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# The identification of potential behavioural indicators of pain in periparturient sows

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ABSTRACT

Periparturient pain is a welfare concern and could contribute to piglet losses. This has led to studies investigating post-farrowing analgesia. A clear reduction in pain has not been demonstrated, partly due to a lack of pain indicators. This study quantified behaviours as potential pain indicators (PPIn) in sows: i) before, during and after farrowing, and ii) 2 min before and after piglet births. Twenty-five sows were observed during and after, and ten pre-farrowing. Behaviour recorded included: 1) back leg forward (back leg pulled forward and/or in); 2) tremble (movement as if shivering); 3) back arch (leg(s) stretch forming an arched back); 4) paw (leg scraped in pawing motion); and 5) tail flick (tail moved rapidly up and down). Behaviours were analysed using generalized linear models and Spearman's rank correlations. All PPIn were rare or absent pre-farrowing, highest during farrowing, and back leg forward, tremble and back arch were greater in the early post-farrowing period. Several significant positive correlations between PPIn during and post-farrowing were found. Back arch, tail flick and paw were higher before than after a piglet birth, and were more frequent earlier in the birth order. Back leg forward and tremble did not differ before and after births, and tremble increased with birth order. These behaviours, which were absent or rare pre-farrowing, present during farrowing and were lower afterwards, and showed consistent individual variation, may be quantitatively associated with pain. Spontaneous behaviours could be used to test the efficacy of analgesics or identify sows that may benefit.



## 1. Introduction

A key component of farm animal welfare, where possible, is freedom from pain, injury or disease (FAWC, 1979), yet farm animals may experience pain during their lifetime. For breeding females, this includes parturition, which in the life of human females is often the most painful event ever experienced, as 60% of primiparous and 45% of multiparous women report severe or extremely severe pain (Melzack, 1984). Scientists studying pain in non-human animals can only assume that pain is likely to be present due to the presence of anatomical structures and physiological processes associated with pain, the fact that animals respond to noxious stimuli by avoidance and to minimise damage, sometimes involving complex behavioural responses, and that analgesics modify the response to stimuli thought to cause pain (Bateson, 1991; Sneddon et al., 2014).

Previous studies on stress and pain at parturition in pigs indicate pain is likely to be present (reviewed by: Mainau and Manteca, 2011). A rise in the stress hormone cortisol (Gilbert et al., 1996; Jarvis et al., 1998, 1999a) and an increase in the endogenous opioid β-endorphin are present at parturition (Jarvis et al., 1999b, 1998). These increases took place in different farrowing environments and with the use of an opioid antagonist, indicating that parturition is likely to be stressful and painful in itself. In addition, an opioid-mediated increase in nociceptive threshold in response to a noxious thermal stimulus was present in late gestation and at parturition, providing evidence for an endogenous defence against parturition pain (Jarvis et al., 1997). More recent studies have shown the provision of non-steroidal anti-inflammatory drugs (NSAIDs) post-farrowing produce some improvements to sow health, welfare and productivity (Homedes et al., 2014; Mainau et al., 2012; Sabaté et al., 2012; Viitasaari et al., 2014, 2013). For instance, differences in sow posture and activity levels with the post-farrowing administration of NSAIDs have been shown. Sows treated with meloxicam spent less time lying on the third day following parturition (Mainau et al., 2012) and younger sows (parity 2–3) treated with the ketoprofen were more active post-farrowing than younger sows given a placebo (Viitasaari et al., 2014). However, standing behaviour was not altered with meloxicam treatment in another study (Tenbergen et al., 2014). More detailed behaviours may be better indicators of pain in assessing the efficacy of post-farrowing NSAIDs. Post-farrowing NSAIDs also produce benefits for piglet welfare and performance. Piglet mortality was reduced in sows given ketoprofen (Homedes et al., 2014) and on a farm with a high incidence of post-

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partum dysgalactia syndrome (Sabaté et al., 2012). Meloxicam increased average daily gain (ADG) of low birthweight piglets (Mainau et al., 2012), and an oral dose improved immune transfer to piglets, as well as increasing ADG and weaning weight (Mainau et al., 2016). Additionally, oral meloxicam administered to the sow, provided a therapeutic dose to piglets, which reduced indicators of pain associated with castration and tail docking (Bates et al., 2014).

The detailed measurement of spontaneous behaviour was included in a range of studies investigating pain associated with painful management procedures such as tail docking and castration in pigs (O'Connor et al., 2014). Pain specific behaviours associated with parturition were quantified in other polytocous species (rats: Catheline et al., 2006; Tong et al., 2008; mice: Mirza et al., 2013). These behaviours included inward turning of one of the hind paws, squashing the lower abdomen and legs towards the floor, asymmetrical contraction of the lower abdomen, elongation of the abdomen and legs and a humped back posture. These behaviours are likely related to pain and do not simply aiding the muscular movement of the fetus along the birth canal, as they were significantly reduced by epidural morphine administered when these behaviours were first seen, indicating the start of painful uterine contractions (Catheline et al., 2006). Spontaneous behaviours were also reduced in a dose dependent fashion with an intrathecal morphine infusion, administered one day before delivery, with all but the lowest dose showing significantly fewer behaviours than those given saline (Tong et al., 2008). In mice, pain-behaviours were also reduced in a dose-dependent manner with a systemic morphine infusion, without altering behaviour not thought to be pain-related, indicating that the behaviours were not reduced due to a sedative effect of the drug (Mirza et al., 2013). These behaviours were also associated with pain from uterine contractions as they began prior to fetal expulsion and their frequency increased with the administration of subcutaneous oxytocin, which increases the frequency and intensity of contractions (Catheline et al., 2006).

Although previous studies indicate pain is likely to be present, the severity of pain experienced around parturition in pigs and the impact on welfare and production of sows and piglets has not been fully explored. Given that farmers and veterinarians rated normal farrowing as painful (3.8 and 4.5 out of 10 respectively) and difficult farrowing as highly painful (6.7 and 7.3 out of 10 respectively) and farmers considered 5.3% of gilts and 3.7% of sows to have difficulty farrowing (Ison and Rutherford, 2014; Ison et al., 2016), the study of pain at parturition in pigs deserves further investigation. To our knowledge, potential behavioural indicators of pain at parturition in the pig, like those observed in the rodent studies, have not previously been measured. Therefore the aim of this study was to construct an ethogram of behaviour seen during farrowing and to measure these: i) before, during and after farrowing, and; ii) immediately before and after individual piglet births, as potential indicators of pain. These behaviours could then be validated as behavioural indicators of pain, to assess the benefits of providing pain relief around farrowing, to recognise individuals for the targeted use of drug treatment. In addition, pain assessment measures could be used to evaluate whether pain increases with other aspects, for example, litter size, breed or with the use of exogenous oxytocin, which is frequently given to periparturient sows (Ison et al., 2016).

## 2. Materials and Methods

Experimental procedures were undertaken in compliance with EU Directive 2010/63/EU and following approval by the Animal Welfare and Ethical Review Body (AWERB) at SRUC (Scotland's Rural College).

### 2.1. Animals and Housing

Twenty-five home bred Large White × Landrace sows, ranging in parity from 2 to 8 (mean = 3.88), housed at the SRUC pig research farm were used in this study. Sows, housed in group pens of up to six individuals were artificially inseminated when signs of oestrous were detected and the expected farrowing date was calculated at 115 days following insemination. No more than five days before the expected farrowing date, sows were moved into conventional farrowing crates (1.8 × 0.5 m), with solid concrete flooring (1.8 × 1.5 m), a small slatted area at the back (0.5 × 0.5 m) and a water and feed trough at the front. Piglets had access to a heated creep area (1.5 × 0.65 m) in front of the water and feed trough. Sows were fed a standard pelleted lactation diet consisting of 16.4% crude protein, 6.8% crude oils and fats, 4.0% crude fibre, 5.8% crude ash, 13.8% moisture, 0.8% calcium, 0.94% lysine, 0.25% methionine, 0.51% phosphorus and 0.22% sodium (DL66P Scotlean lactator sow pellets, ABN, Peterborough, UK) twice daily at 0745 and 1530 and had continuous access to fresh water. Individuals were fed 2.5 kg per day before farrowing, which was adjusted slightly based on body condition and increased gradually, based on appetite to up to 10 to 12 kg a day by weaning. Sow pens were mucked out daily at the morning feed when they were provided with two handfuls of fresh, long-stemmed straw, as roughage and nest building material. Additional straw was added at the afternoon feeding time to ensure sow's had access to nest building material and muck was removed in the afternoon on the days leading up to farrowing. Lights were switched on immediately before the morning feed and turned off at 1600 and an additional night-light was provided in the centre of each room of six crates.

### 2.2. Behavioural Observations

Closed-circuit television (CCTV) cameras (LL20, infra-red cameras, FR concepts, Ireland) were mounted above each farrowing crate to record behaviour using GeoVision Digital Surveillance System software (ezCCTV Ltd., Herts, UK). Digital video footage was collected and stored to be analysed later using The Observer XT 9.0 (Noldus Information Technology, Wageningen, The Netherlands). All 25 sows were observed continuously from the birth of the first to the last piglet and then for

**Table 1**
Ethogram of behaviours observed during the study. Behaviours were recorded as duration in seconds (state) or frequencies (event).

| Behaviour | | Description | State | Event |
|---|---|---|---|---|
| Posture | Stand | Upright, with all feet on floor | ✓ | |
| | Sit | Front legs straight and back end down on the floor | ✓ | |
| | Kneel | Front knees on the floor, with back legs straight | ✓ | |
| | Lie lateral | Lying on one side with udder exposed | ✓ | |
| | Lie ventral | Lying with the udder on the floor | ✓ | |
| Other behaviour | Tremble | Visible shaking as if shivering when in a lateral lying position | ✓ | |
| | Back leg forward | In a lateral lying position, the back leg is pulled forward and/or in towards the body | ✓ | |
| | Back arch | In a lateral lying position, one or both sets of legs become tense and are pushed away from the body and/or inwards towards the centre, forming an arch in the back | | ✓ |
| | Tail flick | Tail is moved rapidly up and down | | ✓ |
| | Paw | In a lateral lying position, the front leg is scraped in a pawing motion | | ✓ |
| | Piglet birth | A piglet is fully expelled from the sow | | ✓ |