Is there evidence of 'Learned Helplessness' in horses?

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Abstract

Learned helplessness can be defined as 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 it was found that this lack of control subsequently interfered with the ability to learn an avoidance task. There is evidence that both neural adaptations and behavioural despair occur in response to uncontrollable aversive experiences in rodents, although this has yet to be demonstrated in other species such as horses. However, it has been suggested that certain traditional methods of horse training and some behavioral modification techniques 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 paper reviews published literature and anecdotal evidence to explore the possibility that the phenomenon 'learned helplessness' occurs in the horse.

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1. Introduction

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 there are several descriptions of what could be described as a 'learned helplessness' response and the events that caused this. 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…" and* in Chapter 40, Ginger was seen to have a *"hopeless look in the dull eye".* While this was a work of fiction, it signified 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 utilised, and to identify the situations, practises 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 (Overmeir & 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 an animal had experienced a situation whereby the outcome was independent of their response, they learned to be 'helpless' in similar situations. Such studies, where animals are subjected to extreme forms of pain and distress attracted much criticism from animal advocates, in particular in the United States where much of this original work was carried out. In a thought-provoking and disturbing book by Dr Dallas 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. In order to determine whether the horse is suffering as a consequence, it is

imperative that we determine whether or not there is evidence of 'learned helplessness' in the horse.

The main aim of traditional training techniques is often stated as gaining control over the behaviour 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 or not 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, and 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 that are un-cooperative and aggressive, with some becoming dangerous and un-rideable. This may explain the wastage reported by Ödberg & Bouissou, (1999), who found that 66% of the horses sent to a French abattoir were culled due to behavioural issues. Others however, despite being repeatedly subjected to inconsistent and/or painful techniques 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 paper 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 to either predispose animals to the development of learned helplessness, or to protect them against it, in an experimental situation, will be discussed in relation to the horse. Evidence, based on both published literature and informed anecdotes, will be presented to explore the possibility that learned helplessness occurs in the horse.

2. Experimentally induced learned helplessness in dogs and rodents

The findings of Overmier & Seligman (1967) and Seligman & 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 that 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 behaviours that are central to the learning process (Arias-Carrión and Pöppel, 2007). Dopamine is found in the mesocorticolimbic system which is responsible for motivational systems. Dopaminergic neurons project to three forebrain areas: the pre-frontal 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 pre-frontal cortex, while 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 and the consequence is helplessness or behavioral despair (Cabib, 2006).

Learned helplessness is to a certain extent a logical adaptation. If behavior does not affect consequences then there is no point in repeatedly trying different strategies as the outcome will be the same regardless of the effort expended. However, as this behavioral interference has been found to generalize to other areas of the animal's behavioral repertoire (Joffe, Rawson & Mulick, 1973; Hiroto & Seligman, 1975) it is normally considered to be maladaptive, partly because it results in a loss of motivation and anhedonia (Cabib, 2006). The deleterious effects of inescapable aversive conditions on the health (for example, 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.

3. Evidence of learned helplessness in the horse

Learned helplessness is an emotive term that is clearly defined in terms of its experimental manifestation, but is often misused and misinterpreted by the lay-person. 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). While the term effectively describes the response of a horse that has been placed under pressure and has learned that there is no response that 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 that 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. In order to objectively assess the behavioral responses of the horse and evaluate whether welfare is compromised by procedures commonly adopted by horse 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.

3.1 Potential sources of uncontrollable aversive experiences in horse training

One of the aversive procedures used to induce leaned 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 the horse using straps, ropes and hobbles, so that it learned that resistance was futile and it was 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).

While many of the early training techniques are no longer used, there are a number of different methods of restraint currently used and these are taught to horse handlers of varying levels of experience, by trainers and even via 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 its neck bent round, as adopted in the 1800's, is illustrated in the book *The Horse Breakers* (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 centres, 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 to be 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, but 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 aversive to the horse.

While 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 the use of restrictive training equipment is less clear. It was noted by Ödberg & Bouissou (1999) 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 that 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. The International Equestrian Federation (Fédération Equeste Internationale: FEI) held a meeting to discuss the issue in January 2006, the results of which can be found in their report of 5th March 2006 (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) and it is this approach that has been applied to assessing the impact of riding the horse in a forced rollkür posture (von Borstel, Merkies, Shoveller, Duncan, Keeling & Millman , 2007). Horses were ridden through a Y-maze, one arm of which resulted in them being ridden on a circle in the rollkür posture (achieved using side reins); the other arm resulted in them 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 fifteen horses tested, fourteen 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). Whilst 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 forwards 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'. While 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 mouth 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; i.e. it is negatively reinforced (McGreevy, 2007). If however, 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. See Figure 1.

Figure 1 about here

Horses that 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, which should dissipate if the horse has positive, pleasurable experiences as well. Unfortunately, horses that 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 demeanour.

3.2 Housing and management of the horse

Cabib & Puglisi-Allegra (1994) found that although confinement and isolation were not specifically designated as aversive stimuli in their study, mice that were contained in an unfamiliar environment displayed symptoms that were similar to those that had been exposed to uncontrollable electric shocks, although to a lesser extent. Many horses are confined and isolated in individual housing for large proportions of the time. 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 an individual stall with hay and straw,

hay outside, firm or soft ground surfaces and to be in the company of others or not, the highest priority was always to be in company 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, 1999). 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. While 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 (riding school horses and western pleasure horses for example).

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 that had been domesticated indicated a relatively low occurrence when compared with domestic horses, suggesting 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, but 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 an animal to have some control over its 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 whether they are out in the open or inside (Schatzmann, 1998). Although for most horses group living in an outdoor environment would be the most preferred option, this is not always practical. By offering horses the opportunity of controlling at least some factors in their lives, not only will their welfare be improved, but training may also be enhanced.

3.3 Recognizing learned helplessness in the horse

According to Seligman & Altenor (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 that 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 animal to associate its future behavior with outcomes. This cognitive deficit interfered with subsequent performance. The emotional response to aversive conditions, whether controllable or not, was initially anxiety. In the case of those animals that had experienced inescapable aversive conditions, this anxiety was then replaced with emotional depression. The overall picture is of an animal that is passive, de-motivated and depressed. In some cases this rather un-reactive behavior is considered desirable in the horse. Novice riders are usually provided with ‘steady’ mounts that are not prone to unpredictable responses, but are as ‘bomb proof’ as possible. Many riding school horses are considered to be ‘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 programmes 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 programmes (e.g. Bizub, Joy & Davidson, 2003), however, evaluation of the effects on the equine participants are currently few. Suthers-McCabe & Albano (2005) reported pre- and post-therapy measures of stress in horses in an exploratory study of equine assisted therapy programmes. Plasma cortisol and observed behavior were recorded for 28 horses in four therapy programmes, two for mental health patients and two for patients with physical or mental health problems. Data were also collected when six of the horses were ridden in therapy sessions by able-bodied volunteers. Whilst there were no significant differences reported in the behavior of the horses, six individuals showed an increase in blood cortisol levels. Five of these were ridden by patients and one by a volunteer. The authors suggest that physiological methods may identify horses experiencing levels of stress that may lead to what they termed 'burn out', 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 unfavourable environment (Cooper & Mason, 1998). Although such behavior generally indicates that the horse has been subjected to sub-optimal conditions at some point, it also demonstrates that the horse has adapted to cope with these and has thus exerted some control over its environment. However, certain behavioral features that are comparable to signs associated with learned helplessness have been identified in horses that perform a stereotypy, irrespective of the type of stereotypy performed. When the learning ability of 51 stereotypic horses was compared with 19 non-stereotypic 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 to that spent looking at it, the less stressed the animal was deemed to be (Nicol, Badnell-Waters, Bice, Kelland, Wilson & Harris, 2005). Interest in the environment and exploration are indicative of motivation and may well relate to mood and cognition. The novel object tests and similar that have been used to assess other behavioral responses in horses (Wolff, Hausberger & Le Scolan, 1997) could be adapted to assess the behavioral interference associated with learned helplessness. Cognitive deficits could be tested using simple operant tasks (Hausberger et al., 2006) 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 towards focusing on signs of positive emotions when considering animal welfare, rather than the absence of negative emotions (Boissy, Manteuffel, Jensen, Moe, Sprujt, Keeling, Winckler, Forkman, Dimitrov, Langbein, Bakken, Veissier & Aubert, 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. Harmonisation 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 that 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 & 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, Ashenbrenner & Brügner, 2005), although it has been suggested that heart rate variability may have potential as a measure of emotional well-being and welfare in farm animals 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 that 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, those animals that show repeated signs of ill health could be focused on. 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.

3.4 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 that may be suffering from a condition similar to human depression. From the evidence presented above, 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 'bomb-proof' 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 that we subject the horse to. Objective measures, such as assessing rein tension (Warren-Smith et al., 2007), will assist in providing evidence on which people can base their judgements.

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 emphasized too strongly. 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 behaviour (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 (Søndergaard & Ladewig, 2004; Nicol et al., 2005) 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 practised at the Cadre Noir. While the experience of riding real horses is obviously necessary in the development of balance and communication skills, it is often the quiet, unresponsive horse that is used predominantly for such training. In order to minimize the non-contingent aversive effects on these animals, interspersing riding lessons with sessions on their mechanical counterparts may alleviate the situation somewhat. In the case of horses used for equine-assisted human therapy, it has been found that stress related behavior

492 in the horses (ears pinned, head turned, down, raised, shaken or tossed and defecation)
493 was significantly higher when ridden by 'at risk' children as compared with
494 recreational riders, physically handicapped, psychologically handicapped and special
495 education children (Kaiser, Heleski, Siegford & Smith, 2006). The authors conclude
496 that while being ridden by physically and psychologically handicapped people is no
497 more stressful to the horses than being ridden by recreational riders, the time that 'at
498 risk' children are allowed to ride should be limited on a daily and weekly basis.

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

510 The motivation to focus on improving the emotional well-being (happiness) of
511 performance horses and to reduce their exposure to inescapable aversive experiences
512 would be increased if the criteria for success were reviewed. Disciplines that favour
513 'flat', submissive 'ways of going' are currently almost advocating that the horse
514 should be in a state of learned helplessness. Dressage horses that show physical signs
515 of well-being, as described by Thiel (2006), should receive higher marks than those
516 that appear tense and under pressure. By encouraging both competitive and non-
517 competitive riders to look for signs that their horses are experiencing positive
518 emotions and by rewarding this aspect of performance, the likelihood of learned
519 helplessness developing in the horse will be reduced. As a consequence, the
520 behavioral interference of inescapable aversive experiences on equine motivation,
521 mood and cognition will be lessened and the result will be beneficial for human
522 owners, trainers, riders, drivers and handlers; and most importantly for the horse.

523

4. In 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 a horse in a situation where they could develop this phenomenon. There are therefore two main challenges for scientists working in this developing area of science: firstly to develop validated, agreed indicators of good and bad welfare that can be used in assessing the impact that training and management practises have on ridden and driven horses; and secondly 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.

References

Arias-Carrión, Ó. and Pöppel, E. (2007) Dopamine, learning and reward-seeking behaviour. *Acta Neurobiol Exp.,* 67, 481-488.

Ball, M.A. (1998) Restraint techniques. *The Horse,* September, 34-37.

Berger, A., Scheibe, K.-M., Michaelis, S. & Streich, W.J. (2003) Evaluation ofliving conditions offree-ranging animalsby automated chronobiological analysis of behaviour. *Behavior Research Methods, Instruments & Computers,* 35, 458-466.

Bizub, A.L., Joy, A. & Davidson, L. (2003) "It's like being in another world": Demonstrating the benefits of therapeutic horseback riding for individuals with psychiatric disability. *Psychiatric Rehabilitation Journal,* 26, 377-384.

Boissy, A., Manteuffel, G., Jensen, M.B.,Moe, R.O., Sprujt, B., Keeling, L.J., Winckler, C., Forkman, B., Dimitrov, I., Langbein, J., Bakken, M., Veissier, I. & Aubert, A. (2007) Assessment of positive emotions in animals to improve their welfare. *Physiology & Behavior,* 92, 375-397.

Boswinkel, M., Ellis, A.D. & Sloet van Oldruitenborgh-Oosterbaan, M.M. (2007) The influence of low versus high fibre haylage diets in combination with training or pasture rest on equine gastric ulceration syndrome (EGUS). *Pferdheilkunde,* 2, 123-130.

Brunt, A., Van Driel, K.S., Owen, D. & Talling, J.C. (2006) Responses of school horses to a flat lesson. *Poster presented at the 2nd International Equitation Science Symposium, Milan.*

Cabib, S. (2006) The Neurobiology of Stereotypy II: the Role of Stress. *In:* Mason, G. and Rushen, J. (Eds.) Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare (2nd Ed.) Oxon: CABI. 227-255.

Cabib, S. & Puglisi-Allegra, S. (1994) Opposite responses of mesolimbic dopamine system to controllable and uncontrollable aversive experiences. *The Journal of Neuroscience,* 14**,** 3333-3340.

Cabib, S. & Puglisi-Allegra, S. (1996) Stress, depression and the mesolimbic dopamine system. *Psychopharmacology,* 128**,** 331-342.

570 Clayton, H.M., Singleton, W.H., Lanovaz, J.L. & Cloud, G.L. (2003) Measurement of
571 rein tension during horseback riding using strain gage transducers. *Exp. Tech.,* 27, 34-
572 36.

573 Cook, W.R. (2003) Bit-induced pain: a cause of fear, flight, fight and facial neuralgia
574 in the horse. *Pferdeheilkunde,* 19**,** 75-82.

575 Cooper, J.J. & Mason, G.J. (1998) The identification of abnormal behaviour and
576 behavioural problems in stabled horses and their relationship to horse welfare: a
577 comparative review. *Equine Veterinary Journal, Supplement 27 (Equine Clinical*
578 *Behaviour),* 5-9.

579 Cooper, J.J., McDonald, L. & Mills, D.S. (1999) Increasing visual horizons reduces
580 stereotypic patterns of weaving in the stabled horse. *Proceedings of BEVA Specialist*
581 *Day (Behaviour and Nutrition), London.*

582 Dodman, N.H., Normile, J.A., Cottam, M.S., Guzman, M. & Shuster, L. (2005)
583 Prevalence of compulsive behaviours in formerly feral horses. *International Journal*
584 *of Applied Research in Veterinary Medicine,* 3**,** 20-24.

585 Duncan, I.J.H. (1992) Measuring preferences and the strength of preferences. *Poultry*
586 *Science,* 71, 658-663.

587 Farmer-Dougan, V.A. & Dougan, J.D. (1999) The man who listens to behaviour: Folk
588 wisdom and behaviour analysis from a real horse whisperer. *Journal of the*
589 *Experimental Analysis of Behavior,* 72**,** 139-149.

590 Fazio, E., Calabrò, G., Medica, P., Messineo, C. & Ferlazzo, A. (2006) Serum cortisol
591 levels of Quarter Horses: Circadian variations and effects of training and western
592 riding events. In: Lindner, A. (Ed.) *Management of lameness causes in sport*
593 *horses*.175-179. Wageningen: Academic Publishers.

594 FEI (Fédération Equeste Internationale) Veterinary & Dressage Committees'
595 Workshop (2006) Report on: *The use of overbending ("Rollkur") in FEI competition.*
596 31st January 2006, Olympic Museum, Lausanne.

597 Flannigan, G. & Stookey, J.M. (2002) Day-time time budgets of pregnant mares
598 housed in tie stalls: a comparison of draft versus light mares. *Applied Animal*
599 *Behaviour Science,* 78, 125-143.

Gieling, E.T., Cox, M. & VanDierendonck, M. (2007) Group housing with automatic feeding systems: implications for behaviour and horse welfare. *Paper presented at the 3rd International Equitation Science Symposium, Michigan.*

Goodwin, D., Davidson, H.P.B. & Harris, P. (2002). Foraging enrichment for stabled horses: effects on behaviour and selection. *Equine Veterinary Journal*, 34, 686-691.

Hausberger, M., Gautier, E., Müller, C. & Jego, P. (2007) Lower learning abilities in stereotypic horses. *Applied Animal Behaviour Science, 107, 299-306.*

Heleski, C.R., Shelle, A.C., Nielsen, B.D. & Zanella, A.J. (2002) Influence of housing on weaning horse behaviour and subsequent welfare. *Applied Animal Beahviour Science,* 78**,** 291-302.

Hiroto, D.S. & Seligman, M.E.P. (1975) Generality of learned helplessness in man. *Journal of Personality and Social Psychology,* 31**,** 311-327.

Houpt, K.A. & Houpt, T.R. (1988) Social and illumination preferences of mares. *Journal of Animal Science,* 66, 2159-2164.

Inglis, F.M. & Moghaddam, B. (1999) Dopaminergic innervation of the amygdala is highly responsive to stress. *Journal of Neurochemistry,* 72**,** 1088-1094.

Joffe, J.M., Rawson, R.A. & Mulick, J.A. (1973) Control of their environment reduces emotionality in rats. *Science,* 180**,** 1383-1384.

Kaiser, L., Heleski, C.R., Siegford, J. & Smith, K.A. (2006) Stress-related behaviors among horses used in a therapeutic riding program. *Journal of the American Veterinary Medical Association,* 228, 39-45.

Lester, G.D. (2004) Gastrointestinal diseases of performance horses. In: Hinchcliff, K.W., Kaneps, A.J. & Geor, R.J. (Eds.) *Equine Sports Medicine and Surgery*, 1037-1048. Edinburgh: Saunders.

Mal, M.E., Friend, T.H., Lay,D.C., Vogelsang, S.G. & Jenkins, O.C. (1991) Behavioural responses of mares to short-term confinement and social isolation. *Applied Animal Behaviour Science,* 31, 13-24.

McAfee, L.M., Mills, D.S. & Cooper, J.J (2002) The use of mirrors for the control of stereotypic weaving behaviour in the stabled horse. *Applied Animal Behaviour Science,* 78, 159-173.

McGreevy, P.D. (2007) The advent of equitation science. *The Veterinary Journal,* 174, 492-500.

McGreevy, P.D. & McLean, A.N. (2005) Behavioural problems with the ridden horse. In: Mills, D.S.& McDonnell, S. (Eds.) *The Domestic Horse,* 196-211. Cambridge: University Press.

McLean, A.N. (2003) *The truth about horses.* Australia: Penguin Books.

Mills, D.S. & Riezebos, M. (2005) The role of the image of a conspecific in the regulation of stereotypic head movements in the horse. *Applied Animal Behaviour Science,* 91, 155-165.

Myrtek, M., Aschenbrenner, E. & Brügner, G. (2005) Emotions in everyday life: an ambulatory monitoring study with female students. *Biological Psychology,* 68, 237-255.

Nicol, C. (1999) Understanding equine stereotypies. *Equine Veterinary Journal, Supplement 28 (The Role of the Horse in Europe),* 20-25.

Nicol, C.J., Badnell-waters, A.J., Bice, R., Kelland, A., Wilson, A.D. & Harris, P.A. (2005) The effects of diet and weaning method on the behaviour of young horses. *Applied Animal Behaviour Science,* 95, 205-221.

Ninomiya, S., Sato, S., Kusonose, R., Mitumasu, T. & Obara, Y. (2007) A note on a behavioural indicator of satisfaction in stabled horses. *Applied Animal Behaviour Science,* 106, 184-189.

Ödberg, F.O. (1987) Chronic stress in riding horses. *Equine Veterinary Journal,* 19, 268-269.

Ödberg, F.O. & Bouissou, M.-F. (1999) The development of equestrianism from the baroque period to the present day and its consequences for the welfare of horses. *Equine Veterinary Journal Supplement,* 28**,** 26-30.

Overmier, J.B. & Seligman, M.E.P. (1967) Effects of inescapable shock upon subsequent escape and avoidance learning. *Journal of Comparative Physiological Psychology,* 63**,** 28-33.

Pratt, D. (1980) Alternatives to Pain in Experiments on Animals. U.S.A.: Dallas Pratt.

Puglisi-Allegra, S. & Cabib, S. (1997) Psychopharmacology of dopamine: the contribution of comparative studies in inbred strains of mice. *Progress in Neurobiology,* 51**,** 637-661.

Richardson, C. (1998) *The horse breakers.* London: J.A.Allen.

Schatzmann, U. (1998) Winter pasturing of sport horses in Switzerland: An experimental study. (Abstract) *Equine Veterinary Journal: Supplement 27 (Equine Clinical Behaviour),* 53-54.

Schramme, M. (1995) Investigation and management of recurrent colic in the horse. *In Practice,* July/August, 303-314.

Seligman, M.E.P. (1975) *Helplessness: On depression, development and death.* San Francisco: Freeman.

Seligman, M.E.P. & Groves, D. (1970) Non-transient learned helplessness. *Psychonomic Science,* 19**,** 191-192.

Seligman, M.E.P. & Maier, S.F. (1967) Failure to escape traumatic shock. *Journal of Experimental Psychology,* 74**,** 1-9.

Sewell, A. (1877) *Black Beauty*. Berkshire: Purnell.

Søndergaard, E. & Ladewig, J. (2004) Group housing exerts a positive effect on the behaviour of young horses during training. *Applied Animal Behaviour Science,* 87**,** 105-118.

Suthers-McCabe, M. & Albano, L. (2005) Evaluation of stress response of horses in equine assisted therapy programme. *Anthrozoos,* 18**,** 323-325.

Thiel, U. (2005) Learned helplessness: Translation of St Georg article by Linda Waller. Retrieved August 2, 2007, from http://www.hippocampus-nl.com/index.php?content_id=337

Thiel, U. (2006) Assessing the happy athlete. *British Dressage,* April/May**,** 28-29.

von Borell, E., Langbein, J., Després, G., Hansen, S., Leterrier, C., Marchant-Forde, R., Minero, M., Mohr, E., Prunier, A., Valance, D. & Veissier, I. (2007) Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals. *Physiology and Behavior,* 92, 293-316.

von Borstel, U.U., Merkies, K., Shoveller, A.K., Duncan, I.J.H., Keeling, L.J. & Millman, S.T. (2007) Impact of riding in rollkür-posture on welfare and fear of performance horses. *Paper presented at: 3rd International Equitation Science conference, Michigan.*

Waran, N., McGreevy, P. & Casey, R.A. (2002) Training Methods and Horse Welfare. In: The Welfare of Horses (Ed. Waran, N.) Dordrecht: Kluwer Academic Publishers, 151-180.

Warren-Smith, A.K., Curtis, R.A., Greetham, L. & McGreevy, P.D. (2007) Rein contact between horse and handler during specific equitation movements. *Applied Animal Behaviour Science,* 108, 157-169.

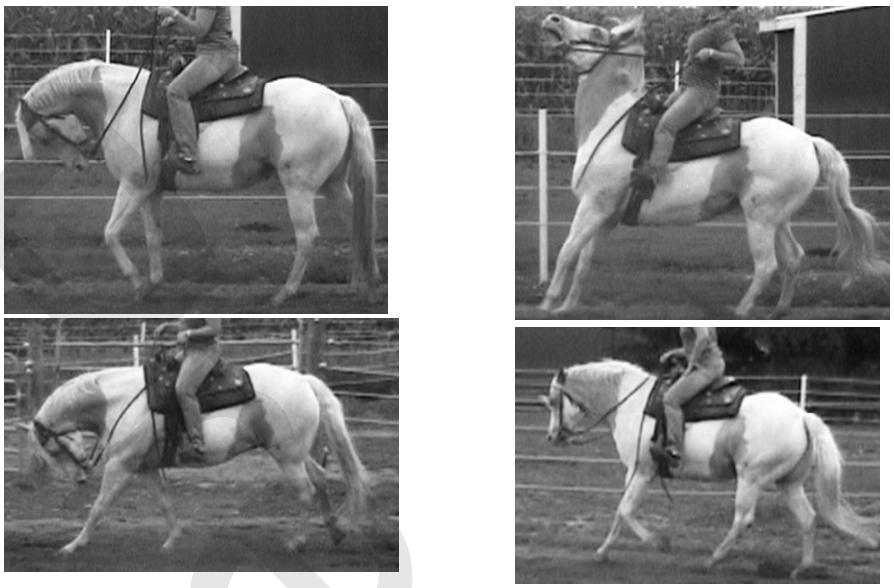
Warren-Smith, A.K. & McGreevy, P.D. (2007) The use of blended positive and negative reinforcement in shaping the halt response of horses. *Animal Welfare,* 16, 481-488.

Webster, J. (1994) *Animal welfare: A cool eye towards Eden.* Oxford: Blackwell Science.

Weinraub, M. & Schulman, A. (1980) Coping behaviour: Learned helplessness, physiological change and learned inactivity. *Behavioural Research and Therapy,* 18**,** 459-512.

Wolff, A., Hausberger, M. & Le Scolan, N. (1997) Experimental tests to assess emotionality in horses. *Behavioural Processes,* 40, 209-221.

708 Figure 1. Examples of crank and yank, photos on left; conflict behaviour, photo upper
709 right; complacent photo lower right.



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.

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