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Evidence for litter differences in play behaviour in pre-weaned pigs

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ABSTRACT

The aim of this study was to analyse spontaneous play behaviour in litters of domestic pigs (*Sus scrofa*) for sources of variation at individual and litter levels and to relate variation in play to measures of pre and postnatal development. Seven litters of commercially bred piglets ($n = 70$) were born (farrowed) within a penning system (PigSAFE) that provided opportunities for the performance of spontaneous play behaviours. Individual behaviour was scored based on an established play ethogram for 2 days per week over the 3 week study period. We found strong evidence of litter differences in play behaviour ($F_{(6,63)} = 27.30$, $p < 0.001$). Of the variance in total play, 50% was attributable to differences between litters with a lesser proportion (11%) to between piglets within litters. We found similar evidence of litter differences when we analysed the separate play categories (e.g. for locomotor play: $F_{(6,63)} = 27.50$, $p < 0.001$). For social and locomotor play the variance was partitioned in a broadly similar way to total play; however for object play the variance was distributed with a more even balance across and within litters. In terms of explanatory factors we found little evidence that at the litter level differences in play were associated with differences in general activity. Of the prenatal factors measured, we found that birth weight was positively associated with total play and the play categories (e.g. with total play: $F_{(1,64)} = 12.8$, $p < 0.001$). We also found that postnatal piglet growth up to weaning (as a percentage of birth weight) had a significant positive association with total play and the play categories (e.g. with object play: $F_{(1,66)} = 20.55$, $p < 0.001$). As found in other studies, on average males engaged in more social play (e.g. non-injurious play fighting: $F_{(1,63)} = 39.8$, $p < 0.001$). Males also initiated more play bouts on average than females ($F_{(1,62)} = 4.41$, $p = 0.040$). We conclude that the study of differences between litters and individuals provides a robust approach to understanding factors potentially influencing play behaviour in the pig. This work also provides support for the use of play as a welfare indicator in pre-weaned piglets as the litter differences in play we observed were associated positively with physical development.

1. Introduction

Play is a commonly observed and characteristic behaviour of young mammals (e.g. Bekoff and Byers, 1998). Despite difficulties posed by the scientific study of play behaviour (e.g. Burghardt, 2005) it has been and remains a topic of considerable interest in the behavioural sciences (see Graham and Burghardt, 2010; Held and Spinka, 2011 for recent reviews). Recent studies have aimed to understand the function of play (e.g. Cameron et al., 2008), and the mechanisms underlying play behaviour including analyses of the neural networks associated with and potentially causal to play behaviour (e.g. Northcutt and Nguyen, 2014). Play also has applied relevance as it has been suggested as a potential indicator of high levels of animal welfare given that play tends to be expressed only under good or 'optimal' environmental conditions (e.g. Lawrence, 1987; Held and Spinka, 2011).

Pig play behaviour has been described in wild and domesticated species (e.g. Frädich, 1974; Dobao et al., 1985), and generally has similarities to play found in other species of young mammal. For example play in pigs is age-dependant. In a study of play in domesticated pigs (*Sus scrofa*) living in a semi-natural environment (Newberry et al., 1988), play increased in the first 6 weeks of life but thereafter declined to low levels by week 14 of life. As with other species, play behaviour in pigs can be categorised into

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locomotor, object-directed and social play (e.g. Blackshaw et al., 1997). The behaviours that are recognised as play in pigs have some resemblance to adult behaviours (e.g. running; play fighting) but at the same time are recognisably different, being performed in an exaggerated, energetic and repetitive manner (e.g. Newberry et al., 1988).

The study of individual differences in behaviour has become of considerable interest in behavioural science and there is a growing body of literature (reviewed by Bell et al., 2009) reporting that individuals across different species show consistent differences in behaviour (e.g. aggression (Dingemanse et al., 2007), exploratory behaviour (Quinn and Cresswell, 2005)). Individual behavioural differences provide one approach to the study of behavioural genetics (e.g. Turner et al., 2008), to the proximate mechanisms underlying behaviours (e.g. Andari et al., 2014) and to the function of behaviour (e.g. Laskowski and Bell, 2014). Despite the general interest in individual differences in behaviour, there are few studies that set out to specifically look for stable individual differences in play behaviour (see Held and Spinka, 2011). In polytocous species there have been only a few studies studying the consistency of play within and across litters with reports of consistent litter differences in play in cats (Martin and Bateson, 1985) and dogs (Pal, 2010). There have been no similar studies in the pig although a recent study (Rauw, 2013) found that litter of origin was significantly associated with play behaviour in post-weaned pigs.

The aim of this study was to analyse spontaneous play behaviour in pre-weaned pigs for evidence of litter and individual differences in play behaviour and also to estimate the proportional distribution of variation in play behaviour between its different constituents. The pigs were born and reared in an environment that provided opportunities (space and 'enrichment') for the performance of play behaviours. We additionally collected other data on the piglets relating to their pre and post-natal development in order to investigate associations of potential explanatory variables with observed within and between litter differences in play behaviour.

2. Material and methods

2.1. Animals and housing

The 70 piglets that were studied were bred from seven commercial cross-bred dams (Large White × Landrace); the boar-line was American Hampshire. Litters were born within a 4 day time window. Litter size was not standardised and was dependent on biological variation (9–12 piglets per litter in this study). Cross fostering was kept to a minimum and only performed where piglet welfare was considered at risk.

The experimental animals were housed in the *Pig and Sow Alternative Farrowing Environment* (PigSAFE) pens (Edwards et al., 2012). PigSAFE pens allow species-specific behaviours in both the sow and the piglets to be expressed by providing more space and the possibility for provision of straw (1 kg per pen per day, approximately) as a substrate for 'environmental enrichment' compared to conventional farrowing environments (Fig. 1). No other manipulable materials were provided. Temperature within the unit was controlled in accordance to the Defra Code of Recommendations for the Welfare of Livestock (Defra, 2003), and pigs were maintained on a 12 h light/dark cycle. Piglets were managed according to standard farm practice (UK) including iron injection at 3 days of age, vaccination against Porcine Circoviral Disease (PCVD) at 28 days of age and ear tagging for identification at weaning. No tooth clipping was performed and males were not castrated.

2.2. Piglet Measures

Within 24 h of birth piglets were measured manually from crown of the head to base of tail (as reported in Baxter et al., 2008) to within 5 mm. Piglets were also weighed at this stage and at weekly intervals (based on birth date) up to weaning. We estimated ponderal index (PI = weight (kg)/length (m)^3) and body mass index (BMI = weight (kg)/length (m)^2) which have both been shown to be relevant indicators of pre-natal development in the pig (e.g. Baxter et al., 2008). Litter size was the number of piglets that survived beyond the first 2 weeks post farrowing. Post-natal growth was calculated as the percentage change in mass from birth to weaning.

2.3. Ethical approval

This project was reviewed and approved by SRUC (Scotland's Rural College) ethical review committee. All routine animal management procedures were adhered to by trained staff and health issues treated as required. All piglets were returned to commercial stock at the end of the study.

2.4. Experimental Design

The experiment spanned approximately 27 days from farrowing until weaning. Play behaviours were determined largely using an ethogram based on previous work in pigs (see Table 1); non-harmful fighting was included in the category of social play.

2.5. Recording of play behaviours

The animals were digitally recorded from day 1 using Sony LL20 low light cameras with infra-red and a Geovision GV-DVR. Two cameras were set up per pen, one at the rear and one at the front to provide maximal coverage. Piglets were not visible when in the creep box but could be seen at all other times. Behavioural observations were started when piglets were approximately 1 week old and continued with two observations per week (Mondays and Fridays from 0900 until 1300) until the piglets were weaned (six observation days in total).

On observation days (between 0800 and 0900), piglets were numbered on the back with numbers corresponding to their post-farrowing ID's using a black permanent marker. Cameras were set to record and video data analysed for the time period 0900–1300. The time period was chosen to commence after early morning husbandry and to extend for a period that would contain sufficient play bouts for analysis. The collected video material was searched for play bouts, defined as episodes where at least one piglet was observed to engage in playful behaviour. Play behaviour for each individual piglet during these play bouts was then recorded using focal sampling with Noldus' *The Observer XT 11* (Noldus Information Technology bv, Wageningen, the Netherlands) software package. A coding scheme was created, relating each behaviour from the ethogram and every individual piglet with a specific key. Where more than one animal were observed starting a play bout simultaneously, the video was analysed for one animal and then rewound and analysed for the others. All data recorded was in the form of frequency counts. One observer completed all video analysis to remove any reliability issues relating to multiple observers.

2.6. Activity score

On observation days, an activity score for each individual piglet was recorded on an Excel spread sheet during a 5 s window every half hour between 0900 and 1300. Individuals were defined as