The effect of rope and an activation ball on the performance of harmful social behaviors in pigs

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This report is a degree thesis at the Bachelors level (16 ECTS credits) performed by the author in collaboration with a study colleague, Emma Nilsson. This cooperation included the planning of the study, the collection of data and analyses. Thereafter each student has written and structured the report in all its parts individually.
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Abstract: A widespread problem in the housing of captive animals is the occurrence and development of abnormal behaviors. In the pig breeding industry the abnormal behaviors causing the biggest welfare problems are stereotypies such as tail-biting, ear-biting, equipment-biting and belly-nosing. In this study a rope and an activation ball were tested as curative treatments to reduce the performance of these stereotypies by inducing the underlying innate behaviors. A total of 141 pigs spread over 18 pens were used as test-subjects. They were divided into three groups which were introduced to one of the two enrichments or no enrichment at all. Both the enrichments contained characteristics which mostly targeted exploratory and foraging needs and, if functional, were thought to mainly have an effect on tail-biting, ear-biting and equipment-biting. The pigs were observed both at initial contact with the enrichments and after having familiarized with them for three days, and the amount of registered enrichment interaction and performed stereotypies were used to evaluate the effect of the enrichment objects. In both enrichment treatments the enrichments occupied the pigs both on day one and after three days. The presence of equipment-biting was successfully reduced on both day one and day three while the presence of tail-biting and ear-biting only were initially reduced. No effect was found on belly-nosing in either enrichment treatment. This suggests that both enrichments are functional over time and efficient in reducing some types of harmful social behaviors. However, belly-nosing would need to be targeted with a different kind of object.
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1 Abstract

A widespread problem in the housing of captive animals is the occurrence and development of abnormal behaviors. In the pig breeding industry the abnormal behaviors causing the biggest welfare problems are stereotypies such as tail-biting, ear-biting, equipment-biting and belly-nosing. In this study a rope and an activation ball were tested as curative treatments to reduce the performance of these stereotypies by inducing the underlying innate behaviors. A total of 141 pigs spread over 18 pens were used as test-subjects. They were divided into three groups which were introduced to one of the two enrichments or no enrichment at all. Both the enrichments contained characteristics which mostly targeted exploratory and foraging needs and, if functional, were thought to mainly have an effect on tail-biting, ear-biting and equipment-biting. The pigs were observed both at initial contact with the enrichments and after having familiarized with them for three days, and the amount of registered enrichment interaction and performed stereotypies were used to evaluate the effect of the enrichment objects. In both enrichment treatments the enrichments occupied the pigs both on day one and after three days. The presence of equipment-biting was successfully reduced on both day one and day three while the presence of tail-biting and ear-biting only were initially reduced. No effect was found on belly-nosing in either enrichment treatment. This suggests that both enrichments are functional over time and efficient in reducing some types of harmful social behaviors. However, belly-nosing would need to be targeted with a different kind of object.

2 Introduction

A widespread problem in housing of captive animals is the occurrence and development of abnormal behaviors. It can be seen in a wide variety of animals such as pet-parrots (Garner et al, 2005), elephants in the zoo (Iossa et al, 2009) and pigs bred for their meat (Lawrence and Terlouw, 1993). The rise up of such stereotypies comes from the fact that a lot of animals are unable to perform their innate behaviors because of the environment in which they are held (Lawrence and Terlouw, 1993). One such example, and the focus of this study, is the housing environments and stereotypies of fattening pigs in today’s pork production.

Pigs in general are explorative and curious animals and an important part of their behavioral repertoire is to investigate novel objects in their surroundings (Wood-Gush and Vestergaard, 1991). Already at an early age the piglets start to chew, root, nose and otherwise manipulate different objects in trying to learn what is eatable and what is not (Petersen, 1994). In today´s modern housing systems there is, however, not much novelty for the pigs to explore which eventuate in that these innate behaviors are redirected towards pen mates and equipment. Stereotypies thought to be derived from the inability to perform exploratory and foraging behaviors are tail biting, ear biting and biting directed towards equipment (Lawrence and Terlouw, 1993). Another common stereotypie is belly-nosing, a behavior that consists of suckling and rooting motions towards other individuals bellies. This stereotypie, however, is thought to originate from a suckling motivation that is not met and the social distress of being weaned from the mother at an early age (Weary et al, 1999; Gardner et al, 2001).
In order to prevent and counteract these kind of harmful social behaviors a lot of today’s research on commercial pork production is focused on enrichment (Bench and Gonyou, 2006; Bracke et al, 2006; Day et al, 2008). Understanding the origin of different stereotypies and making distinctions between them according to that knowledge is very important in this work. When understanding which ethological needs that actually lay behind specific stereotypies, that knowledge can be used to develop enrichments that induces these specific behaviors (Bench and Gonyou, 2006; Van de Weerd and Day, 2009).

The most difficult part in finding and developing new enrichments is to find objects or substrates that not only succeeds in preventing and counteracting harmful behaviors, but is also practical and economical to use (Van de Weerd and Day, 2009). One such substrate that comes close to fit all the criteria for a suitable enrichment is straw. It provides both thermal comfort as bedding and functions as stimulus for the pigs (Fraser, 1985), and is for most farmers also both practical and economical to use since straw is a byproduct of grain farming. It has also previously been confirmed (Tuyttens, 2005; Day et al, 2008; Van de Weerd and Day, 2009) that the use of straw is very suitable in dealing with a number of stereotypies. The use of straw, however, is limited in modern housing systems due to the floor design. The use of partly or fully slatted floors are standard today and using too much straw on these floors will jam the gaps and thus preventing the manure from being extracted (Tuyttens, 2005; Van de Weerd and Day, 2009). So even though straw seemingly could help solve a lot of the problems with harmful social behaviors it is still important to find other types of enrichment which are both practical and functional to use.

Previous studies have been made which have focused on the effects of different objects as enrichments, so called point source enrichments (Van de Weerd et al, 2003; Bracke et al, 2006). One of the difficulties with finding such functional objects is the novelty aspect. Several studies have shown that when the novelty factor disappear the pigs quickly loses interest in the enrichments and the effect on behavior is then lost (Wood-Gush and Vestergaard, 1991; Bracke et al, 2006). When providing pigs with enrichment it is therefore important that it has characteristics that both induces specific behaviors and keeps up the pig’s interest in the object. In a study by Van de Weerd et al (2003) the most important characteristics needed to achieve this was mapped out. Van de Weerds study showed that characteristics such as odor, deformability and chewability were initially attractive while ingestability, destructibility and being contained were important characteristics after a few days.

With this in mind the present study aimed towards testing two different types of enrichments which in some aspects fall in line with the findings of Van de Weerd et al (2003). The two enrichments were a knotted rope tied to the metal bars above the trough and an activation ball filled with piglet food and sawdust. Both these enrichments aimed at giving the pigs the opportunity to express their innate foraging behaviors and thereby divert their attention away from harmful social behaviors directed towards fellow pen mates and equipment. The tested equipment both contained several of the key characteristics found by Van de Weerd et al (2003), and the hypothesis was that if the characteristics of the enrichments really provide an outlet for the pigs foraging behaviors the amount of foraging derived stereotypies performed by these pigs will be reduced.
3 Materials & Methods

3.1 Animal Housing

The study was conducted on Vreta Naturbruksgymnasium located 15 km west of Linköping, Sweden. This study involved 141 Pigham pigs distributed over 18 pens. Each pen contained a trough for feeding, a concrete floor area for sleeping (3.2m*2.1m) and a slatted floor area for excretions (1.6m*1.4m). The 18 pens were placed wall to wall in two rows and in each pen’s excretion area there were two locked metal bar wickets, one to each of the adjacent pens. The wall above the trough consisted only of metal bars whilst all the other walls consisted of a lower half made out of concrete and an upper half made out of metal bars. The feeding system consisted of plastic pipes running below the ceiling branching off down to each trough. All the food came in liquid form and its constituents were intermixed in a separate tank located outside of the stable. All feedings were computerized and occurred at roughly the same times each day and all the excretions were mechanically removed from beneath the slatted floors at regular intervals. Once a day the pens were also provided with a small amount of straw by the personnel at Vreta and, although this was not provided according to a certain schedule, at least on observation days it was always provided after the midmorning observations. The pigs were housed in these pens from 12 weeks of age and were 18 weeks old when the experiment was initiated. Since the breeding of pigs on Vreta was an integrated production, which means that all the pigs are both born and bred on the same farm, it was also known that all pigs had been bred alike for the first 12 weeks of their lives. After the experiment was initiated no mixing of individuals was carried out throughout the observation period. Overall, all measurements for living space, all equipment and the amount of supervision was standardized and/or in line with Swedish animal welfare laws.

3.2 Enrichments

Two types of enrichments were used in the study which both contained characteristics mostly targeted towards exploratory and foraging needs.

3.2.1 Rope

An 18mm thick rope, “förtöjnings- och ankarlina” 18 mm x 10 m (item number: 25-0776), was bought at “Biltema” which is a local hardware store. The rope was used as enrichment in six of the pens. The rope initially consisted of three separate strings weaved together into one rope. In order to make it harder for the pigs to unravel it the three strings were taken apart, put parallel to each other and then instead knotted together with multiple knots to make one final piece of rope. Two knotted ropes, roughly 1m long, were then tied to and hung from the upper most metal bar above the trough. All and all twelve ropes were made and never was one rope used in two different pens.
3.2.2 Activation ball

An activation ball (snak-a-ball made by Likit) originally made for horses was used as enrichment in six of the pens. An activation ball is a spherical plastic object divided into two chambers by a plastic disc which has small openings all around the edge. One of the chambers is bigger, roughly ¾ of the volume, with an opening for filling and provided with a lid, while the other chamber is smaller, roughly ¼ of the volume, and provided with only a small opening and no lid. The main idea is to fill the bigger chamber with a content of interest and when the animal starts rolling it around small doses of the content will fall through the plastic disc into the smaller chamber and eventually get spilled out on the floor through the small opening. In this study the activation ball was filled with 3 liters of piglet food mixed with 3 liters of sawdust and one liter of shredded paper. It was then left in the pens for the pigs to play with. Throughout the experiment only one activation ball was used and it was moved between the pens as the observations went on. The ball was always refilled with the same amount of substrates when introduced to a new pen.

3.3 Experimental setup and observations

All the 18 pens were divided into three equal groups and each group was subject to a different treatment. Group A contained the pens subjected to the activation ball, group R contained the pens subjected to the rope and group C contained the pens that constituted the control group. All pens of the three different groups were distributed evenly throughout the stable in relation to the location of windows, ventilation, doors, order of feeding etc. Originally there were eight pigs in each pen but due to a few injuries three pigs had to be relocated during the observation period and could not be a part of the study. This resulted in that one pen in group A consisted of six pigs and one pen in group R consisted of seven pigs.

All observations were conducted in connection with the feedings since the pigs are naturally aroused by this and therefore would be expected to be more active for that period of time. The pigs on Vreta were fed three times a day and the focus of this experiment were the midmorning feeding and the midevening feeding. During the first week and a half of the observation period these feedings occurred at 10:30am and 5:30pm and during the last one and a half weeks they occurred at 9:50am and 4:50pm. This change of feeding times was due to a diet shift that is always implemented as the pigs grow to a certain age.

On day one enrichments were put into the pens in question as soon as the feeding started and the pigs were then given a period of time to finish their meal. As soon as the troughs were emptied, this usually took about 15 minutes, the observations started immediately. The length of each observation was one hour and during each hour two adjacent pens were observed simultaneously during 15 second intervals. A stopwatch set on 15 seconds were used and during each minute two 15 second intervals were spent observing one pen and two 15 second intervals were spent observing the other pen. 1/0-recording were used to register the occurrence of different stereotypies during the 15 second intervals and instantaneous recording was used to count the number of pigs performing other, in this context, interesting behaviors on each 15 second mark. Nine behaviors were observed during each observation period (Table 1).
After the initial one hour observation the pigs were left with the enrichments for two days. On day three another one hour observation was conducted on the same two pens and in connection to the same hour of feeding. This procedure was carried out the same way on all 18 pens and all performed behaviors were registered using a specially designed protocol. In some pens subjected to the activation ball the ball also had to be refilled and/or cleaned between observations on day one and day three. However the enrichment never left the pen during these works.

Table 1. Ethogram which provides all the observed behaviors with a more detailed description.

<table>
<thead>
<tr>
<th>Ethogram</th>
<th>Describing term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tail biting</td>
<td>Putting the tail of a fellow pig in the mouth and manipulating it.</td>
</tr>
<tr>
<td>Ear biting</td>
<td>Putting the ear of a fellow pig in the mouth and manipulating it.</td>
</tr>
<tr>
<td>Equipment biting</td>
<td>Putting pieces of equipment in the mouth and manipulating it.</td>
</tr>
<tr>
<td>Belly-nosing</td>
<td>Nibbling, sucking and chewing motions directed towards a fellow pig’s belly.</td>
</tr>
<tr>
<td>Rooting</td>
<td>A back and forth movement of the head, using the snout to move or manipulate the substrate of the floor surface.</td>
</tr>
<tr>
<td>Interaction with enrichment</td>
<td>Rooting, chewing, eating, sniffing, licking, and otherwise manipulative behaviors directed towards the enrichment.</td>
</tr>
<tr>
<td>Aggressive behavior</td>
<td>Biting towards fellow pigs in an aggressive manner. Using the snout to push other pigs away (aggressively). Otherwise dominating behaviors directed towards fellow pigs.</td>
</tr>
<tr>
<td>Lying down</td>
<td>Lying passively on the floor (sleeping), stomach touching the ground or lying on the side. No manipulation of any material.</td>
</tr>
<tr>
<td>Other</td>
<td>Any behavior that does not fit any of the above described.</td>
</tr>
</tbody>
</table>

3.4 **Statistics**

In the statistical analysis each pen was considered as one separate test subject. The data for each of the nine observed behaviors were therefore calculated as nine means
for each pen. The behaviors registered with instantaneous recording gave the mean number of pigs performing the certain behavior at the mark of each 15 second interval and the stereotypies registered with 1/0-recording gave the mean proportion of intervals where the stereotypie was performed. All these means were then compared behavior for behavior both in between the three treatments (A,R and C) and between the day one observations and the day three observations within each treatment. For the comparison between day one observations and day three observations 27 paired t-tests were performed, one for each behavior in each treatment. For the comparison between the three treatments 18 one-way ANOVAs with following Tukey-post-hoc-tests were performed, one for each behavior on the day one observations and one for each behavior on the day three observations. All tests were performed with SPSS 19, using a confidence level of 95%.

4 Results

No significant difference (p=0,101) between day one and day three observations was found on treatment A when comparing the amount of performed interaction with enrichments in these pens (Figure 1). However, it was found that the pigs in treatment R interact significantly less (p=0,001) with the enrichment on day three compared to day one (Figure 1). When instead comparing this behavior between all the three treatments, A and C (day 1 p=0,032; day 3 p=0,599) R and C (day 1 p=0,000; day 3 p=0,091) and A and R (day 1 p=0,000; day 3 p=0,420), all treatments were found to be significantly separated from each other on day one but not on day three (Figure 8). The pigs in treatment C were also found to be lying down more on day one compared to both treatment A (day 1 p=0,005; day 3 p=0,402) and treatment R (day 1 p=0,001; day 3 p=0,993) but by observations on the third day this difference was no longer present (Figure 7).

Moving on to the stereotypies the behavior equipment biting was performed significantly less in treatments A (day 1 p=0,02; day 3 p=0,046) and R (day 1 p=0,000; day 3 p=0,047) compared to treatment C on both day one and day three (Figure 2). No difference however was found in the performance of belly-nosing comparing A and C (day 1 p=0,341; day 3 p=0,568), R and C (day 1 p=0,168; day 3 p=0,159) and A and R (day 1 p=0,888; day 3 p=0,639) on either day one or day three (Figure 4). The same result, no difference between A and C (day 1 p=0,921; day 3 p=0,920), R and C (day 1 p=0,980; day 3 p=0,752) and A and R (day 1 p=0,980; day 3 p=0,519), was also found for the performance of aggressive behavior on both day one and day three (Figure 3). However when comparing the results of day one and day three within the treatments, aggressive behavior were found to be performed significantly less on day three compared to day one in treatment R (p=0,008) but not significantly less in treatment A, although close (p=0,077) (Figure 3). Effects on both ear biting and tail biting can be seen on day one where both treatment A (ear biting p=0,018; tail biting p=0,013) and treatment R (ear biting p=0,008; tail biting p=0,032) are significantly separated from treatment C, but in both cases these differences between treatment A and C (ear biting p=0,231; tail biting p=0,960) and R and C (ear biting p=0,231; tail biting p=0,833) are not present on the day three observations (Figure 5 and 6 respectively). For further analysis of these results see the discussion.
Fig 1. The number of pigs (means+s.d.) that interacted with the enrichments at each 15 second mark in treatments A (Activation ball) and R (Rope), on day one and day three after the introduction of the enrichments.

Fig 2. The proportion of intervals (means+s.d.) where equipment biting was performed in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.
Fig 3. The proportion of intervals (means+s.d.) where aggressive behavior was performed in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.

Fig 4. The proportion of intervals (means+s.d.) where belly-nosing was performed in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.
Fig 5. The proportion of intervals (means+s.d.) where ear biting was performed in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.

Fig 6. The proportion of intervals (means+s.d.) where tail biting was performed in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.
Fig 7. The number of pigs (means+s.d.) that were lying down at each 15 second mark in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.

Fig 8. The number of pigs (means+s.d.) that interacted with the enrichments at each 15 second mark in treatments A (Activation ball), R (Rope) and C (Control), on day one and day three after the introduction of the enrichments.
5 Discussion

The aim of this study was to come up with and test two different types of enrichment objects for the commercial production of fattening pigs. The hope was that these enrichments would work as a stimulus and prevent some of the observed stereotypies in these establishments. The result of the study showed both that the amount of performed equipment biting was significantly less in the two enrichment treatments compared to the control group and that both ear biting and tail biting showed initial reduced presence in these pens. Both enrichments also seem to remain interesting to the pigs over time which suggests that they might be effective also in the long run. Although both the rope and the activation ball effectively reduce the performance of some stereotypies among the pigs; however none of the enrichments seemed to have any effect on the amount of performed belly-nosing on fellow individuals.

Equipment biting was the most prominent stereotypie observed throughout the study, and also the stereotypie that was reduced the most during observations. This suggests that the characteristics of the chosen enrichments really do induce the underlying innate behaviors of this particular stereotypie. This was also the expected results considering that the enrichments were chosen to induce exploratory and foraging behaviors and previous studies have suggested that equipment biting, along with tail biting and ear biting, are derived from exploratory and foraging needs (Lawrence and Terlouw, 1993). The effect on tail biting and ear biting, however, was not as explicit as the effect on equipment biting showing only an initial reduction that did not last throughout the observation period. These ambiguous results might however be an effect of the small amount of overall collected data for these behaviors which makes it difficult to draw any definitive conclusions concerning the effects of the enrichments.

The presence of tail biting and ear biting in the studied pens might for instance have been influenced by the daily provision of a small amount of straw, something that previously have been shown to be an effective preventive and curative method when dealing with such behaviors (Zonderland et al, 2003; Day et al, 2002). The presence of these behaviors therefore might have been low already when the enrichments were introduced making it hard to know what objects or substrate had what effect. However, since equipment biting, ear biting and tail biting are all thought to be derived from the same ethological needs (Lawrence and Terlouw, 1993) the initial effect on ear biting and tail biting is still very much worth noting. The results still indicate a reducing effect also on tail biting and ear biting and additional studies to further clarify the full extent of the effects from these enrichments might be relevant.

While the effects on equipment biting, ear biting and tail biting were more or less prominent the effects on belly-nosing on the other hand was absent. Neither the activation ball nor the rope treatment differed from the control group in the amount of performed belly-nosing, a result however which was not completely unexpected. The fact that the enrichments with their exploratory and foraging directed characteristics did not reduce the presence of belly-nosing only further supports previous studies which claims belly-nosing to originate from a different set of ethological needs which might be more socially oriented (Weary et al, 1999; Gardner et al, 2001). The hope in the current study was that the provision of enrichments would engage and activate the pigs in such a way that they would be generally distracted from performing any kind of stereotypies. However the results only suggests what has already been proposed by
Bench and Gonyou (2006) which is that when aiming at reducing a certain stereotypie you need an enrichment targeted for that purpose in order to see any real effects.

A major goal with the enrichment objects, besides reducing stereotypies in general, was to give them characteristics which would keep them interesting over time. When analyzing the results it was found that the amount interaction with the activation ball did not differ between day one and day three observations but for the rope the amount of interaction declined over the same time span. The fact that the interest for the rope was lower after a few days does not mean, however, that the interest was lost altogether. This reduction in interaction might instead be explained by the pig’s strong reaction towards novel objects, a reaction which was stronger in the rope treatment compared to the activation ball treatment. This is a fact that might be explained by the characteristics of the rope working slightly better at inducing foraging related behavior compared to the activation ball at the initial encounter. However, in both enrichment treatments the initial amount of interaction with the enrichments on day one was found to be higher than on day three, even if this difference is more dramatic in the rope treatment. These findings only supports the previous study by Wood-Gush and Vestergaard (1991) who have found that novel objects always gains more attention than familiar objects and that interest for novel objects always declines over time. In the current study these findings are supported by the fact that the highest amount of enrichment interaction also correlated with the highest levels of activity during day one observations and that both these behaviors were reduced after a few days. This was found in both enrichment treatments although it was most obvious with the rope. However, the fact still remains that the amount of interaction with the enrichments on both day one and day three has a reducing effect on equipment biting and to some extent ear biting and tail biting, as previously mentioned. This suggests that the characteristics of both the activation ball and the rope still are rewarding for the pigs even when the initial novelty aspect has gone.

None of the enrichments showed any effect on the presence of aggressive behavior among the pigs compared to the control treatment. An previously conducted study has shown that the provision of point source enrichments both can lower the presence of aggressive and dominance behaviors amongst pigs (Schaefer et al, 1990) but also that they in some cases can increase the presence of these behaviors. (Ishiwata et al, 2004) found that the provision of a tire to weaned piglets in some cases increased the occurrence of aggressive behavior and suggested that this might be because the tire became an object which the pigs tried to claim dominance over. In the current study the only effect found on aggressive behavior was a lower presence on day three observations compared to day one observations in the rope treatment, but this is a fact probably best explained by the simultaneous decrease in the amount of overall interaction with the enrichment in the same treatment. Besides this no effect was found on aggressive behavior in neither direction in either enrichment treatment. However, it should also be noted that the overall amount of collected data was quite small for this particular behavior. The low presence of aggressive behavior might be because all the pigs in the current study were familiar with their pen mates and that dominance relationships were established and stable between them. This is supported by earlier studies which have shown that aggressive behavior is more present among unfamiliar than familiar individuals (Friend et al, 1983; Arey and Franklin, 1995).
would again be interesting to further test these enrichments, for instance when pigs are moved between different stages in the production causing unfamiliar pigs to be mixed, to better understand their full effects.

When it comes to the question of whether the enrichments are practical, easy to use and sustainable over time it is more difficult to draw definitive conclusions from this study. The activation ball definitely requires some work and attention when needed to be filled up or cleaned at regular intervals. Other than that it seemed to withstand the harsh environment that a pig pen is and did not show any signs of breaking too easily. The ropes did not demand any extra work from the observers during this study besides the initial tying to the metal bar. With all the knots the ropes also seemed to be able to withstand the pig’s hard playing without unraveling or untying. With this in mind the activation ball might be best suited as an enrichment object used in particularly difficult pens while the ropes might work better on a larger scale. However, developing these enrichments even further might make them even more usable, practical and economical.

5.1 Conclusion

In conclusion this study found both the activation ball and the ropes to be effective point source enrichment objects targeted at harmful social behaviors derived from exploratory and foraging needs. They contained characteristics that enabled them to keep up the rewarding stimulus over time and they did not induce any aggressive or dominance behaviors in the observed pens. However, while being effective at reducing some types of stereotypies, other behaviors such as belly-nosing was not reduced and different object characteristics might be needed to target this problem. Further studies are needed to better understand the origin of this behavior and to find other enrichments better suited for those ethological needs.

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7 References


