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Measuring chronic social tension in groups of growing pigs using inter-individual distances

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ABSTRACT

Chronic social stress in pigs compromises immune function, reduces ADG, increases activity and skin lesions and affects feeding behaviour but to different extents in individuals and contemporary groups housed in the same way. Assessing the animals' perception of chronic social stress is difficult. A large inter-individual distance has been suggested to indicate acute stress immediately following regrouping. The current study hypothesised that large inter-individual distances between grower pigs in groups whose composition was stable for 6 weeks would also be predictive of the expression of other traits sensitive to chronic social stress. Group sizes (20 and 80) and feeder space allowances (32.5 and 42.5 mm/pig) were studied in a 2 × 2 factorial design replicated four times to simulate commercially relevant social environments. Inter-individual distances were calculated for individual resting pigs and defined as the mean distance to the nearest resting neighbour (MNND) and mean distance to all other resting group members (MD). Relationships between MNND or MD and potential stress response variates were examined by appropriate linear or generalised linear mixed models. The mean growth rate was poorer in large groups and the mean number of skin lesions was greater in pens with a small feeding space ($P < 0.05$), suggesting that these treatments may have increased social tension, but the effects on the mean proportion of activity ($P < 0.001$) and feeding behaviour ($P < 0.05$) were not in the expected direction. Pigs which spaced at large distances from other group members had high ADG ($P < 0.05$). However, large distances between pigs were associated with a higher mean level of activity ($P < 0.001$) and a lower mean frequency of feeding bouts ($P < 0.05$) and total feeding duration ($P < 0.05$), as would be predicted if spacing behaviour was indicative of social stress. Furthermore, fewer lesions were found when pigs rested at a large distance from their nearest neighbour on days 3 and 21 post-mixing ($P < 0.05$) but, on average, maintained close proximity to other group members in general on day 3 ($P < 0.05$), suggesting that the group as a whole was more tightly clustered. Spacing behaviour, even in the confined conditions of commercial indoor environments, appears to relate to some measures of chronic stress, although the relationship with skin lesions was complex and that with ADG was not in the expected direction. Measuring spatial responses to activation of neuroendocrine stress response pathways or modifying affective state through anxiolytic drug administration could help to validate how spacing behaviour reflects the perception of chronic social stress.

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1. Introduction

Under semi-natural conditions, unfamiliar domestic pigs placed into the same enclosure do not fully spatially integrate until at least 3.5 months following introduction (Petersen et al., 1989; Stolba and Wood-Gush, 1989). Social stress under commercial production conditions in which pigs are unable to avoid close proximity can be prolonged following the initial mixing of unfamiliar pigs. Meese and Ewbank (1972) for example reported the presence of a chronic level of aggression that persisted for at least 80 days after mixing. Séguin et al. (2006) and Turner et al. (2000) also showed that the number of fresh skin lesions, which were believed to be less than 24 h old and largely the result of aggression, remained higher than pre-mixing levels for several weeks after regrouping. Chronic social stress can have negative impacts on growth performance, health and welfare (Stookey and Gonyou, 1994; Hyun et al., 1998; de Groot et al., 2001). However, the severity of this on-going social stress is variable. Individuals and groups of individuals show differences in their aggressiveness, competition for access to limited resources and long-term productivity, despite being housed contemporaneously in very similar environments (e.g. Meese and Ewbank, 1972; Stookey and Gonyou, 1994). The development of methods to measure this chronic level of social tension for an extended period and attempts to understand the causes of variation have received less research interest in pigs than the more acute period of social instability immediately following regrouping. Physiological measurements such as corticosteroid and catecholamine profiles and changes in heart rate commonly used to assess the severity of acute stress tend to return to baseline values when exposure to stress is prolonged and are therefore not sensitive measures of chronic stress (de Groot et al., 2001; Dwyer and Bornett, 2004). Conversely, measurements of anhedonia, cognitive bias, behavioural circadian rhythms and the detailed temporal complexity of behavioural patterns are sensitive to chronic stress but are not easy to measure (Phillips and Barr, 1997; Rutherford et al., 2006; Doyle et al., 2011). Due to the negative impacts of prolonged social stress, a behavioural measure that can be readily assessed and that provides information on the animal's perception of the stressfulness of its long-term social environment would be valuable.

During the days immediately following regrouping, resting pigs space further apart if the likelihood of receiving aggression is high, prolonging spatial integration (Moore et al., 1993; Spoolder et al., 1996; Erhard et al., 1997). For example, Erhard et al. (1997) examined the spatial integration of pigs of known aggressive phenotype following mixing. Those groups composed of low aggression animals showed a greater degree of spatial integration 7 days after mixing than groups composed of aggressive or mixed phenotypes. Based on such observations, spacing behaviour has been advocated as a sensitive, holistic way of assessing the animal's perception of the stressfulness of its social environment during the initial period after regrouping (O'Connell et al., 2004). In particular, it has been suggested to be a more informative welfare indicator than other measures of social stress, such as aggression, whose significance for the animal may be difficult to interpret (Erhard et al., 1997). Variations in spacing behaviour are also present in the months following mixing (Moore et al., 1993; Spoolder et al., 1996; Turner et al., 2003) and there is evidence to suggest that spacing may also be a useful indicator of social tension in more established groups. For example, in a number of species, members of a dyad space furthest apart when they differ greatly in dominance rank, probably as a result of avoidance of dominants by subordinates (chaffinches; Marler, 1956; pigs; McCort and Graves, 1982; hens; Mankovich and Banks, 1982; Keeling and Duncan, 1991; red deer; Pollard and Littlejohn, 1999). Modest increases in the size of established groups of dairy cattle are also associated with long-term increases in both aggression and the distance between animals (Rind and Phillips, 1999) and Japanese macaques locate more closely when levels of social stress are low, as indicated by the intensity of aggression (Zhang and Watanabe, 2007).

Using resting locations of pigs in groups of stable composition during the fifth and sixth week post-mixing, this study examined the relationships between spacing behaviour and other behavioural and performance traits which have been shown to be sensitive to chronic stress. It was hypothesised that large distances between pigs would be associated with a poorer growth rate, disrupted feeding patterns, aggression during feeding and heightened activity levels and skin injuries. Associations between these traits and spacing behaviour would help to determine whether spacing behaviour has value as a sensitive method of observing animal perceptions of long-term social environments. Group size and feeder space allowance were manipulated in order to stimulate social tension to different degrees whilst being representative of systems found in commercial practice. As the distance between individuals is likely to be affected by their behaviour (Keeling, 1995), the study focused on inter-individual distances between resting animals. In addition, individuals are likely to be influenced by not only their nearest neighbour, but by all others in the pen. Consequently the nearest neighbour distance and the mean distance to all other group members were both recorded in the experiment.

2. Methods

2.1. Experimental design

The study was approved by the SRUC ethical review committee. A total of 800 crossbred (Large White × Landrace) grower stage animals (437 males and 363 females; Mean (SD): 29.3 (5.4) kg) were assigned to one of four treatments in a 2 × 2 factorial design replicated four times. The factors were group size (20 vs. 80) and feeder space allowance (32.5 vs. 42.5 mm feeder length/pig). These environmental conditions, which may be found under commercial production conditions, have previously been shown to affect social organisation and feed intake (Turner et al., 2001, 2002) and as such may stimulate chronic stress to different extents. Groups of 20 were formed from the occupants