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Playful pigs: Evidence of consistency and change in play depending on litter and developmental stage

S.M. Brown[a,*], R. Peters[b,1], I.M. Nevison[c], A.B. Lawrence[b]

[a] University of Edinburgh, Roslin Institute, Penicuik, EH25 9RG, United Kingdom
[b] SRUC, West Mains Road, Edinburgh, EH9 3JG, United Kingdom
[c] Biomathematics and Statistics Scotland, James Clerk Maxwell Building, Peter Guthrie Tait Road, Edinburgh EH9 3FD, United Kingdom

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ABSTRACT

Play behaviour in pre-weaned piglets has previously been shown to vary consistently between litters. This study aimed to determine if these pre-weaning litter differences in play behaviour were also consistent in the post-weaning period. Seven litters of commercially bred piglets were raised in a free farrowing system (PigSAFE) and weaned at 28 days post-farrowing (+/−2 days). Post-weaning piglets were maintained in litter groups in the PigSAFE pen. Analyses have been adjusted for sex both within and between litter as the only statistically significant covariate to play behaviour. Litter differences were observed in locomotor play in both the pre- and post-weaning stage (Pre: $F_{(6,76)} = 5.51$ $P < 0.001$; Post: $F_{(6,69)} = 4.71$, $P < 0.001$) and run (Pre: $F_{(6,76)} = 4.96$, $P < 0.001$; Post: $F_{(6,69)} = 4.58$, $P < 0.001$; the major element of locomotor play). Twenty eight% of the variance for a single observed animal in pre-weaning locomotor play and 26% of variance post-weaning could be attributed to the litter. There was no statistical evidence of differences in social play between litters at either stage with only 8% of pre-weaning variance, and 1% of post-weaning variance being attributable to the litter level. However non-harmful fighting (the major element of social play), showed strong evidence of litter differences in both periods (Pre: $F_{(6,76)} = 2.38$, $P = 0.037$; Post: $F_{(6,69)} = 2.60$, $P = 0.025$), and was the only aspect of the play behaviour to correlate between the pre- and post-weaning periods ($r = 0.765$, $df = 5$, $P = 0.045$). On average play increased post-weaning. Litters showed a 'litter weaning effect' by differing in their locomotor play behavioural response to weaning, measured as the change in locomotor play behaviour from pre- to post-weaning ($F_{(6,70)} = 5.95$, $P < 0.001$). These results generally confirm previous work showing litter differences in aspects of play behaviour in both the pre and post-weaning period. However, there was no consistency in litter differences between pre- and post-weaning periods in the categories of play behaviour with the exception of non-harmful fighting. We demonstrated a 'litter weaning effect' where litters respond as a 'unit' to weaning in terms of their locomotory play behaviour. In general these results add further support to the use of play as a sensitive welfare indicator in neonatal pigs.

1. Introduction

Play behaviour remains a topic of considerable interest in the behavioural sciences (see Graham and Burghardt, 2010 for a recent review). Play has also been proposed as an indicator of animal welfare (e.g. Held and Špinka, 2011), partly on the basis of play being adversely affected by fitness challenges such as loss of nutrition (Muller-Schwarze et al., 1981) and injury (Berger, 1979). Conversely play also responds positively to nutritional supplementation (e.g. Sharpe et al., 2002). The general sensitivity of play to environmental conditions suggests that play has the characteristics of a 'luxury' or 'elastic' behaviour, only being performed when environmental conditions are 'good' and 'proximate needs' have been met (Lawrence, 1987).

Pigs present an excellent model of play behaviour. Play in pigs has been described in wild and domesticated species (*Sus scrofa*) (e.g. Frädich, 1974; Dobao et al., 1985; Pellis and Pellis, 2016), and generally has similarities to play found in other species of young mammal (e.g. Newberry et al., 1988). As with other species, play behaviour in pigs can be categorised into 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

* Corresponding author at: University of Edinburgh, Roslin Institute, Penicuik, EH25 9RG, United Kingdom.
E-mail address: sarah.brown@ed.ac.uk (S.M. Brown).
[1] Current address: University of Aberdeen, Zoology Building, Aberdeen, AB24 2TZ, United Kingdom.

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performed in an exaggerated, energetic and repetitive manner (Newberry et al., 1988). Social play in pigs demonstrates some of the difficulties involved in defining play behaviour as fighting in young pigs can be rough and closely resemble real fighting (e.g. Šilerová et al., 2010).

The study of individual differences in behaviour has become commonly used as an approach to understanding the causes and consequences of behaviour (e.g. Bell et al., 2009). Despite this, few studies have examined individual consistency in play behaviour over time. For polytocous species such as the pig, there is the added complexity that variation in play behaviour can come from the individual or the litter levels. There are reports of consistent litter differences in play in cats (Martin and Bateson, 1985) and dogs (Pal, 2010), and more recently in mink (Dallaire and Mason, 2016). In previous work we have reported on within and between litter differences in the play of pre-weaned domesticated pigs (Brown et al., 2015). Half of the variation in play in our study was attributable to consistent differences over time between litters (50%), with considerably less (11%) arising from consistent differences over time between individuals within litters. In our study (unlike Dallaire and Mason, 2016) there was no evidence that these litter differences were associated with differences in general activity. We also reported a strong positive association between litter differences in play and physical growth.

Weaning under natural conditions is a complex process involving phased reductions in the receipt of maternal investment (e.g. Martin, 1984; Borries et al., 2014). Under experimental and practical conditions (e.g. on farm) weaning is often abrupt, occurring at relatively early developmental periods (e.g. Jarvis et al., 2008). In rodents it is known that early abrupt weaning can have long-term, potentially detrimental effects on social behaviour and anxiety (Shimozuru et al., 2007). In pigs there is much evidence that this abrupt and early weaning poses challenges in terms of development of the piglets' gut and adaptation to solid food (e.g. Wijtten et al., 2011) and also through the physiological and behavioural responses of piglets to the psychological components of weaning (e.g. Weary and Fraser, 1995). Mason et al. (2003) found that there were individual differences in vocalisation responses to weaning that correlated with piglet weight and teat choice; heavier piglets responded to weaning as a nutritional challenge (with 'begging' calls) with lighter piglets responding more as if they experienced maternal separation (with 'separation calls'). Given the sensitivity of play to environmental challenges (see above) it seems reasonable to anticipate that play might be a good indicator of weaning stress.

This study extended our previous research (Brown et al., 2015) to investigate whether litter differences in play existed in both the pre- and post-weaning period and how these litter differences associated with physical development over the weaning event. We hypothesised (a) that there are litter differences in play behaviour in the pig prior to and following weaning imposed at 4 weeks post-partum; (b) that these litter differences in play will reflect the relative changes in developmental trajectory from pre- to post-weaning as measured by physical growth. Confirmation of these hypotheses would further indicate the usefulness of litter differences as an approach to the study of play and provide evidence of play behaviour as a potential indicator of development and welfare.

2. Material and methods

2.1. Ethical review

All work was carried out in accordance with the U.K. Animals (Scientific procedures) act 1986 under EU Directive 2010/63/EU following ethical approval by SRUC (Scotland's Rural College) Animal Experiments committee under ED AE 05-2015. 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.

2.2. Animals and housing

Pre- and post-weaning behavioural observations were carried out on litters from seven commercial cross-bred dams (Large White x Landrace); the boar-line was American Hampshire. Litters were born within a 72 h time window. Eighty three piglets were used in the study. Litter size was not standardised and was dependent on biological variation (11–13 piglets surviving until weaning per litter in this study). Sex ratios were not standardised with percentage of males range 15%–75% (mean = 48%). Cross fostering was kept to a minimum and only performed where piglet welfare was considered at risk, at which point piglets were fostered off the trial sow and on to the recipient sow within 24 h of farrowing. Pre-weaning mortality was 2.5%, with no piglet losses beyond 48 h after birth.

The experimental animals were housed in the *Pig and Sow Alternative Farrowing Environment* (PigSAFE) pens (Baxter et al., 2015) from birth through to 8 weeks of age (4 weeks post-weaning). PigSAFE pens allow species-specific behaviours in both the sow and the piglets to be expressed (Baxter et al., 2015) by providing more space and the provision of straw (1 kg per pen per day approximately). All pens have barred sections in the dividing walls allowing sows and piglets to see and touch those in neighbouring pens. Sows were of parity one or 2 with no prior experience of PigSAFE pens. Temperature within the unit was automatically controlled at 20 °C from birth until 1 week old, then reduced to 18 °C from 1 week to weaning, in accordance to the Defra Code of Recommendations for the Welfare of Livestock (Defra, 2003). Additional heat was provided in the creep area via under-floor heating at 30 °C. At weaning room temperature was increased to 22 °C with the creep temperature allowing additional heat source. Artificial lighting was maintained between the hours of 0800–1600 with low level night lighting ensuring Defra codes were adhered to. Piglet management included weighing at birth and a standard iron injection at day 3 post-partum. No teeth clipping, tail docking or castration was performed. Piglets were ear tagged for identification at both birth and at weaning. Sows were fed according to a standard feeding curve prior to farrowing (Baxter et al., 2015) and fed to appetite from approximately 2 days post-farrowing. Sows and piglets had ad libitum access to water. At weaning sows were removed from the pen and returned to the sow house while piglets were weighed and vaccinated against Porcine Circoviral Disease (PCVD). Litters remained intact in PigSAFE pens until the end of the study period (8 weeks of age) when they were moved to commercial farm stock. At approximately day 21 of age piglets were introduced to "creep feed" (Primary Diets DQ63P SL Silver pellets with no additional additives, AB Agri Ltd., Yorks, UK). Between 28 and 35 days of age piglets were gradually moved onto Primary Diets Prime Link Extra (pelleted, AB Agri Ltd., Yorks, UK). This was provided ad libitum post-weaning. Piglets were provided with additional drinkers post-weaning.

2.3. Piglet measures

Piglets were weighed within 24 h of birth. Piglets were subsequently weighed at days 5, 14 and 21 post-farrow, at weaning and when moved to farm stock at 8 weeks of age. For statistical purposes litter size pre-weaning was taken as the number of piglets that survived to weaning. No piglet losses occurred post-weaning. Piglet growth in the pre- and post-weaning periods are displayed as average daily gain (ADG). ADG was calculated as (end period weight-start period weight)/number of days and is presented in grams.

2.4. Recording of play behaviours

The animals were digitally recorded from birth in their home pen using Sony LL20 low light cameras with infra-red (RF Concepts Ltd, Belfast, Ireland) and a Geovision GV-DVR (Geovision GV-DVR, ezCCTV Ltd, Herts, UK). Two cameras were set up per pen, one at the rear and