



Stereotypies and their relation to management

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SUMMARY

The results of 5 recent cross-sectional surveys of equine stereotypies are compared. The surveys have resulted in data on a total of 11,797 horses, from 13 different populations, obtained by postal questionnaire or by direct interview. The average prevalence figures for the 13 populations show that 4.13% of horses were crib-biters, 3.25% were weavers, and 2.20% were box-walkers. In addition, wood-chewing, classed as a redirected behaviour, rather than a stereotypy, was performed by 11.78% of horses. Generally, differences were found between populations within the same studies. Therefore, a greater prevalence of crib-biting and weaving was reported for Thoroughbreds than other breeds, and for stallions than mares. These variations in prevalence cannot be attributed solely to genetic factors, as the different breeds and sexes are subjected to radically different management conditions. The role of management factors can more easily be determined by looking for differences within populations. The most significant management factors positively associated with equine stereotypies appear to be low forage ration, high concentrate ration, and limited social contact between horses. The results of the cross-sectional surveys are compared with preliminary data from the first prospective study of equine stereotypies. This shows a much higher incidence of crib-biting (10.5%) than revealed in the other surveys, with a median age of onset of just 20 weeks. Therefore, many foals develop crib-biting prior to weaning. The provision of concentrate feed from birth, or prior to weaning, appears to be a risk factor in these young animals in addition to its association with crib-biting in older horses.

INTRODUCTION

Stereotypies are invariant and repetitive behaviour patterns that seemingly have no function. They typically develop in captive animals faced with insoluble problems (Mason 1991) and may be indicative of reduced welfare. However, the story is complex and there is considerable debate about the specific causes and functional significance of different stereotypic behaviour patterns. In horses, behaviours such as crib-biting, weaving and box-walking are classed as stereotypies. Historically, the blame for performing these stereotypies (which are still sometimes described by horse owners as 'vices') has been apportioned to the horse itself. Many owners, fearing loss of financial value or simply irritated by the performance of the stereotypic behaviour, resort to drastic measures to prevent the appearance of crib-biting and weaving stereotypies, including surgery, pharmacological treatments or direct intervention with physical barriers, collars or electric shock devices (McGreevy and Nicol 1998). A more recent view has been that equine stereotypies are caused by boredom. Although initially this view appears more enlightened it is not supported by either physiological or behavioural evidence. Intense stimulation, rather than under stimulation, appears to be involved in the early development of many stereotypies (Nicol 1999). Research is now demonstrating that equine stereotypies are caused and further influenced by management practices that frustrate specific behavioural needs.

CROSS-SECTIONAL STUDIES: DIFFERENCES BETWEEN POPULATIONS

A powerful method of establishing the relationship between equine stereotypies and management factors has been to survey horse owners using epidemiological techniques. Five separate cross-sectional studies, providing information on 13 different equine populations, have been published recently (Borroni and Canali 1993; McGreevy *et al.* 1995a,b; Luescher *et al.* 1998; Redbo *et al.* 1998). The characteristics of each survey are summarised in Table 1. Redbo *et al.* (1998) deliberately framed some of their questions in the same way as Borroni and Canali (1993) and McGreevy *et al.* (1995b), allowing some standardisation between studies. The study of McGreevy *et al.* (1995a) was concerned primarily with stereotypy prevalence, although a question was included about the amount of time horses spent out of their stables. The other surveys all included detailed questions about housing, diet, exercise, and the nature and degree of social contact between horses. Luescher *et al.* (1998) and Redbo *et al.* (1998) additionally asked about the degree of contact horses had with humans.

All of the surveys asked owners to report the separate prevalences of crib-biting, weaving and box-walking stereotypies on their stables or yards. In addition, McGreevy *et al.* (1995a,b) and Redbo *et al.* (1998) asked owners to report wood-chewing prevalence. Wood-chewing is not generally regarded as a stereotypy as it is variable in appearance and does not show certain other characteristics often associated with stereotypies, such as emancipation from the original causal factors. A small amount of wood-chewing seems almost ubiquitous among young horses and the classification of 'excessive' wood-chewing as a behavioural problem is subjective and may depend on owner tolerance. Despite this, it is useful to consider wood-chewing as it may precede or be associated with other oral behaviours, particularly crib-biting (Nicol 1999).

The prevalences of stereotypies in the 13 separate populations that have been surveyed are shown in Table 2. Considering the likely extent of fundamental differences between populations in genetic, structural (e.g. age and sex composition) and environmental factors, the relatively low standard deviations indicate that overall prevalence rates between populations are strikingly similar. Approximately 12% of horses wood-chew, 4% crib-bite, 3% weave and 2% box-walk.

Despite the overall similarities, most authors have reported significant within-study differences in the prevalence of stereotypies between different breeds, disciplines and sexes. A greater prevalence of crib-biting and weaving is reported for Thoroughbreds than other breeds (Luescher *et al.* 1998; Redbo *et al.* 1998), for dressage and event horses compared to endurance horses (McGreevy *et al.* 1995b) and for stallions compared to mares (Borroni and Canali 1993; Luescher *et al.* 1998). In contrast, Arabs are reported to perform more box-walking (McGreevy *et al.* 1995b; Luescher *et al.* 1998). Unfortunately, considerable difficulties arise in disentangling the

TABLE 1: The study characteristics of 5 cross-sectional surveys of equine stereotypy

Authors	Populations studied	Country where survey conducted	Total number of units (farms, studs)	Total number of horses in study	Questionnaire administration in study
McGreevy <i>et al.</i> 1995a	Dressage	UK	465	744	Postal
	Eventers		471	796	
	Endurance		165	211	
McGreevy <i>et al.</i> 1995b	TB racing	UK	86	2946	Postal
Borroni and Canali 1993	TB use not stated	Italy	20	1125	Not stated
Luescher <i>et al.</i> 1998	TB	Canada	9	263	Direct interview
	Standardbred		9	168	
	Quarter Horse		-	101	
	Arab		14	81	
	Ponies		-	67	
Redbo <i>et al.</i> 1998	Warmbloods	Sweden	-	54	Postal
	TB racing		38	644	
	Standardbred		234	4597	

causal factors that may be responsible for these varying prevalences of stereotypies between populations in any one study. Genetic factors are likely to play a part, but the different breeds and sexes are usually subjected to radically different management, feeding and exercise regimens. Redbo *et al.* (1998), for example, reported that Thoroughbred racehorses were given larger amounts of concentrate than Swedish trotters and had fewer opportunities for social contacts with other horses. Similarly, McGreevy *et al.* (1995a) reported that endurance horses, primarily Arabs, spent significantly more time out of their stables than dressage and event horses, which are primarily Warmblood or Thoroughbred crosses respectively.

GENETIC INFLUENCES ON EQUINE STEREOTYPIES

The link between breed and management can be important because it has been suggested frequently that some breeds or types of horse are more susceptible to developing stereotypies than others. A hereditary component to stereotypy development was initially suggested by evidence that certain Thoroughbred bloodlines were more likely than others to perform stereotypies (Vecchiotti and Galanti 1986). The 1035 horses included in this survey had been raised in stables annexed to 6 Italian racecourses, suggesting that environmental management practices were similar for all. However, there is no easy way to be sure and it is not known whether horses from each bloodline were distributed equally between yards. Horses from different bloodlines may have been subjected to differential management regimens. In the absence of a heritability study that holds environmental factors constant we have to assume, rather than know, that the inheritance of some degree of susceptibility to develop stereotypies is likely.

The nature of any genetic susceptibility is not known, although there has been much speculation that horses that are more reactive in stressful situations may be more prone to develop stereotypies. Unfortunately, no prospective study has been conducted to establish whether more reactive horses are more likely to develop stereotypies. Instead, studies have examined the stress responses of horses with stereotypies and compared them with nonstereotypic controls. Interpreting the results of such studies is difficult. One influential hypothesis has proposed that some stereotypies may assist animals to cope with stressful conditions (for review see Mason 1991), and predicts therefore that the performance of stereotypy should lower concentrations of stress indicators such as plasma cortisol. However, if horses that develop stereotypies are inherently more reactive than other horses, then their baseline concentrations of hormones such as cortisol may be higher. The subsequent

performance of stereotypy may lower cortisol concentration by an unknown amount, possibly to a level that remains higher than that observed in nonstereotypic animals (as found by McGreevy and Nicol 1998) but equally possibly to a level that does not differ from that observed in nonstereotypic horses (as found by McBride 1996; Lebelt *et al.* 1998; Pell and McGreevy 1999). Until a clearer picture emerges about the relationship between equine stereotypy and stress, preferably involving data from a prospective study, it seems premature to speculate that genetic susceptibility to develop stereotypy is mediated via differences in susceptibility to stress. Genetic influences on factors such as the sensitivity of the digestive tract to high-concentrate or low-forage diets, or strength of motivation to maintain social contact, could equally be involved.

CROSS-SECTIONAL SURVEYS: WITHIN-POPULATION DIFFERENCES

Because of the way in which breed differences may interact with environmental differences, the role of management factors can more easily be determined by looking for differences within populations. Borroni and Canali (1993) did not report detailed within-population findings, and the population sizes in Luescher *et al.* (1998) study were too small to allow this level of analysis. Population sample sizes were sufficiently large to allow the detection of overall associations of management factors with stereotypic behaviour in 2 studies (McGreevy *et al.* 1995b; Redbo *et al.* 1998), although even in these studies sample sizes were too small to allow accurate associations between management factors and individual types of stereotypy.

McGreevy *et al.* (1995b) found positive associations between stereotypy prevalence and stable designs that limited the degree of social contact between horses, the use of nonstraw bedding and a forage ration of less than 6.8 kg per day. Redbo *et al.* (1998) confirmed a significant positive association between stereotypy and low forage ration in both Swedish Thoroughbreds and between wood-chewing and low forage ration in both Thoroughbreds and Standardbreds. Although, wood-chewing was not influenced by the amount of concentrate fed, an increased concentrate ration was associated with an increase in stereotypies in the Thoroughbred horses. With hindsight, it is unfortunate that McGreevy *et al.* (1995b) did not include a question on concentrate feed so that the two studies could be more directly compared.

PROSPECTIVE STUDIES

Although surveys of the type described are useful, they are not very



TABLE 2: Reported % prevalence of stereotypies and wood-chewing from studies published between 1993 and 1998

	Crib-biting 13 populations	Weaving 13 populations	Box-walking 13 populations	Wood-chewing 6 populations
Mean	4.13	3.25	2.20	11.78
Standard deviation	2.57	3.23	2.33	6.12
Median	3.66	1.98	3.50	12.00
Minimum	0	0	0	5.00
Maximum	8.30	9.5	7.32	20.00

TABLE 3: The percentage of horses that initiated stereotypies or wood-chewing during a 4 year prospective study

	Crib-biting	Weaving	Box-walking	Wood-chewing
Mean	10.5	4.6	2.3	30.3

effective in establishing cause and effect relationships. The horses that perform stereotypies may not have been exposed to the current management factors when their stereotypies developed. Alternatively, equine yards with a certain set of management factors may be more likely to purchase cheaper, stereotypic animals. For these reasons prospective studies, where animals are followed individually over time, are an important and more powerful source of information. The first prospective study of horses that focuses on the effects of management on horse behaviour has just been completed (A. Waters and C. Nicol, unpublished data). A total of 218 foals were entered into the study, the first cohort in 1995. The foals were observed regularly and their management followed even when they moved to new yards. The percentages of horses that had initiated each abnormal behaviour by April 1999 are shown in Table 3. In this study, the number of horses performing locomotor stereotypies is within the range reported by others. Horses initiated weaving at a median age of approximately 60 weeks, and box-walking at approximately 64 weeks. In dramatic contrast, horses initiated wood-chewing at a median age of approximately 30 weeks, and crib-biting at only 20 weeks, in many cases prior to weaning. In addition, the percentages of horses performing crib-biting and wood-chewing exceed the maximum prevalences reported in any cross-sectional study. This could be because horse owners surveyed by postal questionnaire or even by direct interview under estimate the number of horses in their care that are stereotypic. A prospective study where the horses are visited over a period of time is likely to detect stereotypies more accurately. But it is also possible that prevalence figures from older populations under-represent the true incidence of equine stereotypy. Stereotypic foals may be more likely to be culled, or they may suffer from higher natural mortality. A more optimistic possibility is that a proportion of young horses cease to perform these oral stereotypies as they age or in response to management changes by owners. In voles, transfer to an enriched environment can reverse the process of stereotypy development in young animals but not in those with more established stereotypies (Cooper *et al.* 1996). In a similar way, young foals may be responsive to appropriate changes in management when older horses are not. Further analysis of our data will provide answers to these questions.

STEREOTYPIES AND MANAGEMENT FACTORS

The lack of solid evidence for a relationship between stereotypy and stress reduction in horses leads to an alternative view that each stereotypy is derived from a different source behaviour pattern and

reflects the frustration of a particular motivational system. Thus, weaving may derive from frustrated attempts to escape from the stable, primarily to regain contact with other horses (Nicol 1999). McGreevy *et al.* (1995b) report of an association between increased social contact and a lower prevalence of stereotypy has recently been tested experimentally. Cooper *et al.* (1999) showed that weaving was significantly reduced when stabled horses were given increased visual contact with others. It now remains to be tested whether the use of housing that allows a greater degree of social contact can prevent the onset of weaving behaviour in horses.

The appearance of crib-biting suggests that it is an oral behaviour that may reflect a very different form of frustration. The epidemiological evidence from the various surveys reported above is compatible with the view that crib-biting derives from feeding behaviour and may serve a digestive function in young horses, although it does not provide proof. Evidence of a link between crib-biting and digestive function was provided in an experimental study by McGreevy and Nicol (1998) who found that the prevention of crib-biting slowed gut motility.

There are reports that providing a high fibre diet can reduce the performance of established stereotypies (Haupt and McDonnell 1993). The mechanism by which high fibre feeds may reduce the risk or the performance of oral stereotypies is not known. It could be that more time is spent feeding, leaving less time available to stereotype, or that high fibre feeds reduce the motivation to forage via feedback mechanisms such as increased gut-fill (Cooper and Mason 1998). Alternatively, a high forage ration may simply mean that few concentrates are given, and concentrates may pose their own inherent risks to digestive function.

A specific hypothesis was proposed by Nicol (1999) who suggested that crib-biting may increase the flow of alkaline saliva and reduce the acidity of the gastric tract that is known to be associated with feeding concentrate rations (Rowe *et al.* 1994). Alexander and Hickson (1970) showed that horses secrete saliva only during mastication and, unlike dogs, not in response to the sight or smell of food. Horses fed low fibre rations may simply not produce sufficient saliva to buffer their stomach contents. If concentrates are fed together with a low forage diet then the situation may be further compounded. Many foals receive concentrate feed from birth, whilst others are given concentrate diets prior to weaning with the intention of reducing the stress of weaning and minimising any slow-down in growth (McCall *et al.* 1985). It is certainly difficult to believe that the high incidence of crib-biting in pre-weaned foals, many at pasture with their dams, is a consequence of stress. It seems more plausible that there is an association between the early introduction of concentrate feed and the onset of abnormal oral behaviours in these animals. However, stress may interact with digestive function in many ways, for example by reducing the duration of long bouts of grazing behaviour, that could further increase gastric acidity and increase the likelihood of stereotypy development.

CONCLUSIONS

The cause and potential function of any stereotypy is most



apparent during its early development. Thereafter, stereotypies tend to become increasingly self-organised and less dependent on the original causal situation. In voles up to 8 months after weaning, the development of locomotor stereotypies can be halted or even reversed by providing an enriched environment. However, the same environmental enrichment treatment is ineffective in voles 14 or 16 months after weaning (Cooper *et al.* 1996). This is the only experimental confirmation that stereotypies become increasingly independent of their original causes, but many other researchers have proposed that this is the case (Mason 1991). There is no information for horses about the age at which different stereotypies may become independent of their original causal factors. However, it is possible that in older horses, stereotypies become conditioned responses, activated in advance of the situation that originally led to the development of the stereotypy. Thus, horses may weave in anticipation of neighbouring horses leaving the yard for exercise, or may crib-bite before (or just as) concentrate feed is delivered, as a protective response.

The appearance of established equine stereotypies suggests that they may be only partially successful strategies for alleviating the consequences of management practices. An element of frustration or discomfort may remain, leading to excessive repetition and increasing invariance in timing and appearance of the behaviour. A real challenge lies ahead in changing the attitudes of horse owners as the inadvertent but deleterious consequences of traditional routines and practices become apparent.

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