

## **Sensory stimuli and the effect on pig welfare**

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Sensory stimuli such as olfactory, auditory or visual cues can be used in communication between conspecifics with the function to elicit responses in the receiver (Manning and Dawkins, 2012). These signals can also cause emotional contagion from one animal to another.

Several researchers experiment with different types of sensory stimuli to study their effect on the behaviour, emotions and production indicators on pigs.

Understanding ways in which pigs can be influenced through sensory stimuli can contribute to improving animal welfare standards, guidelines and evaluation protocols. Therefore, this short overview will investigate research methods on the effect of olfactory, auditory and visual stimuli on behaviour, emotion and production indicators in pigs. Furthermore, it will be argued that they should be enhanced.

### **The effect of olfactory stimuli**

Pigs have a highly sophisticated olfactory sense which plays an important role in communication and emotional contagion (Vieuille and Signoret, 1992). Natural behaviours such as exploring the environment, as well as feed intake and weight gain of weaned pigs of 3 or 4 weeks of age improved when exposed to a synthetic scent of sow skin secretion. Also, reduction of fighting and time lying down was observed versus a control group (McGlone and Anderson, 2002). Although in some circumstances, a certain level of aggression among conspecifics is important for optimal social development, fighting in general is regarded as unwanted. Furthermore, in a review on pheromone stimulation, Wells (2009) described positive effects of pheromone therapy on weight gain of piglets who were regrouped after weaning and also on the reduction of aggression. These studies show the possibility to improve the welfare of pigs via scent.

Furthermore, the fact that Wells (2009) mentioned that suckling piglets stop drinking upon removal of the scent of maternal pheromones of their lactating mothers, confirms the importance of olfactory stimuli on welfare.

One could be triggered by such publications to wonder if there are more animal-friendly ways to measure olfactory influence than to remove the smell of a piglet's mother, as this is likely to cause stress for the animals. Is it really necessary to reduce animal welfare to conduct such research? It can be argued that there already are piglets that have no maternal scent: those that need to be artificially fed due to the fact that the number of piglets regularly exceeds the number of teats on a sow (Kobek-Kjeldager *et al.*, 2020). These piglets can also be used as study subjects, and perhaps even in a more animal-friendly experimental set-up: by adding artificial mother's scent. This way, the same information can be collected on the influence of maternal scent, but by addition instead of removal of something positive.

Pigs latency to feed from a food dispenser is increased by the scent of urine of a conspecific that previously had been stressed and/or aggressive, versus control urine of unstressed pigs (Vieuille and Signoret, 1992). Such studies could also be done differently. As pigs are stressed at several times in their productive cycle due to regrouping or management procedures such as tail docking (Martínez-Miró *et al.*, 2016), it seems more animal-friendly of a researcher wanting to measure the effect of smell on pigs, to do so on those moments, instead of introducing more moments of stress and reduced welfare in test situations.

Another example of research on the effect of olfactory stimuli on newborn piglets was conducted by Rohde Parfet and Gonyou (1991), who tested the attraction of birth fluid, sow's milk (maternal odours) and water. Results show a preference for maternal odours as the piglets would spend more time in contact with birth fluid and sow's milk compared to water. As this research is only focused on piglet attraction to olfactory stimuli immediately after birth, it is not known if these maternal odours will also be important later in life. It is reasonable to think that such effects change with age, as can be seen for vocalizations (Puppe *et al.*, 2003).

### **The effect of auditory stimuli**

Pigs also use different frequencies and durations of vocalization while communicating about play or alarming situations (Murphy *et al.*, 2014).

Although few studies have been conducted on these signals as a measure of emotion among pigs, as well as the possible contagious effects of these sounds on conspecifics, there are some experimental results that show that vocalizations of one pig can affect the behaviour of another.

In an experiment with juvenile pigs at six weeks of age, Dupjan *et al.* (2011) found no evidence for direct effects of aversive stimuli, i.e. audio playbacks of distress calls of unfamiliar conspecifics of the same age. They measured heart rate, heart rate variability and behavioural displays such as flight, elimination, wall contact etcetera. The pigs reacted with a decrease in locomotion, a decrease in vocalization rates and a lower heart rate. Therefore it was suggested that they did have heightened attention. However, they did not find evidence for emotional contagion.

Nevertheless, this could very well be caused by the fact that the audio playbacks were from juvenile conspecifics instead of adult pigs. This hypothesis is supported by measurements from Chan (2011), who found that juvenile pigs showed an increase in freeze behaviour and fleeing responses when confronted with alarm calls of unfamiliar adult pigs older than 1 year but not when the sounds were produced by unfamiliar juveniles of 4 -8 weeks of age. This study shows that pigs are able to discriminate between vocalizations of pigs of different ages and that juveniles are more frightened during confrontation with alarm calls produced by adult pigs than when similar calls were produced by other juveniles.

Puppe *et al.* (2003) found that suckling piglets between the age of 1 and 5 weeks chose to enter and stay in a compartment with audio replays of nursing vocalization of their own mother more often and longer than in alternative compartments with the same sounds from unrelated sows or artificial sounds composed with

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the same frequencies. They also tested piglet locomotor activity in an open-field environment when listening to sow grunting compared to a control sound, observing a decrease in locomotion when sow grunting was present and suggesting that these grunts have a calming effect on the piglets. However, Goumon and Špinková (2016) state that a decrease in locomotion is an indicator of fear, leading to a completely different conclusion from the same results.

It is clear why it seems to be important to conduct research on the reaction of juvenile pigs on vocalizations of unfamiliar peers as they are frequently regrouped with unknown conspecifics. At such moments, stress and aggression levels increase alongside alarm barks which can affect individual and group welfare. However, the aforementioned studies have shown that emotional contagion among individuals of the same age is not likely for juveniles of 4-8 weeks of age. It might therefore be wise to conduct more research on the effects of the vocalizations of pigs of a certain age, on emotions of pigs of a different age and, for the sake of animal welfare, do so with sounds that are related to positive emotions. Evidence of a phenomenon such as emotional contagion is limited and should be investigated further because it has the potential to be used in production practice to improve animal welfare.

### **The effect of visual stimuli**

Vision is not well developed in pigs. Their ability to distinguish shapes and details is significantly lower compared to humans and cattle (Zonderland *et al.*, 2008). It is not known whether or not visual effects are strong enough to influence pig behaviour in itself. It is possible that vision plays a complementary role to the more pronounced olfactory and auditory cues. What is certain however, is that in any study on this subject, the potential strong effect of cues other than visual must be eliminated.

There is a limited number of publications on species-specific visual stimuli, i.e. individuals observing (images of) conspecifics. Goumon and Špinková (2016) studied the behaviour of piglets in reaction to observing restrained and distressed penmates. One pig was restrained while the other pig observed the situation. In the next trial the pigs and their situations were switched. The researchers found that the observing pigs showed physical changes which indicate that they were emotionally affected, e.g. they showed an increase of attention for the distressed pigs and also locomotion decreased and freezing increased, both indicators of fear. Pigs who had been restrained and stressed prior to acting as observers showed the same reactions but stronger than the pigs who had not been restrained and stressed beforehand. The pigs were separated by wire, therefore sound and smell could have affected the observer pigs as well.

In contrast, Anil *et al.* (1997) conducted research in a slaughterhouse and found no evidence of emotional contagion among pigs who could see the slaughter of conspecifics in a pen nearby. Blood samples were taken, heart rate was monitored and also behavioural indicators were assessed. Although they did find indicators for distress among the pigs, they contributed this to the handling of the pigs. No increase in heart rate could be measured, neither could they detect indicators for distress while their conspecifics were hoisted. These results suggest that observing slaughter of conspecifics does not affect the emotional state

of pigs. However, it must be noted that the environment and stimuli at slaughterhouses may affect the emotional state of pigs on itself and the transfer from farm to slaughterhouse is likely to cause distress. The fact that this study found no emotional contagion should therefore not be seen as indication that there is no such thing. It merely indicates that it is not measurable in this particular experimental setting.

It is difficult in some studies to determine the exact stimuli that (could) lead to emotional contagion as could be seen with Goumon and Špinka (2016). Reimert *et al.* (2013) and Reimert *et al.* (2017) conducted a study where test pigs were classically conditioned to anticipate a positive or negative experience. The supposedly positive experience was access in pairs to an enriched compartment with straw, peat and chocolate raisins hidden in the bedding. The supposedly negative experience was a situation of social isolation in a barren compartment combined with a nose sling restraint. While these test pigs were anticipating the upcoming situation, they were observed by pigs who were not previously conditioned, the so-called naïve pigs. This showed evidence of emotional contagion in both a positive and negative way during and after the tests. It is not known however, if the naïve pigs could also smell and hear the test pigs and if visual stimuli alone caused the effect. This study did prove that emotional contagion can persist even after the cues have stopped, something that has not been investigated in other studies. Therefore, it is suggested that research protocols should involve an extended test period to determine if emotional contagion can persist and if so, for how long. This knowledge could be used in practice, by understanding and possibly even preventing the development of chronic stress.

## **Conclusion**

The studies that have been conducted indicate that some sensory cues can influence behaviour, emotion and production indicators in pigs. Some studies show contradictory results and indicators are sometimes interpreted in opposite ways by different researchers. There are also some studies in which it is unknown which stimuli were responsible for the discussed effects in pigs.

More studies should be conducted on the possible long-lasting and fading effects of olfactory, auditory and visual stimuli and studies need to take into account the age of pigs and interpretation of results such as decrease or increase of locomotion. Furthermore, studies should consider the possible effect of more than one stimulus. When focusing on the effect of one stimulus such as a visual one, all other possible cues which might influence results should be eliminated.

Positive and negative emotions can be transferred from one pig to another and consequently enhance or undermine the welfare of the individual or a larger number of animals. Therefore, it is advised to mainly focus on stimuli which are likely to result in positive emotional states, use addition instead of deprivation of positive cues and use animals that can benefit from the experiments such as the piglets who cannot be nursed naturally. This prevents the negative effect on animal welfare that is sometimes associated with animal experimentation and ensures that not only the outcome but also the activity itself contributes to the aim that all scientific work on this topic should have: enhanced animal welfare.

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