Influence of different types of environmental enrichment on the behavior of finishing pigs in two different housing systems 3. Hanging toy versus rootable toy of the same material

Kamara Scott a,*, Lisa Taylor b, Bhupinder Pal Gill b, Sandra A. Edwards a

a School of Agriculture, Food and Rural Development, University of Newcastle, Newcastle upon Tyne NE1 7RU, United Kingdom
b Meat & Livestock Commission, Winterhill House, Milton Keynes MK6 1AX, United Kingdom

ABSTRACT
This study aimed to assess the effects of (1) environmental enrichment with either straw bedding or a plastic toy and (2) the way in which the plastic toy was presented on the behaviour of finishing pigs in two different housing systems. One thousand and twenty-four (Large White × Landrace) × Large White pigs were housed contemporarily in either a straw-based (ST) or fully slatted (FS) building from 35 kg to slaughter at 104 kg. In each building, half of the pens received additional environmental enrichment in the form of a hanging plastic toy. The remaining pens in the ST house were enriched only by the straw bedding. In the FS house, the remaining pens were provided with a rootable toy of the same plastic material presented on the floor of the pen. There was no significant effect of housing system on the level of manipulation of the hanging toy. Within the FS system, the level of manipulation of the hanging toy tended to be higher than that of the plastic toy presented on the floor (P = 0.052). Neither form of additional environmental enrichment provided a comparable level of occupation to that of straw bedding. In the absence of straw, more investigatory behaviours were directed towards both pen-mates (P < 0.001) and pen components (P < 0.001). Further study is required to identify functional forms of environmental enrichment in slatted systems to occupy pigs and prevent them from performing adverse behaviours.

© 2008 Elsevier B.V. All rights reserved.

1. Introduction

Pigs have developed foraging strategies that depend on high levels of exploratory behaviour involving the mouth and snout (Arey, 1993), probably as a result of having evolved in semi-woodland areas where they had to forage in the ground for food. In barren environments, typified by concrete flooring and lack of rooting materials, the pig still displays an inherent motivation to explore. However, in such cases, the behaviour is directed at the limited number of substrates available, namely pen-mates (Scott et al., 2006a; Beattie et al., 2000; Kelly et al., 2000) and pen components (Scott et al., 2007, 2006a; Guy et al., 2002). The lack of suitable means of expression of motivated exploratory behaviour in such housing systems has been implicated in the development of adverse behaviours, such as tail biting (Scott et al., 2006b; Van de Weerd et al., 2005).

The provision of environmental enrichment has been shown to reduce the amount of time pigs spend in potentially harmful social behaviours, such as the nosing and chewing of pen-mates (Fraser et al., 1991; Arey, 1993; Kelly et al., 2000) by providing objects or materials capable of satisfying the pig’s behavioural needs. Whilst previous studies have shown that pigs of all ages use enrichment when it is provided (Beattie et al., 2000; Petersen et al., 1995), there is still much debate on what constitutes effective environmental enrichment. Pig producers within the EU are legally required to provide...
pigs with environmental enrichment, and EU Directive 2001/93/EU lists straw, hay, wood, sawdust, mushroom compost and peat as suitable materials for this purpose. Whilst the merits of peat, sawdust and mushroom compost as effective forms of enrichment have been demonstrated (Beattie et al., 1995), the use of most, if not all, of these materials is often considered to be infeasible in slatted systems with liquid manure handling facilities. This is particularly pertinent given that the majority (>90%) of EU pig producers use part- or fully slatted housing systems (Hendriks et al., 1998). There is therefore a requirement to identify alternative forms of environmental enrichment that are capable of satisfying the behavioural needs of the animal within the constraints imposed by the housing system.

Whilst there has been much research carried out on identifying suitable substrates and objects as functional environmental enrichment for pigs, there have been relatively few studies that have considered the effects of the way in which the environmental enrichment is presented to the pig. Enrichment presented on the floor of the pen may become soiled by faecal material, which has been shown to result in a loss of interest (Blackshaw et al., 1997). Enrichment offered at pig head height may be more accessible to all of the pigs in the pen, and has less risk of becoming soiled by faecal material; however it may be not as appropriate for the expression of rooting behaviours.

The aims of this study were therefore to assess the effects of (1) environmental enrichment with either straw bedding or a plastic toy and (2) the way in which the plastic toy was presented to the pigs on the behaviour of finishing pigs in two contrasting housing systems.

2. Materials and methods

2.1. Experimental design

Two different environmental enrichment treatments were compared in each of two housing systems, giving a total of four treatments each replicated across eight pens of pigs. In a straw-based building, pens with straw bedding as the only form of enrichment were compared with pens which had an additional hanging plastic toy. In an otherwise similar building with fully slatted flooring, the same plastic hanging toy was compared with a rooting toy of the same plastic material presented free on the floor of the pen.

2.2. Housing system

Animals were housed in either a fully slatted (FS) or straw-bedded (ST) building, purpose built on the same site to an otherwise similar design (see MLC, 2004 for full details). Each house consisted of four rooms, each containing four pens. The ST pens measured 5.8 m × 3.7 m, including the scrape-through passage, which was cleaned out daily whilst pigs were shut in the lying area. After cleaning out, fresh barley straw was added to the pens at the rate of 0.38 kg straw per pig per day. FS pens measured 5.5 m × 3.7 m and had flooring of concrete slats with 83 mm width and 18 mm gap.

The ventilation and environment in both housing systems were automatically controlled (Euromatic DOL34H, Skov, Denmark) to set maximum and minimum ventilation, relative humidity and temperature against occupancy day. Each room had two windows, allowing natural daylight, and artificial light was mainly used during husbandry tasks, weighing and behaviour observations.

Pigs in both houses received the same liquid diets which were automatically fed ad libitum. Water was freely available from four nipple drinkers per pen.

2.3. Animals

One thousand and twenty-four externally sourced (Large White × Landrace) × Large White pigs were received in eight equal batches of 128 over 13 weeks. The pigs had previously been housed in both slatted and straw-based accommodation and were approximately 12 weeks of age at entry. Batches were allocated alternately between the housing systems until all rooms were filled. After a 4-day period of acclimatisation to the housing system, each pig was ear tagged for individual identification and then weighed. The batch was divided into four groups of 32 pigs in order of weight. Each group was then randomly allocated to one of four pens within a single room. Numbers per pen were reduced at week 6 (mid-point) to 25 in the FS system (0.8 m² per pig) and 20 in the ST system (1.1 m² per pig), in accordance with normal commercial stocking densities for these housing types. Pigs were slaughtered at approximately 104 kg liveweight.

At entry, three entire males and three females in each pen were chosen as ‘focal pigs’ for detailed behavioural scans. Focal animals were selected according to the following criteria: two pigs (one of each sex) at approximately median weight for the group, two within the upper quartile weight band and two within the lower quartile band. Only focal pigs were used for detailed investigations of behaviour.

2.4. Environmental enrichment treatments

All environmental enrichment treatments, with the exception of the straw bedding, were introduced at the end of the 4-day acclimatisation period. In both the straw-based and slatted housing system, half of the pens received additional enrichment in the form of a hanging plastic ‘toy’. This ‘toy’ was constructed on-farm from two lengths (50 cm) of rigid plastic piping of different diameters (50 and 65 mm) suspended from their centre on a chain at pig head level. In the ST system, the remaining pens were enriched only by the straw bedding. In the FS system, the remaining pens were provided with lengths of the same rigid plastic piping used to construct the hanging ‘toy’; however these were presented free on the floor where they could be rooted around the pen. Each pen received two lengths (120 cm) of plastic pipe of 50 mm diameter and two lengths of plastic pipe of 65 mm diameter. Whilst the hanging ‘toy’ was always accessible from 360° and remained clean and hygienic throughout the study, the toy presented free on the floor could be pushed against walls and into corners, thus restricting potential access, and was easily soiled with faecal material as a consequence of being on the pen floor. For these reasons it was considered more appropriate to provide a greater accessibility (via an increased surface area) to the...
toy presented free on the floor. The hanging toy was not of the same dimensions as the toy presented free on the floor as this would have encroached on the space necessary for routine husbandry tasks.

2.5. Behavioural measurements

Behavioural time budgets were recorded for three 2 h-periods (09.00–11.00, 12.00–14.00, 15.00–17.00) in the week of entry, week before group size reduction at approximately 60 kg (mid-point) and week before slaughter. Focal pigs were individually identified using stock marker spray and observations were carried out by a single observer. Scan samples were taken at 10 min intervals during each 2 h-period according to a predetermined ethogram, based on the method of Day et al. (2002). This ethogram detailed the animal’s posture, behaviour and the substrate towards which the behaviour was directed (Table 1).

2.6. Statistical analyses

For all data analyses, the pen was the experimental unit. Behaviour data were first collated and the frequency at which each behavioural category of the ethogram occurred was expressed as a percentage of the total number of observations for the three observation periods on the same day. The possible effect of time (entry, mid-point and pre-slaughter) was tested using repeated measures ANOVA; however, this revealed no statistical interaction between environmental enrichment treatment and time. Consequently, the data were subsequently averaged across the three observation days. Enrichment-directed behaviour data were not normally distributed, and could not be normalised by transformation. Therefore, non-parametric Mann–Whitney tests (Minitab Release 14.11) were carried out for specific valid comparisons within and between buildings; i.e. comparison of the hanging plastic toy in the different housing systems and comparison of the two presentation forms of toy within the FS system only. All other data were normally distributed and were analysed by the General Linear Model function of Minitab.

3. Results

3.1. Enrichment-directed behaviour

Pigs in the ST system spent 18.2% of the observations in straw-directed behaviour, and this was not affected by the provision of additional environmental enrichment in the form of the plastic hanging toy. Levels of toy manipulation were low in both housing systems compared with levels of straw manipulation. There was no significant effect of housing system on the level of manipulation of the hanging toy (ST median 0.86 versus FS median 1.57, $W = 54.5$, $P = 0.169$). Within the FS system, the level of manipulation of the hanging plastic toy tended to be higher than that of the plastic toy presented on the floor (hanging toy median 1.57 versus floor toy median 0.71, $W = 87.0$, $P = 0.052$).

3.2. Pig- and pen-directed behaviours

Whilst there were no significant effects of the type of toy on the level of behaviour directed at pen-mates or pen-components in the FS system (Table 2), a significant effect of housing system was observed on these measures. Behaviours directed at pen-mates were more frequently observed in the FS system than in the ST system (ST 4.6%...
versus FS 8.6%, S.E.M. = 0.51, P < 0.001), with a similar effect observed in behaviours directed at pen components (ST 3.5% versus FS 14.1%, S.E.M. = 0.71, P < 0.001).

### 4. Discussion

The current EU Directive (2001/93/EC) aims to improve the welfare of pigs by legally requiring producers to provide pigs with suitable materials to “enable proper investigation and manipulations activities…” Straw is the most studied rooting material for pigs, and the efficacy of alternative forms of environmental enrichment is often compared with the effects of straw (Studnitz et al., 2007), in spite of pigs displaying preferences for other materials over straw (Beattie et al., 1995). In the present study, straw manipulation occupied pigs for 18% of daytime observations, which is comparable to that reported previously in other situations (e.g. Jensen et al., 1993; McKinnon et al., 1989). However, the use of straw is often infeasible in most part- and fully slatted housing systems with liquid manure handling facilities; therefore alternative forms of environmental enrichment must be sought.

Pigs need to be provided with functional environmental enrichment, defined as that which will occupy them to a great extent to divert them from performing adverse behaviours (Van de Weerd et al., 2005). The choice of environmental enrichment for intensively housed pigs is often based more on economic or health-related factors than on the requirements of the animals themselves (Van de Weerd et al., 2003). Anecdotal comments from farmers suggest that they have a preference for environmental enrichment that is suspended from on-high compared with enrichment offered at floor level so that there is limited interference with routine husbandry tasks. However, several studies have reported much lower occupation times with such forms of enrichment compared with that seen with straw bedding (e.g. Day et al., 2002; Van de Weerd et al., 2005; Scott et al., 2006a, 2007). In the present study, neither form of additional environmental enrichment (hanging or floor-level plastic toys) provided a comparable level of occupation to that of the straw bedding. The provision of the hanging plastic toy in the ST pens did not significantly affect the level of ST occupation, providing less than 16% of the occupation time provided by the straw. This is comparable to values reported in two previous studies at the same site using alternative forms of additional environmental enrichment (Scott et al., 2007, 2006a). Both forms of additional environmental enrichment in the current study were made from the same rigid plastic piping, favoured by farmers as being durable, and shared none of the main characteristics of objects used most intensively by growing pigs that were identified by Van de Weerd et al. (2003) (especially ‘ingestible’, ‘odorous’, ‘chewable’, ‘deformable’, and ‘destructible’).

One of the primary aims of the study was to investigate if the way in which the plastic toy was presented affected pig behaviour. Results showed that, within the FS system, pigs tended to spend more observations occupied by the hanging plastic toy than by the toys presented at floor level. Previous results of such comparisons have been contradictory. Courboulay (2004) reported more enrichment-directed behaviour in pigs provided with a toy (three 60 cm long plastic pipes suspended from their centre) fixed on the floor of the pen than those provided with the same toy suspended on a chain at pig height. However, Blackshaw et al. (1997) reported that pigs made more use of a fixed toy (old metal sow tether covered with hard chewable plastic piping) suspended from the ceiling than the same toy presented free on the floor. They concluded that this may have been due to the toy becoming soiled with faeces due to its location on the part-slatted floor. In the present study, despite the use of fully slatted flooring, the plastic toy presented on the floor was frequently observed to be contaminated with faecal material, and was often located in the corners of the pen. Conversely, the hanging plastic toy could not be soiled with excreta, and was always both visible and accessible to the pigs.

Both the present and previous studies (e.g. Scott et al., 2006a; Guy et al., 2002; Beattie et al., 2000; Kelly et al., 2000) have demonstrated that, in the absence of a suitable substrate providing an outlet for oral exploratory behaviours, pigs re-direct such behaviours towards pen-mates and pen components. Whilst the current Directive lists straw, hay, wood, sawdust, mushroom compost and peat as suitable materials to enable proper investigation and manipulation, it does not elaborate on materials or objects that may be suitable for this purpose; however a recent review of the exploratory behaviour in pigs in relation to environmental enrichment concluded that exploratory behaviour in pigs is best stimulated by materials that are complex, destructible, manipulable, and contain sparsely distributed edible parts (Studnitz et al., 2007). Furthermore, the Directive does not specify the way in which such materials should be presented. It has been suggested that they should be presented at floor level to allow for natural rooting behaviours; however there is contradictory evidence for this in the literature (e.g. Blackshaw et al., 1997). The results of the present study indicate that a hanging object tends to provide better occupation than an equivalent at floor level. However, in neither case was

---

### Table 2

Mean percentage of observations over three time periods that pigs provided with either straw or different enrichment devices (H: hanging plastic toy; F: floor level plastic toy) spent engaged in behaviours directed at pen-mates or pen components.

<table>
<thead>
<tr>
<th>Housing enrichment</th>
<th>Straw-based</th>
<th>Fully slatted</th>
<th>S.E.M.</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>% behaviour towards</td>
<td>Control +H</td>
<td>+H</td>
<td>+F</td>
<td></td>
</tr>
<tr>
<td>Other pig</td>
<td>4.1</td>
<td>5.1</td>
<td>8.3</td>
<td>8.9</td>
</tr>
<tr>
<td>Pen components</td>
<td>3.5</td>
<td>3.6</td>
<td>14.2</td>
<td>13.9</td>
</tr>
</tbody>
</table>

N = 8 pens for each treatment combination.
the total level of occupation provided adequate to prevent an undesirable increase in pig-directed behaviours, as reported in the previous two studies in this series (Scott et al., 2007, 2006a) and much better design of alternatives to straw for use in fully slatted housing is necessary.

5. Conclusion

For environmental enrichment purposes, a hanging toy is used more than one presented loose on the floor. However, in the present study, neither form of plastic toy provided a comparable level of occupation to that seen with straw bedding. The modern domestic pig still displays an inherent need to perform exploratory behaviour; therefore suitable materials/objects must be identified to fulfil this and occupy them to the extent necessary to prevent other adverse behaviours.

Acknowledgements

The authors acknowledge the support of the Department for Environment, Food and Rural Affairs in funding this research and the assistance of Mr Trevor Warren and all the staff at the MLC Stotfold Pig Development Unit.

References