

## **Introduction to equine stereotypies**

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In the past decade equine stereotypies have received considerable attention in scientific literature. A stereotypy is defined as a repetitive invariant behaviour pattern with no apparent function. Are equine stereotypies an inherent condition of the domesticated horse? They can involve both oral and locomotary stereotypies, some of which are regarded as 'true stereotypies' including crib biting, weaving and box walking. A number of hypotheses exist as to why equine stereotypical behaviour is carried out; in particular what triggers such aberrant, repetitive behaviour in some individuals but not in all. Aspects of these hypotheses will be discussed in the context of a few selected scientifically peer reviewed journal articles, although this by no means provides an extensive review of work.

### **Development of stereotypies and risk factors**

The functional significance of stereotypies remains unclear. Diet and feeding are heavily implicated as is boredom, frustration and sub-optimal environments associated with domestication (Cooper *et al*, 2005; Cooper and Albentosa, 2005; McBride and Hemmings, 2009). Stabling and social isolation is also cited as a potential risk factor for stereotypical behaviour, due to lack of contact and interaction with conspecifics (Cooper and Albentosa, 2005). In a surprising study 67% of horses performed one or more stereotypy when housed individually in stalls for the first time. Those who were housed in pairs did not exhibit stereotypic behaviour (Visser *et al*, 2008). Equally stallions, which are often kept in individual stalls to prevent aggression and accidental breeding, are more likely to crib-bite than mares (Wickens and Heleski, 2010). Regulation of stress in the stabled animal by way of behavioural adaptation is discussed by Cooper and Albentosa (2005) whose paper focuses on abnormal behaviour as a behavioural adaptation, and provides a succinct overview on potential theories for development of stereotypical behaviours.

Interestingly Cooper and Albentosa (2005) address the hypothesis that stereotypies are ‘copied’ when in fact no epidemiological or empirical study has proven any such evidence of learned behaviour manifesting as true stereotypical behaviour. A good example of this is the low rate of stereotypical behaviour witnessed in the highly regimented and controlled environment such as those of the Household Cavalry horses in London. Cooper and Albentosa (2005) explain that this could largely be due to the close social contact, despite the very controlled environment, which is an entirely plausible explanation. The authors also suggest the use of mirrors to reduce stereotypies, which has been suggested in other work. However one must question whether the horse has the ability for self-recognition in mirrors when dogs do not, and thus whether stereotypical horses respond accordingly only because they believe they are in the company of conspecifics and not that it can recognise itself.

Nagy *et al* (2008) suggest that housing horses that exhibit stereotypical behaviours next to susceptible individuals may influence them to perform stereotypies. In a study of 287 horses (126 non-competition horses, 161 competition horses) a prevalence of 16.70% exhibiting stereotypic behaviour was noted. For clarity only the data involving the non-competition horses was presented. The study revealed some interesting findings. Firstly horses who had more than two different riders showed increased weaving behaviour but decreased odds of box walking, a risk factor not previously studied. The presence of an aggressive neighbour increased the odds of crib-biting behaviour, as did the presence of a weaving neighbour. Nagy *et al* (2008) suggest that the constant movement during weaving behaviour, or sounds produced during wind sucking may disturb sensitive individuals and illicit stereotypical behaviour as a stress release mechanism. The authors do not suggest that these behaviours are learned or copied but that stereotypic behaviour can be induced in a vulnerable individual in a stressful environment (Nagy *et al*, 2008).

Cooper *et al* (2005) introduce the association of oral stereotypy with feeding regime and the ratio of high concentrate feed to low amounts of forage so typical of stabled animals. This hypothesis is supported to an extent by the suggestion that an increase in salivary flow in cribbing horses could help to alleviate increasing acidity in the digestive tract associated with high concentrate feeds and a lack of forage (Cooper and Albentosa, 2005). Indeed it has been demonstrated that crib-biters have a lower

basal and post-feeding gastric PH compared to non crib-biters (Wickens and Heleski, 2008). Re-direction of grazing behaviour has also been cited as potential hypothesis for stereotypical behaviour given that the horse in its natural environment would graze for between 16-18 hours a day, which is wholly prevented when stabled (Cooper *et al*, 2005). Essentially development of stereotypical behaviours may lie within the phenotype of the individual animal, which can be influenced by situations deemed stressful or whereby a psychological need to respond to environmental factors exist (Cooper *et al*, 2005).

Other risk factors, which influence abnormal behaviour, include breed, genetic predisposition, post weaning housing and social ranking. Thoroughbreds and warmbloods are more likely to crib-bite with one or more relatives in eight families of thoroughbreds exhibited crib-biting behaviour (Wickens and Heleski, 2010). As these horses are more likely to be involved in high performance activities such as show jumping and racing they are more likely to be housed individually, a factor which increases cribbing.

Post weaning housing is also important in the development of stereotypies. Horses that were stable weaned or stabled after weaning as compared to pastured weaning showed a higher increase in stereotypies based on the epidemiological studies. Foals of dominant mares were also more likely to develop behavioural problems (Waters *et al*, 2002). This may well reflect the influence of the mares behaviour towards the foal prior to weaning or relate to the nature of the mare foal bond and effects of severance at weaning.

### **Dopamine and neurological causes of stereotypies**

The ontogeny of stereotypical patterns of behaviour are interesting, particularly during the animals period of development i.e. weaning phase, up until which no real stressors have been placed on the young animal. Cooper *et al* (2005) address how it is possible to reduce the incidence of stereotypies in certain animals in accordance with individual backgrounds and husbandry regimes. In contrast McBride and Hemmings (2009) explore the hypothesis of central nervous system (CNS) dysfunction as a causal factor in development of stereotypical behaviour.

A 2007 paper by Hemmings *et al* looked to distinguish between two hypotheses of the aetiology of crib-biting; the first that stereotypies arise from the dysregulation of the basal ganglia, the second that crib-biting stems from visceral discomfort, as a result of the acidic consequences of eating a concentrated cereal-based diet. The action of crib-biting is potentially a means of producing additional alkaline saliva to counteract the high acidity. Hemmings, *et al* (2007) anticipated that crib-biting horses should not display signs of basal ganglia dysfunction in the form of perseverative responding during the extinction process, due to the belief that crib-biting is an artefact of nutritional restrictions. Ten control and ten stereotypic horses (crib-biting) were conditioned to press a wall-mounted button in response to a conditioned stimulus (CS), then placed under extinction conditions whereby button pressing following CS delivery would yield no food reward. Their responses were monitored and recorded.

Crib-biting horses performed significantly more overall button pressing ( $P < 0.01$ ) and required more unreinforced trials ( $P < 0.01$ ) to achieve total extinction learning than the control horses. Plausibly, the crib-biting horses could have alterations in basal ganglia physiology suggested by their increased perseveration. This conclusion suggests that crib-biting is not only a method of alleviating visceral discomfort.

The results of this study indicated an altered basal ganglia function in crib-biting horses in comparison to controls. Thus placing this stereotypy in the same aetiological category as other stereotypies in differing species. The authors also claim that visceral discomfort may have an important role to play in the alteration of the basal ganglia activity, which then leads to manifestation as an oral stereotypy. It must be remembered that horses that perform oral stereotypies are prone to obsessive repetitive behaviour. Therefore the pushing of a button is not an ideal stimulus since that action can in itself become obsessive, leaving us unable to distinguish between an action for a purpose and a stereotypy.

In a review paper, which explores the neurological perspective of equine stereotypy (in particular addressing the role of dopamine and the way in which it is responsible for dictating the day-to-day motivation to obtain goals, and the extent of the goal directed behaviour) the work provides a concise impression of how dopamine

agonists and antagonists can have a dramatic affect on the basal ganglia within the brain and thus the overall behaviour of the animal (McBride and Hemmings, 2009).

McBride and Hemmings (2009) draw comparisons to human psychostimulant addiction by elucidating how excessive endogenous opioid release due to high levels of substrates in the form of concentrate feed can place the animal in a similar state, and a higher propensity of developing aberrant behaviours. Another viewpoint evaluated by McBride and Hemmings (2009) involves the animal's restricted environment, which does not allow attainment of a goal, and how it could lead to the animal being maintained in a highly motivated state directed by goal attainment i.e. stereotypical behaviours. In support of this theory, and directly linking dopamine tone, it has been proven that administration of pharmacological antagonists (dopamine antagonists) can dampen such behaviours.

A consequence of increased dopamine levels in stereotypic horses may be an impaired learning ability. Hausberger *et al*, (2007) aimed to investigate the relationship between the occurrence of stereotypic behaviour in individual horses and their ability to learn a task, in this case opening a chest to acquire food. The study tested both stereotypic and non-stereotypic horses and found that stereotypic animals were less successful at completing the task and also required more time. In all 36 of 51 stereotypic animals were unsuccessful compared with 3 of 19 non-stereotypic individuals. This study demonstrated for the first time that motor stereotypies and a diminished learning capacity in an animal were related. The possible causes put forward by the authors were that endorphins increased by performing stereotypic behaviour caused a decrease in learning ability.

Hausberger *et al* (2007) also suggest that stereotypic horses may be focusing their attentions on performing the behaviours and may not be able to focus their attention on new stimuli. It must also be considered that those horses who became stressed by their inability to access food would crib as a coping mechanism, possibly explaining the increased time it took to open the chest and not an impaired learning capacity. The study also described how horses displaying stereotypic behaviours typically lie down and sleep less than their non-stereotypic counterparts. Since the link between sleep

deprivation and diminished ability to learn a new task is well documented, Hausberger *et al* (2007) suggest that this may partly explain the result.

The multi causal aspects of stereotypical behaviour are clearly outlined in the Hughes and Duncan 1988 in the McBride and Hemmings (2009) paper, which concludes that stereotypies are appetitive behaviours, which have a positive feedback on their own performance. There would however be great value in carrying out a study directly measuring dopamine levels, which many stereotypical studies fail to effectively address.

### **Management techniques**

It has been widely demonstrated that various management techniques can influence the prevalence of stereotypic behaviour. Social contact with others and an increase in the amount of time spent outside of the stable are known to decrease stereotypic behaviour (Wickens and Heleski, 2010). Physical prevention of the behaviour such as by removing cribbing surfaces or through the use of cribbing straps or muzzles have proved ineffective. More radical techniques such as modified Forssell's procedure, surgically removes the paired omohyoideus and sternothyrohyoideus muscles and transects the accessory nerve leaving the horse unable to physically perform the behaviour. Far from solving the problem, these techniques may cause increased stress in the animal as they leave the horse unable to perform stress-alleviating behaviours (Nagy *et al*, 2009).

A study by Nagy *et al* (2009) aimed to assess the success rate of the prevention of crib-biting, by comparing the modified Forssell's procedure and the traditional collar treatment. They measured the stress-related behavioural and physiological variables in order to evaluate the 'quality of life' of the horses following one of these treatments and investigate if horses prevented from performing crib-biting may either persist with the stereotypy in a modified form or may show behavioural and/or physiological indicators of distress. The behavioural and heart rate variables were monitored and assessed in a crib-biting triggering stress test on 40 horses divided into 1 of 4 groups (controls; crib-biting; collar treated; surgically treated).

Results found that stress triggered an elevation in oral activities among the crib-biting and inhibited groups (collar-treated & surgically-treated group) and no such increase in the control group, instead their stress response behaviour was more directed towards motor activities (such as pawing and head-tossing). Interestingly horses inhibited from carrying out crib-biting (collar-treated; surgically-treated groups) exhibited elevated stress levels throughout the test period. In contrast changes in stress levels were indistinguishable between controls and untreated crib biters. These findings indicate that crib-biting may develop to cope with stress, and such coping function diminishes when an animal is inhibited from performing the stereotypy Nagy *et al* (2009). Importantly no significant differences between the collar-treated and surgically treated horses were noted so a comparison of the success rates of these techniques cannot be evaluated. However the results do lead to questions about the benefits of a surgical procedure over a non-invasive method such as collar treating.

### **Increasing meal frequency in order to alleviate oral stereotypies**

Cooper *et al* (2005) carried out research evaluating the effect of increasing meal frequency on horses that exhibited oral stereotypical behaviour including cribbing, weaving and nodding. The hypothesis was that more frequent meals may reduce the stereotypies at feed time due to lowered feeding motivation at mealtime. However the alternative view would be that if the stereotypies were in fact a conditioned response associated with feeding time, then increasing meals would increase the rate of stereotypical behaviour.

The main study involved increasing feed times (of concentrates) from twice daily to six times per day including two rations of forage which took place over a number of weeks conditioning. Differences in behaviour did become apparent as meal frequencies increased, including an increase in time spent feeding and eating haylage, and decreased bedding directed behaviour (suggesting fulfillment elsewhere in the horse's environment). The rate of oral stereotypies also decreased in the treatment animals compared to the controls and proved to be significantly statistically different at the level of  $P < 0.05$ , although overall values were not remarkable, and management recommendations could not be made on the basis of such results. Interestingly the rate of weaving and nodding increased respectively ( $P < 0.05$ ,  $P < 0.01$ ).

Weaving and nodding are largely seen as anticipatory behaviours prior to feeding in comparison to cribbing, which is generally postprandial. Cooper *et al* (2005) acknowledge this fact, but suggest that the removal of pre-feeding cues may serve to alleviate the rate of oral stereotypies, however this would be largely impossible on commercial yards, and thus is not a substantial enough suggestion. Operant feeding devices are also suggested which prove useful in domestic situations, but again are impractical on commercial yards. Whilst the study itself is robust enough in design, and proves some interesting avenues for discussion and consideration into the alleviation of stereotypical behaviour it does not provide practical answers for the prevention of such behaviours, which warrants further work.

### **Pharmacological techniques to alleviate oral stereotypies**

Pharmacological agents have been demonstrated to cause a reduction in stereotypical behaviours. Rendon *et al* (2001) showed that treatment of horses that crib-bite with the NMDA receptor antagonist dextromethorphan (DM) caused a marked decrease in the behaviour. In the hour following treatment with DM, the frequency of crib-biting in 9 horses decreased by 48%. Although this result appears promising, pharmacological treatment of stereotypical behaviour is unfeasible. Constant administration is required to continually suppress the behaviour, a factor that is both time consuming and undesirable in performance horses. However the authors suggest that this, along with eliminating other risk factors, could be used to treat younger horses beginning to exhibit the behaviour (Rendon *et al* 2001).

### **Discussion**

The diversity of behaviours observed in the domesticated horse today is dramatically different in comparison to their early-undomesticated relatives. A naturally freely moving, social, herd animal has been forced to adapt to confined spaces and regimented feeding and exercise regimes. It is likely that equine stereotypies are the result of domestication and adjustment of horses to an essentially unnatural environment. Although there is no evidence that stereotypies are copied or learned by

other horses, more often than not those animals are isolated in the misconception that others will 'copy' the behaviour, which in vulnerable animals can exacerbate anxiety and in turn increase the behaviour. Stereotypies remain highly undesirable to horse owners; indeed performance of the behaviour can reduce the value of a horse dramatically. This may lead to a poorer quality of life in the long term as they often change hands more quickly as owners become aware of their behaviour. Whilst treatment of the behaviour with physical and pharmacological agents are somewhat effective we must ask ourselves if invasive and uncomfortable treatments are actually beneficial to the animal, especially if inhibition of the behaviour causes an increase in stress.

## **Conclusion**

Stereotypies in susceptible animals can manifest vigorously, so employing prevention strategies, which do not deal with the root of the problem and just physically prevent them from carrying out the stereotypy can reduce the quality of life of the animal. Identifying susceptible individuals early on and reducing potential causal factors may help to prevent development of the behaviour. However ultimately the best method for preventing and managing stereotypic behaviour is to allow horses to engage in natural behaviours as frequently as possible.

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