

The enriching effect of non-commercial items in stabled horses

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ABSTRACT

The effect of the provision of simple objects to stabled horses on their behaviour was investigated to determine whether these objects can affect horses' behaviour in a positive way and thus enrich their environment. A positive influence can for example be measured by a decrease in stereotypical or abnormal activities. In this study, 35 horses were observed in their boxes during three observation periods per observation day. Each observation period lasted one hour and during one hour, each horse was observed 30 times. The observation periods were at noon (11:00–12:00 h), in the afternoon (15:00–16:00 h) and in the evening (20:00–21:00 h). The horses were observed before the objects were provided to set a baseline and then during the presence of the objects. A plastic bottle filled with sand and a rope were chosen as potential enrichment items and placed in a box for one week. For an average of 3.85% (± 0.420) of our observations, the horses exhibited behaviour involving the items. This frequency does not significantly reduce after a week. The frequency of item related behaviour was associated with the age and gender of the horse, with a higher frequency in younger horses ($P=0.0151$) and in stallions ($P=0.0217$). It was also associated with the quantity of hay, with the highest frequency when no hay was available. It is possible that horses are expressing either frustration of having no roughage towards the item or a need for fibres by chewing on the objects. It is suggested that oral activities show the motivation to eat, to attempt to supplement the concentrate feed or the absence of roughage with additional sources of fibres. The use of the items had the tendency to reduce one specific type of abnormal behaviour, i.e. the occurrence of licking walls and other objects ($P=0.0586$). However, it is possible that horses redirect their abnormal behaviour towards the items. Biting behaviour was associated with the quantity of hay, with a higher frequency when no hay was available. This possibly also suggests a search for other sources of fibres when roughage is absent. Although horses exhibited item related behaviour, the used objects do not offer a food reward and arouse the interest only to a very limited extent, showing a limited enriching effect.

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1. Introduction

In their natural habitat, horses are social animals and they live together in groups. Horses travel long distances and they keep on grazing during the day. They spend 50% to 70% of their time eating. Only a small part of their time is spent drinking, lying and grooming (Zeitler-Feicht,

2003). Housed domestic horses, by contrast, are much more restricted in their activities. Housing in boxes entails limitations for eating and walking behaviour. In fact, horses are not able to engage in natural behaviour all day long and, hence, abnormal behaviour and stereotypical behaviour may develop. The actual reasons for the development of stereotypical behaviour vary and different authors disagree on these. Boredom is often cited as a possible cause (Litva et al., 2010) but frustrations from a lack of normal grazing behaviour are also put forward (Christie et al., 2006).

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To allow more natural behaviour, environmental enrichment can be introduced. As described by Newberry (1995), environmental enrichment is every modification of a captive environment which leads to an improvement in the biological function of animals. In addition, environmental enrichment should be complex and conducive to elicit the expression of foraging and explorative behaviour patterns. The horse's environment can be enriched by providing eating material. For instance, the provision of hay is recommended (Bishop, 2003). In this way an opportunity to perform foraging/eating behaviour is provided. The way of presenting chewing material can also be a form of environmental enrichment. The hay can be placed on the ground or in a hay net. With a hay net, a horse is occupied for a longer time than when the hay is placed on the ground and therefore the hay net has a stronger enriching effect.

Another option for enrichment is the "feeding ball", which keeps a horse occupied for a longer time with his concentrates (Winskill et al., 1996). Research has shown that it decreases stereotypical activities (Henderson and Waran, 2001; Henderson et al., 1997). In addition to this specific ball, there are numerous commercial toys that can be placed or hung in the horse's box. Wisher et al. (2011) tested different types of commercial toys and their effect on stereotypical behaviour in horses. The results show that one of the toys, the Tongue Twister®, significantly reduced crib-biting in horses. The other toys had no significant reducing effect. In their study some toys were not used at all.

Another way to stimulate natural behaviour, more specifically foraging behaviour, is to increase the frequency of feeding times (Cooper et al., 2005) or to give the horse a diet that is based on more than one kind of forage (Thorne et al., 2005). Changes in housing (such as increasing the visual horizons) aimed at improving welfare and stimulating social behaviour, are also found to be effective (Cooper et al., 2000). The previously mentioned types of enrichment offer roughage, a reward in the form of concentrates, or require changes in housing and management. However, these changes are not always possible and giving the horse more edible material is not always recommended. Feeding horses more roughage when they have to stay in a box for a longer period and when only little training is given, could result in gaining more weight. For those reasons, we provided simple objects in this study that did not include access to food. And we tested the hypothesis that these simple objects can arouse the interest of the horse and can be used as environmental enrichment for horses that were stabled for a longer period. These objects were used while maintaining normal day-to-day management. We also checked what behavioural patterns the horses exhibited towards the items.

2. Materials and methods

2.1. Housing and management

The horses were housed at three different riding schools in Belgium. The housing and management slightly varied depending on the riding school but all the horses were housed on bedding material (straw or flax straw) and they

all received hay once or twice a day. During the observations, normal day-to-day management was maintained. In the afternoon the horses received concentrates or carrots, a moment which is henceforth referred to as a "feeding event". During the summer the horses stayed on pastures most of the time, whereas they stayed in the boxes during the winter (November until February). The intensity with which the horses were ridden varied across horses and riding schools. So did the size of the boxes. Hence, each box was categorised by type (from 1 to 7) based on its size and on whether it allowed the horse to put its head out of the box. All observed horses were housed individually and had an automatic or manual water supply and a feeding bucket. Most horses had the same box all the time and all box changes were recorded during the observations and taken into account for the analysis of the results. The management and housing parameters that were used, are reported in Table 1. For each observation period and for each horse the relevant level of each housing and management parameter was recorded.

2.2. Animals and items

The horses ($n=35$) to which the objects were introduced, were chosen based on whether they were present in their box on the two days of observations and with permission of the owner from the riding school. In the first riding school 9 horses were used, 13 in the second and 13 in the third. Gender and year of birth were individually collected. There were 17 geldings, 16 mares and 2 stallions of varied breeds, aged 2 – 25 years and ranging in height from 130 cm to 180 cm. In December 2010 the items were introduced. Per riding school, the chosen group of horses was divided randomly into three groups: the first group received a bottle during one week, the second group received a rope and the third group, the control group, did not receive any item. After one week, the items were moved. The first group became the control group and did not receive any item, the second group received a bottle and the third group received a rope. This rotation system was used and repeated until each horse was familiar with each item. The items were introduced at the first riding school and when the observations were finished there, the observations at the next riding school started. To prevent undesirable side-effects on behaviour, such as behaviour induced by odour, the used items were not used again in the next riding school but were replaced by new ones. During this study, a plastic bottle filled with sand and a rope were used to possibly enrich the environment of the stabled horse. Plastic bottles with a length of 25 cm and a diameter of 5 cm and ropes with a length of 30 cm and a diameter of 2 cm were used. These items are cheap, simple and do not require maintenance, important features of objects for use in a riding school. The items were hung up with the lower end on eye level of the horse, against the front wall of the box. One item at a time was introduced in a horse's box and stayed in the box for one week.

2.3. Behavioural observations

Observations took place from November 2010 until February 2011. During this period, there was a winter

Table 1
The different management and housing parameters and their levels.

Parameter	Levels
Time	Noon, afternoon, evening
Quantity of bedding	None (there is no bedding material at all), limited (the quantity of bedding material does not cover the whole floor of the box), enough (the whole floor of the box is covered with bedding material), fresh bedding material
Quantity of hay	None (there is no hay at all), limited (there is only a small quantity of hay), enough (there is enough hay to keep the horse busy for a few hours), fresh given before observation, fresh during observation
Training or turn-out before observation	Yes, no
Feeding event	Before, during or after observation
Level of surrounding activities	Low (1), medium (2), high (3)
Type of box	Large, closed (1) Large, open (2) Medium, closed (3) Medium, open (4) Small, closed (5) Small, open (6) Very large box, possibility to house more horses in this box (7)

regime. This means horses were most of the days and nights stabled in boxes and only got out of their box during training or when they were released for a short period in an inside paddock. The horses assigned to the treatment were first observed without the items, three times a day during one hour, during 14 days (pre-enriched period). The first observation took place at noon (11:00 h–12:00 h), the second one in the afternoon (15:00 h–16:00 h) and the last one in the evening (20:00 h–21:00 h). During an observation period, the observer walked along the boxes and recorded the behaviour and position of the horses, using the scan sampling method. Each horse was scanned every 2 minutes, which resulted in 30 scans per horse per observation period. Per observation period of one hour and per horse, the number of scans that a horse showed a specific behaviour, were expressed in the database as a percentage of the 30 scans during one hour. The behaviour categories used during observation were based on the ethogram by Cooper et al. (2005) and McAfee et al. (2002). The following general activities were observed: “Standing alert”, when the horse was standing with the eyes open and the ears pricked, “Stand doze”, if the horse was standing but not appearing to pay attention to surroundings, “Lying”, if there was a ventral or lateral recumbence or “Locomotion”, if the horse was moving from one location in the box to another. Ingestive behaviour was recorded as one of the four activities: “Drink”, if the horse was drinking water, “Eat”, if the horse was eating concentrates or carrots, “Hay”, if the horse was eating hay or “Bedding”, if the horse was sniffing, nosing or eating bedding material. During the scan sampling, we also distinguished between different abnormal activities. These were: “Weave”, if the horse showed a repetitive lateral swinging movement of the head, “Nodding” was recorded if the horse showed a repetitive vertical movement of the head, “Licking box-fittings” was recorded if the horse licked or bit on box fittings, “Wind-sucking” was recorded when the horse showed some repetitive oral activity in which it grasped box fittings and sucked some

air, “Chewing” was recorded when the horse showed repetitive sham chewing and “Licking” was recorded when the horse was playing with the tongue or licking the mouth.

Recording of the observed behaviour towards the potential enrichment was based on the ethogram developed by McDonnell and Poulin (2002) and on a few observations in presence of an item, carried out before the start of the study. “Item related behaviour” included sniffing, licking, biting, pushing or looking at the item. “Looking at the item” is difficult to define, but keeping the visual field of a horse in mind, it was seen that some horses focussed their ears and head towards the item. This was recorded as looking at the item.

Each horse was accustomed to the presence of the observer before behaviour was recorded. In December 2010 the items were introduced at the first riding school. The items were always introduced at the same time and, where possible, in the absence of other factors that can influence behaviour, such as concentrates or hay. If the horse appeared to be frightened, the item was removed immediately. The items stayed in the boxes and the observations started at noon, in the afternoon and in the evening, using the same method as during the pre-enriched period. The same observation method was used. In the enriched period, the observations were limited to twice a week, on the day of introduction (Sunday) and on a day during the week after the introduction (Saturday). On Saturday, the items were removed after the evening observation. A rotation system, described in Section 2.2, was used to replace the items. When all horses were given both objects, the treatment was started at the next riding school. All observations were carried out by the same person.

2.4. Management parameters

Management factors, such as the quantity of hay and bedding material in the box, feeding events and the activity level in the surrounding environment were also recorded

(reported in Table 1) to allow us to check the effect of these factors on the horse's behaviour. The relevant level of each management factor was recorded for each observation period and each horse (see Table 1). Prior to observation, the boxes of the horses were checked and categorised.

2.5. Statistical analysis

Behavioural data from the observations during the pre-enriched and the enriched period (one-hour observations) were analysed together. The number of scans for each behaviour was calculated as a percentage of the total number of scans for each observation period (Cooper et al., 2000). The data were analysed with SAS version 9.2.

First analysis of the observations showed that the data were not distributed normally. The data set was therefore dichotomised using the median as the cut-off value. Every observation value below the median was assigned a zero, while values above the median were assigned a one. This cut-off value yielded a classification that corresponded best with the original behavioural data. Data were analysed using a logistic mixed model. Within this model, the following parameters were included: gender, age, time of observation, the quantity of hay and bedding material, feeding events, surrounding activities, training before observation, the type of box and the orientation of the box. Parameters that did not have a significant effect on behaviour, were excluded from the model. The rotation system was included as a fixed effect: per observation day, the observer recorded whether it was the first item the horse had access to or the second. Thus, the potential effect of a previously acquired familiarity could be controlled. We also checked if the time the horses spent with the items was different on the day of introduction compared to the last day. We determined both the effect of the item on the behaviour as well as the effect of the different parameters on the time the horses spent with the item. At first, behaviours related to the item (looking, sniffing, pushing, licking and biting) were analysed together and thereafter they were also analysed separately.

The horse's identity was used as a random factor in each analysis. Statistical significance was accepted at $P < 0.05$. Data are presented as percentages of scans in the results.

3. Results

3.1. Item related behaviour at the start and after a week

The horses displayed item related behaviour on average in 3.85% (± 0.420) of our observations. They spent 4.54% (± 0.706) of the observations with the bottle and during 3.22% (± 0.471) of the observations they were interacting with the rope.

Next, we report the results for bottle and rope together, for day of introduction and after a week. The frequency of object related behaviour was associated with the time of day, feeding events, the quantity of hay, training or turn-out, gender and age (Table 2). In the afternoon and at noon the frequency was lowest and in the evening the frequency was highest. Feeding events were associated with object related behaviour, with the lowest frequency

Table 2

This table shows the % of scans horses showed item related behaviour (both for bottle and rope together), at the different levels. Significant differences ($P < 0.05$) are indicated with letters per parameter.

Parameter	Average (%)	S.E.M.	P value
Time			
Noon	4.20 ^a	0.672	0.00120
Afternoon	2.94 ^a	0.722	
Evening	4.43 ^b	0.781	
Feeding time			
Before	4.69 ^a	0.928	0.00350
During	0.631 ^b	0.253	
After	3.99 ^a	0.522	
Quantity of hay			
No hay	5.24 ^a	0.666	0.000200
Limited	1.67 ^{bc}	0.611	
Normal quantity	3.78 ^b	0.844	
Fresh hay, given during observation	1.23 ^{bc}	0.774	
Fresh hay, given before observation	0.455 ^c	0.318	
Training/turn-out before observation			
Yes	1.49 ^a	0.430	0.0397
No	4.39 ^b	0.501	
Gender			
Stallion	15.1 ^a	3.79	0.0217
Gelding	2.87 ^b	0.423	
Mare	3.17 ^b	0.557	
Age			
0–5 years	12.9 ^a	2.80	0.0151
6–10 years	5.08 ^b	0.863	
11–15 years	1.96 ^b	0.364	
16–20 years	2.04 ^b	0.581	
21 years or older	1.52 ^b	0.462	

in observations with a feeding event relative to a pending feeding event and relative to a passed feeding event. When there was no hay in the box, object related behaviour was shown with a higher frequency than in the case when hay was given just before the observation. Training or turn-out before the observation caused the frequency of object related behaviour to be lower than in the cases without turn-out or training. Stallions exhibited a higher frequency of object related behaviour than mares or geldings. The frequency of object related behaviour was higher for horses aged 2 to 5 than for horses aged 25 or over.

Both for rope and bottle there was no significant difference in behaviour towards the items between the day of introduction and after a week (Fig. 1). There was no difference in frequency of behaviour towards the bottle between the beginning and the end of the week; a similar result was obtained for the rope.

During the three observations per day, the horse displayed more push and bite behaviour than any behaviour classified in the other categories. On average, horses bit the items during 5.13% (± 0.624) of the observations and pushed the objects during 4.61% (± 0.502) of the observations. Biting behaviour towards both items was associated with gender ($P = 0.0343$). Stallions exhibited this behaviour more than mares ($P = 0.0126$). Biting behaviour was also associated with the available quantity of hay ($P = 0.0023$), with a higher frequency when hay was not available. The frequency of pushing behaviour was associated with the type of object, with more pushing behaviour towards the

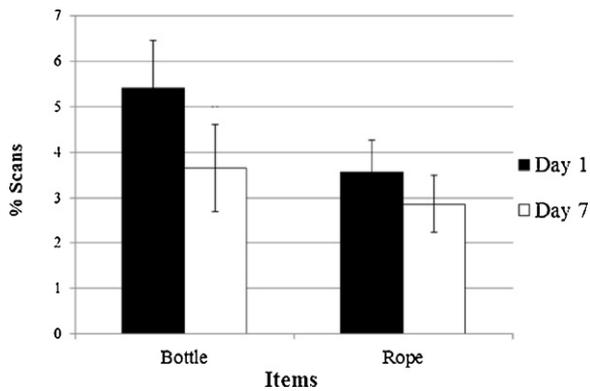


Fig. 1. Item related behaviour, shown in % of scans, at the day of introduction (Day 1) and after a week (Day 7).

bottle ($P=0.00210$). Pushing behaviour towards both items was also associated with gender ($P=0.00980$), with more pushing behaviour in stallions than in mares ($P=0.0114$) and geldings ($P=0.0024$).

3.2. Behaviour before and during treatment

The presence of objects influenced the behaviour of the horses. Standing alert was influenced by the presence of the rope, which decreased the frequency of standing alert compared to the frequency recorded in the presence of a bottle or in the absence of objects. The presence of an item had an effect on the frequency of vocalisation. When a bottle was present, horses vocalized less than when there was no object present. The frequency of licking stable fittings tended to be lower in the presence of a rope than in the absence of an object (Table 3).

4. Discussion

4.1. Item related behaviour at the start and after a week

During the observations, horses displayed object related behaviour in 3.85% of our observations on average. Our results are comparable to findings of previous studies on the use of commercial toys. Wisher et al. (2011) found that horses displayed behaviour towards enrichment items during 1 to 5% of their time. However, since this frequency is not very high, the usefulness of the used items could be questioned. The attention displayed for the objects was associated with the time of day, with the interest recorded being highest in the evenings. This result is not surprising because the horses were fed in the afternoon and sometimes also around noon, meaning that the horses were more alert to the environment and had less interest in the objects during those times. Cooper et al. (2000) showed that the frequency of standing alert is higher during the period before feeding than at other times of the day. Our results support the effect of feeding time, as we find horses show less interest in the objects when fed during the observation. Furthermore, previous work on the effects of the feeding ball found that horses used the feeding ball mostly in the evening (Winskill et al., 1996) and our results show

that horses also displayed more item related behaviour in the evening. Jørgensen et al. (2010) also showed that the use of an item depended on the time of day and interest in the items was lowest in the afternoon.

Management and housing varied across riding schools and hence behaviour towards the objects may vary too. Training or turn-out of the horses was included as a possible determining factor. The reason for including this factor lies in the fact that, when horses spend limited time on pastures, the risk of developing abnormal behaviour increases (Hockenhull and Creighton, 2010). A possible cause for this is boredom. Because it occupies the horse, environmental enrichment can prevent boredom. The results show that interest in the objects is higher when the horse had no turnout or training before the observations. In this case, horses possibly showed item related behaviour due to boredom.

Horses will also show less item related behaviour when there is a lot of hay or bedding material in their box. The opposite was also observed. Previous work already showed that horses preferred straw to an object, such as a ball (Jørgensen et al., 2011). This suggests that giving the horse eating material is preferred as enrichment. Gender and age also had an influence on the time spent with the items and on the behaviour towards the items. Previous studies on suitable enrichment for horses rarely include gender and age as determining factors. However, it is known that the behaviour of a horse can be influenced by gender (Mills and McDonnell, 2005). Therefore, investigating to what extent gender influences the behaviour towards potential enrichment could be an interesting issue for future research. For example, the time budget for stallions in a natural environment is different from the one for mares. Stallions spent less time foraging (Duncan and Crowtan, 1980) and this could possibly have an effect on their behaviour towards enrichment. If research shows that there is a difference in behaviour, the gender could be taken into account in choosing suitable enrichment. Furthermore, it is seen that stallions displayed more biting behaviour than mares or geldings. The reason for this difference is however not very clear.

In general, pushing and biting of the items were the most common types of behaviour. Looking and sniffing behaviour occurred less because of the fact that this type of behaviour has a more exploratory purpose and horses will exhibit it less over time. The horse may, however, adapt its behaviour towards the objects, because more pushing behaviour was seen with the use of a bottle. A higher frequency in biting behaviour is observed when horses have no hay available. This implies that horses are expressing either frustration of having no roughage towards the item or a need for fibres by chewing on the objects. It is suggested that oral activities show the motivation to eat, to attempt to supplement the concentrate feed or the absence of roughage with additional sources of fibres (Cooper and Albertosa, 2005).

Surprisingly, this study shows there is no significant decrease of item related behaviour after a week. However, these results only give information about interest after a week; the evolution in interest after a few weeks can be very different. In fact, previous work on pigs showed that

Table 3

This table shows the % of scans horses showed different behaviours when items were absent, or a rope or a bottle were present. Significant differences ($P < 0.05$) are indicated with different letters per behaviour.

	No item		Rope		Bottle		P value
	Mean (%)	S.E.M.	Mean (%)	S.E.M.	Mean (%)	S.E.M.	
Standing alert	15.4 ^a	0.499	15.1 ^b	1.14	15.2 ^a	1.12	0.0300
Vocalisation	0.203 ^a	0.0285	0.101 ^{ab}	0.0580	0.0541 ^b	0.0310	0.0346
Licking box fittings	0.553 ^a	0.0592	0.387 ^a	0.117	0.342 ^a	0.0904	0.0586

pigs lose their interest for enrichment and that variety is therefore necessary to maintain interest (Driessen et al., 2008).

It is possible that horses showed behaviour related to the objects outside the regular observation periods. A study by Jørgensen et al. (2010) suggests that regular inspection of the items is therefore important. Jørgensen et al., who used a pole in their experiment, noticed hairs on the pole, indicating that the horses used the pole outside observation periods. Horse play with the object can be manifested in many ways; destruction of the object is one of them.

4.2. Behaviour before and during treatment

The presence of an object reduced the frequency of standing alert. This may be explained by the fact that, when there is an item in its stable, the horse spends more time with the item and, therefore, stands less alert. A similar result was obtained by Winskill et al. (1996), who found that horses stood less alert in their stable when a feeding ball was present in their stable as enrichment than in the absence of enrichment. Vocalisation also occurred less in the presence of the bottle compared to the cases in which an object was absent. Previous work (Cooper et al., 2005; Henderson and Waran, 2001; Wisher et al., 2011) reports contrasting findings regarding the effect of enrichment items on abnormal behaviour. In our study, the rope was found to have a positive effect on licking box fittings, which is considered to be a type of abnormal behaviour (Cooper and McGreevy, 2002): it can possibly reduce the occurrence of licking box fittings. However, it is possible that the horse redirects its behaviour from the box fittings to the items and in such case, the items do not prevent abnormal behaviour.

5. Conclusion

The used objects do not offer the horse the opportunity to engage in more natural behaviour and the reasons for showing item related behaviour in this study are not very clear. The enriching effect of the used objects seems to be limited. Behaviour when no roughage is available shows that the horse's natural needs should not be forgotten.

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