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The effect of short term prevention on the subsequent rate of crib-biting in Thoroughbred horses

P. D. McGREEVY*† and CHRISTINE J. NICOL

Department of Clinical Veterinary Science, University of Bristol, Bristol BS18 7DU, UK.

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Summary

The results of an experimental study of the motivational consequences of short-term prevention of crib-biting are reported here. Eight test horses wore a cribbing collar for 24 h. This was effective in preventing crib-biting in 6 subjects. Using analysis of co-variance that accounted for baseline differences in crib-biting rate, test horses showed significantly more crib-biting than control horses on the first day after prevention (P<0.05). There was also a highly significant increase in the crib-biting rate of test horses on the first day after prevention in comparison with their baseline rate (P<0.01). This defines the increase as a post inhibitory rebound. An increase in the novelty of the cribbing bar and an increase in feeding motivation during the period of prevention are rejected as explanations of the rebound in this study. Instead, it is suggested that the rebound reflected a rise in internal motivation to crib-bite during the period of prevention. Behaviours that exhibit this pattern of motivation are generally considered functional; and it has been argued that their prevention may compromise welfare.

Introduction

Crib-biting is a repetitive and invariant behaviour reported in 5.5% of young racehorses (McGreevy *et al.* 1995a). It also lacks any immediately apparent function and, for these reasons, it is commonly regarded as a stereotypy.

There has been much recent debate about the functional significance of stereotypies performed by captive domestic animals (Broom 1991; Cooper and Nicol 1991; Mason 1993). One influential theory is that stereotypies enable animals to cope with stress (Fentress 1976; Levine *et al.* 1978; McBride 1980; Wood-Gush *et al.* 1983). However, experimental studies that have examined the effects of preventing animals from performing stereotypies in order to assess the validity of the stress-coping hypothesis have produced equivocal results (Kennes and de Rycke 1988).

An alternative hypothesis is that stereotypies function, with an unknown degree of effectiveness, within their originating motivational system (Rees 1984; Kiley-Worthington 1987; Prince 1987). Therefore, since crib-biting is an oral behaviour that involves activity of the lips and teeth and distension of the oesophagus, it may retain a digestive function (Houpt 1991) or may help to meet unsatisfied foraging needs (Toates 1981; McGreevy *et al.* 1995b).

Despite the fact that the functional significance of crib-biting has yet to be established, prevention of the behaviour is regularly attempted by horse owners (McGreevy and Nicol 1998b). These attempts at prevention may be counterproductive and it is possible that they may even compromise welfare. McGreevy and Nicol (1998a) have shown that the gut transit time of ingested feed is significantly increased in crib-biting horses during periods of short term prevention of crib-biting behaviour. Such observations can be complemented by studies of the behaviour of crib-biting horses after a period of short term prevention, as this can shed light on the underlying pattern of motivation to crib-bite.

Behaviours that arise solely in response to current external conditions would be predicted to resume again, after a period of prevention, at the same rate as that observed prior to prevention (Kennedy 1985). However, many behaviours are caused by a combination of internal changes and external conditions. An important subclass of such behaviours are those whose internal motivation can be shown to increase as a function of time since the behaviour was last performed. This increase in internal motivation can be most easily inferred by looking for increases in the rate or intensity of the activity after period of prevention, for example in the additional feeding behaviour observed after the animal has missed a meal. Such a compensatory increase is termed a rebound in behaviour (Nicol 1987).

Dairy cattle (Wierenga *et al.* 1985) showed a compensatory increase in lying behaviour when the animals were let out of sheds with limited numbers of cubicles. Similar patterns have been found for 'playing' behaviour when caged rabbits are

TABLE 1: Experimental plan of study of motivational consequences of short term prevention of crib-biting

	Habituation		Baseline		Treatment		Post treatment	
Days	-1 and -2		1		2		3, 4 and 5	
	Video	Collar	Video	Collar	Video	Collar	Video	Collar
Control horses (n = 8)	-	-	+	-	+	-	+	-
Test horses (n = 8)	-	-	+	-	+	+	+	-

*Author to whom correspondence should be addressed.
†Department of Animal Science, University of Sydney, NSW 2006, Australia.

Fig 1: A conventional cribbing collar in place (courtesy of John Conibear).

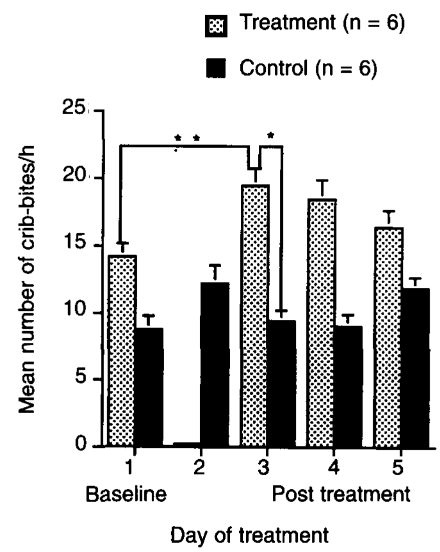

Fig 2: Mean hourly crib-biting rates (± s.e.) over a 5-day period (treatment group wore a cribbing collar on Day 2).

released (Lehmann 1989) and for wing-flapping in battery hens (Nicol 1987). Because the rebound effect has also been incorporated into models of displacement activities, it has been proposed that it may be a more widespread phenomenon than is realised (Nicol 1987). The welfare consequences of preventing behaviours that do and do not exhibit postinhibitory rebound are quite different (Nicol 1994).

The current study examined the behavioural consequences of short term prevention on the subsequent frequency and intensity of crib-biting in subjects that had worn a cribbing collar (Fig 1) for 24 h.

Materials and methods

Sixteen crib-biting Thoroughbred geldings (mean age 8.8 years) were hired sequentially from the public for 7 days each. Each was fed soaked hay *ad libitum*, bedded on wood shavings and housed in a wooden loose box. The box measured 3.6 x 3.7 m, was built against the interior wall of a brick barn and had wooden partitions on 3 sides to a height of 1.2 m, above which were vertical metal bars (0.8 m long and 5 cm apart). The door was of similar construction and had no upper edge that could be used as a substrate for crib-biting. The test stable included a wooden 'cribbing bar' (65 x 4 x 15 cm) which was bolted to a pair of metal cups, which in turn were bolted to the brick wall at the rear of the box.

A nonstereotypic 18-year-old pony gelding was used as a companion animal for each hired horse and was housed in the loose box next to the experimental stable. Tungsten lighting was used from 1600 to 0900 h. The 2 animals were turned out together into a 1 acre paddock with wooden post-and-rail fencing between 0830 and 0930 h every morning. Each subject was allowed to habituate to the experimental stable and paddock for 2 days before recording began.

After the 2 habituation days, the behaviour of horses in the stables was video-taped for 23 h/day (1 h/day was spent in the paddock), for 5 days, at intervals of 10 s/min. From these observations, the hourly rates of crib-biting were calculated for 5 days. The hourly rates of eating were also calculated for baseline and post treatment days (Days 1 and 3, respectively) to determine any rebound in ingestive behaviour as a consequence of the treatment.

Eight of the horses were randomly selected to wear a collar on the second day and the remainder were controls. The collar was applied at the end of the hour in the field, as soon as the horse had been brought into the stable. It was removed at the same stage on the third day. The experimental plan is shown in Table 1. Hay consumption (kg) was monitored throughout the experiment in 10 of the horses (n = 5 test; n = 5 control).

Analysis

The data for treatment and control horses were analysed separately using repeated measures analysis of variance to compare crib-biting rates on post deprivation days with matched baseline crib-biting rates. The effects of time of day were included in this analysis. The combined data for all horses were then examined using analysis of covariance, with differences in baseline crib-biting rates between the 2 groups entered as the covariate factor.

Results

The deprivation technique was incomplete in 2 of the 8 test

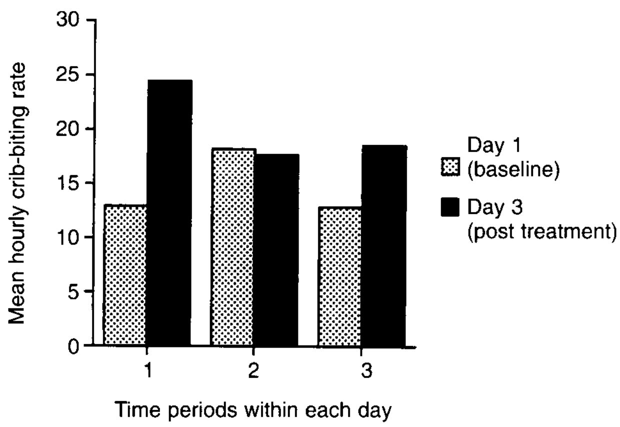

Fig 3: The post treatment crib-biting rate of test horses on the first day after prevention (Day 3) compared with the baseline levels (Day 1). The rebound in crib-biting rate was more pronounced during the first time period (0800–1500 h) than the third (2400–0700 h). No rebound was apparent during the second time period (1600–2300 h).

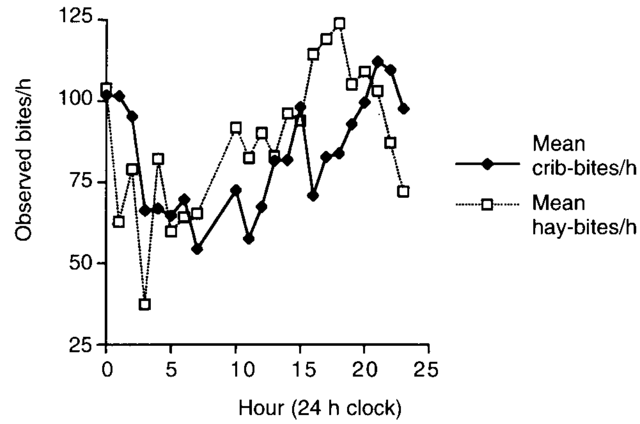

Fig 4: Diurnal rhythm in rate of crib-biting and eating hay (from 64 days of observation). Horses were in paddock between 0830 and 0930 h.

horses. These horses attempted to perform a similar behaviour during the deprivation day by resting their chins on the empty metal cups. Two of the control horses failed to crib-bite at all. Therefore, these 4 animals were removed from the analysis.

Because there was some diurnal variation in crib-biting rates over each day, the 24 h periods were divided into thirds from 0800 h for analysis of response to the treatment.

There was a highly significant increase in the crib-biting rate of test horses on the first day after prevention in comparison with their baseline rate (F = 8.73; d.f. 1, 15; P<0.01) (Fig 2). An interaction with the time of day approached significance (F = 3.41; d.f. 2, 15; P = 0.06) indicating that the rebound effect on the first day after prevention was most pronounced during the first time period, not at apparent at all during the second time period and apparent again during the third time period (Fig 3). The mean crib-biting rates of test horses on Days 4 and 5 were numerically higher than their baseline rates but the differences were not statistically significant. There were no significant changes in crib-biting rate between baseline and post treatment days for control horses.

Prior to performing the analysis of covariance the relationship between baseline crib-biting rates and post treatment crib-biting rate was examined separately for both treatment and control horses. Highly significant regressions with approximately parallel slopes were obtained in all cases, suggesting that the baseline crib-biting rate is an important determinant of post treatment crib-biting rate. The overall regression of the pooled data from both groups was also highly significant for all 3 analyses of covariance performed to compare treatment and control horses on the first, second and third days after prevention. The analyses revealed that the crib-biting rate of the test horses on the first day after prevention was significantly higher than that of the control horses (F = 5.84; d.f. = 1,29; P = 0.022), even when the differences in their baseline crib-biting rate were taken into account. However, during the next 2 days the difference between the 2 groups was smaller and no longer reached significance.

Stereotypy peaked at between 2100 and 2200 h while feeding peaked at between 1700 and 1800 h (Fig 4). For both behaviours, the trough in the hourly mean of activity occurred in the hour when horses were turned out in the paddock.

Polynomial regression tests for trend in the rhythm showed that for the 14 horses that did crib-bite, a monophasic curve with a peak at 1200 h was significant (P<0.05) in 5 of the horses on Day 1 and 8 on Day 3. When cribbing rates were combined from Days 1, 3, 4 and 5, the control horses (mean ± s.e. 9.98 ± 0.61) seemed to have cribbed less than the test horses (16.79 ± 0.84) but this was not a significant difference (unpaired *t*-test, d.f. = 10, t = 1.82, P = 0.0988).

No significant differences were found when analysis of variance was used to examine the rate of bites taken from the hay net between test and control animals on Day 3 (d.f. = 29.1; F = 0.48, P = 0.494).

Hay consumption did not differ significantly between test and control horses on Day 2 (13.81 kg ± 2.87 and 17.66 kg ± 1.05, respectively, ANOVA, F = 2.04, d.f. = 10, P = 0.1832). Mean daily hay consumption for the 5 days did not differ significantly between test and control horses (15.71 kg ± 3.15 and 17.55 kg ± 1.05, respectively, ANOVA, F = 0.5, d.f. = 10, P = 0.4952).

Discussion

Substitutability of eating and crib-biting.

In this study, the diurnal rhythm of crib-biting was similar to that of eating, supporting the findings of Kusunose (1992), who studied 3 horses given intermittent concentrate feeds and found that crib-biting frequency increased around the time of delivery of the concentrates. This author suggested that crib-biting occurred in response to frustration in association with food that is more physically concentrated than forage. Crib-biting rates in the current study were similar to those reported by Dodman *et al.* (1987).

Peak rates of eating and crib-biting did not coincide because both behaviours involved the mouth and therefore, at any given instant, they were mutually exclusive. This does not mean that the stereotypy can be viewed as a direct analogue of eating. However, if one compares the morphologies of crib-biting and other oral behaviours e.g. grooming or Flehmen, the appetitive chewing action and involvement of the tongue in crib-biting suggest that it is most closely related to an ingestive process.

Over a 24 h period, major peaks and troughs in crib-biting and eating occurred in the same parts of the day largely because these behaviours were not seen during rest or recorded during the turn out period. However, comparison of the relationship between the 2 behaviours during hours that recorded activity other than rest, revealed increases in the rate of eating that were mirrored by falls in the rate of crib-biting and *vice versa*. Eating is the first part of a complex ingestive and digestive process. Crib-biting may play a role in post oral gut function in addition to its involvement in oral activity (McGreevy and Nicol 1998a).

Rebound

The fact that the level of stereotypic activity after prevention was significantly higher than its original level defines it as post inhibitory rebound (Kennedy 1985). The post inhibitory rebound in crib-biting is unlikely to be related to novelty. The novelty value of a cribbing bar to a crib-biter would be maximal at the time of the first ever bout of stereotypy. Anecdotal reports from the owners of crib-biters suggest that the behaviour increases in daily frequency over a period. Similarly, evidence from voles (Cooper 1993) and mink (Mason 1993) suggests that stereotypy frequency undergoes a gradual, rather than quantum, rise to an established mean level.

The 'novelty' argument has been applied to rebound dust bathing in fowl (Murphy and Wood-Gush 1978; Hughes 1980). However, Nicol (1987) negates novelty as a cause of post inhibitory rebound by indicating that post deprivation eating in a food deprived animal is not related to novelty but reflects an adaptive motivation to supplement depleted energy reserves. Although meriting discussion from a philosophical point of view, it may be that 'rising internal motivation' and 'increased novelty' are merely labels for the same process.

Since wind-sucking can develop in horses that have been deprived of a crib-biting substrate, there is an implication that crib-biting is preferred to wind-sucking and that suitable substrates enhance rather than stimulate the behaviour. Having a substrate to seize facilitates crib-biting and may increase reinforcement.

The cribbing collar did not reduce the ingestion of hay and, therefore, the rebound in crib-biting associated with its removal cannot be linked to any need to replenish gut fill and energy requirements. When fitted properly, collars do not appear to limit the swallowing of an individual's daily bulk requirement through pain or oesophageal/pharyngeal constriction. This may explain why cribbing collars have not been implicated as a cause of unthriftiness in crib-biters.

Crib-biters are usually surrounded by suitable substrates, e.g. stable doors indoors and fence rails outdoors. The presence of a cribbing bar does not stimulate crib-biting as an external stimulus in the same way that palatable food seems to (Dodman *et al.* 1987; Gillham *et al.* 1994). Since cribbing bars are therefore unlikely to act as a novel external stimulus and because there was no evidence of increasing feeding motivation, the only remaining possibility is that the post inhibitory rebound results from an increase in motivational tendency during the period of restriction. This may explain why prevention of crib-biting is highly unlikely to effect a cure since the motivation to perform the behaviour is likely to rise rather than fall. Furthermore, if the motivation to crib-bite increases with time since the behaviour was last performed then to thwart the behaviour by prevention is likely to cause frustration and possibly suffering (Dawkins 1988). Most behaviours that show this characteristic pattern of motivation show some obvious and important function. In the case of crib-biting this function is not clear but it may include activation of oesophageal stretch receptors (McGreevy *et al.* 1995b).

The development and implementation of management practices that prevent the occurrence of crib-biting should be given priority in future research initiatives. However, an immediate conclusion from this study may be that all affected horses should be provided with adequate foraging opportunities and allowed to crib-bite. The damage done to incisors during a lifetime performing this behaviour could be minimised by the provision of cushioned cribbing-bars throughout the horse's environment. However, despite evidence to suggest that true aerophagia is not involved in the stereotypy (McGreevy *et al.* 1995b), this would meet with opposition from those who feel that crib-biting is directly linked to an increased risk of flatulent colic. The link between crib-biting and colic has yet to be proved, perhaps because the incidence of the disorder is low. Tests that identify the occasional crib-biters that may be at risk of abnormal flatus should be developed so that others can be allowed to crib-bite.

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