The role of novelty in environmental enrichment for the weaned pig

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1. Introduction

Environmental enrichment has been suggested to improve animal welfare in barren environments by creating behavioural opportunities that allow animals to express control over their environment, as well as meeting more of their species-relevant needs (Van de Weerd et al., 2003, 2006). Valuable enrichment strategies for pigs, such as provision of an object suitable for chewing and rooting, may present a stimulus or route for eliciting and reinforcing exploratory and manipulatory activities involving the snout and mouth (Van de Weerd et al., 2003), resulting in a reduction in adverse behaviours such as tail-biting and belly nosing (Fraser et al., 1991; Peterson et al., 1995). This behavioural requirement is acknowledged within the EU Directive...

Habituation to environmental enrichment objects can occur rapidly. Novelty of an object is an important property involved in initiating and maintaining exploration, and this can be achieved by renewing objects. The aims of this study were to assess whether alternation of two contrasting objects increased enrichment value, and whether simultaneous access increased overall object-directed behaviour in comparison with single presentation of each object. The experiment was designed as a 2 × 2 factorial, with 2 enrichment objects (suspended rope and loose wood block) and 2 presentation methods (continuous access, or weekly alternation). An additional treatment examined object use when both objects were presented simultaneously. Five replicate pens, each of 10 weaned pigs, were allocated to each treatment: R, continuous rope; W, continuous wood; R/W, alternation rope-wood; W/R, alternation wood-rope; R + W, simultaneous rope and wood. Observations of behaviour were made for two 1-h periods, three times a week for a 4-week period. Direct scan samples at 5-min intervals measured use of the enrichment object(s), penmate and pen manipulation, and general activity. These were supplemented by two 24 h time-lapse video recordings made in the first and last experimental weeks. Object interaction was significantly affected by treatment, with W spending a lower overall proportion of observations in contact with the object than the other treatments (in order 0.102, 0.037, 0.093, 0.110, 0.134, s.e.d. 0.007; \( P < 0.001 \)). In R, week had a significant effect on rope interaction, which decreased in week 2 and increased again in week 3 when new rope was added, although rope interaction was still lower in week 3 than in week 1 (0.106 vs. 0.151, respectively, s.e.d. 0.017; \( P < 0.01 \)). When R/W and W/R received rope for a second time, rope interaction was lower than in the first presentation week (R/W, 0.166 vs. 0.129, s.e.d. 0.017; \( P < 0.05 \)). Interaction with wood was always lower than with rope (in R + W, 0.03 vs. 0.19, respectively, s.e.d. 0.027; \( P < 0.001 \)). Object interaction was additive in R + W when compared to R and W. To conclude, the rotation of enrichment objects did increase novelty, although habituation still occurred. Rope was extremely effective at occupying the pigs’ time, with interaction levels comparable to those previously reported for straw.
stimulated by increased competition due to spatially-
can occur rapidly in pigs (Apple and Craig, 1992; Van de
2008). Furthermore, habituation to point source objects
2006; Day et al., 2008) which might be further
could be responsible for generating an unfulfilled
the pig. On the other hand, some studies have also found
that the properties of individual enrichment objects
could be responsible for generating an unfulfilled
behavioural expression, leading to agonistic behaviours
(Wemelsfelder and Birke, 1997; Van de Weerd et al.,
2006; Day et al., 2008) which might be further
stimulated by increased competition due to spatially-
limited access to a particular object (Docking et al.,
2008). Furthermore, habituation to point source objects
occur rapidly in pigs (Apple and Craig, 1992; Van de
Weerd et al., 2003), consequently reducing their usefulness
in stimulating exploration (Wemelsfelder and Birke,
1997). Thus, novelty of an object is an important
property involved in initiating exploration (Gifford
et al., 2007), and has been reported to be intrinsically rewarding to pigs (Wood-Gush and Vestergaard, 1991).
One way that novelty can be attained is by replacing familiar objects with new objects, although little is known about how long a pig can remember a particular object (Gifford et al., 2007).
Therefore, the objectives of this study were: (1) to assess the effects of habituation to two contrasting environmental enrichment devices, a suspended rope or a loose wood block, on the behaviour of weaner pigs and to determine whether alternating the provision of the objects increased novelty and maintained the attractiveness of each object to the pig; (2) to determine whether the relative attractiveness of each object when given simultaneously mirrored their attractiveness when presented individually, and whether combining enrichment objects had additive or substitutive effects on object-directed behaviour.

2. Materials and methods

2.1. Experimental design

The experiment was designed as a 2 × 2 factorial, with two contrasting environmental enrichment objects (suspended rope and a loose wood block), and two schedules of object presentation (continuous access to the same object, or weekly alternation of the object) to pens of weaned pigs. An additional treatment examined choice when both objects were presented simultaneously over the 4-week experimental period. Treatments were replicated 5 times, in weekly time blocks, making a total of 25 pens.

2.2. Environmental enrichment treatments

All enrichment treatments were introduced to the pens after a 4-day acclimatisation period after weaning (Thursday–Sunday). During this period, each pen received the same type of environmental enrichment which consisted of a suspended polythene tube (0.03 m diameter, 0.4 m long). The five treatments were as follows:

- R: Continuous access to two lengths of suspended rope (each 0.51 m long after the rope was tied to the bracket). The rope was suspended from a bracket (0.6 m high) at the back of each pen and was replaced every 2 weeks due to progressive destruction.
- W: Continuous access to an untreated loose wood block (0.3 m × 0.1 m × 0.06 m), which was washed daily to remove any soiling.
- R/W and W/R: Weekly alternations of wood block and rope (dimensions and procedures as for R and W). R/W received the rope in the first week, and W/R the wood.
- R + W: Simultaneous access to both the rope and wood block (dimensions and procedures as for R and W) throughout the experimental period.

2.3. Animals, housing and management

Two hundred and fifty Large White × Landrace crossbred weaner pigs were allocated to treatments, in groups of 10, in five weekly blocks of 50 pigs. Pigs were weaned at 4 weeks of age according to normal farm procedure and housed in a controlled environment, fan ventilated room, set initially at a temperature of 26 °C. Pens measured 1.66 m × 1.84 m, separated by solid plastic dividers (0.8 m high) and with fully slatted plastic floors. Each pen contained 10 pigs of equal sex ratio (entire males and females). Pigs on all treatments were fed ad libitum the same commercial weaning diets from a three-space hopper. They had free access to water from two nipple drinkers per pen. All animals were weighed at the start of the 4-day acclimatisation period and again at the end of the experimental period (4 weeks later).

2.4. Behavioural measurements

Behavioural time budgets were recorded for two 1 h periods, one each in the morning (between 8:30 and 11:30) and afternoon (13:00–17:00), every Monday, Wednesday and Friday during the 4-week experimental period. The exact starting time for observations was fixed at the same hour within each replicate to avoid confounding of week and observation time. On Mondays, any new test objects were introduced immediately before observations started. Direct scan samples were taken at the group level at 5 min intervals during each period, recording the number of pigs showing use of enrichment object(s), penmate manipulation, manipulation of the pen and general activity (for an ethogram of behaviours, see Table 1). These direct observations were supplemented by 24 h time-lapse video recordings which were taken on day 5 (the first day of the experimental period) and during the last experimental week for each block. Scan samples were subsequently taken from these videos every 30 min to record the diurnal pattern of object use. Behavioural categories recorded from the videos were the same as those taken during the direct scan samples, although nosing and biting behaviour could not be differentiated from the videos and so were categorised together.

2.5. Statistical analyses

For all data analyses, the pen was the experimental unit. Behaviour data were first collated and, for both the direct and video observations, a frequency of occurrence was obtained for each of the behaviours listed in the ethogram. Data were checked for normality using an Anderson–Darling test in the statistical package MINITAB (Release 13.1; MINITAB Inc., State College, PA, USA), and then analysed using a repeated measures analysis of variance in the statistical package Genstat (Second edition for Windows, Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, UK). Two separate analyses were performed, the first used week as the repeated measure and the second used individual days. Treatment, replicate and time of day (morning or afternoon) were included as factors in the model. Pig weights and liveweight gain were also analysed using analysis of variance in Genstat, with treatment and replicate as factors.

3. Results

3.1. Enrichment-directed behaviour

The proportion of direct observations spent in object interaction was affected by treatment (P < 0.001)
Pigs in W, which had continuous access to the wood block, spent less time interacting with the object compared to pigs in the other four treatments. Furthermore, pigs in R + W, with rope and wood objects provided together throughout, had higher object interaction than all other treatments which only had access to one object at a time. Week also had an effect on the proportion of time pigs spent in object interaction in the different treatments (week × treatment interaction, $P < 0.001$) (see Fig. 1). Object interaction in R, which received continuous rope, decreased in week 2, and then increased again in week 3 when new rope was added. However, the proportion of time spent interacting with the rope was still lower in week 3 than in week 1 (0.106 vs. 0.151, respectively; $P < 0.01$) (Fig. 1). There was no significant effect of week on object interaction in W, which received continuous wood, with levels of interaction staying consistently low. R/W, which received alternating enrichment, had a decrease in object interaction when new wood was added for week 2, before rising again in week 3 when new rope was added. However, the level of object interaction was lower in week 3 when new rope was added, than in week 1 when rope was initially added (0.129 vs. 0.166, respectively, $P < 0.05$) (Fig. 1). W/R, which also received alternating enrichment, had an increase in object interaction at the start of week 2 when new rope was added, before decreasing in week 3.

Table 1

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrichment use (after Scott et al., 2006)</td>
<td></td>
</tr>
<tr>
<td>Nosing substrate</td>
<td>Movement of snout along or close to substrate</td>
</tr>
<tr>
<td>Chewing Substrate</td>
<td>Substrate in mouth (with/without visible chew)</td>
</tr>
<tr>
<td>Rooting substrate</td>
<td>Displacing substrate with circular movements of the mouth/nose</td>
</tr>
<tr>
<td>Pen manipulation (Van de Weerd et al., 2005)</td>
<td></td>
</tr>
<tr>
<td>Nosing conspecific</td>
<td>Nose or mouth in contact with pen sides or floor</td>
</tr>
<tr>
<td>Penmate manipulation (after Beattie et al., 2000)</td>
<td></td>
</tr>
<tr>
<td>Nosing conspecific</td>
<td>Rubbing the body of pen mate with the snout, mostly directed to back,</td>
</tr>
<tr>
<td>Bitting conspecific</td>
<td>shoulders belly of flank and around the soft tissue between the limbs</td>
</tr>
<tr>
<td>Rubbing conspecific</td>
<td>Nibbling, sucking or chewing ears, legs, feet or tails</td>
</tr>
<tr>
<td>Chasing conspecific</td>
<td>The resistance encountered when one pig is moved in contact with another</td>
</tr>
<tr>
<td>Head-thrusting conspecific</td>
<td>pig (including mounting).</td>
</tr>
<tr>
<td>General activity (after Van de Weerd et al., 2005)</td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Head in feeder or very close to feeder (includes nosing feeder)</td>
</tr>
<tr>
<td>Drinking</td>
<td>Mouth at drinker</td>
</tr>
<tr>
<td>Active</td>
<td>Animal performing any of the previously listed behaviours</td>
</tr>
<tr>
<td>Inactive</td>
<td>Standing or lying down and performing none of the above behaviours</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>W</th>
<th>R/W</th>
<th>W/R</th>
<th>R + W</th>
<th>s.e.d.</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrichment interaction</td>
<td>0.102</td>
<td>0.037</td>
<td>0.093</td>
<td>0.110</td>
<td>0.134</td>
<td>0.0071</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Active</td>
<td>0.403</td>
<td>0.381</td>
<td>0.397</td>
<td>0.449</td>
<td>0.451</td>
<td>0.0142</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pennate manipulation</td>
<td>0.069</td>
<td>0.085</td>
<td>0.078</td>
<td>0.099</td>
<td>0.081</td>
<td>0.0055</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pen manipulation</td>
<td>0.062</td>
<td>0.090</td>
<td>0.061</td>
<td>0.070</td>
<td>0.071</td>
<td>0.0060</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Values in the same rows bearing different superscripts (a–c) are significantly different ($P < 0.05$).

Fig. 1. Effect of experimental week on object interaction with different enrichment treatments (s.e.d. ~ 0.0174).
when rope was replaced with wood. When rope was added
again in week 4, object interaction increased compared
with that of wood. However, like R/W, this increase in rope
interaction was lower in the second presentation week
when compared to the first week that the pigs were
presented with the rope \( P < 0.001 \) (Fig. 1). For both R/W
and W/R, wood interaction was always lower than rope
interaction \( P < 0.001 \) (Fig. 1), and the proportion of time
spent in wood interaction was not significantly different
when presented a second time than on first presentation.
Changes over time for R + W, which received both rope and
wood simultaneously, mirrored R, with object use declin-
ing in week 2 and increasing when new rope was added in
week 3.

Furthermore, when looking at object interaction on a
day-to-day basis (Fig. 2), it is evident that in all treatments
(except W) after a new object has been added object
interaction decreased within a week \( P < 0.001 \). However,
in W which received continuous wood, there was no effect
day on the level of object interaction which was always
relatively low. Additionally, the results show that the
introduction of a novel rope at any time increased interest,
and this was shown very clearly when pigs in R/W and
W/R (alternating enrichments) received rope after wood
for either the first or second time. Object interaction
was always greater than seen on the comparable day for
R, which had received continuous rope. Wood interaction
after rope in W/R was slightly greater on the first
introduction day than for W, which had received
continuous wood; however, this was not true for R/W
(Fig. 2).

When R (continuous rope) and W (continuous wood)
were compared, the results showed that the pigs inter-
acted more with rope than they did with wood \( P < 0.001 \)
(Fig. 3). The same was true for R + W, with pigs interacting
more with rope than wood when both were present
simultaneously \( P < 0.001 \). Object interaction in R + W
was additive, as the results showed the same trends and
level of interaction with each object individually as that of
R and W, where the objects were presented singly.

Analysis of the 24-h object use pattern from video tapes
demonstrated that time (week 1 or 4) had an effect on
object interaction \( P < 0.001 \), with interaction decreasing
in all treatments except W/R, which received novel rope in
the final week (Fig. 4). There was also an effect of time of
day on object interaction \( P < 0.001 \), with object interac-
tion at a high level between 09:00 and 17:00, decreasing
in all treatments (except W) between 17:00 and 05:00,
and increasing again between 05:00 and 09:00 (Fig. 5).
However, there were no significant diurnal differences
in W, which showed a low level of object interaction
throughout.
3.2. Pig- and pen-directed behaviours and activity

Table 2 (based on direct observations) shows differences in overall mean activity levels, penmate-directed behaviour and pen manipulation between the different treatments. There was an effect of treatment on the activity levels of pigs, with pigs being more active in W/R (alternating wood-rope) and R + W (simultaneous rope and wood) compared to the other treatments (\(P < 0.001\)). Penmate-directed behaviour was also affected by treatment (\(P < 0.001\)), with R having lower levels of this behaviour than all other treatments except R/W. Pen-manipulation was also different between treatments (\(P < 0.001\)), being higher in W than all other treatments.

Week of observation had an effect on activity (\(P < 0.001\)), penmate-directed behaviour (\(P < 0.01\)) and pen-manipulation (\(P < 0.001\)). When new rope was provided in treatments R, R/W and R + W (at the start of week 3) and W/R (at the start of weeks 2 and 4), penmate and pen manipulation decreased. The converse was true when rope was replaced with wood in R/W and W/R; the proportion of time spent manipulating penmates and pen increased (\(P < 0.05\)).

3.3. Production and feeding behaviour

There were no significant effects of treatment on the growth of pigs during the 4-week period (Table 3). The direct observations also showed no significant effect of treatment on the feeding behaviour of pigs. However, there was an effect of treatment on the drinking behaviour of pigs, with R/W spending less time drinking than the other treatments (\(P < 0.05\)), although the difference was small and therefore of low biological significance.

<p>| Table 3 |
|-------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|
| Effect of treatment on weight gain of weaner pigs and the proportion of observations spent feeding and drinking |</p>
<table>
<thead>
<tr>
<th>R</th>
<th>W</th>
<th>R/W</th>
<th>W/R</th>
<th>R + W</th>
<th>s.e.d.</th>
<th>(P)-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight at start (kg)</td>
<td>10.90</td>
<td>9.06</td>
<td>9.21</td>
<td>9.02</td>
<td>8.89</td>
<td>0.900 NS</td>
</tr>
<tr>
<td>Weight after 4 weeks (kg)</td>
<td>24.16</td>
<td>22.85</td>
<td>21.55</td>
<td>22.11</td>
<td>22.35</td>
<td>0.900 NS</td>
</tr>
<tr>
<td>Daily gain (g/day)</td>
<td>0.44</td>
<td>0.43</td>
<td>0.38</td>
<td>0.39</td>
<td>0.42</td>
<td>0.031 NS</td>
</tr>
<tr>
<td>Drinking</td>
<td>0.030(^a)</td>
<td>0.030(^a)</td>
<td>0.023(^b)</td>
<td>0.031(^a)</td>
<td>0.034(^a)</td>
<td>0.003 &lt;0.05</td>
</tr>
<tr>
<td>Feeding</td>
<td>0.137</td>
<td>0.137</td>
<td>0.141</td>
<td>0.137</td>
<td>0.130</td>
<td>0.006 NS</td>
</tr>
</tbody>
</table>

Values in the same rows bearing different superscripts (a and b) are significantly different (\(P < 0.05\)).

Fig. 4. Effect of experimental week on object interaction over a 24 h day, from video recordings of different enrichment treatments.

Fig. 5. Diurnal pattern of object use, from video recordings of different enrichment treatments.
4. Discussion

Both wood and rope tested in the present study were used by all groups for a significant proportion of their time, indicating the value in providing some form of enrichment for indoor-housed pigs. However, pigs on treatment W, which received continuous access to a wooden block, always had a lower object interaction than those which continuously had access to rope. This is in agreement with Van de Weerd et al. (2003), who found that pigs interacted with suspended sisal rope (which was chewable, deformable and destructible) for 8.4% of their active time on day 1, whereas objects that had similar properties to that of wood, such as a loose concrete block or a loose rubber boot, gave interaction for less than 4.9% of the active time on day 1. Thus, as much research has shown (Chamove, 1989; Apple and Craig, 1992; Hill et al., 1998; Van de Weerd et al., 2003, 2006; Day et al., 2008), the physical properties of an object are paramount in maintaining its attractiveness to a pig. As anticipated, the two objects selected therefore gave a significantly contrasting baseline against which to explore the effects of novelty. During the initial 4-day adaptation period after weaning, all pens were enriched with a suspended polythene tube. This shared some properties with both objects (suspended like the rope, but non-deformable like the wood), and is therefore unlikely to have greatly influenced subsequent preferences.

Whilst the destructable nature of the material was probably the major factor in this contrast, method of object presentation (i.e. suspended or presented on the floor) could also contribute to the explanation of why suspended rope was more popular that loose wood. Blackshaw et al. (1997) found that the object they tested (a sow neck tether) maintained interest when it was suspended at eye level as opposed to being presented on the floor. They suggested that the pigs lost interest in loose objects which became soiled, an effect also observed by Grandin et al. (1983). Thus, although in the current study the wood block was washed daily (which may also have added some level of novelty), it still became soiled relatively quickly and this could have been a major factor leading to reduced object interaction.

The provision of rope (an object suitable for chewing and deformation) compared to wood, which is harder to chew and deform, provided a better stimulus or outlet for exploratory behaviour and manipulatory activities involving the snout and mouth, which are important behavioural activities of pigs (Van de Weerd et al., 2003). This was associated with a reduction in adverse behaviours: penmate and pen manipulation were higher in groups offered wood than those offered rope, suggesting that because wood did not meet the pigs’ exploratory need, their exploratory behaviour may have been redirected towards pen-mates and pen fittings, as found in many previous studies (Beattie et al., 1995; Peterson et al., 1995; Scott et al., 2006, 2007). Van de Weerd et al. (2005) also found that pigs in barren environments spent more time expressing undesirable behaviours such as tail-biting, compared to pigs housed in enriched environments where exploratory behaviour could occur (through provision of straw).

A range of studies have reported that when pigs are presented with plentiful straw they spent 10–20% of the total daytime interacting with the substrate (Kelley et al., 2000; Day et al., 2002; Van de Weerd et al., 2006; Scott et al., 2006, 2007). This value is comparable with results found for rope interaction in the present study, where pigs that had access to continuous rope spent on average 10% of observations manipulating rope. Furthermore, when the rope was initially added, rope interaction during the first week accounted for 16% of observations, and when fresh rope was added (either in object alternation, or in week 3 for all other rope treatments) rope interaction again exceeded 10% of observations. This indicates that the rope used here occupied the pigs for almost as much time as that previously reported for straw, and thus it may be a suitable, cost effective form of practical enrichment.

When both wood and rope were presented simultaneously, the effect on time spent in object interaction was additive, suggesting that the more objects that are provided, the more time will be spent in object interaction. It is possible that the additive effect of two objects arose because a single object imposed some spatial limitation on access of all animals within the group, particularly since enrichment-directed behaviour shows synchronisation within a group (Docking et al., 2008). However, Scott et al. (2007), working with a larger group size than in the current experiment, found no significant difference in the level of enrichment-directed behaviour when one object was provided compared to four similar objects, suggesting that it is variety rather than number which is important in achieving an additive effect.

The results show that both wood and rope interaction decreased within the first week after introduction in all treatments. Van de Weerd et al. (2003), when using a test period of 5 days to measure habituation, found that very significant habituation to most objects occurred, with sisal rope interaction declining from 8.4% of active time in day 1 to 4.6% of active time in day 5. These results are comparable to those in the present study. Apple and Craig (1992) found a decline in object use even after the first hour of object presentation. In the current study, the video recordings showed a clear decline in object interaction as day 1 progressed, but also showed a diurnal pattern in object use which might have confounded this reduction. Additionally, the recent study by Docking et al. (2008) showed a significant effect of age of the pig on time spent interacting with objects, with grower pigs (13 weeks of age) showing less interaction with objects after the initial introduction period than weaner pigs (5 weeks of age). Thus, although habituation was undoubtedly occurring over the 4-week trial period in the current study, the decrease in object interaction may also be in part due to an increase in age of the animals.

Although the introduction of a novel object at any time increased object interaction, when rope and wood were added for a second time after a break of 1 week, object interaction was always lower than when the object was added initially. This is in accordance with research by Gifford et al. (2007), who found that pigs that had received an object for 2 days still retained a memory for the object 5 days later, and thus interacted with the object less when presented with it again. This ability for pigs to retain a memory of an object that they have been exposed to can
significantly affect how effective and novel an enrichment object can be. Thus, although some authors suggest that rotation of objects on a regular basis is a good way to add novelty to the enrichment (Grandin et al., 1983), the ability of pigs to recognise objects may significantly affect their use of such repeated enrichment. Nevertheless, in the present study an indication that even limited novelty was important to maintain pigs' attention was given in treatments R and R + W (continuous access to rope) by the fact that when the rope was renewed in week 3, object interaction significantly increased. Zonderland et al. (2001) also concluded that the highest interaction with the rope in their study may have been partly caused because the material had to be replaced regularly. It is noteworthy in the present study that replacement of rope with fresh rope resulted in a greater increase in object-directed behaviour than replacement of rope with wood. The daily cleaning and reintroduction of the wood block could also be viewed as renewing enrichment, but this did not stimulate any major increase in attraction to this object. Therefore, it is not just the degree of novelty, but also the stimulus properties which act together to determine attractiveness of enrichment items. More research is needed to investigate the extent of memory for different objects, how object properties and their generalisation might affect later perception of novelty and how this is linked to rate of habituation in use.

Whilst the rotation of objects on a daily basis and a delay before re-exposure of more than 5 days may help to preserve the exploratory value of objects rotated among pens (Gifford et al., 2007), the labour involved in implementing such a policy might raise some practical concerns with pig farmers and synthesis of the most effective strategy for object rotation requires further research.

5. Conclusions

The results from this study highlight a number of considerations for the provision of environmental enrichment in commercial pig production systems. Firstly, enrichment properties, in terms of the objects' physical attributes and/or method of presentation, can markedly affect the level of object interaction realised, and it is suggested that suspended objects are the most hygienic and effective way to effect enrichment. Secondly, although the rotation of objects does increase novelty, habituation still occurs and thus a greater understanding of memory, recognition and habituation would assist in the design of effective practical strategies. Nevertheless, the results demonstrate that rope was an extremely effective form of enrichment, occupying the pigs' time for almost as much time as reported previously for straw. Thus, rope could be an alternative and more commercially practical method of providing environmental enrichment for pigs in fully slatted housing.

Acknowledgements

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References