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General Articles

Management factors associated with stereotypic and redirected behaviour in the Thoroughbred horse

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Summary

A greater knowledge of the effect of management factors is required to investigate the ontogeny of abnormal behaviour in the stabled horse. A postal survey of racehorse (flat) trainers yielded information about 22 yard and management factors. The relationship of the factors to the prevalence of abnormal behaviour was analysed by logistic regression. Management factors related to the time spent in the stable showed the strongest associations with stereotypic behaviour. The risk of horses performing abnormal behaviour increased: 1) as the amount of forage fell below 6.8 kg/day, 2) when bedding types other than straw were used, 3) when the total number of horses on the yard was fewer than 75, 4) in association with box designs that minimised contact between neighbouring horses, 5) when hay, rather than other types of forage, was used.

Introduction

Stabled horses often exhibit behaviours which owners regard as unwelcome. These include stereotypies, defined as repetitive, relatively invariant and apparently functionless (Mason 1991) and behaviours directed towards an inappropriate target (redirected behaviour) (Fraser and Broom 1990).

The prevalence of box-walking, wind-sucking/crib-biting and weaving in UK Thoroughbred populations has been estimated at 1.1, 4.2 and 2.8% (Prince 1987) and 1.7, 4.0 and 4.0% (P.D. McGreevy; unpublished data) respectively; and in Italy at 2.5, 2.4 and 2.5%. Estimates of the combined prevalence of all abnormal behaviours have reached 26% (Kiley-Worthington 1983).

In other species, cage-design (Odberg 1986), isolation-rearing (Morgan 1973) and food-deprivation (Appleby and Lawrence 1987) have been implicated as proximate causes of stereotypic behaviour. Arousal, generated by frustrated motivation, is a possible shared underlying cause (Duncan *et al.* 1993) although others emphasise the possible heterogeneity in the cause of different stereotypies (Mason 1991). Despite much work on farm and laboratory species, the causes of stereotypic and redirected behaviour in the horse remain unclear. Heritability plays some role (Hosoda 1950; Vecchioti and Galanti 1986) but little is known about the relative importance of management factors that might frustrate motivation in the horse. Feeding practices have a greater effect than housing practices on the incidence of abnormal behaviour (Marsden 1993) and wood-chewing increased when high protein rations were fed due to a concomitant reduction in the total fibre content (Ralston *et al.* 1979) and when exercise was withdrawn (Krzak *et al.* 1991). Other possible causes of abnormal behaviour include factors associated with weaning, social contact, crowding, feeding, housing and/or training practices (Kiley-Worthington 1983; Luescher *et al.* 1991). Exposure to a stereotypic neighbour may also increase the likelihood of stereotypy development or performance. Such social influences, known in voles (Cooper and Nicol 1994), may affect stereotypy levels in horses (Houpt and McDonnell 1993), despite no current indication that horses can learn by observation (Baer *et al.*1983; Baker and Crawford 1986).

The aim of the current study was, for the first time, to establish the relative influence of management factors on the risk of abnormal behaviour (weaving, box-walking and wind-sucking/crib-biting stereotypies, and wood-chewing) in the horse by sampling a large relatively uniform population.

Materials and methods

The survey examined the prevalence of 4 behavioural patterns:

Weaving: an obvious lateral swaying movement of the head, neck forequarters and sometimes the hindquarters.

Box-walking: a circular route-tracing within the stable

Crib-biting/wind-sucking: an oral-based behaviour frequently involving the horse grasping a fixed object with its incisor teeth and engulfing air with an audible grunt.

Wood-chewing: a redirected behaviour involving the horse chewing wood from a number of different sites within its stable.

Study population

Three hundred trainers in England and Wales with more than 10 horses listed in the Raceform publication 'Horses in Training 1992' were selected. Of these, 159 listed as training more than 25% 2-year-olds and 3-year-olds were included.

Study design

A self-administered 4 page postal questionnaire was used to collect data. A pilot study involving 10 trainers was used to test the questionnaires in October 1992. A questionnaire was sent to trainers in November 1992 and followed-up by telephone or a second mailing.

Dependent variables

Weaving, box-walking, wind-sucking/crib-biting and wood-chewing: Trainers were asked to state how many of all the horses, and specifically the yearlings, 2-year-olds and 3-year-olds, in their yards ever performed each of these behaviours. Results for these 4 variables were taken as the numerator while the total number of horses on the yard was the denominator. A calculated dependent variable representing abnormal behaviour in general allowed comparison between horses that performed *any* of the 4 listed behaviours and those that showed none.

Independent variables

The trainers' responses to the questionnaire were categorised before inclusion as independent variables in the analysis. The 17 questions trainers were asked can be summarised as follows:

1. *Number of horses on the yard:* Included as a categorical variable with 4 levels (1–25 horses, 26–50 horses, 51–75 horses and 76–200 horses). The smallest yards were selected as the reference category (R=reference category) when it was included in the multivariate analysis.

2. *Type of training involvement over the following 12 months:* Included as a binary variable: 'flat only' or 'mainly flat' (R).

Stable management of horses in training

3. *Communication possibilities between neighbouring horses in the most common loose-box design:* Included as an ordered categorical variable with 3 levels: most contact (see and touch), visual contact (see over stable door and within stable interior) and minimal contact (see only over the stable door) (R).

4. *Bedding type provided for youngsters:* Included as a binary variable: those that bed more than 50% of youngsters on straw (R) and those that bed less than 50% of youngsters on straw.

5. *Forage type provided for youngsters*: Included as a binary variable: hay (R) or any forage source other than hay.

6. *Forage amount offered to youngsters over a 24 h period:* Included as a binary variable: less than (R) or more than 6.8 kg of forage per day.

7. *Frequency of forage provision for youngsters over a 24 h period:* Included as a variable with 3 levels: fewer than 3 times per day (R), 3 times per day and more than 3 times per day.

Management of yearlings and foals prior to training

8. *Were foals and yearlings kept on yards prior training?*

9. *Were foals and yearlings housed in groups or individually?*

10. *Were foals and yearlings fed* ad libitum *forage?*

11. *Did foals and yearlings remain on the yard for the start of their working careers?*

These were all included as a binary variable in the univariate analysis.

Management of horses out of their stable

12. *How many times per day horses were ridden?* Included as a binary variable.

13. *Did yard possess a horse-walker?* Included as a binary variable according to whether the trainers did or did not possess a horse-walker (R).

14. *Yard possess an exercise area (paddock, sandpit, playpen or menage)?* Included as a binary variable according to whether the trainers did or did not possess such an exercise area (R).

Data analysis

All analyses were performed on data for individual horses calculated from replies from each yard.

Univariate analyses: The data were entered onto a database within SPSS 4.0 for analysis. Chi-squared tests were used to examine associations between independent variables and each of the 5 dependent variables. In addition, Mantel-Haenszel tests of trend were carried out where approximately linear relationships were found. Associations between the independent variables were also investigated.

Regression analyses: In order to adjust for potential confounding, the relationship between dependent and independent variables was investigated further using stepwise unconditional logistic regression in Genstat 5 (1987). Yard size and stable design were offered to the model as categorical variables while all the others were included as binary variables. Maximum likelihood estimates of adjusted odds ratios and 95% CIs (confidence intervals) were obtained. This was done in order to allow for the possible confounding effects of other variables. Final models included only variables that resulted in a significant change in deviance according to the Likelihood Ratio Statistic generated by the logistic regression analysis.

Odds ratios: The odds of an event occurring are defined as the ratio of the probability that it will occur to the probability that it will not. The odds ratio is the ratio of the odds of anomalous behaviour (e.g. a given horse being a weaver) in the exposed group (e.g. medium-sized yards) to the odds of anomalous behaviour in the unexposed group (e.g. small-sized yards). An odds ratio greater than 1.0 indicates an increase in risk whereas an odds ratio less than 1.0 represents a decrease in risk.

Validity, non-response bias and repeatability: The validity of the response was measured by comparing the results with known measures of yard size, the number of 3-year-olds and the number of 2-year-olds, from the 1992 edition of 'Horses in Training' (Raceform Ltd., Compton, Newbury, Berks). Non-response bias was assessed by comparing these parameters for respondents with those for non-respondents. Early and late respondents were compared using the same variables.

The repeatability of the response was tested by sending a questionnaire to a subgroup of 10 systematically sampled respondents on December 8 1993 asking identical questions which provided a comparison with answers for 1992 after 12 months.

Results

Response rate

The response rate was 62.3% (99 out of 159). The usable return rate was 54.0% (86 out of 159), giving results on 2946 horses involved in flat racing. Of these, only 48 horses were reported as being box-walkers. This number was too small to elicit any statistically significant correlations between this behaviour and any management factors (however, box-walking was included as part of the calculated dependent variable, 'abnormal behaviour').

Survey quality

Estimates of the number of horses in the yards were taken from 'Horses in Training 1992'. The correlation between these values and those quoted in the survey responses was taken as an indication of the validity of the information gathered. The correlation coefficient for the total number of horses on the yard was 0.9. The correlation coefficients for the number of 3-year-olds and number of 2-year-olds were 0.6 and 0.9 respectively.

The repeatability study comparing yard size, number of 3-year-olds and number of 2-year-olds as reported in 1992 and then in 1993 found correlation coefficients of 0.7, 0.9 and 0.7 respectively in 4 replies from the 10 trainers who were contacted.

Using the independent measures of yard size, number of 3-year-olds and number of 2-year-olds, there were no significant differences between the respondents and the non-respondents. The same measures were used to compare early and late respondents and no significant difference was detected.

The management of yearlings and foals prior to training

This study showed that 33 of the 85 respondents (38.8%) had more than one system of management because, apart from horses in training, they also kept foals and yearlings prior to their going into training.

Of the 33 trainers who kept foals and yearlings, 24 (72.7%)

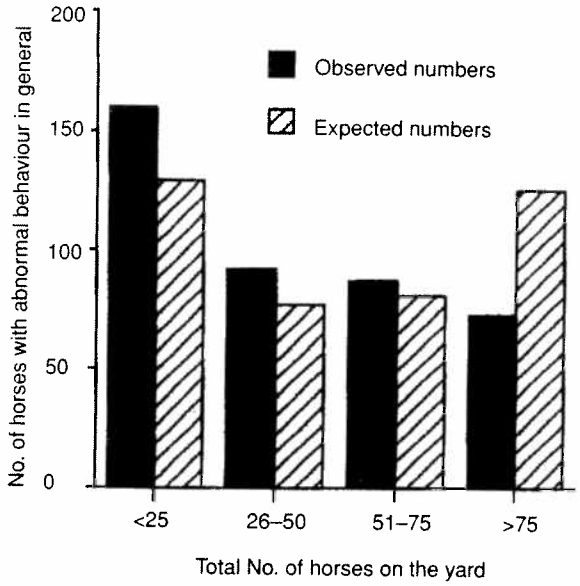

Fig 1: Number of horses with abnormal behaviour. Yards with more than 75 horses show significantly less abnormal behaviour in general than statistically expected (chi-squared).

TABLE 1: The multivariable relationships between yard variables (order of significance of entry into the model shown in parentheses) and the risk of an individual horse performing anomalous behaviours in England and Wales in 1992. From a cross-sectional survey of flat trainers

	Abnormal behaviour		Wood-chewing		Weaving	
Variable	Adjusted odds ratio	95%CI	Adjusted odds ratio	95%CI	Adjusted odds ratio	95%CI
Forage amount						
>14 lbs/day	0.41	0.55–0.30	0.24	0.43–0.14	0.42	0.82–0.26
<14 lbs/day	1.00 R*** (1)		1.00 R*** (4)		1.00 R*** (2)	
Yard size (No. of horses)						
up to 25	1.00 R*** (2)		1.00 R*** (3)		1.00 R*** (1)	
26–50	1.33	1.83–0.97	1.96	3.16–1.22	0.59	1.18–0.30
51–75	1.05	1.49–0.75	0.35	0.72–0.17	1.98	3.15–1.24
76 or more	0.31	0.45–0.22	0.14	0.25–0.08	0.46	0.82–0.26
Type of training						
Flat only	1.88	2.45–1.45	6.71	10.54–4.27	-	-
Mainly flat	1.00 R*** (3)	1.00 R*** (2)				
Bedding type						
Other bed	1.89	2.44–1.46	-	-	1.88	2.79–1.27
Straw bed	1.00 R*** (4)		-	-	1.00 R** (3)	
Box design						
Minimal contact	1.00 R** (5)		1.00 R*** (1)		1.00 R (4)	
Visual contact	0.60	0.80–0.45	0.15	0.27–0.08	1.02	1.71–0.61
Visual and tactile contact	0.81	1.14–0.58	0.47	0.89–0.25	1.58	2.83–0.89
Forage type						
Other than hay	0.52	0.78–0.35	0.48	0.92–0.25	0.27	0.63–0.12
Hay	1.00 R*** (6)		1.00 R*** (6)		1.00 R*** (5)	
No. times forage is offered						
<3 times/day	1.00 R** (7)		-		-	
3 times/day	1.07		-		-	
>3 times/day	0.45	0.79–0.26	-	-	-	-
Possession of exercise area						
Yes	-	-	0.47	0.75–0.30	-	-
No	-	-	1.00 R*** (5)		-	

R = reference category; * = P<0.05; ** = P<0.01; *** = P<0.001.

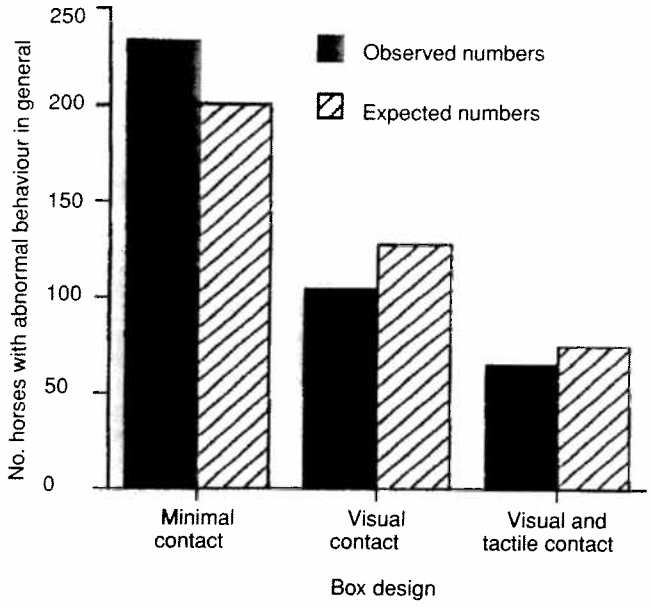

Fig 2: Yards with box-designs which allowed minimal contact show significantly more abnormal behaviour in general than statistically expected (chi-squared).

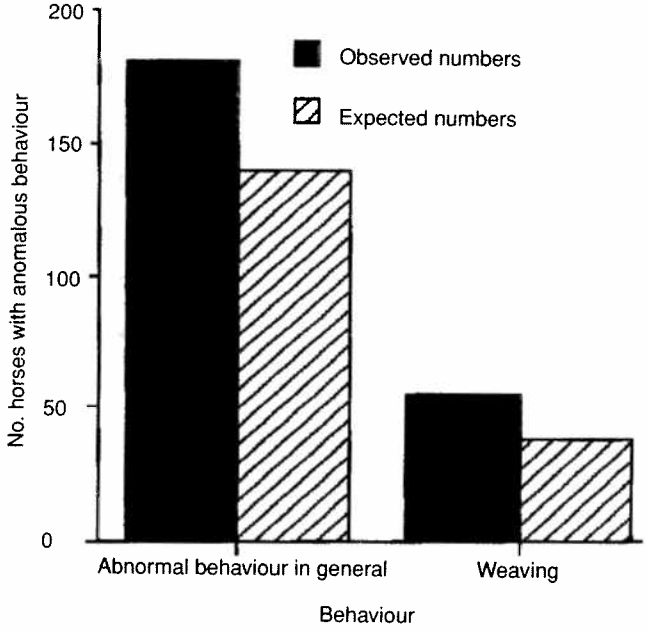

Fig 3: Horses with bedding types other than straw show significantly more weaving and abnormal behaviour in general than statistically expected (chi-squared).

housed them in individual boxes rather than group houses, 15 (45.45%) gave them *ad libitum* forage and all but one generally kept such youngsters on for the start of their training career.

Associations between type of training, yard size and management factors

Yards which were described as being 'flat only' were more likely to have more horses in training (Mantel-Haenszel tests of trend chi-squared = 336.105 P<0.001). They were also more likely to

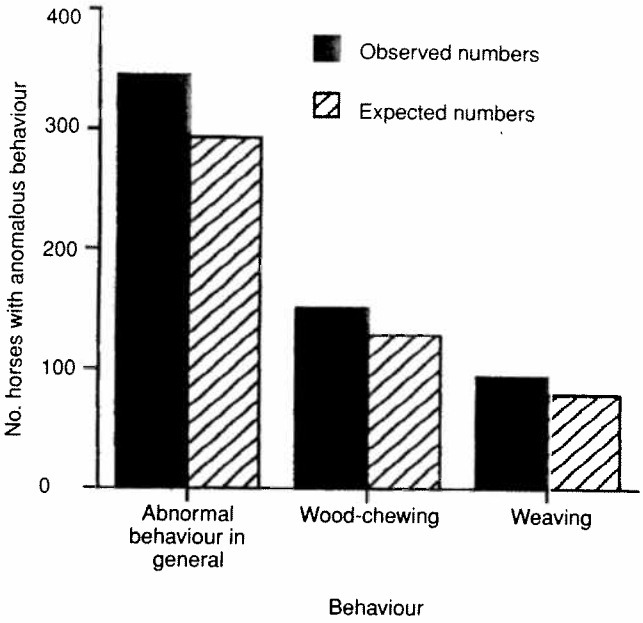

Fig 4: Horses fed less than 6.8 kg of forage per day show significantly more wood-chewing, weaving and abnormal behaviour in general than statistically expected (chi-squared).

have a horse-walker (Mantel-Haenszel tests of trend chi-squared = 347.912 P<0.001) and an exercise area (Mantel-Haenszel tests of trend chi-squared = 55.067 P<0.001). These were the yards which had the more traditional stable designs (Mantel-Haenszel tests of trend chi-squared = 10.545 P<0.005). Yards which bedded more than 50% of their horses on straw were negatively correlated with the offering of forage more frequently per day (Pearson chi-squared = 19.048 P<0.001) and were less likely to possess a horse-walker (Pearson chi-squared = 79.678 P<0.001). Larger yards were less likely to have an exercise area (Mantel-Haenszel tests of trend chi-squared = 88.684 P<0.001), more likely to possess a horse-walker (Mantel-Haenszel tests of trend chi-squared = 20.554 P<0.001) and less likely to offer forage frequently (Mantel-Haenszel tests of trend chi-squared = 20.554 P<0.001) and this forage was less likely to be hay (Mantel-Haenszel tests of trend chi-squared = 119.240 P<0.001). Larger yards were more likely to offer more than 6.8 kg of forage per day (Mantel-Haenszel tests of trend chi-squared = 31.171 P<0.001). Yard sizes ranged from 4 to 230. The mean yard size was 33.9 horses.

Associations between management factors and abnormal behaviours

Yard size: The size of the yard was significantly related to the prevalence of abnormal behaviours in general (Fig 1). Yards with more than 75 horses had a reduced risk (Adjusted Odds Ratio [AOR] 0.31). This was most apparent for weaving which peaked in prevalence (AOR 1.98) on yards with between 51 and 75 horses. A similar pattern was found with wood-chewing which peaked in prevalence on yards with between 26 and 50 horses (AOR 1.96) (Table 1).

Type of training: Trainers who defined their work as 'flat only' for the coming season were linked to increased risk (AOR 1.88) of abnormal behaviours in general compared to those who defined their work as 'mainly flat'. When the behaviours were examined individually, this trend was primarily due to the contribution of wood-chewing (AOR 6.71) with other individual behaviours having non-significant correlations.

Box design: The presence of bars and grilles between stables rather than the traditional stable design was related to a reduced risk of abnormal behaviour in general (0.60 and 0.81 compared to the reference category of 1.00) (Fig 2). Individually, wood-chewing showed the strongest trend (Pearson chi-squared = 80.91. P<0.0001) in this direction, and there was no significant effect for weaving (Pearson chi-squared = 3.73 P=0.15473).

Bedding type: The use of non-straw bedding was associated with an increased risk of abnormal behaviours in general. Specifically, this trend was found for weaving alone (AOR 1.885 with a Pearson chi-squared = 12.297 P<0.0005) alone with other behaviours having non-significant correlations after adjustment for the confounding effects of other variables (Fig 3).

Forage type: The use of non-hay forage source was associated with a reduced risk of abnormal behaviours in general (AOR 0.523). Of the individual behavioural patterns studied, weaving (AOR 0.27) followed by wood-chewing (AOR 0.475) showed the strongest relationships.

Forage amount: Giving less than 6.8 kg of bulk daily (Fig 4) was associated with a reduced risk of horses performing abnormal behaviours in general (AOR 0.407). This relationship was found for wood-chewing (AOR 0.241) and weaving (0.353) in order of descending significance.

Number of times forage was offered: Offering forage 3 times per day was associated with an increased risk (AOR 1.067) of abnormal behaviours in general when compared with individuals offered forage once or twice per day. However, feeding forage more than 3 times per day was related to a reduced risk of abnormal behaviours in general (AOR 0.454). This variable had no significant relationships with individual behaviours after adjustment for confounding.

Possession of a paddock: The possession of a paddock was related to an reduced adjusted risk (0.47) for wood-chewing (Pearson chi-squared = 4.92 P<0.05) with other behaviours having non-significant correlations after adjustment for the confounding effects of other variables.

There was no significant correlation of any other individual variables with the prevalence of abnormal behaviour.

Discussion

This study showed that the performance of abnormal behaviours by Thoroughbreds in English and Welsh flat training yards was associated with the amount and type of forage offered, number of times per day forage was offered, total number of horses in the yard, type of training in which the yard was involved, design of loose-boxes, type of bedding used and the possession of an exercise area. The majority of these factors pertain to the management of young horses in training. In our study, 38.8% of yards kept their own foals and yearlings for future training. Remaining yards are more likely to purchase foals or yearlings than older horses. Over the last 4 years, for example, the mean number of foals and yearlings sold by Tattersalls (1990–1993) per year was 1686 compared to 942 for the total number of racehorses of any other age (Webber, personal communication). Although the number of private sales remains largely undisclosed, these figures suggest that the horses in our survey had generally been housed in the reporting yard for some considerable time (6 months to many years). Therefore, it is possible that the management factors of a reporting yard caused the abnormal behaviours reported by that yard. Alternatively, to explain the statistical relationships found, it must be postulated that yards alter their management practices in response to abnormal behaviour of their horses or that yards with particular management practices selectively purchase foals and yearlings already exhibiting, or with a greater potential to develop, stereotypies.

Most trainers feed high ratios of concentrate to forage. However, offering relatively large amounts of forage per day and offering forage frequently were both associated with a reduction in the prevalence of abnormal behaviours. If insufficient fibre is fed, satiety indicators may not be activated, leaving horses with a high feeding motivation. The development of stereotypies in this context may depend on the frustration of this high motivation (Duncan *et al.* 1993). However, because horses at pasture spend nearly 70% of their time grazing (Kownacki *et al.* 1978) whilst few yards offer forage *ad libitum* (e.g. only one of the 85 yards in this study) the time-budgets of stabled and free-ranging horses also differ markedly. It was interesting that both oral-based (crib-biting/wind-sucking) and locomotor (weaving) stereotypies were more prevalent on those yards which fed less forage per day. The enforced 'free-time' of the stabled horse may allow stereotypies to develop via a somewhat different process involving the continued performance of both locomotor (food searching) and oral appetitive sequences of behaviour when excess time is available (Hughes and Duncan 1988).

Horses offered forage types other than hay were less likely to perform abnormal behaviours. The feeding of hay alternatives is rarely exclusive because these kinds of forage often have prohibitively high protein contents. This practice may provide horses with a greater variety of forage that more closely approximates the varied food selection of horses at pasture (Waring 1983).

Larger yards were generally associated with a reduced risk of abnormal behaviour. Weaving is anecdotally quoted as the behaviour most likely to be learnt by observation. Horses in larger groups may be more likely to encounter weavers. Unfortunately, the yard size variable gives no indication of the number of horses visible for an individual horse to mimic and the largest of the yards did not follow this trend. Difficulties also arise when one considers the relationship between prevalence of wood-chewing and yard size. Houpt (1986) indicates that making social contact may be part of ponies' motivation to chew wooden partitions. Clearly, many design features (including the proximity of other animals) may differ with yard size and, hence, influence the horse's motivation to escape from the stable.

The importance of social contact and attachment in normal horse behaviour (Waring 1983; Rees 1984; Kiley-Worthington 1987) is more clearly indicated by the finding that visual contact between stable interiors was associated with a reduced risk of abnormal behaviour, especially wood-chewing, although there was no additional benefit associated with stables which provided opportunities for physical contact.

Trainers who described themselves as 'flat only' had more wood-chewing horses in their yards. These trainers usually have a greater proportion of younger horses that may react more strongly to intensive yard management than older horses. Because the mixed yards in our survey (with a greater proportion of older horses) had fewer wood-chewers, we propose that the wood-chewing horses from flat yards either do not move on to the mixed yards, or 'grow out' of this behaviour with age. This may be more likely for wood-chewing than for stereotypic behaviour, which tends to become fixed with age. Because stereotypies can become emancipated from their initiating causes (Cooper and Odberg 1991), observed levels of stereotypies are to be related to the current environment of the individual. Another possibility is that trainers who prepare horses solely for sprint racing on the flat may keep their horses confined for longer period relative to those who train under both rules. Wood-chewing was less prevalent if the yard possessed an exercise area. Further work is required to determine the proportion of exercise areas with grass surfaces which may have allowed more time to be spent out of the stable or greater supplementary fibre intake.

In contrast to wood-chewing, neither possession of an exercise area, nor any other variable associated with time spent

out of the stable, had a significant association with stereotypic behaviour. Therefore, for stereotypies, factors associated with time spent stabled (often more than 20 h/day) were more important than factors associated with periods spent outside the stable.

The use of bedding types other than straw, in the majority of boxes in a yard, was associated with increased weaving. If horses eat their straw beds this can increase the risk of intestinal impaction (Hayes 1978) but our results suggest straw may ameliorate some of the behavioural problems associated with restricted fibre diets. This could better be achieved by feeding adequate quantities of a more appropriate fibre source. Stereotypic behaviour is often morphologically or functionally related to its motivational origin (Mason 1991). Therefore, it was interesting that an anomalous behaviour from the 'locomotor group' should emerge as having the strongest inverse relationship with the use of straw. Possibly, straw enriches the locomotory environment of horses in a way that has yet to be specified.

We conclude that management factors related to the time spent in the stable showed the strongest associations with stereotypic behaviour in flat training yards, while wood-chewing was also affected by factors related to the time spent outside the stable. In general, oral and locomotor groups of behaviours showed similar rather than divergent associations with management factors. This finding contradicts current thinking which highlights the heterogeneity of stereotypies.

This study now forms an objective basis from which hypotheses can be generated. For example, the apparent importance of the mass and delivery of forage either by hand or via some operant device.

The prevention of stereotypies in young stock is important because, once established, such behaviours rarely disappear. A thorough knowledge of the precipitating factors involved in the ontogeny of stereotypies in horses is essential if prevention is to be effective in studfarms and training yards. Further study is required to establish which management factors on studfarms are linked to the development of stereotypies in horses at weaning and which factors concerning the horses themselves might be used to predict the performance of abnormal behaviours.

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