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The influence of a barrier on the behaviour and growth of early-weaned piglets

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Abstract

When designing environments for animals, the quality of space as well as the amount of space should be considered. In this study the influence of an opaque barrier on the aggressive behaviour and growth of Large White × Landrace piglets that were weaned at 24 days was examined. The behaviour and weight gain of 120 piglets were recorded during a 4-week period following weaning. These piglets were housed in either a conventional flat-deck pen or a straw pen, with or without an opaque barrier. There was no significant difference between the two types of accommodation in the frequency of aggressive interactions that occurred during the weaning period but where a barrier was present the frequency of aggressive interactions was 40% lower during the 1st week after weaning and growth rate was proportionately 0·15 greater. Piglets that were the recipients of most aggressive behaviour used the barrier most frequently during the weaning period and barrier users gained the most weight during the week immediately following weaning.

It was concluded that a barrier improved the weaning environment because it offered piglets an escape route during the period when most aggressive interactions occurred. A barrier may be an effective way of improving the welfare of animals housed in confined conditions.

Keywords: *behaviour, growth, piglets, weaning.*

Introduction

Early weaning of piglets can lead to a reduced ability to cope with immunological challenges (Blecha and Kelley, 1981), a reduction in growth rate (Sherritt, Graves, Gobble and Hazlett, 1974; McGlone and Curtis, 1985) and an increased incidence of injuries or death (Symoens and van den Brande, 1969; McGlone and Curtis, 1985). Hence it is clear that welfare is often poor at this time (Fraser and Broom, 1990). Early-weaned piglets are usually subjected to an abrupt change in both their physical and social environment and the pens in which they are typically housed in the United Kingdom (UK) are very barren. The intensity and frequency of aggressive behaviour increases following weaning and regrouping (Fraser, 1978) and there is an increase in the concentration of plasma glucocorticoids associated with the fighting that normally occurs (Blecha, Pollman and Nichols, 1985). The aggressive and abnormal behaviour associated with weaning and regrouping can also result in injuries to the piglets (Algers, 1984a and b), but these are seldom severe.

Another behaviour that is associated with the practice of weaning is belly-nosing. Belly-nosing movements are similar to the teat-seeking movements addressed to the sow during the suckling phase but are directed towards other piglets in the weaning group. Piglets that belly-nose sometimes grow less well (Fraser, 1978) and piglets that are subjected to belly-nosing may be injured. The incidence of belly-nosing has been reduced in some cases by enriching the weaner environment with straw (Schouten, 1986).

The amount of space that is recommended for piglets kept in standard commercial conditions in the UK is 0·22 m^2 for each piglet up to 20 kg (Ministry of Agriculture, Fisheries and Food, 1987). This space allowance gives piglets the room to lie, stand, eat and

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defaecate. However a piglet also needs to be able to maintain a space between itself and other members of its group in different social situations (Petherick, 1983). This 'individual space' (Wilson, 1975), is not catered for in the confined conditions of a flat-deck cage or in other weaner accommodation, where space allocation has been dictated by economic factors. Jensen (1982) reported that in confined conditions it is difficult for unfamiliar pigs to establish a stable dominance hierarchy. An inadequate space allowance probably interferes with the progress of fights and does not allow pigs to retreat during a fight. In confined conditions pigs that are unable to escape from aggressors may be chased around the pen by one or more individuals (Kiley, 1973).

One way of enriching the environment and of allowing piglets to escape from the unwanted attention of others is to provide a hiding area in the weaner pen. If there is a hiding area piglets can display normal signals of submission during an aggressive interaction, such as running away and maintaining a distance of at least 1 m between itself and the aggressor, and can protect the head and neck area (Hafez, 1975). McGlone and Curtis (1985) reported a 42% reduction in the frequency of aggressive behaviour in groups of weaned piglets during the first 30 min following weaning and regrouping in weaner pens fitted with limited hiding areas which they called 'pop-holes'. These were boxes that allowed piglets to hide their head and neck during an aggressive interaction. Similarly, Blackshaw (1981) found that the growth rates of piglets during the first 4 days after weaning were improved when the side wall of a box was placed into a weaner pen. However, although these boxes have short-term beneficial effects, they have the disadvantage that they require extra space in the weaner pen to accommodate them with some consequent extra costs. Ideally, measures of this kind should be shown to be effective in all weaner housing including flat-deck cages.

A simple and economical hiding area that needs no extra space, is created by a wooden or metal barrier that can be slotted into an existing weaner pen. This allows a piglet to get out of the sight of another and provides two extra corners in the pen in which piglets can hide their head and neck. The present study examined the influence of such barriers on the behaviour and growth rates of early-weaned piglets housed in both flat-deck and straw pens.

Material and methods

Animals and management

Three trials involving a total of 120 piglets were carried out at the Cambridge University pig unit. In each trial 40 Large White × Landrace piglets from four or five litters were weaned at between 24 and 25 days of age and were placed into one of four types of weaning accommodation. The litters were mixed so that each weaner group of 10 piglets contained at least two piglets from each litter, usually a male and a female. Immediately before regrouping the piglets were individually weighed and each was marked on its back with an identifying number using a commercial pig marking fluid. Piglets were also identifiable by their ear tattoo. Detailed behavioural observations and weight changes were recorded over a 4-week period.

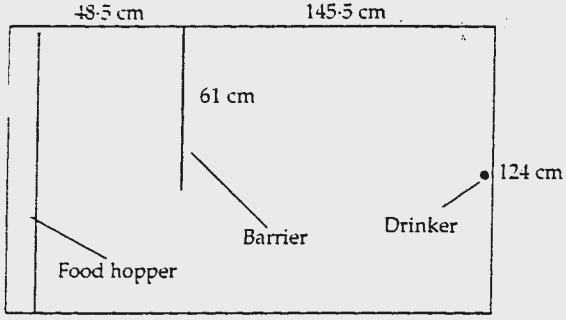

Figure 1 A plan of the flat-deck cage showing the position of the barrier.

Housing

1. The flat-deck pen. These were Quality Equipment 2·4 m^2 pens with plastic floors. In the pen there was an enamelled bowl drinker with a valve plate, providing water at a flow rate greater than 0·6 l/min and a food hopper which had 10 feeding spaces so that all 10 piglets in the group could feed simultaneously. The feeder had head and neck partitions so that piglets could feed next to each other but could not see each other when feeding.

2. The flat-deck pen with a barrier. The design was the same as for the flat-deck pen described previously except for the presence of a barrier (Figure 1). The barrier was made of galvanized metal which was steel framed. It was suspended on two arms from the sides of the pen and fixed to the floor, so that the pigs could not move it with their snouts. The barrier took up very little space in the pen.

3. The straw pen. The area of the straw pen was 4·08 m^2 and the feeder and drinker was the same as for the flat-deck pens. The pens had a dunging and lying area and the lying area was provided with fresh straw once a day.

4. The straw pen with a barrier. The straw pen was of the same design as described previously, except for the addition of a steel framed barrier with a wooden

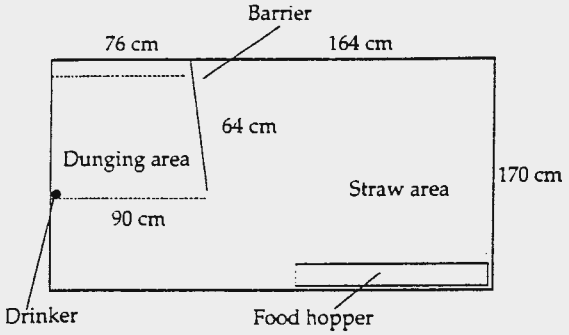

Figure 2 A plan of the straw pen showing the position of the barrier.

inset (Figure 2). The barrier separated the dunging area, where the water source was located, from the strawed lying and feeding area.

General management

The weaner pens were cleaned and the feeders filled every morning before observations were made. Piglets were given a starter diet containing 220 g protein per kg for the 1st week after weaning, after which time the diet was changed gradually to a pelleted weaner diet that contained 180 g protein per kg as is normal commercial practice.

Observations

Direct observations were made as soon as the piglets were regrouped and placed into weaning accommodation. All occurrences of aggressive and belly-nosing behaviour and use of the barrier were recorded during a 4-week period after weaning and the identity of the piglet that initiated an interaction (the performer) and the recipient of the interaction (the receiver) was noted as well as the interaction type and the outcome.

Each group of piglets was observed at least twice a week for a period of 1 h during which time all interactions that occurred in the group were recorded. The mean frequency per h of each behaviour was calculated on a weekly basis.

Aggressive behaviour included knocking, biting, fighting and chasing as defined by Jensen (1980). Belly-nosing was recorded when a piglet was observed nuzzling and massaging the underside of a pen mate (van Putten and Dammers, 1976). Use of the barrier was scored when a piglet that was involved in an interaction turned and walked or ran away into the area divided by the barrier and was not then visible to piglets standing at the other side of it.

Statistical analyses

The effects of treatments on aggressive and belly-nosing behaviour and on use of the barrier and weight gain were compared using a sign test (Siegel and Castellan, 1988). Spearman rank correlations (R_s) were used to investigate the relationships between the various types of behaviour that were recorded and live-weight gain.

Table 1 *Frequency of aggressive acts (per h of observation)*†

Pen type	Mean	s.e.
Straw	9·48	2·24
Straw/barrier	6·48	1·43
Flat deck	8·4	2·5
Flat deck/barrier	4·3	1·68

† In this and in subsequent tables values from the three trials have been pooled.

Table 2 *Frequency of aggressive and belly-nosing behaviour in all weaner pens with and without a barrier*†

	Aggression		Belly-nosing	
Pen type	Mean	s.e.	Mean	s.e.
Barrier	5·41[a]	1·03	1·96	0·64
Non barrier	8·9[b]	1·54	3·24	1·1

[a,b] Values with different superscripts differ significantly ($P < 0·05$).

† Values from straw and flat-deck pens have been pooled.

Results

Aggressive behaviour

The frequency of aggressive behaviour in the four types of accommodation during the 4-week period after weaning is illustrated in Table 1. There was no significant difference between flat-deck cages and straw pens in the average frequency of aggressive interactions. However there was a difference between barrier and non-barrier groups ($P = 0·03$, sign test) (Table 2). The average frequency of aggressive interactions in the barrier groups was 5·4 per h and in non-barrier groups the frequency was 8·9 acts per h. Thus a barrier resulted in a 40% reduction in the frequency of aggressive interactions during the week after weaning.

Belly-nosing

Belly-nosing did not occur in all pens or during any specific week after weaning. Hence inter-group comparisons of the frequency of belly-nosing were made over the entire 4-week period.

Table 3 illustrates the mean frequency of belly-nosing in each type of accommodation. It was noticed that belly-nosing was most frequent within a group of piglets housed in a pen next to two lactating sows and, as this appeared abnormally high compared with other groups housed in the same

Table 3 *Frequency of belly-nosing behaviour (per h of observation)*

Pen type	Mean	s.e.
Straw	1·15	0·12
Straw/barrier	1·9	1·5
Flat deck	4·63	1·26
Flat deck/barrier	2	0·81

type of accommodation in other trials, it was not included in the final analysis.

The incidence of belly-nosing behaviour was similar in both straw pens and flat-deck cages and there was no reduction in belly-nosing behaviour in pens with a barrier. Although belly-nosing behaviour was 56% lower in flat-deck pens with a barrier this was not significantly different from the mean frequency of belly-nosing in flat-deck pens with no barrier.

Live-weight gain

The average live weights of all groups at weaning was similar. There was no significant difference between piglets in flat-deck cages and straw pens in their mean weight gain during the week immediately following weaning (Table 4), however there was a significant difference between barrier and non-barrier groups (Table 5). All groups that were weaned into pens with a barrier gained more weight than non-barrier groups ($P = 0·03$, sign test). The average weight gain of barrier groups was 220 g higher during the week after weaning which was proportionately about 0·15 higher than non-barrier groups.

Barrier users

In the flat-deck cages, those piglets that were recipients of the most aggressive behaviour during the 4-week period after weaning used the barrier most frequently during that time ($R_s = 0·56$, no. = 30, $P = 0·001$). Barrier use was also positively correlated with weight gain during the week following weaning ($R_s = 0·37$, no. = 30, $P = 0·05$).

There was no relationship between barrier use and behaviour or weight gain in the straw pens.

Table 4 *Weight gain during the 1st week post weaning*

Pen type	Mean	s.e.
Straw	1·2	0·34
Straw/barrier	1·35	0·74
Flat deck	1·39	0·5
Flat deck/barrier	1·68	0·61

Table 5 *Weight gain in all pens with and without a barrier*

Pen type	Mean	s.e.
Barrier	1·52[a]	0·33
No barrier	1·3[b]	0·28

[a,b] Values with different superscripts differ significantly ($P < 0·05$).

† Values from straw and flat-deck pens have been pooled.

Discussion

The quality of space as well as the amount of space must be considered when animal housing is being designed (Fraser and Broom, 1990). An important aspect of any environment in which social animals are to be housed must be the provision of an area that animals can use to escape from the unwanted attention of other group members. This allows them to control their social environment. This study demonstrates that the quality of space for newly weaned piglets in restricted environments can be improved by fitting pens with a barrier. This allows them to behave in a more natural way during an aggressive interaction. The frequency of aggressive acts in pens with barriers was lower than in pens with no barriers. The weight gain in weaner pens was better when a barrier was placed in them perhaps because piglets that spend a great deal of time involved in aggressive interactions probably spend less time feeding and also expend more energy.

Piglets that used the barrier most were those that received the most aggression. Barrier users grew faster perhaps because they had better control of their social environment.

Although the incidence of belly-nosing behaviour was not influenced by the barriers, it did appear that belly-nosing was reduced in flat-deck pens with barriers. However the frequency of belly-nosing was highly variable between groups.

An added advantage of the barrier was that it divided the area in the weaner pens into two and so gave piglets the opportunity to choose a resting area away from their dung. When given the opportunity pigs will orientate themselves with their hindquarters towards or parallel to a wall, away from areas of potential commotion, whilst defaecating (Baxter, 1982). Therefore the barrier environment with the extra wall created by the barrier and the siting of the water source at one side of the barrier, probably aided piglets in choosing their dunging area.

The barrier effect was less marked in the straw pens. This was probably because the area in the straw pens

was almost twice the size of the flat decks and the straw made the environment more complex.

Since barriers appear to offer piglets the opportunity to perform behaviour that does not occur in conventional weaner pens it can be concluded that they improve the weaner environment, at least in the flat-deck cages. Thus placing a barrier in pens for young piglets is an inexpensive way of improving growth rate and probably welfare. Barriers may also be of value in systems where large numbers of older animals are housed together, such as in yards with electronic sow feeders.

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References

Algers, B. 1984a. Animal health in flatdeck rearing of weaned piglets. *Zentralblatt fur Veterinarmedizin Reihe A* **31:** 1-13.

Algers, B. 1984b. Early weaning and cage rearing of piglets; influence on behaviour. *Zentralblatt fur Veterinarmedizin Reihe A* **31:** 14-24.

Baxter, M. 1982. Environmental determinants of excretory and lying areas in domestic pigs. *Applied Animal Ethology* **9:** 195.

Blackshaw, J. K. 1981. Effect of environmental design on the growth and behaviour of weaned pigs. *Livestock Production Science* **8:** 367.

Blecha, F. and Kelley, K. W. 1981. Effects of cold and weaning stressors on the antibody mediated immune response of pigs. *Journal of Animal Science* **53:** 439.

Blecha, F., Pollman, D. S. and Nichols, D. A. 1985. Immunological reactions of pigs regrouped at or near weaning. *American Journal Veterinary Research* **46:** 1934-1937.

Fraser, A. F. and Broom, D. M. 1990. *Farm animal behaviour and welfare.* 3rd ed. Balliere Tindall, London.

Fraser, D. 1978. Observations on the behavioural development of suckling in early-weaned piglets during the first six weeks after birth. *Animal Behaviour* **26:** 22-30.

Hafez, E. S. E. 1975. *The behaviour of domestic animals.* Bailliere Tindal, London.

Jensen, P. 1980. An ethogram of social interaction patterns in group-housed dry sows. *Applied Animal Ethology* **6:** 341-350.

Jensen, P. 1982. An analysis of agonistic interaction patterns in group-housed dry sows-aggression regulation through an 'avoidance order'. *Applied Animal Ethology* **9:** 47-61.

Kiley, M. 1973. Delving into pig behaviour. *Pig Farming* **21:** (7), 42-43, 45.

Ministry of Agriculture, Fisheries and Food. 1987. Codes of recommendations for the welfare of livestock: pigs. *Leaflet 702.* Ministry of Agriculture, Fisheries and Food, London.

McGlone, J. J. and Curtis, S. E. 1985. Behaviour and performance of weanling pigs in pens equipped with hide areas. *Journal of Animal Science* **60:** 20-24.

Petherick, J. C. 1983. A biological basis for the design of space in livestock housing. In *Farm animal housing and welfare* (ed. S. H. Baxter, M. R. Baxter and J. A. C. MacCormack). Martinus Nijhoff. The Hague. pp. 103-120.

Putten, G. van and Dammers, J. 1976. A comparative study of the well-being of piglets reared conventionally and in cages. *Applied Animal Ethology* **2:** 339-356.

Schouten, W. G. P. 1986. Rearing conditions and behaviour in pigs. *Ph.D. Thesis, University of Wageningen.*

Sherritt, G. W., Graves, H. B., Gobble, J. L. and Hazlett, V. E. 1974. Effects of mixing pigs during the growing-finishing period. *Journal of Animal Science* **39:** 834-837.

Siegel, S. and Castellan, N. J. 1988. *Non-parametric statistics for the behavioural sciences 2nd ed.* McGraw-Hill.

Symoens, J. and Brande, M. van den 1969. Prevention and cure of aggressiveness in pigs using the sedative Azaperone. *Veterinary Record* **85:** 64-67.

Wilson, E. O. 1975. *Sociobiology — the new synthesis.* Belknap Press, London.

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