

**SATELLITE ARTICLE**

For corresponding Case Report see pages 142-147

Stereotypies in horses: their relevance to welfare and causation

D. M. BROOM and M. J. KENNEDY

Department of Clinical Veterinary Medicine, University of Cambridge, Madingley Road, Cambridge CB3 0ES, UK

INTRODUCTION

Repetitious behaviour of various kinds, such as the route-tracing of human prisoners and animals in cages (Hediger 1934; Meyer-Holzapfl 1968), rocking and weaving in children with autism or other psychiatric disorders (Levy 1944; Hutt and Hutt 1970) and bar-biting or sham-chewing in confined sows (Fraser 1975; Stolba *et al.* 1983; Fraser and Broom 1990), has long been commented upon by biologists and psychiatrists and referred to as stereotyped. Some of the movements which are repeated are brief, as in head nodding, whereas others are prolonged, as in route-tracing. Some are repeated continuously for long periods whereas others occur intermittently. A stereotypy is a repeated, relatively invariant sequence of movements with no obvious function. This definition, or a similar form of words, has been used by many authors, e.g. Ödberg (1978), Broom (1983), Mason (1991a), Broom and Johnson (1993).

The occurrence of stereotypies in horses is well-known and has been the subject of some detailed description (Brion 1964; Fraser and Broom 1990; and see case report by Kennedy *et al.* 1993). It is clear from these descriptions that stall-walking, crib-biting, wind-sucking, weaving, swaying, pawing, stall-kicking, head-shaking, head-nodding, crib-whetting and tongue-dragging are all examples of movement sequences which horses repeat with very little variation in form. If the movements are not necessary for locomotion to a particular place, food ingestion, cleaning the body, social communication or any other normal biological function, they are included by the above definition as stereotypies. In most cases the stereotypy is so obvious and bizarre that an observer can recognise it very readily.

Stereotypies are sometimes referred to as vices. As Houpt (1986) emphasised, the term 'vice' implies that there is something morally wrong with the individual which is showing the behaviour. In its attempts to cope with the highly unnatural environment in which it finds

itself, the horse may come to show stereotypies, but whereas these can be considered to be behavioural pathologies, the word vice is entirely inappropriate for them. If people are kept in solitary confinement or are otherwise severely frustrated they may also show stereotypies but we would not call these vices. The term 'vice' should not be used for stereotypies or for other abnormal behaviour which is induced by human imposed housing or management procedures.

CAUSES OF STEREOTYPIES

Stereotypies are abnormal behaviour in that they occur very rarely in individuals living in a relatively complex environment which is appropriate to the biology of the species and where a wide range of their behavioural repertoire can be shown. Stereotypies are recognisably abnormal in the context in which they are shown, the frequency of their performance and often in the pattern of movement (Broom 1983; Fraser and Broom 1990). All stereotypies have some energetic cost, which may be high enough to result in deterioration of body condition in some circumstances. In some cases, injury or disease results from a stereotypy but there may be no such consequence. People who show stereotypies, even for quite a short time, are considered to have some psychological problem (Broom 1991a, b) and are treated differently from other people and so stereotypic behaviour has important social consequences. There is some anecdotal evidence of similar effects on social relationships in other species.

The circumstances in which stereotypies are shown (as for several of the cases described by Kennedy *et al.*, p.142) are those where there is confinement, some particular frustration, or some unpredictability in the environment which makes it difficult for the individual to control its interactions with its environment (Fraser and Broom 1990; Mason 1991a). Social isolation, inability to make normal movements, inadequacy of diet and inability to prevent aversive events all increase the likelihood that stereotypies will be shown.

Despite the variation in the movements which become stereotyped, in many cases it appears that the stereotypy originates in a movement which is relevant to the problem which the animal is encountering.

The movement may be an attempt to get out of a cage, or a component of eating if deprived of food, or a grooming movement if unable to groom properly, or sucking when a young mammal is deprived of a teat. It appears that the animal is trying initially to do something about the problem but the behaviour continues to a point where it is useless and indicative of psychological disturbance. Stereotypies must therefore be considered as behavioural pathologies which are a consequence of trying to cope with a problem.

Not all animals in a given situation show stereotypies. This is not surprising because we know that animals have many different methods for trying to cope with adversity and there are many different consequences of failing to cope (Broom 1991a; Broom and Johnson 1993). For example, when attacked, some individuals are active in fighting back whereas others show very passive responses (Mendl *et al.* 1992). In confinement in stalls, some sows are very inactive and unresponsive whereas others show high levels of stereotypies and there are differences in their brain opioid receptor densities as a consequence (Broom 1987; Zanella *et al.* 1992). Animals which show either of these responses must be considered to have a problem.

If animals which show stereotypies are put into better conditions (Ödberg 1987; Cooper and Nicol 1991), they usually show a reduction in occurrence of the stereotypy but long-established stereotypies may continue.

The younger the animal, the more likely it is to stop showing stereotypies. These observations led Mason (1991b) to suggest that some stereotypies may be considered as 'scars' of previous difficulties.

It could be that the stereotypy helped the individual to cope with the difficulty at some time, although there is little clear evidence for this (Rushen 1993), but for most of the time that it is shown it is just a behavioural pathology.

The crucial point about what the presence of a stereotypy tells us is that the individual showing it must have some difficulty in coping with its environment. Whether the stereotypy reduces the adverse impact of the environment on the individual at that time, or just shows that the individual is psychologically damaged, the problem must be there and the stereotypy is an indicator of poor welfare.

The welfare is worst if the stereotypy dominates the life of the individual in that it takes up much time or appears to substitute for normal behavioural responses in a way which impairs adaptation to the environment. Briefer stereotypies which have less effect on normal responses indicate a smaller problem.

CAUSES OF STEREOTYPIES IN HORSES

GENETIC FACTORS

There is little scientific evidence concerning the factors which affect the occurrence of stereotypies in horses. A first possibility which should be considered is that stereotypies are merely, or largely, a manifestation of some genetic factor and that they can be bred out of the horse population. There has been selection against stereotypers and stereotypies are still widespread, and therefore whereas it is inevitable that the genotype of the horse affects the chances that stereotypies will be shown, it seems unlikely that this abnormal behaviour could be eliminated by selection.

In a survey of Thoroughbred horses in Italy, Vecchiotti and Galanti (1986) found that crib-biting, weaving and stall-walking occurred more often within closely related horses than would be expected by chance. They concluded that a genetic component was important in the causation of the behaviour. Hosoda (1950) came to a similar conclusion following a study of wind-suckers in Japan.

It is likely that this conclusion is true in part, but many closely related horses are also kept in more similar housing and management conditions than unrelated horses and the results could therefore be explained by these environmental factors.

DIET AND FEEDING

A second factor which is likely to affect whether or not certain stereotypies are shown is diet and feeding. It is known that low levels of feeding increase the chances that stereotypies are shown by tethered gilts (Appleby and Lawrence 1987); and it may be that inadequately fed horses are more likely to show oral and other stereotypies. This could be due to lack of energy content or to lack of sufficient roughage.

Because horses normally spend a very high proportion of their day grazing, more than half of the 24 h in winter and more than 40% in summer (Arnold 1985), the inability to show the feeding behaviour itself is likely to be a problem for a horse which eats all of its food in a short time.

The needs of the horse are not just to obtain the nutrients but also to show the behaviour associated with food acquisition (Toates and Jensen 1991; Broom and Johnson 1993). At present we know that horses at pasture seldom show stereotypies in comparison with stabled horses and it is sometimes said that a high concentrate, low volume diet is more likely to result in stereotypies.

However, clear experimental evidence concerning the role of diet and feeding behaviour is limited to reports of a few individual animals which showed less stereotypy when given more roughage.

INSUFFICIENT SPACE FOR MOVEMENTS

Most reports of stereotypies in horses concern individuals confined in a relatively small space, sometimes by a tether. Many authors (e.g. Houpt 1981; Fraser and Broom 1990) suggest that inability to carry out normal movements and to exercise causes frustration which leads to stereotypies.

This argument is based partly on observations that stereotypies are rare in horses which are not confined and reduced in frequency or disappear completely when the horses are given more space. However, an experiment which distinguishes between the 'space for movement' factor and the more general 'environmental complexity' factor would be necessary to discover how much of any frustration is due to the former.

INSUFFICIENT SOCIAL AND OTHER ENVIRONMENTAL STIMULATION

Horses which live in a complex environment in which there are many different stimuli to respond to and activities to carry out seldom develop stereotypies. Among the most stimulating part of a horse's environment are companions of their own or a similar species and it is therefore not surprising that direct contact with social companions can reduce the incidence of stereotypies.

However, stereotypies can still occur in horses housed close to others. Again we lack precise information but unsubstantiated reports and our own observations suggest that the incidence of stereotypies decreases in the order: horses confined in isolation with no other horses present, horses stalled but able to see others but not make contact, horses confined but able to see and make contact with others, horses kept socially but in a small stable, horses kept socially with much more space at pasture.

OTHER KINDS OF FRUSTRATION

Lack of food, inability to graze or manipulate food, inability to carry out movements for exercise and inability to make social contact all result in frustration for horses and hence are potential causes of stereotypies. Other situations can also be frustrating and it is therefore of interest that Ödberg (1973) reported stereotyped pawing by horses in a variety of such situations. For example, horses pawed when they could see unreachable food or hear sounds of the food pails which had not yet arrived; foals pawed when prevented from sucking (Tyler 1972); pawing occurred when horses were about to depart for exercise or racing but were prevented from leaving; stallions pawed when approach to a mare in oestrus was prevented; some confined animals paw. Pawing and other stereotypies can also be shown when a horse is treated in an inconsistent way by a rider or other person, elements of frustration and disturbance caused by unpredictability also being involved here.

THE PRESENCE OF OTHER STEREOTYPERS

The anecdotal evidence for increased stereotypy in the presence of other stereotypers is considerable, although not substantiated by well-controlled experiments. Horses show social facilitation of various activities and the copying of such behaviours is therefore not surprising. However, the development of stereotypies does not normally occur at pasture and it seems unlikely that any such behaviour would be copied in this circumstance. When stabled horses show stereotypies they must have some problem, whether or not they initiate the behaviour by copying others.

NEUROLOGICAL DISORDERS

As with other species certain forms of brain damage, e.g. frontal lobe damage (Luria 1973), could cause stereotypies in horses. However these rarely if ever are the cause of the stereotypies which are commonly seen. Certain stimulant drugs such as amphetamine increase the incidence of stereotypies. Amphetamine increases the effect of forebrain dopamine systems on the basal ganglia (Robbins *et al.* 1990) and there is evidence for high dopamine activity in the nigrostriatal pathways of isolation-reared rats which show stereotypies. Although these brain changes may be associated with the abnormal behaviour, we do not know that they are causal and, even if they are, there is no evidence that a lesion is causing the brain and behavioural changes.

CONCLUSIONS ABOUT CAUSES OF HORSE STEREOTYPIES

A major difficulty when trying to draw conclusions about the causes of stereotypies in horses is that on this subject there are very few data which have been collected in a systematic way. However, it seems clear that no simple factor, such as diet, is the cause of stereotypies. It appears that, as in other species, stereotypies appear in those horses which have insufficient control over their environment. Frustrations about activities such as feeding, exercising, interacting socially and general lack of an adequate level of stimulation appear to be the major causes of stereotypies in horses.

WHAT SHOULD BE DONE ABOUT STEREOTYPIES IN HORSES?

As in other species, the existence of stereotypies in horses indicates poor welfare. Any horse showing stereotypies has a real problem. The cause in almost all cases is some inadequacy in the way in which the horse is housed and managed. The stereotypy may cause other clinical problems such as gas colic or excessive tooth wear but it is itself an indicator that the animal has a problem. Any attempt to prevent the stereotypy, for example by removing the object of attention of a crib-biter, or by restricting neck muscle movements in a wind-sucker, or by severing muscles or

nerves will have no beneficial effect on the animal's real problem. In fact it will cause additional frustration for the animal in most cases and unnecessary pain and suffering in those horses subjected to surgery.

Biologists and veterinary surgeons studying horse behaviour and physiology have argued for some time that it is the causes of stereotypies that should be treated rather than the actions (Ödberg 1978; Houpt 1981; Kiley Worthington 1987; Fraser and Broom 1990) If a horse is showing a stereotypy, the action often causes no direct damage and unless it does it should not be treated by blocking the action by the methods mentioned above and by Kennedy *et al.* (1993). The horse is unlikely to benefit from most attempts to block stereotypies and horse welfare should be the primary consideration.

The positive action which should be taken in the long term to prevent the occurrence of stereotypies is to improve the housing and management of horses.

Genetic selection is unlikely to have a substantial effect although horses do vary genetically and some horses need different treatment from others. All horse management should take account of the needs of the horses. Nutrition should be adequate but food which takes a long time to collect and eat should be provided. Housing for horses should provide sufficient opportunity for movement and variety of stimulation. There should be adequate for exercise for all horses, either in the place where they are kept or at intervals which should be at least daily. Social contact between horses should be maximised, preferably by being kept in groups or with at least one companion. When animals are grouped in a small space, they must be monitored frequently to detect any serious aggression and should be separated if necessary. However, the general practice of housing horses individually should be reconsidered.

REFERENCES

- Appleby, M.C. and Lawrence, A. B. (1987) Food restriction as a cause of stereotypic behaviour in tethered gilts. *Anim. Prod.* **45**, 103-110.
- Arnold, G.W. (1985) Ingestive behaviour. In: *Ethology of Farm Animals, World Animal Science A5*. Ed: A. F. Fraser. Elsevier, Amsterdam. pp. 183-200.
- Brion, A. (1964) Les tics chez les animaux. In: *Psychiatrie Animale*. Eds: A. Brion and H. Ey. Desclée de Brouwer, Paris. pp. 299-306.
- Broom, D. M. (1983) Stereotypies as animal welfare indicators. In: *Indicators Relevant to Farm Animal Welfare*, Ed: D. Smidt, (*Curr. Top. vet. Med. Anim. Sci.*, 23) Martinus Nijhoff, The Hague. pp. 81-87.
- Broom, D. M. (1987) Applications of neurobiological studies to farm animal welfare. In: *Biology of Stress in Farm Animals: an Integrated Approach*. Eds: P. R. Wiepkema and P. W. M. van Adrichem. (*Curr. Top. vet. Med. Anim. Sci.* **42**) Martinus Nijhoff, Dordrecht. pp. 101-110.
- Broom, D.M. (1991a) Animal welfare: concepts and measurement. *J. Anim. Sci.* **69**, 4167-4175.
- Broom, D.M. (1991b) Assessing welfare and suffering. *Behav. Process.* **25**, 117-123.
- Broom, D.M. and Johnson, K.G. (1993) *Stress and Animal Welfare*. Chapman and Hall, London.
- Cooper, J.J. and Nicol, C.J. (1991) Stereotypic behaviour affects environmental preference in bank voles *Clethrionomys glareolus*. *Anim. Behav.*, **41**, 971-977.
- Fraser, A.F. and Broom, D.M. (1990) *Farm Animal Behaviour and Welfare*. Baillière Tindall, London.
- Fraser, D. (1975) The effect of straw on the behaviour of sows in tether stalls. *Anim. Prod.* **21**, 59-68.
- Hediger, H. (1934) Über bewegungstereotypien beim gehaltenen Tieren. *Rev. suisse Zool.* **42**, 349-356.
- Hosoda, T. (1950) On the heritability of susceptibility to wind-sucking in horses. *Jap. J. zootech. Sci.* **21**, 25-28.
- Houpt, K.A. (1981) Equine behaviour problems in relation to humane management. *Int. J. Stud. Anim. Problems* **2**, 329-336.
- Houpt, K.A., (1986) Stable vices and trailer problems. *Vet. Clin. N. Am.: Equine Practice* **2**, 623-633.
- Hutt, C. and Hutt, S.J. (1970) Stereotypies and their relation to arousal: a study of autistic children. In: *Behaviour Studies in Psychiatry*. Eds: C. Hutt and S. J. Hutt. Pergamon Press, Oxford. pp. 175-200.
- Kennedy, M.J., Schwabe, A.E. and Broom, D.M. (1993) Crib-biting and wind-sucking stereotypies in the horse. *Equine vet. Educ.* **5**, 133-136.
- Kiley-Worthington, M. (1987) *The Behaviour of Horses*. J. A. Allen, London.
- Levy, D.M. (1944) On the problem of movement restraint. *Am. J. Orthopsychiat.* **14**, 644-671.
- Luria, A.R. (1973) Two kinds of motor preservation in massive injury to the frontal lobes. *Brain* **88**, 1-10.
- Mason, G.J. (1991a) Stereotypies: a critical review. *Anim. Behav.* **41**, 1015-1037.
- Mason, G.J. (1991b) Stereotypies and suffering. *Behav. Process.* **25**, 103-115.
- Mendl, M., Zanella, A.J. and Broom, D.M. (1992) Physiological and reproductive correlates of behavioural strategies in female domestic pigs. *Anim. Behav.* **44**, 1107-1121.
- Meyer-Holzappel, M. (1968) Abnormal behaviour in zoo animals. In: *Abnormal Behavior in Animals*. Ed: M. W. Fox. W. B. Saunders, Philadelphia. pp. 476-503.
- Ödberg, F. (1978) Abnormal behaviours: (stereotypies). *Proc. 1st Wld Congr. Ethology Applied to Zootechnics* 475-480.
- Ödberg, F. (1987) Behavioural responses to stress in farm animals. In: *The Biology of Stress in Farm Animals: an Integrated Approach*. Eds: P. R. Wiepkema and P. W. M. van Adrichem. Martinus Nijhoff, Dordrecht. pp. 135-149.
- Robbins, T.W., Mittleman, G., O'Brien, J. and Winn, P. (1990) The neurobiological significance of stereotypy induced by stimulant drugs. In: *The Neurobiology of Stereotyped Behaviour*. Eds: S. J. Cooper and C. T. Dourish. Clarendon, Oxford. pp. 25-63.
- Rushen, J. (1993) The 'coping' hypothesis of stereotypic behaviour. *Anim. Behav.* **45**, 613-615.
- Stolba, A., Baker, N. and Wood-Gush, D.G.M. (1983) The characterisation of stereotyped behaviour in stalled sows by informational redundancy. *Behaviour* **87**, 157-182.
- Toates, F. and Jensen, P. (1991) Ethological and psychological models of motivation: towards a synthesis. In: *Farm Animals to Animals*, Eds: J. A. Meyer and S. Wilson. M.I.T. Press, Cambridge. pp. 194-205.
- Tyler, S.J. (1972) The behaviour and social organisation of the New Forest Ponies. *Anim. Behav. Monogr.*, **5**, 85-196.
- Vecchiotti, G.G. and Galanti, R. (1986) Evidence of heredity of cribbing, weaving and stall-walking in thoroughbred horses. *Livest. Prod. Sci.*, **14**, 91-95.
- Zanella, A.J., Broom, D.M. and Hunter, J.C. (1992) Changes in opioid receptors in sows in relation to housing, inactivity and stereotypies. *Animal Welfare, Proc. XXIV Wld vet. Congr., Rio de Janeiro World Veterinary Association, London.* pp. 159-166