



Degree of synchrony based on individual observations underlines the importance of concurrent access to enrichment materials in finishing pigs



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ARTICLE INFO

Article history:

Received 29 May 2015

Received in revised form 26 August 2015

Accepted 30 August 2015

Available online 21 September 2015

Keywords:

Synchronous

Exploratory behaviour

Enrichment object

Feeding regime

ABSTRACT

Pigs are sociable animals with a strong motivation to explore and forage, and it has been stated that they have a strong motivation to do so synchronously. We examined the synchrony of exploration in groups of finishing pigs when enrichment materials were offered. We used a novel measure of relative synchrony for which no artificial threshold for synchrony was needed and which takes into account detailed individual data for calculating expected random synchrony.

One hundred and ninety-two growing pigs were housed in groups of six animals in pens with partly-slatted floors. In two experiments, four enrichment materials each were tested one at a time and, for a given group of pigs, the material was changed every three weeks. Half of the groups were fed twice daily in a restricted manner, the other half *ad libitum*. Exploratory behaviour directed to the material and to the pen was scored. Relative synchrony was calculated as the observed divided by the expected synchrony for two, three, four, five and six pigs behaving synchronously. The expected synchrony was calculated using the daily individual data of each pig. Data were analysed using linear mixed-effects models.

Results showed that relative synchrony for combined exploration (exploring material or pen) monotonously increased with increasing number of animals behaving synchronously in both experiments and reached above-chance values of synchrony at three to four animals. A similar pattern was found for exploring cut straw as litter with maize and cut straw as litter: synchrony increased with the number of synchronously exploring pigs to above-chance values of synchrony for four and more pigs. Relative synchrony for exploring a straw block decreased with increasing number of animals exploring synchronously with all values of synchrony below chance level. Relative synchrony increased for all the other materials (straw rack, chopped straw, chopped *Miscanthus giganteus*, pellet dispenser, bark compost) for up to three to four animals exploring synchronously. For higher numbers of animals, relative synchrony decreased. Above-chance values were reached at three to four animals.

In conclusion, finishing pigs seem to have a strong motivation to explore synchronously in groups of up to six animals. If enrichment material is available and accessible to all animals, they will direct their behaviour to that material, whereas they redirect exploration behaviour to pen structures to achieve a high level of synchrony if access to enrichment material is restricted. The method of calculating relative synchrony based on individual observations and for any given number of animals in a group proved useful.

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1. Introduction

Pigs perform behaviours like resting, exploring and foraging as a group adjusted in size to the available resources

(Rodríguez-Estévez et al., 2010; Stolba and Wood-Gush, 1989), and one can therefore claim that they do so synchronously. However, in intensive housing systems, foraging and exploring are often limited because little material to forage and explore is available and food availability is restricted to short feeding times. Even if enrichment material is provided in sufficient quality (Day et al., 2008; van de Weerd et al., 2003) and quantity (Day et al., 2002; Kelly et al., 2000), this may not be accessible synchronously for all animals (van de

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Weerd et al., 2006; Zwicker et al., 2012). Relatively inaccessible material would therefore restrict the pigs' possibility to follow their presumed motivation to explore synchronously.

When enrichment material is explored by a pen mate, it might become more interesting to other pigs due to social facilitation. Consequently, when more animals are trying to access a spatially limited source of enrichment, competition and aggression could ensue if the enrichment object sufficiently raises the pigs' interest (Scott et al., 2007). Docking et al. (2008) investigated the degree of synchrony in object-directed behaviour in pigs of three ages (suckler, weaner, grower) which were kept in small groups in response to 10 different enrichment materials provided for five days each. They highlighted that the accessibility of enrichment material should be considered in order to avoid competition in groups of pigs specifically in the fattening phase, where they observed a higher degree of synchrony than in other age groups. An adequate ratio of enrichment material in regards to the number of pigs therefore seems important. Studies which investigate this relationship in order to prevent competition or aggression in the pen are quite rare and focused on the level of exploratory behaviour directed towards the material and on redirected, abnormal or agonistic behaviours, and they mention synchrony only in passing (Day et al., 2002; Pedersen et al., 2014; Scott et al., 2007; van de Weerd and Day, 2009; Zwicker et al., 2012).

Former studies assessing behavioural synchrony in groups of animals used a variety of different measures. Many of the studies used an (arbitrary) absolute or relative threshold in respect to the number (e.g. a pair) or proportion (ranging between 12% and 100%) of animals acting in the same way at the same time. If more animals than the threshold showed the same behaviour, they were considered to behave synchronously (e.g. Gibbons et al., 2010; Ruckstuhl and Neuhaus, 2001; Schouten, 1985; Stoye et al., 2012). The choice of such a threshold may heavily influence the observed patterns and complicates the comparison of different studies. Moreover, such a threshold can be reached by pure chance, and therefore any measure of synchrony should be corrected for animals showing the same behaviour by chance (e.g. Asher and Collins, 2012). Approaches such as Kappa coefficients and derived methods (Asher and Collins, 2012; Foerder et al., 2013; Walker et al., 2010), permutations (Docking et al., 2008; Rook and Penning, 1991) and overdispersion (Raussi et al., 2011), or the assumptions that animals would behave randomly (Collins et al., 2011; Daniel et al., 2007) or independently (Engel and Lamprecht, 1997; King and Cowlshaw, 2009; Stoye et al., 2012) have been proposed to correct for random synchrony. Many of these studies calculated random synchrony and the corresponding measures on the basis of a complete group, that is, the group was considered to be synchronous or not at any given sampling time (e.g. Gibbons et al., 2010; King and Cowlshaw, 2009).

In the present study, we investigated synchrony in groups of six finishing pigs in exploring different enrichment materials considering the process of habituation and two feeding regimes. For this, we used the data from Zwicker et al. (2013) and evaluated the synchrony of the pigs in exploring eight different enrichment materials that were provided one at a time. The materials differed, for example, in their accessibility, their palatability, and their structure such as the size of single units of the material. Also, pigs were fed either restrictively or ad libitum. The relative synchrony of the behaviours 'exploring material' and 'combined exploring' (i.e. pooled 'exploring material' and 'exploring the pen') was investigated. Relative synchrony was corrected for chance based on the individual pig data for each observation day. Also, we did not include an artificial threshold for assessing synchrony such as the proportion of pigs showing the same behaviour, but calculated our measure of relative synchrony for two, three, four, etc. pigs showing the same behaviour.

We expected that the relative synchrony of pigs would be highest for the most accessible enrichment materials, which were those used as litter. Accordingly, we predicted that synchrony would be low for spatially restricted point source enrichment objects, for example a compressed straw block. We also expected that the relative synchrony would increase with restrictive feeding because provision of feed was an external signal in this feeding regime per se leading to synchronised satiety which could lead to synchronised exploration due to similar hunger states of the animals.

2. Materials and methods

2.1. Animals and housing

In total, 192 finishing pigs with undocked tails were housed in pens with partly-slatted floors at six animals per pen. The pens had a space allowance of 0.97 m² per pig. Before, the pigs had been housed in deep straw bedding until they were selected for both of the experiments described in Section 2.2 (Zwicker et al., 2013). At the outset of the finishing period, the average (\pm SD) weight of the pigs was 30 \pm 4 kg and 30 \pm 7 kg in experiments 1 and 2, respectively. The experimental groups were balanced with respect to sex and live weight. Water was available ad libitum (for more details see Zwicker et al., 2013).

2.2. Experimental design, foraging materials and feeding regimes

Two experiments (1 and 2) were carried out each with two replicates. In each replicate, eight groups were used, four with restricted and four with ad libitum feeding (i.e. 96 finishing pigs in total per experiment). In each of the experiments, four different enrichment materials were offered to groups of pigs one at a time (Table 1). The straw used as enrichment material was threshed. Litter materials covered the floor when provided. All materials were checked twice daily and refilled as necessary, and were therefore continuously available to the pigs under all experimental conditions.

The four materials per experiment were swapped every three weeks. This was done in a cross-over design such that in each three-week period of the experiments, one group of each feeding regime had the same enrichment material (Zwicker et al., 2013). Restrictively fed groups received their liquid feed twice daily (at 06:40 and 16:25) in a trough, whilst the other groups were fed ad libitum on dry fodder in a two-space tube feeder with the same commercial feed. The Latin square design used ensured that each enrichment material was provided simultaneously to one group in each feeding regime and to two groups in each of the four age categories (first, second, third and fourth three-week experimental period) within the finishing period.

2.3. Behavioural observations

The pigs' behaviour was recorded by video on the second and eighteenth day after provision of a new enrichment material. Data were recorded over the main hours of activity (07:00–11:00 and 14:00–17:00). Video cameras were fitted at the ceiling above the pens. The video recordings were analysed by means of one-minute scan sampling of all pigs, and all pigs were individually marked. It was noted whether each of them showed one of the behavioural elements 'exploring material' (by rooting, nosing, chewing or manipulating the material or the pellets, or by manipulating the chain or the attached scantlings of the pellet dispenser with the snout) and 'exploring pen' (moving the snout along or close to pen equipment, or on the barren floor; see also Zwicker et al., 2013). The former was used to identify the specific exploration behaviour in respect to the material and the pooled data of both behaviours as an overall estimate of exploration ('combined exploration').

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