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Using air-blow and floor vibration to trigger posture changes in gestating and lactating sows

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ABSTRACT

Recent approaches to minimise piglet crushing are usually active interventions in the behaviour of the piglets or the sow. However, interfering pig behaviour with the help of actuators has rarely been studied with respect to suitability, effectiveness and impact on animal welfare. In this study floor vibration and air-blows as methods to trigger posture changes have been tested on 12 sows in their late gestation and early lactation period. The intention was to quantify the effectiveness and unwanted side effects such as panic reactions as well as effects on neighbouring sows when applied in regular farrowing pens. The observed variables were reactivity, with reaction defined as posture change from lying to sitting, reaction latency and recline latency. In most cases, a reaction was achieved within 25 s and the arousal ceased in less than two minutes. In 22% of all stimulations the reaction latency was lower than 3 s, which could suggest an alarm reaction. The reactions of neighbouring sows could not be distinguished from natural occurring spontaneous posture changes and no low latency reactions were observed here. The sows in the late gestation phase showed a high reactivity on both actuators of about 80%. After farrowing, the reactivity was reduced to about 50% and nearly no low latency reactions could be observed. Hence, actuators need to be scalable to the individual reactivity level of the specific sow. This level is a complex variable that not only depends on the sow's age and individuality but also on its antecedent and current state. The examined actuators can be dynamically adapted to the individual reactivity level. Together with a posture tracking system and a piglet stress monitoring system, such as the stress monitoring and documentation system STREMODO, this would allow an active piglet crushing intervention. With further research on the effect on piglets this technology might be usable with farrowing crates as well as in loose-housing farrowing systems.

1. Introduction

There is an on-going dispute to what extend intensive captive breeding is responsible for piglet crushing. The increased litter size of modern breeds and subsequently lowered birth weights accompanied by a prolonged parturition are widely accepted as major risk factors. This might be worsened by confining the sows in farrowing crates which seems to result in an impaired maternal behaviour due to hindered nest building behaviour and piglet contact. On the other hand, increased piglet mortality in an early lactation stage is a central part of the evolutionary strategy of sus scrofa (reviewed in Edwards, 2002). Methods for piglet protection originated in the late 19th to early 20th century starting with fenders (Sommer, 1920) and somewhat later farrowing crates (Barker, 1929). At this time, pig breeding was recommended in free ranging groups on pasture, with open straw bedded shelters (Potter, 1912). Such housing conditions would be called extensive today (e.g. Temple et al., 2011). Given the natural reproduction strategy and current physique of domesticated pigs, it seems even modern extensive breeding could not provide means to avoid piglet crushing altogether. Even pigs with a less commercialisation oriented physique, as it was the case 100 years ago, were obviously not exempt from piglet crushing. Thus, measures complementing the sow's nursing behaviour in their respective husbandry conditions are eligible in any case with respect to piglet welfare.

The most recent approaches to minimise piglet crushing are usually active interventions in the behaviour of the piglets or the

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sow. However, interfering pig behaviour with the help of actuators has rarely been studied so far with respect to suitability, effectiveness and impact on animal welfare. There are some studies on the general sensory responsiveness of pigs. These studies show that sows react little on olfactory stimulation, but show distinct aversive reactions on some visual, acoustic and tactile stimuli (Cronin and Cropley, 1991; Hutson et al., 1993; Talling et al., 1996). On the other hand, some tactile stimuli such as umbrellas and prods can even cause attraction (Hutson et al., 2000). A few studies investigated commercially available actuators. Friend et al. (1989) tested the effectiveness of the commercial ELARM system. This system recognised piglet crushing by monitoring the piglet vocalisation for typical patterns in volume and duration. In case of a supposed crushing event, a posture change of the sow was triggered by administering 100 V shocks through electrodes in a heart girth attached to the sow. This was successful in all five crushing events throughout the study. A different approach targeting the piglets has been reported by Jeon et al. (2005). Here, posture changes of the sow were monitored using photo sensors. In case of reclining, an air-blow was administered underneath the sow to displace the wind chill sensitive piglets. This method resulted in a significant reduction of crushed piglets.

We have tested stimulations with heat, different sounds such as white noise, sinus tones of different frequencies, sow "barks", door slapping and different intensities of floor vibration and air-blows in order to find an actuator that can trigger posture changes in adult sows. From these small-scale screening tests on juvenile sows, the most effective methods – floor vibration and air-blows – have been selected to quantify their effectiveness and unwanted side effects when used with middle-aged gestating and lactating sows.

2. Material and methods

2.1. Animals and housing

The study was conducted in the experimental pig unit of the Leibniz-Institute for Farm Animal Biology (FBN), Dummerstorf, Germany. The sows (German Landrace) were housed in two separate farrowing compartments, each containing six farrowing pens (model Scan, Jyden-Dantec, Denmark). Once for each trial run, four sows were selected for treatment from a group of twelve. The remaining sows were not treated but housed in the same compartments. The sows were located in a way that next to each treated sow two untreated sows were kept in the neighbouring farrowing pens. Both treated and untreated sows were distributed equally over the two compartments. The behaviour of the untreated sows was evaluated for indirect effects from noise and vibration of the corresponding treatment. All in all, 12 sows were treated and the behaviour of 24 untreated sows was observed in three successive trial runs.

One farrowing pen measured 3×2 m of slatted floor and was equipped with a trough, nipple drinkers for the sow and the piglets and with a variable restriction. A detailed description of the pen and the management system used can be found in Stabenow and Manteuffel (2002). During each trial, the treated sows were restricted for the time of the experiments and held unrestricted otherwise until the farrowing. After farrowing, the treated as well as the untreated sows were permanently restricted for one week. The animals were fed manually at 7:00 a.m. and 12:30 p.m. using pelleted feed for gestating and lactating sows respectively. Water was provided ad libitum. All tests were performed in accordance with directive 2010/63/EU and with permission from the animal care and use committee of the country.

2.2. Selection of the treated sows

On day zero, the sows were weighted and then transferred from the gestation to the farrowing compartments. Along the way, the sows were checked for lameness and other leg injuries or abnormalities. In addition, the general health state of the sows was visually assessed by looking for discharge from nose and eyes, peculiar breathing and by checking the attentiveness, the claws and the leg posture. Sows that seemed to be ill, were lame or had severe leg wounds were not selected for treatment. Furthermore, a basic visual inspection was carried out on each trial day. For sows that developed illnesses, lameness or injuries during the trial, the treatment was stopped and the data excluded from evaluation. Also, only sows having the second or third gestation were taken into consideration for treatment in order to gain a comparable weight and reactivity. The average weight of the sows was 265 ± 34 kg (SD).

2.3. Experimental setup

The two farrowing compartments were differently adjusted for the experiments. The air-blow compartment was equipped with a 30 m flexible force main (6×8 mm polyamide) and a blow gun (model Typhoon, CoilhosePneumatics, USA). This blow gun was equipped with a 600 mm extension pipe and the Coilhose standard nozzle for this model (Fig. 1B). A 24 l mobile compressor (model BT-AC 200/24 OF, Einhell Germany AG, Germany) was used to supply the blow gun with pressurised air at 6 bar. The compressor was placed outside of the compartment to lower the influence from its compression noise.

In the floor vibration compartment, one floor segment of each of the two trial farrowing pens was equipped with a 12 V direct current vibration motor scaled down to 12% of its original

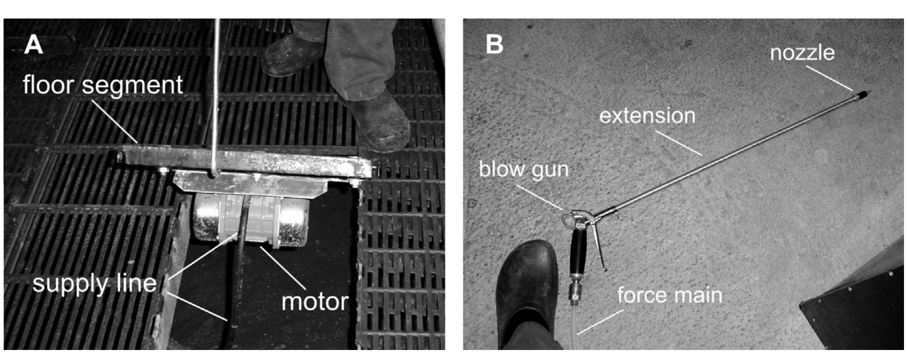

Fig. 1. Installation of the floor vibration and the air-blow actuator. Image (A) shows the floor segment holding the vibration motor during its inset into the slatted floor. Image (B) depicts the blow gun and its extension pipe.