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Do domestic pigs prefer short-term to medium-term confinement?

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Abstract

A preference test was used to demonstrate that gilts have the ability to associate two sets of neutral cues with two different periods of confinement and water deprivation and to anticipate the long-term consequences of their choice in the test. Twelve gilts housed in two large, straw-bedded pens were trained to go to two sets of 12 crates, positioned on each side of a choice point, for feeding twice a day. Following initial training, the two sets of crates were marked with contrasting visual patterns and the patterns were associated with either 30 min ('short' confinement) or 240 min ('long' confinement) of confinement in the crates after entry. During 16 days of preference testing, the gilts were sent alternately to one side or the other in the mornings and allowed to choose in the afternoons. Eight gilts chose the short confinement side more often, two, the long confinement side more often and two, each side an equal number of times, indicating that most gilts learned the association and preferred to be released shortly after feeding. However, gilts still chose the long confinement side on occasion, suggesting that they did not find 240 min of confinement very aversive. When the gilts were sent to the crates in the morning, their behaviour indicated that they expected to be released or confined depending on which crate they were in. The cognitive abilities of animals with respect to perception of time and anticipation of future events have important implications for their welfare. This study demonstrates that methods can be developed to ask animals about such things.

Keywords: Cognition; Pig-housing; Preference tests

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1. Introduction

Prolonged or permanent housing of farm animals in close confinement is often criticized as one of the main factors compromising their welfare. However, the terms 'prolonged' and 'permanent' reflect human perceptions of time; little is known of how animals perceive such time intervals. The aversiveness of any confinement may differ considerably depending on how the animals perceive its duration and whether they are able to anticipate its conclusion (Duncan and Petherick, 1991). Also, there may be positive rewards associated with confinement that out-weigh any aversiveness. For example, dairy cows willingly and regularly enter the confines of a milking place, presumably because being milked is more positive than being confined is negative. Another example is the case of hens in a research establishment kept in small pens with trap-nests which trapped hens with their newly-laid eggs so that each egg could be identified with a hen. During the week, when plenty staff were available, hens were released from the nests soon after laying. At weekends, the hens could be trapped in the nests for 20 h without food, water or social contact. However, on succeeding days, and in spite of this apparent 'punishment', they continued to use the nests (Duncan, personal observation). One interpretation could be that the confinement was not very aversive and the hens did not mind being trapped for 20 h. However, it seems more likely that at the moment of nest entry, nesting was all-important and future confinement much less important to the hen. Or perhaps, the hen's ability to anticipate a future consequence and act accordingly is minimal.

The question of an animal's ability to perceive the duration of confinement is especially important for adult female domestic pigs. Domestic pigs are descended from the European wild boar (*Sus scrofa*, L.) which spends about 33–46% of its time active, engaged in foraging, exploring, and interacting socially (von Briedermann, 1971; Mauget, 1981). However, it should be said that when wild boar are supplied with an abundance of food, activity can decrease to 20% of the time (Mauget, 1981). Feral pigs have also been reported to spend a similar amount of time active (Müller et al., 1979) and domestic sows in extensive conditions have been observed walking and foraging for over 50% of daylight observations (Stolba and Wood-Gush, 1989). Domestic sows kept in indoor pens spend less time active, often about 4 h per day (or 17% of the time) (Vestergaard and Hansen, 1984). Nevertheless, even this amount of activity is denied them when they are kept for most of their gestation period in stalls. There is some indirect evidence that long-term confinement of sows in stalls affects their welfare adversely (e.g., Vestergaard, 1984) but it has proved difficult to 'ask' sows what they feel about long-term confinement. As pointed out by Duncan et al. (1993), the state of animals that have been confined for months or years may prevent them from answering such a question.

Because of the difficulties of investigating very long-term confinement, we decided to 'ask' gilts to choose between a short duration and more moderate duration of confinement in feeding crates. We gave the gilts a choice between two conditions which differed mainly with respect to the duration of confinement, which was either 30 min (hereafter called 'short' confinement) or 240 min ('long' confinement). The gilts were not given water after feeding in the crates so that duration of confinement was also

associated with increasing thirst. We followed their preferences and behaviour over time to see whether they would perceive the two situations to be different from each other. If gilts demonstrated a preference for short-term confinement, then we would feel reasonably confident in concluding that gilts have the ability to associate two sets of neutral cues with two different periods of confinement in a preference test and to anticipate the long-term consequences of their choice in the test.

2. Materials and methods

2.1. Animals and housing

We used 12 pregnant gilts averaging 8 months of age at the start of the experiment. They had been housed in pens since birth. They arrived in the experimental barn 1 month before the experiment was due to start as two established social groups of five and seven gilts and these were placed in two large straw-bedded pens measuring 3.1×6.8 m and 3.1×7.9 m, respectively. This gave a space allowance of 4.2 m^2 per gilt for the group of five and 3.5 m^2 per gilt for the group of seven. Each pen was subdivided into a lying area covered with straw and an area with a bare concrete floor for drinking and elimination. Old tires and strips of cloth were added to the pens periodically to provide enrichment. The gilts were fed 2.6 kg of standard pelleted food in two equal portions at 0800 and at 1430 h. During the pre-experimental phase, all the ration was fed in feeding crates, whereas, during the experiment itself, part was given in the home pens and part in the crates (see below). Numbers were painted on the backs of the gilts to make them easily identifiable.

2.2. Testing apparatus

The choice apparatus consisted of 24 feeding crates with solid sides measuring $2.1 \times 0.6 \times 1.0$ m ($l \times w \times h$) 12 of which were positioned to the left side of the choice point and 12 to the right (Fig. 1). The crates were on a bare concrete floor. No water was

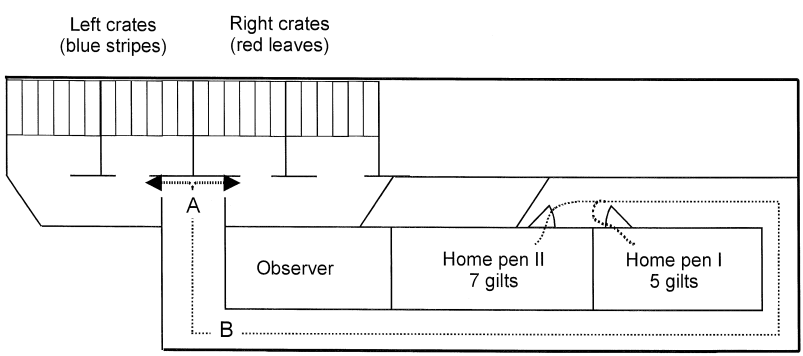

Fig. 1. Floor plan of the testing apparatus. (A) Choice point during the training period. (B) Choice point during the experimental period.

provided in them. During the pre-experimental period when gilts were being trained to go to the crates for food, all walls were painted neutral grey. During the experimental periods, the two lots of 12 crates were equipped with contrasting visual patterns, blue-white oblique stripes on the left and red maple leaves on a white background on the right. The patterns were painted on plywood sheets positioned on the wall in front of the crates, on partitions at the end of the corridors leading to each set of crates, and at the choice point itself.

2.3. Training to feed in crates

During the pre-experimental phase, the gilts were trained to go to the crates for food. Each morning, the gilts were released individually from their home pens according to a random order generated for that day. On alternating days, one set of crates was partitioned off at the choice point [A] (Fig. 1) such that the left set of crates was available on even numbered days and the right set of crates on odd numbered days. In order to reach the choice point, the gilts had to walk 34 m down an alleyway which included several turns (Fig. 1). When a gilt entered a crate, she was locked in by closing the rear gate and the next gilt was released from her home pen. The whole procedure of releasing the 12 animals from the home pens usually lasted between 20 and 25 min. Most gilts ate their ration within 10–15 min. Thirty minutes after being locked in her crate, each gilt was released and herded back to her home pen by a more direct route. A similar procedure was followed during the afternoon feedings, except that the crates on both sides were available and the gilts could choose to go either left or right and enter any unoccupied crate.

2.4. Experimental period 1—association of long and short duration confinements with cues

After the training period ended, the gilts were assigned to two cohorts: Stripe (Left) and Leaf (Right). The cohorts were roughly equally distributed between home pen I and home pen II (Fig. 1). The procedure of going to the crates was the same for both cohorts. However, the time of release of a gilt from her feeding crate depended on the 'match' of her cohort with the side. For example, if a Stripe (Left) gilt was in the Stripe (Left) side crate, she was released after 30 min; if she was in a Leaf (Right) crate, she was not released until 240 min after she entered the crate.

On each of 6 days, every gilt was exposed to both the long and short duration confinement. During the morning feedings, Stripe (Left) or Leaf (Right) sides were closed off in random order on successive days. During the afternoon feedings, the other side was closed off. Each gilt was assigned one crate on each side, and only that crate was open during her turn. For instance, before releasing gilt no. 7 from her home pen, we closed all crates except for crates L7 or R7, depending on whether she was sent left or right for that feeding.

2.5. Experimental period 2—preference testing

Preference testing began immediately following the period of pairing visual cues with long and short durations of confinement. On the mornings of even days, the Leaf (Right)

lot of crates was closed off and all gilts went for their food into the Left crates. The six Stripe (Left) gilts were released after 30 min, whereas, the six Leaf (Right) gilts were released after 240 min. The reverse was true on odd days. During the afternoon sessions, the gilts could choose to go either way. Those which chose their short confinement side (Stripe gilts–Stripe side, Leaf gilts–Leaf side) were crated for 30 min; those that did not were confined for 240 min. Whether a gilt chose the side which resulted in short confinement or long confinement, the consequences were the same during the first 30 min; she consumed the food in the crate and had to stay there. It was not until 30 min later that the consequences began to differ. If she had chosen the side associated with short confinement she went home, whereas, after choosing the side matched with long confinement she remained in the crate for another 210 min.

After 4 days of preference testing, it became apparent that the gilts had developed a left-sided bias during training. The initial training period was scheduled to last 2 weeks, but one of the gilts fell ill and had to be replaced, which prolonged the training phase. By the third week of training, most of the gilts had developed a preference for the left side. Even after Experimental Period 1, when gilts were forced to alternating sides and cues were paired with long or short durations of confinement, the gilts seemed to be overtrained and preferred to go to the left; their journeys to the feeding crates were rapid and fixed and they did not appear to be paying attention to the choice point.

To overcome the gilts' left-sided bias, the testing was interrupted after 4 days and several modifications to the procedure were made. The set-up of the choice apparatus was modified by positioning a solid partition into the original choice point which effectively moved the choice point backwards to the point [B], just before the pigs turned right (Fig. 1). This changed the spatial configuration of the choice point and made it more remote from the feeding crates. Additionally, an iron L-profile measuring 6×6 cm was attached to the concrete floor in the middle of the length of each crate in an attempt to make the period of confinement less comfortable. It was also decided that at each feeding, $2/3$ of the ration would be fed on the floor in the straw-bedded part of the pens, the rest would be given in the crates. This was done to reduce the reinforcement value of feeding in the crates, slowing the gilts' approach to the crates and thus, making the test more sensitive to any possible differences in the aversiveness of the short vs. long durations of confinement.

In addition to changing the spatial arrangement and feeding schedule, the left side was closed off for three feedings and then gilts were given a choice on the fourth feeding over a period of 8 days. All sows were released after 30 min during these 8 days. Following the modifications to the apparatus and the 8-day period of forcing gilts to the right, preference testing began again and continued for a total of 16 days.

2.6. Data collection and analysis

An observer standing in an area behind solid pen walls (Fig. 1) recorded the times when each gilt left her home pen, passed the choice point, and entered the feeding crate. Video-cameras positioned above and behind the two lots of crates recorded the behaviour of the gilts during feeding and confinement for both the morning and afternoon feedings.

The numbers of times that gilts chose the short vs. long confinement and left vs. right sides during the afternoon feedings over the 16 days of testing were recorded. Wilcoxon paired-sample tests were used to determine whether there was an overall bias to the left or right side and to determine any preference gilts had for the side associated with short confinement vs. the side associated with long confinement.

The durations of time gilts took to travel from their home pen to the choice point and from the choice point to the crate were calculated from the records of the morning sessions. Data from morning sessions were used because these data were balanced, in contrast to data from the afternoon sessions, which were unbalanced due to the free choice of side by the gilts. The assumption was that if the gilts perceived entering the side associated with short duration differently from entering the side associated with long duration, it might be reflected in different latencies to enter the crates. The durations were averaged for each gilt for all morning travels to the short confinement crates and again for travels to the long confinement crates. Wilcoxon paired-sample tests were applied to find out whether the gilts were slower to enter long confinement crates than they were to enter short confinement ones.

The behaviour of gilts in the crates during the 5-min interval which occurred 20–25 min after they were locked in was also recorded from the videotapes of the morning sessions. Every 30 s, it was recorded whether each gilt was lying, sitting or standing. This evaluation enabled us to compare the behaviour of gilts on different days in order to assess whether the gilts behaved differently after they had been sent to the long confinement vs. the short confinement side. Any difference might indicate that the gilts were anticipating whether they would be released after a short or a long time. Percentages of observations that gilts were standing, sitting or lying were averaged for days gilts were observed in the short confinement crates, and for days in the long confinement crates. Wilcoxon paired-sample tests were used to determine whether percentages of time in each posture differed between short and long confinement days.

There were indications that the behaviour of the gilts tended to change over time. In order to assess this, we evaluated the preferences, latencies, and behaviour in long

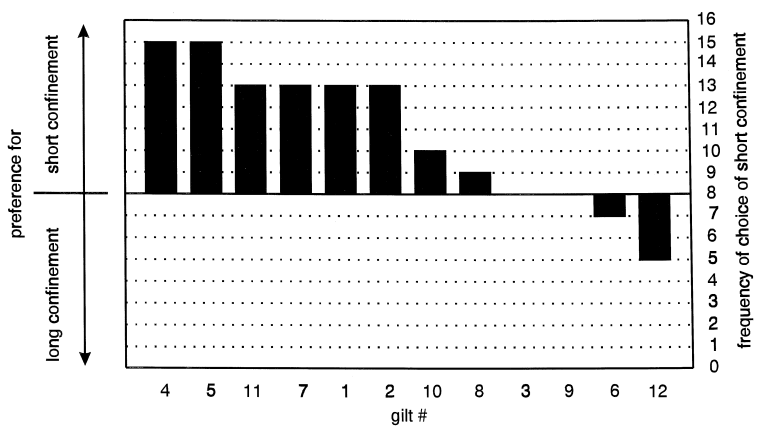

Fig. 2. Frequency distribution of choices by the 12 gilts for the short (or long) confinement crates.

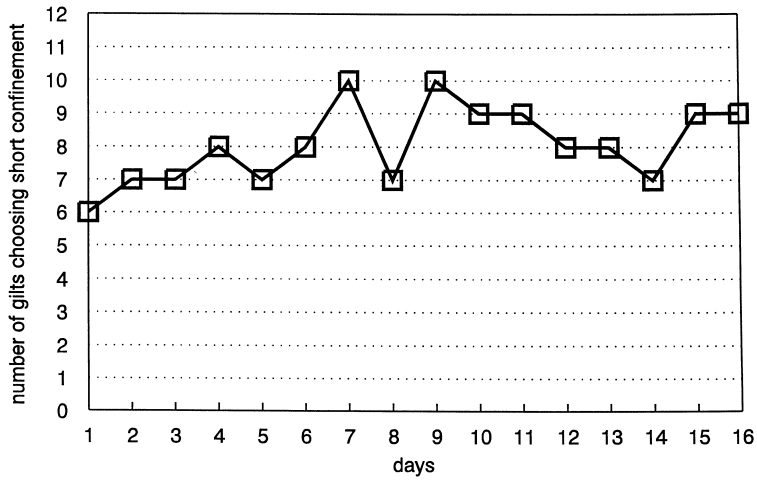

Fig. 3. Numbers of gilts choosing the short confinement crates on the 16 testing days.

confinement vs. short confinement crates for the first 8 and the last 8 days of testing as well as for the entire 16-day period of preference testing.

3. Results

3.1. Preferences

Over the 16 days of preference testing, eight gilts chose the short confinement side more often, two gilts chose the long confinement side more often and two chose each

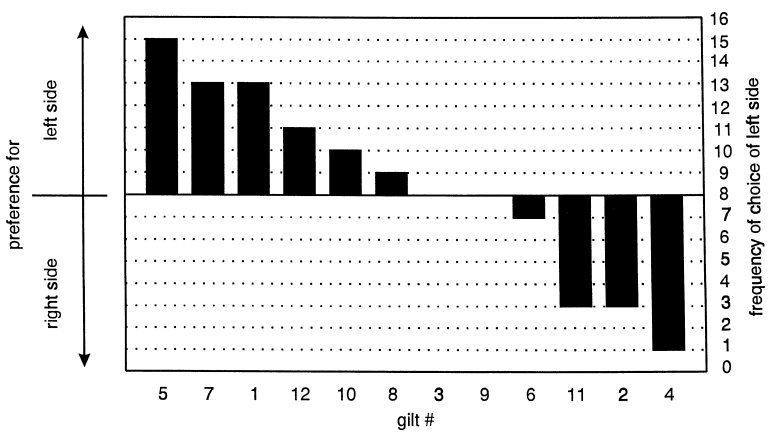

Fig. 4. Frequency distribution of choices by the 12 gilts for left or right side of the choice apparatus.

Table 1
Differences in latencies to reach feeding crates and in behaviour in crates during the interval 20–25 min after being locked in

Variable	Short confinement crates	Long confinement crates	*P*
Travel time from home pen to choice point (s)	42.3	39.7	0.3013
Travel time from choice point to crate (s)	19.7	18.1	0.2661
Proportion of time in crates spent lying	35%	54%	0.0640
Proportion of time in crates spent sitting	37%	30%	0.1099
Proportion of time in crates spent standing	28%	16%	0.1016

Significance levels are results of Wilcoxon paired-sample tests.

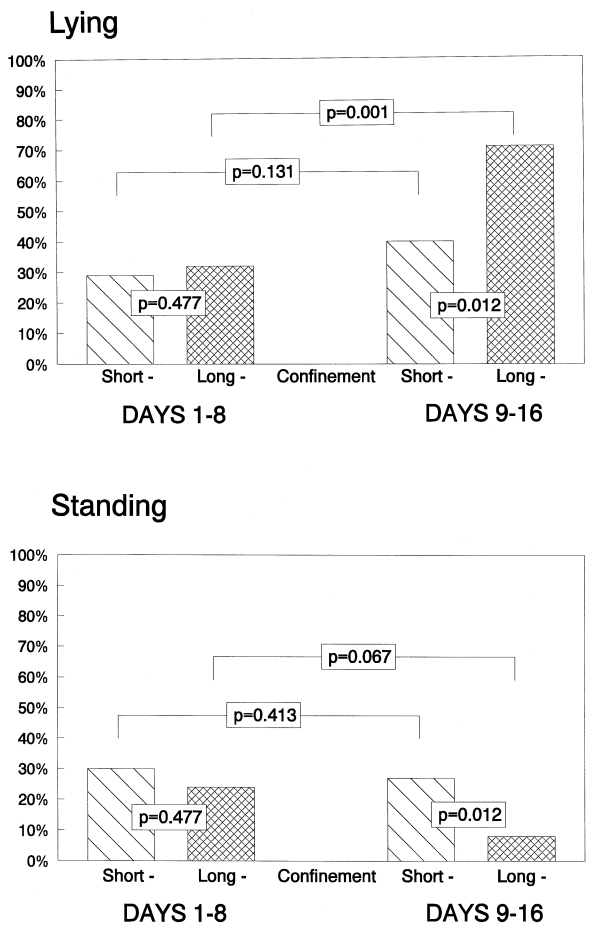

Fig. 5. Proportion of time spent lying and standing (during the interval 20–25 min after being locked in) in the short and in the long confinement crates, during the first 8 and last 8 days of testing. Significance values are results of the Wilcoxon paired-sample tests.

side an equal number of times (Fig. 2). Overall, gilts went to the short confinement side on 67% of choices which is significantly different from the expected 50% (Wilcoxon paired-sample test, $n = 12$, $P = 0.020$). There was a slight increase in the proportion of short confinement choices from first 8 days (62% correct, $P = 0.100$) to the last 8 days (72% correct, $P = 0.023$), but the increase was not significant ($P = 0.459$, Fig. 3).

During the second experimental period, the period of preference testing, there was no evidence of an overall bias for left or right side (52% choices left, $P = 0.76$; Fig. 4).

3.2. Latencies to enter crates

There were no differences in the durations of travelling times from the home pen to the choice point or from the choice point to the crate between the side associated with short confinement and the side associated with long, either during the whole 16 days (Table 1) or during the first and last 8 days of the testing period.

3.3. Behaviour in the crates

There were differences in the behaviour exhibited by gilts on days they were observed in the short confinement crates vs. days they were observed in the long confinement crates during the 5-min interval which occurred 20 to 25 min after being locked in, i.e., 10 to 5 min before each gilt was released (Table 1). Over the 16-day test period, the gilts tended to stand more and lie less when in the short confinement crates. The difference, however, was not present from the beginning. The gilts behaved similarly on both sides during the first 8 days of testing, but differences emerged during the last 8 days of the testing period (Fig. 5). There were few changes in the percentages of time gilts spent lying, sitting or standing in the short confinement crates between the first and the last 8 days (Fig. 5). However, when gilts were sent to the long confinement crates, lying increased from 32% to 71% and standing decreased from 24% to 8% when comparing the first to the last 8 days of the testing period (Fig. 5).

4. Discussion

The gilts displayed an overall preference for the short confinement crates. There was little, if any, change in the distribution of choices during the course of the experiment. This suggests that most gilts learned to associate ‘side’ and visual cues with the duration of confinement during the training phase. They tended to go to the short confinement side more often throughout the experiment, but they often chose to enter the long confinement crates as well. This suggests that the gilts perceived the difference in the durations of confinement and that they generally preferred to be released shortly after eating. However, it also suggests that they did not find 240 min of confinement very aversive. During the initial training phase, some gilts behaved anxiously and struggled against the crates the first few times they were confined, but within a week, all of the gilts appeared to adapt to the crates, readily entered them for feed and waited without struggle to be released.

One interpretation of the visits to the long confinement crates would be to label them as errors in the performance of the learning task. The gilts in our study received a positive food reward immediately after entering either the short or long duration confinement crates. It was not until 30 min after making their choice that the consequence of duration of confinement began. This probably increased the chance that gilts would make errors at the choice point (Tarpy and Sawabini, 1974).

Another explanation for the gilts' visits to the long confinement crates may have to do with their exploring or monitoring the environment (Nicol, 1986). Deliberate visits to a non-preferred site by gilts were observed by Hutson et al. (1993). Their sows clearly preferred a dry floor pen to a wet floor pen, but when they were prevented from entering the wet pen overnight, they consequently visited it markedly more often than previously. Nicol (1986) found that laying hens often spent time in a less-preferred environment and suggested that the hens were motivated periodically to monitor the environment for changes.

Four of the gilts in our study (nos. 3, 9, 6 and 12, Fig. 2) did not exhibit a preference for short over long duration confinement. It is possible that these gilts either did not perceive any difference between the long and short durations of confinement, or, if they did, it was not important to them. It is also possible that they were unable to associate the cues with the consequences, or that they were unable to learn that their choices had consequences, because the consequences, being released or not being released until later, were delayed for 30 min.

One gilt (no. 12, Fig. 2) appeared to prefer the long duration confinement side. For her, the feeding crate on the long duration side may have had some feature whose attractiveness outweighed any aversion to the confinement. We used long-established groups of gilts in the hope that their choice would reflect their feelings on duration of confinement and not their response to social friction in the home pen (Stookey et al., 1996). However, it is possible that this gilt preferred not to return quickly to her home pen for social reasons.

The gilts demonstrated their ability to differentiate between short and long confinement in another way besides exhibiting a preference. This was in the way that they behaved during the interval from 20 to 25 min after being locked in the crate during the morning trials in which they had no choice. During the first 8 days of testing, the gilts lay, sat and stood the same proportions of time during this period when in the short and long confinement crates (Fig. 5). During the last 8 days of testing, the proportion of time spent lying increased from about 30% to about 70% when gilts were confined in the long duration crates. Their behaviour did not change over time in the short confinement crates. This suggests that at the beginning of testing, the gilts anticipated being released from all the crates after 30 min and remained standing or sitting. Over time, they learned that they would not be released from the long confinement crates after feeding and they lay down.

If gilts could perceive a difference between long and short durations of confinement, and if they found the long confinement aversive, then we might expect that gilts would hesitate before entering the long duration crates during the morning trials when they had no choice. Latencies of running a maze have been used as measures of anticipatory behaviour in learning trials with rats (Capaldi et al., 1983). In our study we observed no

differences in latencies to enter the crates when gilts were sent to the short vs. the long duration crates during the morning trials. This supports the notion that the gilts did not find the 240 min of confinement very aversive. Additionally, their anticipation of the food reward overwhelmed any hesitancy to enter the less-preferred crate.

The results are, to our knowledge, the first experimental evidence that gilts can learn to associate external cues (visual patterns and/or direction) with two different periods of confinement in a preference test and are able to anticipate the long-term consequences of their choice in the test. In future studies of this kind, several refinements could be made to our methods. In our experiment, duration of crating was also associated with an increase in thirst, since gilts were not provided water in the crates and had just consumed a dry ration. The gilts may have made the association between cues and the degree of thirst that they experienced during confinement. Nevertheless, they were able to anticipate this experience minutes or even hours in advance and made their choices accordingly. The gilts were also easily over-trained and rapidly developed a preference for the left side of the room. One possible reason for the left side preference was that the pigs were forced to make three right hand turns after leaving their home pen before coming to the choice point. We were able to overcome this side preference (Fig. 4), but in future studies of this type with pigs, shorter training periods and strictly symmetric spatial design are recommended.

No attempts have ever been made to measure a farm animal's perception of time as it might relate to periods of confinement. There is abundant evidence that animals have internal timing mechanisms that help them know the time of day and predict when events may occur (Gallistel, 1994). Animals are also able to learn time intervals between events (Gallistel, 1990). Admittedly, the difference used in this experiment, namely, half an hour crating vs. 4-h crating and water deprivation, does not correspond to situations which commonly occur in practical pig husbandry, and duration was confounded with thirst. Nevertheless, our results demonstrate that methods can be developed to 'ask' pigs what they feel about various durations of confinement.

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