PREFERENCE TESTING OF SUBSTRATES BY GROWING PIGS

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Abstract *Animal Welfare 1998, 7:* 27-34

The preferences of growing pigs for substrates were investigated by giving small groups of pigs a choice between two substrates in each test. The seven substrates examined were concrete, mushroom compost (spent), peat, sand, sawdust, straw and woodbark. Thirteen comparisons of pairs of substrates were tested with four replicates of each comparison. Eleven-week-old pigs (in groups of six) were placed in specially designed choice pens where they had access to two different substrates. The pigs were allowed to habituate to the pen for 1 week and at the end of week 2 the substrates were swapped. In weeks 2 and 3 the time spent by the pigs in each substrate was recorded. Peat, mushroom compost and sawdust were preferred most, with sand next and woodbark and straw being preferred only to concrete. It is suggested that growing pigs may be attracted to substrates which are similar in texture to earth.

Keywords: *animal welfare, behaviour, pigs, preference, substrates*

Introduction

Work by Beattie *et al* (1993) has shown that growing pigs housed indoors and given a substrate to root in, increase the amount of time spent exploring and decrease the time spent inactive and in behaviours directed towards their pen-mates such as chewing ears and tails. This latter behaviour can be persistent and leads to injury which has been unequivocally recognized as a welfare problem (Signoret 1983). The substrate used by Beattie *et al* (1993) was peat; however, a range of alternative substrates might also have produced the same changes in behaviour and consequent improvements in welfare.

Welfare is not an arbitrary measure, it is a characteristic of the animal (Broom 1991). It is only by understanding the motivation underlying behaviour, through 'getting a window' into how the animal perceives its environment, that substantial strides can be made towards improving animal welfare. However, most assessments of welfare are based on what the animal does rather than what it perceives or feels (Gonyou 1994). Welfare research needs to be able to interpret the observable external changes in terms of how the animal perceives. To facilitate this form of interpretation, it is necessary to have an objective method to establish what animals rank as important in their own individual environments (Dawkins 1980; Baxter 1983; Van Rooijen 1983).

Preference testing uses the behaviour of animals to identify how they perceive individual aspects of their environment. However, there are many problems associated with the use of preference tests: firstly the problem of relativity, in that in any preference test the choice is comparative and therefore does not provide information on the absolute qualities of the materials being tested; secondly, an animal's choice in the short term may not reflect the animal's long-term preference (Duncan 1978); and thirdly, social facilitation will influence the choice of an individual animal within a group. These problems are widely considered to be outweighed by the benefits of preference testing, in that preference testing allows the animal to choose (Dawkins 1977, 1988; Hughes 1977).

Material and methods

Treatments and design

Seven substrates were compared. These included insulated concrete, spent mushroom compost (which was obtained from one supplier with the casing layer removed before use) and unchopped barley straw. Peat and wood bark were also used and these were stored in 50l plastic bags prior to use while the sand and sawdust were stored in bulk loads in open-fronted silos. Substrates with high moisture contents (spent mushroom compost, sawdust and woodbark) were dried before testing. The moisture content of the substrates was 340, 460, 500, 130, 20 and 590 g kg^{-1} fresh weight for peat, mushroom compost, sawdust, straw, sand and woodbark respectively. Due to time constraints only 13 of a possible 21 combinations were tested, with four replicates of each treatment (Table 1). The rationale behind the choice of the 13 combinations chosen was determined as the experiment progressed. The first three comparisons tested were peat with straw, sawdust with sand and mushroom compost with woodbark. The three preferred substrates were then tested against one another and the three lesser-preferred were also tested against one another. Spent mushroom compost was then tested against sand and straw to fulfill all comparisons with the other substrates, excluding concrete. The two least-preferred substrates were tested against concrete.

Table 1 Pairs of substrates which were compared.

Treatment	Substrate Pair	
	A	B
1	peat	straw
2	sawdust	sand
3	mushroom compost	woodbark
4	peat	sawdust
5	peat	mushroom compost
6	mushroom compost	sawdust
7	sand	straw
8	straw	woodbark
9	woodbark	sand
10	mushroom compost	sand
11	mushroom compost	straw
12	woodbark	concrete
13	straw	concrete

The test area consisted of a passage 22m long and 1m wide. There was a pen measuring 2x2m at each end of the passage. The floor of one pen was covered with substrate A and the floor of the other pen with substrate B. The depth of all loose substrates was approximately

5cm, as a minimum level. Substrates such as woodbark and straw had at least 5cm depth of material but due to the open nature of the material would have exceeded this in places. A given substrate was placed opposite to its position in the previous replicate. For example, if substrate 1 was initially in pen A and substrate 2 was in pen B for replicate 1, then substrate 2 was in pen A and substrate 1 in pen B for replicate 2 and so on. A feeder supplying both feed and water *ad libitum* was situated at the mid point of the passage, 11m from either substrate area. Each time a pig fed it had to decide which substrate to walk to or whether to remain in the passage. Walker (1991) has shown that growing pigs feed around 20 times a day, therefore these pigs had to make a choice between substrates up to 20 times each day.

Each test lasted 3 weeks. The first week was used as an acclimatization period in which the pigs could experience both substrates. At the end of the second week the positions of the substrates were swapped, with the position of a given substrate changed from one end of the test pen to the opposite end. The house contained four identical test areas which allowed four replicates of any comparison to be carried out simultaneously.

Animals

Three hundred and twelve pigs, the progeny of Landrace sires and 104 crossbred dams from Landrace and Large White origins, were used. For each treatment, four groups each of six pigs, three boars and three gilts, of similar weight were used. Groups were used in preference to individuals to allow for the influence of pen mates on choice (Mench & Stricklin 1990). The group size was determined by the number of animals that could lie together in one substrate area. The pigs were 11 weeks of age when allocated to treatment and were previously housed in fully slatted floor pens with no prior experience of any of the substrates under investigation.

Management

Pigs were tested over a 10-month period beginning in February and ending in November 1994. The pigs were tested in a controlled environment, the temperature of the house being maintained at 18°C by a combination of extractor fans and supplementary heating. Any wet or soiled substrate was removed daily between 0900h and 1000h and replaced with fresh substrate. To avoid any novelty effects, fresh substrate was also added at the same time to the alternative substrate in the comparison. Dunging patterns were recorded once per week. This entailed recording the dispersion of soiled area in relation to the area of the pen. The percentage area soiled in each substrate was averaged across the four replicates for each treatment. Pigs were fed *ad libitum* on a cereal/soya based diet containing 14.2 MJ Digestible Energy kg^{-1} and 13.2 g kg^{-1} total lysine.

Observations

The behaviour of the pigs in each substrate area was recorded using a time-lapse video at 2 frames s^{-1} for the final three, 24h periods of the second and third weeks. The behaviour of the pigs, and in which substrate they were located, was extracted from videotapes by group scan sampling (Fragasky *et al* 1992) at 10min intervals. An inclusive ethogram was not used and only two categories of behaviour were noted. These were 'active' and 'inactive' and the number of pigs in each substrate area performing behaviour within these behavioural categories was recorded. 'Active' was defined as nosing substrate while

standing, sitting or lying, and 'inactive' defined as sitting or lying and not involved in any other activity. The behaviour of pigs in the passage was not recorded.

Statistical analysis

Observational data from all four replicates were used in the analysis, therefore the behaviour score of each group of six pigs, not individual pigs, was used as a data point.

The difference between the mean number of pigs per scan in each substrate area was calculated. This was determined for the number of pigs active, the number of pigs inactive and the total number of pigs in the substrate. Then, *t*-tests were performed to determine if the difference in the number of pigs per scan in the two substrates was significantly different from zero. The standard errors given in Table 2 are those used in these *t*-tests. In addition, the three observational periods in the first week of recording were compared with the three observational periods in the second week of recording to account for any substrate location effects. Further *t*-tests were then performed to determine if there was a significant different between weeks in the number of pigs per scan in the two substrates.

Results

Only significant results are reported in the text. Means and non-significant results are given in Table 2.

In 11 out of the 13 comparisons pigs showed consistency in their choice of substrate after the location of the substrate was changed. However, in the comparison of mushroom compost with sawdust, mushroom compost was preferred (by active pigs) in the first week but sawdust in the second week (Means: week 1, 0.09 pigs scan^{-1}, week 2, -0.10 pigs scan^{-1}; SEM 0.022, $P < 0.05$). In the comparison of straw and concrete, straw was the preferred substrate in both weeks for both active and inactive pigs, although in week 2 the preference was significantly smaller for inactive pigs (Means: week 1, 1.82 pigs scan^{-1}, week 2, 0.39 pigs scan^{-1}; SEM 0.163, $P < 0.05$).

The total number of pigs and the number inactive was greater in peat than in sawdust (total $P < 0.05$, inactive $P < 0.05$) or straw, (total $P < 0.05$, inactive $P < 0.05$). However, in the comparison of peat with mushroom compost only the number of pigs active was greater in peat ($P < 0.01$). The number of pigs in all categories, total ($P < 0.05$), active ($P < 0.01$) and inactive ($P < 0.05$) was greater in mushroom compost than straw while total number of pigs ($P < 0.1$), number active ($P < 0.1$) and inactive ($P < 0.1$) tended to be greater in mushroom compost when compared with sand. When mushroom compost was tested against woodbark only the number of pigs active was significantly greater in mushroom compost ($P < 0.001$). Sawdust was preferred to sand, with the total number of pigs ($P < 0.01$), number active ($P < 0.001$) and inactive ($P < 0.05$) all being greater in the former substrate and there was a trend for greater numbers of pigs to choose sand over straw (total $P < 0.1$, inactive $P < 0.1$). Straw was preferred to concrete as illustrated by total number of pigs ($P < 0.05$), number of pigs active ($P < 0.001$) and number of pigs inactive ($P < 0.1$). The total number of pigs ($P < 0.001$), number active ($P < 0.01$) and number inactive ($P < 0.05$) was greater in the woodbark area when compared to concrete, however, only the number of pigs active showed a preference for woodbark when compared with straw ($P < 0.05$) and sand ($P < 0.05$).

Table 2 **Mean number of pigs, classified by behaviour, observed in each substrate area over a 144h period for each paired substrate comparison (ns-not significant).**

	Substrates compared		SEM	*P* value
	Peat	**Sawdust**		
Active	0.23	0.23	0.037	ns
Inactive	2.80	0.74	0.681	< 0.05
Total	3.03	0.97	0.676	< 0.05
	Peat	**Straw**		
Active	0.29	0.27	0.041	ns
Inactive	3.22	0.91	0.752	< 0.05
Total	3.51	1.17	0.767	< 0.05
	Peat	**Mushroom compost**		
Active	0.30	0.12	0.031	< 0.01
Inactive	1.82	2.02	0.529	ns
Total	2.12	2.13	0.550	ns
	Mushroom compost	**Sawdust**		
Active	0.27	0.28	0.035	ns
Inactive	1.69	1.62	0.565	ns
Total	1.97	1.90	0.584	ns
	Mushroom compost	**Woodbark**		
Active	0.29	0.27	0.002	< 0.001
Inactive	1.97	0.60	0.858	ns
Total	2.26	0.87	0.900	ns
	Mushroom compost	**Sand**		
Active	0.54	0.26	0.100	< 0.1
Inactive	2.59	0.83	0.653	< 0.1
Total	3.14	1.09	0.746	< 0.1
	Mushroom compost	**Straw**		
Active	0.35	0.16	0.030	< 0.01
Inactive	2.60	0.60	0.595	< 0.05
Total	2.94	0.76	0.619	< 0.05
	Sand	**Straw**		
Active	0.22	0.26	0.022	ns
Inactive	3.05	1.16	0.783	< 0.1
Total	3.27	1.42	0.791	< 0.1
	Sand	**Sawdust**		
Active	0.25	0.62	0.050	< 0.001
Inactive	0.81	4.13	0.687	< 0.05
Total	1.06	4.75	0.701	< 0.01
	Straw	**Concrete**		
Active	0.50	0.14	0.047	< 0.001
Inactive	1.18	0.07	0.402	< 0.1
Total	1.67	0.21	0.436	< 0.05
	Straw	**Woodbark**		
Active	0.22	0.41	0.058	< 0.05
Inactive	1.04	1.45	0.774	ns
Total	1.26	1.86	0.825	ns
	Woodbark	**Concrete**		
Active	0.44	0.09	0.023	< 0.01
Inactive	0.26	0.01	0.050	< 0.05
Total	0.70	0.09	0.036	< 0.001
	Woodbark	**Sand**		
Active	0.48	0.25	0.050	< 0.05
Inactive	1.75	2.83	0.874	ns
Total	2.23	3.08	0.909	ns

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Discussion

Providing growing pigs with straw is known to reduce harmful social behaviour such as ear and tail chewing and to increase behaviour directed towards the substrate (Fraser *et al* 1991; Beattie *et al* 1995). In support of these findings, this study has shown that pigs prefer straw to concrete and that pigs performed more active behaviour in the straw area than the concrete area. However, growing pigs preferred all other substrates to straw. Thus it is evident that we shape pig behaviour by the alternatives we provide (Blom *et al* 1993).

Within the range of substrates that were provided, peat, mushroom compost and sawdust were preferred to all others. Of the many different qualities of a substrate there are two likely possibilities for those which may determine the pigs' choice – texture, and moisture content. Peat, mushroom compost and sawdust were of similar texture, however there was a variation of 16 percentage units in moisture content among these substrates. In addition, straw and woodbark, the least preferred of the substrates, had fresh weight moisture contents of 130 and 590 g kg^{-1} respectively. This suggests that particle size or texture played a greater role in determining the preference of pigs than moisture content.

Choice of a substrate is determined by what the animal wants to use the substrate for (Sanotra *et al* 1995). Fraser (1975) claimed that the choice of pigs may be determined by two factors, the need for physical comfort and/or the attractiveness of the substrate to root in. Fraser (1985) demonstrated that pigs only showed a preference for straw bedding over concrete at lower temperatures and concluded that straw was beneficial in the role of thermoregulation but not necessarily the preferred choice for substrate-directed behaviour. This may explain the lack of preference for straw in this experiment, as the temperature was controlled at 18°C possibly eliminating the need for thermal comfort supplied by bedding. Therefore, this leaves the alternative that pigs chose the substrates on recreational value. In more that 50 per cent of the comparisons, pigs expressed similar preferences when active as when inactive. However, for the other comparisons preferences differed between when the animals were active and inactive. Comparisons of woodbark with other substrates showed that pigs preferred woodbark for activity when tested against less preferred substrates such as concrete and sand; but when it was tested against mushroom compost, a preferred substrate, pigs transferred their activity to the latter substrate. Pigs again showed transience in their choice when peat was compared with mushroom compost, activity being transferred from mushroom compost in favour of peat.

This illustrates that pigs, like chickens, have very specific preferences for substrates (Sanotra *et al* 1995). This supposition is supported by work by Mawanjali *et al* (1983). They found that when pigs which had spent their early lives on straw were given a choice of four different floor types, in conjunction with two substrates, straw and sawdust, they worked to get access to sawdust irrespective of floor type. If this is the case, then particle size and texture may be specific key releasers for rooting behaviour (Stolba & Wood-Gush 1984). Pigs evolved in areas of semi-woodland and rooted in the ground for food. Hence, they developed foraging strategies that depend on high levels of exploratory behaviour involving the mouth and snout (Arey 1993). The preference for peat, mushroom compost and sawdust may therefore be due to their similarity in texture to earth.

The choice of the majority of the groups of pigs remained substrate-conservative rather than location-conservative at the end of the second week when the location of the substrates was swapped. This strengthens the argument that the pigs were able to discriminate between

substrates and demonstrate a consistent preference, validating the use of preference testing as a tool for investigating pig perception.

Animal Welfare Implications

The choice of an animal is dependent on the alternatives it is offered. Growing pigs prefer peat, mushroom compost and sawdust to sand, woodbark, straw and concrete. As behaviour involving the mouth and snout are prevalent in growing pigs, irrespective of the environment, providing any substrate will improve welfare (Beattie *et al* 1995). However, providing pigs with substrates of their choice should be one step further towards improving their welfare.

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