideable. This may explain the wastage reported by Ödberg and Bouissou (1999), who found that 66% of the horses sent to a French abattoir were culled due to behavioral issues. Despite being repeatedly subjected to inconsistent and/or painful techniques, others react more passively and appear compliant. It is suggested that these may be exhibiting learned helplessness (Ödberg, 1987; Ödberg & Bouissou, 1999). The aim of this article is to consider whether there is evidence that current management and training methods expose the horse to uncontrollable aversive stimuli and whether the resultant behavior of the horse could be symptomatic of learned helplessness. Factors that have been found either to predispose animals to the development of learned helplessness or to protect them against it, in an experimental situation, are discussed in relation to the horse. Evidence, based on both published literature and informed anecdotes, is presented to explore the possibility that learned helplessness occurs in the horse.

EXPERIMENTALLY INDUCED LEARNED HELPLESSNESS IN DOGS AND RODENTS

The findings of Overmier and Seligman (1967) and Seligman and Maier (1967) that the prior exposure of dogs to unavoidable shocks resulted in interference with subsequent escape-avoidance learning in a shuttle box (two compartments separated by a barrier over which the animal can jump to avoid foot shock), was interpreted by them as being caused by learned helplessness. Although the dogs concerned initially showed normal reactivity to shock, after a few trials they passively accepted the shock and failed to even make escape movements. Dogs who had been exposed to the same electric shocks but had been able to respond in a way that resulted in escape successfully learned the avoidance task (Seligman & Maier, 1967). It was proposed that it was not the experience of shock per se that interfered with subsequent avoidance learning but the uncontrollability of this experience (Weinraub & Schulman, 1980).

Firm evidence to support the concept of learned helplessness remained elusive until recently. Research into how the brain adapts in response to stress has uncovered the physiological basis for the different behavioral consequences

of exposure to controllable and uncontrollable stressors. The neurotransmitter dopamine is associated with reward-seeking behaviors that are central to the learning process (Arias-Carrión & Pöppel, 2007). Dopamine is found in the mesocorticolimbic system, which is responsible for motivational systems. Dopaminergic neurons project to three forebrain areas: the prefrontal cortex, amygdala and hippocampus, and nucleus accumbens (Cabib, 2006). Repeated stressful experiences have been shown to induce changes in these brain dopamine systems (Cabib & Puglisi-Allegra, 1996). Exposure to mildly stressful conditions causes an increase in dopamine release in the amygdala (Inglis & Moghaddam, 1999). Increased aversiveness causes dopamine release in the prefrontal cortex, whereas prolonged and highly aversive stimuli cause dopamine release within the nucleus accumbens as well (Puglisi-Allegra & Cabib, 1997). The dopamine response relates to increased activity at the onset of the stressor as attempts are made to escape. When behavioral responses fail to result in escape from the stressor (as is the case if stress is uncontrollable), profound inhibition of dopamine release in the nucleus accumbens occurs; the consequence is helplessness or behavioral despair (Cabib, 2006).

Learned helplessness, to a certain extent, is a logical adaptation. If behavior does not affect consequences, there is no point in repeatedly trying different strategies; regardless of the effort expended, the outcome will be the same. However, as this behavioral interference has been found to generalize to other areas of the animal's behavioral repertoire (Hiroto & Seligman, 1975; Joffe, Rawson, & Mulick, 1973), it is normally considered maladaptive, partly because it results in a loss of motivation and anhedonia (Cabib, 2006). The deleterious effects of inescapable aversive conditions on the health (e.g., stomach ulcers and weight loss) of the experimental animals (Seligman & Maier, 1967) also make it imperative to determine whether horses may be experiencing similar conditions during some aspects of management and training.

EVIDENCE OF LEARNED HELPLESSNESS IN THE HORSE

Learned helplessness is an emotive term that is clearly defined in terms of its experimental manifestation; however, it is often misused and misinterpreted by the layperson. For example, the exaggerated movement shown by some dressage horses was referred to as acquired or learned helplessness in an article of the same name that appeared in the December 2005 edition of the magazine *St Georg* (Thiel, 2005). Although the term effectively describes the response of a horse who has been placed under pressure and has learned that no response can relieve that pressure, the performance of the exaggerated movement discussed in the article would suggest that the horse is actually trying harder for the elusive

reinforcement. This is very different from learned helplessness as it is induced in experimental animals, which results in an animal who lacks motivation. Interestingly, the term "learned helplessness" did not appear in the abridged version of this article that appeared in *British Dressage* magazine, translated by Linda Waller (Thiel, 2006). The latter article was a compelling account that focused on how to assess whether dressage horses are performing "happily" or are suffering discomfort and/or pain and are under pressure.

To objectively assess the behavioral responses of the horse and evaluate whether welfare is compromised by procedures commonly adopted by horse caregivers (owners) and trainers, it is vital to accurately apply the theories and findings of work carried out using other species. It is only then that these findings can be used to further our understanding of the effect of management and training practices on the horse. Events and procedures that are both aversive and uncontrollable for the horse must first be identified and their duration and frequency assessed. Evidence of behavioral responses that are similar to those exhibited by animals suffering from experimentally induced learned helplessness can then be used as a means of recognizing features of learned helplessness or behavioral despair in the horse.

Potential Sources of Uncontrollable Aversive Experiences in Horse Training

One of the aversive procedures used to induce learned helplessness experimentally is restraint (Cabib & Puglisi-Allegra, 1996). This procedure is used extensively in the training and management of the horse. Central to the early training methods adopted by military horse breakers was the immobilization of horses by using straps, ropes, and hobbles; thus, horses learned that resistance was futile and that they were effectively "helpless." Waran et al. (2002) describe a number of horse-training approaches that depend on instilling a sense of hopelessness in the horse. Even one of the most famous horse tamers, John Rarey (1827–1865), tied up the near foreleg of the horse prior to working with it in order to "conquer" the horse or impose an experience of helplessness (Richardson, 1998).

Although many of the early training techniques are no longer used, a number of different methods of restraint currently are used; these are taught to horse handlers of varying levels of experience by trainers and even through the popular press—albeit with reservations as to usage (Ball, 1998). The practice of tying a horse's head to its tail tightly to force it to stand with neck bent round, as adopted in the 1800s, is illustrated in Richardson (1998) and presumably encouraged compliance. There are anecdotal reports of horses restrained in a similar way; for example, in certain North American horse-training centers, horses left overnight with a leg tied up have occasionally been encountered.

Upon questioning, trainers may state that they are attempting to make the horses more malleable and tolerant of the rest of their training methods.

The practice of applying a "twitch" to the nose of the horse is still a commonly applied form of restraint. The "calming" effect that it has on the horse is considered the result of the release of endogenous opiates in response to the pain caused by the procedure. Its effectiveness in distracting the horse from other stimuli (such as the use of clippers) can be attributed to both the actual pain and these endogenous analgesics (Webster, 1994). This form of restraint most certainly involves an inescapable aversive experience for the horse. Depending on the duration and frequency of such procedures, the subdued behavioral response that occurs may not have long-term consequences; however, it is an example of at least transitory learned helplessness. Welfare concerns regarding this procedure resulted in the development of the "humane twitch," the effect of which is thought to be potentially less unpleasant for the horse.

Although it is certain that extreme forms of restraint are uncontrollable, aversive, and potentially painful for the horse, the effect of procedures such as tying up, harnessing, and using restrictive training equipment is less clear. Ödberg and Bouissou (1999) noted that many horses are routinely fitted with equipment such as side reins and draw reins to enforce bending of the neck. Equipment that restricts the position and movement of one part of the horse is likely to cause discomfort at the very least. A means of objectively assessing the impact of such devices on the well being of the horse is required in order to determine the impact they may have on the horse. Recently there has been much debate about the welfare implications of the use of hyperflexion of the neck (often termed "rollkür") as a dressage training method. In January 2006, the International Equestrian Federation (Fédération Equeste Internationale [FEI], 2006) held a meeting to discuss the issue, the results of which can be found in FEI (2006).

However, when trying to determine how aversive such training methods actually are for the horse, some means of assessing how they feel when being trained or ridden is required. By using preference tests, it is possible to get at least an initial indication of how an animal feels about a situation (Duncan, 1992); it is this approach that has been applied to assessing the impact of riding the horse in a forced rollkür posture (von Borstel et al., 2007). Horses were ridden through a Y-maze, one arm of which resulted in their being ridden on a circle in the rollkür posture (achieved using side reins); the other arm resulted in their being ridden on a circle in regular collection without the use of the side reins to achieve hyperflexion. Following a phase of conditioning to the association between one arm of the maze and the technique in which the horse would then be ridden, the horses were offered a choice of which arm of the maze they went down. Of the 15 horses tested, 14 chose the arm of the maze associated with regular collection significantly more than that associated with the rollkür

posture. It was also noted that when ridden using the latter technique, the horses showed behaviors such as tail swishing and mouth opening significantly more often and also tended to show stronger behavioral fear reactions in a subsequent fear test (von Borstel et al., 2007). Although this was a small-scale study, the approach provides possibilities for enabling researchers to assess whether other aspects of riding and training are unpleasant and/or painful experiences for the horse.

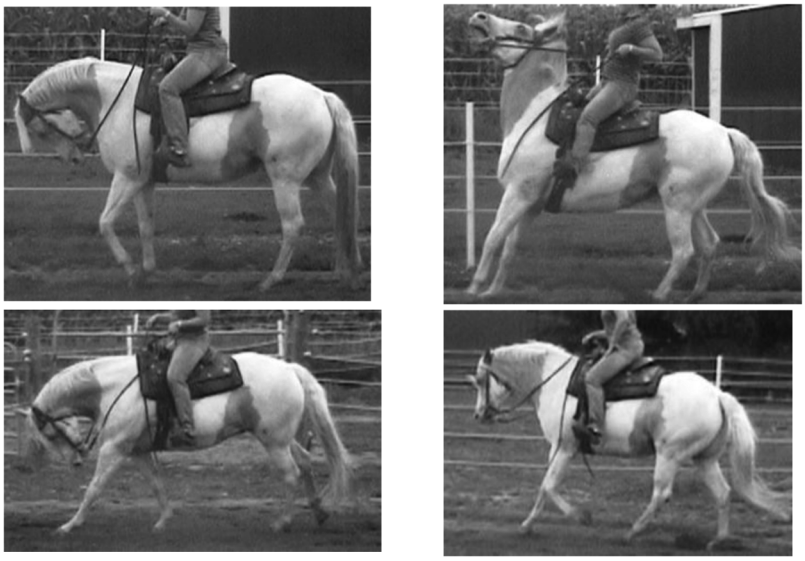
A further potential source of pain and discomfort in both riding and driving horses is the bit, either in association with tight-fitting/restrictive nosebands or by itself. The size, shape, and position of the bit in the mouth vary greatly, as does the ability of the rider or driver to regulate the tension exerted on the horse's mouth. It has been shown that misuse of the bit causes the horse pain and can result in physical damage as well as behavioral signs of discomfort (Cook, 2003). This source of discomfort would be inescapable, especially if the rider/driver maintained a tension on the reins that was not released appropriately. The perception of rein tension by riders has been found to vary significantly from objective measures (Clayton, Singleton, Lanovaz, & Cloud, 2003). By fitting sensors to the reins, the pressure on the horse's mouth can be assessed objectively (Clayton et al., 2003; Warren-Smith, Curtis, Greetham, & McGreevy, 2007), and the rider/driver can be made aware of this. Such information provides the rider/driver with feedback that can be used to monitor rein tension, which can then be kept to a minimum or improved in terms of consistency (Warren-Smith et al., 2007). The extent to which the bit is unpleasant for the horse is likely to relate to the pressure exerted on the mouth, which can now be monitored.

Inconsistent training methods and conflicting signals can be an additional source of inescapable unpleasant/painful experiences for the horse. An extreme example of this may be found in the training of some western pleasure horses where the horse is simultaneously urged forward with the use of spurs and held back with the bit. The horse cannot behave in a way that causes the pain to cease and is thus subject to an inescapable aversive experience, commonly referred to as "yank and crank" or "jerk and spur." Although potentially not as painful for the horse, it is not unusual for riders in all disciplines to simultaneously urge the horse forward with the leg and fail to release the pressure on the mouth, hence giving the horse two conflicting signals (McLean, 2003).

In general, horses are trained to associate behavioral responses with reductions in pressure, either on their mouths when they slow down or on their sides when they go faster or move in a particular direction. The removal of pressure acts as a reward, thus making the response more likely to occur in the future; that is, it is negatively reinforced (McGreevy, 2007). However, if the pressure is not released consistently, the horse's response will sometimes not be reinforced,

and this inconsistency is likely to result in confusion for the horse. Such conflict may result in attempts to avoid the aversive pressure (unwanted behavior and "evasions") or in a failure to respond at all. The latter response would indicate a reduction in motivation as found in experimentally induced learned helplessness (Figure 1).

Horses who are repeatedly exposed to uncontrollable extreme stressors are likely to suffer from long-term debilitating effects. However, exposure to only occasional uncontrollable aversive experiences may cause only short-term deficits in motivation, emotion, and cognition that should dissipate if the horse also has positive, pleasurable experiences. Unfortunately, horses who seem to have "switched off" (are unresponsive, lack motivation, and are apathetic) are often found, and the effects of management style, in addition to the negative experiences linked to training, may contribute to their general demeanor.



Some methods of training can be perceived as aversive stimuli without the opportunity for control; i.e. little to no chance of avoiding the aversive stimulus by making a "correct" choice. One method is referred to occasionally as "yank and crank" and may involve simultaneously applying heavy pressure to the mouth as well as strong spurring action. Some horses may respond by showing conflict behavior (above right), but over time, may respond by becoming complacent—at least while performing under saddle tasks.

FIGURE 1 Examples of crank and yank, photos on left; conflict behavior, photo upper right; complacent, photo lower right.

Housing and Management of the Horse

In their study, Cabib & Puglisi-Allegra (1994) found that although confinement and isolation were not specifically designated as aversive stimuli, mice contained in an unfamiliar environment displayed—although to a lesser extent—symptoms similar to those displayed by mice who had been exposed to uncontrollable electric shocks, Many horses are confined and isolated in individual housing for long periods. The horse is a social, herd-living animal whose survival as a prey species relies primarily on the "safety in numbers" phenomenon. The relative importance of the company of other horses was demonstrated in a study carried out by Schatzmann (1998). When given the option to select from (a) individual stall with hay and straw, (b) hay outside, (c) firm or soft ground surfaces, and (d) the company of others or not, the highest priority was always to be in the company of—or view contact with—other horses. The horses also showed a preference for being outside and eating grass, regardless of the weather conditions (Schatzmann, 1998).

The introduction of stable features that may lessen the aversive nature of this environment has been shown to reduce other signs of stress in the horse. Increasing the visual access to the areas surrounding stables has been found to reduce stereotypic behavior in stabled horses (Cooper, McDonald, & Mills, 2000). The use of stable mirrors (McAfee, Mills, & Cooper, 2002) and two-dimensional images of horses (Mills & Riezebos, 2005) as surrogate companions have also been shown to have a similar positive effect. Although a combination of short-term confinement and social isolation was found to result in higher activity patterns in mares when subsequently tested in an open-field test (Mal, Friend, Lay, Vogelsang, & Jenkins, 1991), more permanent individual stabling may result in depressed behavior patterns. It has been observed that horses stabled for the majority of their lives with no opportunity for social interaction often appear apathetic and lethargic, which in some cases seems to be a desired effect in that the horse may be easier to handle. If the horse is required to work in a particular way, a "flat," somewhat unresponsive style is sometimes valued (e.g., riding school horses and western pleasure horses).

In the experimental work on learned helplessness in other species, previous experience of being able to control events was found to provide some protection against the effects of uncontrollable aversive conditions (Seligman & Groves, 1970). This positive effect of previous experience can also be found in the horse. A survey of the prevalence of equine compulsive disorders in formerly feral horses who had been domesticated indicated a relatively low occurrence when compared with domestic horses. This suggests that their natural early environment may have helped them to cope with subsequent stressful conditions (Dodman, Normile, Cottam, Guzman, & Shuster, 2005).

Domestic foals weaned in small groups and housed in paddocks were found to display time budgets that were more similar to those of feral hoses than individually housed foals, with the latter displaying more behavioral "abnormalities" (Heleski, Shelle, Nielsen, & Zanella, 2002). The long-term effects of these different weaning methods is unclear; however, it has been shown that housing young horses in groups rather than individually facilitates subsequent training, at least in the short term (Søndergaard & Ladewig, 2004).

Allowing animals to have some control over their environment has been shown to reduce anxiety (Joffe et al., 1973), and the resultant contingency between response and outcome may well facilitate training. When kept in groups, horses can choose if and how they engage in social interactions, although there needs to be enough space for animals to be able to control such interactions. It is also possible to design housing systems that allow the horse some control over other environmental features such as lighting (Houpt & Houpt (1988), feeding (Gieling, Cox, & VanDierendonck, 2007), flooring, and an out-in-the-open or inside environment (Schatzmann, 1998). Although, for most horses, group living in an outdoor environment would be the preferred option, this is not always practical. By offering horses the opportunity to control at least some factors in their lives, not only may their welfare be improved but also their training may be enhanced.

Recognizing Learned Helplessness in the Horse

According to Seligman and Altenor (as cited in Weinraub & Schulman, 1980), the experience of being unable to control an aversive situation resulted in three behavioral deficits: motivational, cognitive, and emotional. The animals who had not been able to escape from the aversive stimuli showed a reduced tendency to try to escape; there was no motivation to respond when this had not previously afforded relief. Exposure to uncontrollable events interfered with the ability of the animals to associate their future behavior with outcomes. This cognitive deficit interfered with subsequent performance. Initially, anxiety was the emotional response to aversive conditions—whether or not controllable. In the case of those animals who had experienced inescapable aversive conditions, this anxiety was then replaced with emotional depression. The overall picture is of an animal who is passive, demotivated, and depressed. In some cases, this rather unreactive behavior is considered desirable in the horse. Novice riders are usually provided with "steady" mounts who are not prone to unpredictable responses but are as "bombproof" as possible. Many riding-school horses are considered lazy and hard to "get going." Such animals may well have experienced repeated aversive experiences of unbalanced riders who have little control over rein contact or leg aids. Combined with a lack of contingency between response and outcome, such horses may well have given up trying.

Horses selected for use in human therapy programs tend to be chosen for their passive and tractable behavior, but it is likely that this may mask physiological indicators of stress. There are published reports of the benefits to humans of equine-assisted therapy programs (Bizub, Joy, & Davidson, 2003); however, evaluation of the effects on the equine subjects are currently few. Suthers-McCabe and Albano (2005) reported pre- and posttherapy measures of stress in horses in an exploratory study of equine-assisted therapy programs. Plasma cortisol and observed behavior were recorded for 28 horses in four therapy programs, two for mental health patients and two for patients with physical or mental health problems. Data were also collected when able-bodied volunteers rode 6 of the horses in therapy sessions. Although there were no significant differences reported in the behavior of the horses, 6 individuals showed an increase in blood cortisol levels. Patients rode 5 of these, and 1 was ridden by a volunteer. The authors suggest that physiological methods may identify horses experiencing levels of stress that may lead to what they term "burnout" or health and behavioral problems. However, the results also suggest that outward behavioral signs do not necessarily reflect the emotional state of the animal and that the conclusions that can be drawn from monitoring traditional stress parameters are limited.

The current methods used to assess the welfare of horses in different situations may well prove to be inadequate for the identification of the behaviors and subjective experience associated with inescapable aversive conditions such as those related to the development of a state of learned helplessness. The development of stereotypic behavior has been associated with inappropriate management regimes and may reflect the horse's means of adapting to an unfavorable environment (Cooper & Mason, 1998). Although such behavior generally indicates that the horses have been subjected to suboptimal conditions at some point, it also demonstrates that the horses have adapted to cope with these and have thus exerted some control over their environment. However, certain behavioral features that are comparable to signs associated with learned helplessness have been identified in horses who perform a stereotypy, irrespective of the type of stereotypy performed. When the learning ability of 51 stereotypic horses was compared with 19 nonstereotypic horses, it was found that the former took longer to learn a simple operant task and required longer to perform the required task when successful (Hausberger, Gautier, Müller, & Jego, 2007). It was noted by Nicol (1999) that horses had been found to be less responsive to aversive stimuli while performing a stereotypy than when not performing the stereotypy. Thus, regardless of the signs that the horse has developed a coping strategy in the face of aversive conditions, a reduction in response to environmental stimuli is also indicated. If the animal has not developed any such coping strategy in the face of adversity, this withdrawal is likely to be more apparent.

The interest shown in environmental features has been used as a means of assessing behavioral responses in rodents (Joffe et al., 1973), the results being used as an indication of welfare. In a study that investigated the effects of diet and weaning method on the behavior of young horses, the more time that was spent investigating a novel object compared with that spent looking at it, the less stressed the animal was deemed to be (Nicol et al., 2005). Interest in the environment and exploration are indicative of motivation and may well relate to mood and cognition. The novel object tests that have been used to assess behavioral ractivity in horses (Wolff, Hausberger, & Le Scolan, 1997) could be adapted to test for behavioral signs of learned helplessness. Cognitive deficits could be tested using simple operant tasks (Hausberger et al., 2007) with measures of performance (accuracy, perseverance, and speed) being used to assess both motivation and the ability to form contingencies. In a study that aimed to determine whether riding-school horses were adversely affected by being ridden by a number of different riders during any one day, the limitations of both behavioral observations and salivary cortisol measures in differentiating between training methods were noted (Brunt, Van Driel, Owen, & Talling, 2006). Behavioral tests of exploration and learning ability could be developed and used as more objective methods of assessing the welfare of riding-school horses and other groups of equines.

There is currently a general move toward focusing on signs of positive emotions when considering animal welfare rather than the absence of negative emotions (Boissy et al., 2007). Given that one of the symptoms of learned helplessness is anhedonia (Cabib, 2006), this approach is more likely to result in the identification of this response in the horse. Harmonization between internal body rhythms and external factors has been used to evaluate the welfare of other animal species—such as red deer (*Cervus elaphus*)—under different environmental conditions (Berger, Scheibe, Michaelis, & Streich, 2003). When assessing the welfare of managed horses, comparisons are often made with their free-ranging counterparts—for example, the assessment of the welfare of pregnant mares housed in stalls (Flannigan & Stookey, 2002). Behavioral evidence of eating satisfaction was linked to sleep patterns in stabled horses (Ninomiya, Sato, Kusonose, Mitumasu, & Obara, 2007), and further comparisons of individuals within groups may result in the identification of animals who are coping less well with their conditions. Behavior that is pleasurable for the horse requires further clarification but is likely to include social interaction, choice of food selection, and freedom of movement. The physiological correlates of excitement as a result of pleasurable anticipation as opposed to anxiety and fear do not differ sufficiently to provide conclusive evidence of subjective experience. For example, increased cortisol levels have been found to be associated with ridden exercises that appear exciting for the horse, such as the western riding events of barrel racing and pole bending (Fazio, Calabrò, Medica, Messineo, & Ferlazzo,

2006). Whether such excitement is pleasant or unpleasant cannot be determined by such measures. In human females, physiological activation (in this case, heart rate) was not found to relate to the subjective experience of emotion (Myrtek, Aschenbrenner, & Brügner, 2005), although it has been suggested that heart rate variability may have potential as a measure of emotional well being and welfare in animals on the farm, including the horse (von Borell et al., 2007).

In the experimental studies of learned helplessness—in addition to the effect on motivation, cognition, and emotion—animals given uncontrollable shock were also found to develop more stomach ulcers and lost more weight than animals who had received shocks that they could control (Weinraub & Schulman, 1980). In some of the early experiments, several animals died or became ill as a result of the treatments (Seligman & Maier, 1967). When looking for ways of identifying horses at risk of developing learned helplessness, the studies could focus on those animals who show repeated signs of ill health. Repeated bouts of abdominal discomfort (recurrent colic) occur in certain horses with no apparent cause (Schramme, 1995), and gastric ulceration has been shown to be highly prevalent in performance horses in different disciplines (Lester, 2004) and under different management regimes (Boswinkel, Ellis, & Sloet van Oldruitenborgh-Oosterbaan, 2007). Such animals may also show other behavioral features that are indicative of the learned helplessness response.

Improving Equine Welfare

In the interests of improving equine welfare, we should now be considering ways in which we can improve the quality of life of horses who may be suffering from a condition similar to human depression. From the evidence presented earlier, it is likely that horses do display signs of learned helplessness—including reduced motivation, anhedonia, and cognitive deficits—when exposed to repeated, inescapable aversive experiences in both training and management. It is important that there is an increased awareness that the unresponsive, lethargic, and "bombproof" horse may well be showing signs of behavioral despair rather than being "happy" and "relaxed." Quiet, withdrawn animals should be assessed with as much care as those showing more overt behavioral "problems." It is also imperative that handlers and trainers are fully aware of the aversive nature of some of the experiences to which we subject the horse. Objective measures, such as assessing rein tension (Warren-Smith et al., 2007), will assist in providing evidence on which people can base their judgments.

Opportunities for pleasure and enjoyment should be provided, particularly at times when the horse is experiencing aversive events in other areas of life. The importance of early experience cannot be too strongly emphasized. The positive effects of such factors as group living (Søndergaard & Ladewig, 2004) and paddock housing for weanlings (Heleski et al., 2002; Nicol et al., 2005)

may protect those animals from the depressing effect of subsequent aversive experiences. Providing foraging enrichment for stabled equine athletes facilitates natural patch-foraging behavior (Goodwin, Davidson, & Harris, 2002), and associated effects on performance should be investigated. As these management practices have also been found to be conducive to successful handling and training (Nicol et al., 2005; Søndergaard & Ladewig, 2004), they will also benefit the future performance of the horse.

In ridden work, it may be advantageous to train novice riders, at least initially, on horse simulators, for example, as practiced at the Cadre Noir. Although the experience of riding real horses is obviously necessary in the development of balance and communication skills, it is often the quiet, unresponsive horse who is used predominantly for such training. In order to minimize the noncontingent, aversive effects on these animals, interspersing riding lessons with sessions on their mechanical counterparts may somewhat alleviate the situation. In the case of horses used for equine-assisted human therapy, it has been found that stress-related behavior in the horses (ears pinned; head turned, down, raised, shaken, or tossed; and defecation) was significantly higher when ridden by "at risk" children as compared with recreational riders, physically handicapped, psychologically handicapped, and special-education children (Kaiser, Heleski, Siegford, & Smith, 2006). The authors conclude that although being ridden by physically and psychologically handicapped people is no more stressful to the horses than being ridden by recreational riders, the time that at-risk children are allowed to ride should be limited on a daily and weekly basis.

In ridden work, further emphasis should be put on providing consistent and timely reinforcement for the desired responses, ensuring that reward is contingent upon behavior. Because the predominant form of reinforcement used in horse training is negative reinforcement and because its misuse can be the source of a number of behavioral problems—including the development of unresponsive, lethargic behavior (McGreevy & McLean, 2005)—it is clear that there is a need for riders and trainers to appreciate more fully how to apply pressure effectively and humanely. In order to make training more pleasurable/less aversive for the horse, positive reinforcement should be used either in addition to or, ideally, instead of negative reinforcement. The benefits of this in reducing behavioral signs of discomfort and improving subsequent performance have been clearly demonstrated (Warren-Smith & McGreevy, 2007).

The motivation to focus on improving the emotional well being (happiness) of performance horses and to reduce their exposure to inescapable aversive experiences would be increased if the criteria for success were reviewed. Disciplines that favor flat, submissive "ways of going" are currently almost advocating that the horse should be in a state of learned helplessness. Dressage horses who show physical signs of well being, as described by Thiel (2006), should receive higher marks than those who appear tense and under pressure. By encouraging

both competitive and noncompetitive riders to look for signs that their horses are experiencing positive emotions and by rewarding this aspect of performance, the likelihood of learned helplessness developing in the horse will be reduced. As a consequence, the behavioral interference of inescapable aversive experiences on equine motivation, mood, and cognition will be lessened. The result will be beneficial for human owners, trainers, riders, drivers, and handlers and—most important—for the horse.

CONCLUSION

Although there is some anecdotal evidence to support the hypothesis that horses develop learned helplessness in response to the variety of inescapable, aversive experiences that may occur in both management and training, there is little scientific work in this area. Work on other species carried out under controlled laboratory conditions provides useful models that can be used to identify the types of situations that may provoke the development of this extreme reaction to uncontrollable, aversive situations. There is little doubt that the techniques and devices used in the training and riding/driving of horses, as well as during their management, have the potential to place horses in a situation where they could develop this phenomenon. There are therefore two main challenges for scientists working in this developing area of science: first, to develop validated, agreed indicators of good and bad welfare that can be used in assessing the impact training and management practices have on ridden and driven horses; and second, to investigate more thoroughly the types of situations, protocols, and regimes that more easily lead to a state of learned helplessness or something that is akin to that in the horse.

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