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How do pigs behave before starting an aggressive interaction? Identification of typical body positions in the early stage of aggression using video labelling techniques

Wie verhalten sich Schweine vor Beginn einer aggressiven Interaktion? Identifizierung typischer Körperpositionen im frühen Stadium aggressiver Auseinandersetzungen anhand von Video-Labelling-Techniken

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Summary

The aim of this study was to identify, quantify, and describe pre-signs of aggression in pigs and the early stages of aggressive interactions. The experiment was carried out at a commercial farm on a group of 11 male pigs weighing on average 23 kg and kept in a pen of 4 m x 2.5 m. In total 8 hours were videorecorded during the first 3 days after mixing. As a result, 177 aggressive interactions were identified and labelled to find pre-sign body positions before aggressive interactions, attack positions and aggressive acts performed from these positions. A total of 12 positions were classified as pre-signs (P1–P12) and 7 of them were identified immediately at the start of aggressive interactions (P6–P12). Most common pre-sign positions were P3-pigs approaching and facing each other (24%) and P2-initiator pigs approaching from the lateral side (18%). In 80% of the cases the duration of pre-signs was 1–2 sec 72% of all aggressive interactions were short (1 to 10 sec). The most frequent attack positions were P12-inverse parallel (39.5%), P7-nose to nose, 90° (19.77%) and P9-nose to head (13.5%). The most frequent aggressive acts from attack positions were head knocking (34.4%), pressing (34.4%) and biting of different body parts (29.4%). Head knocking was mostly observed in relation to P7 and P2 positions and biting was common in the P7 position. In conclusion, pigs adopt specific pre-signs and body positions before the escalation of aggressive interactions. This could be used as potential sign to identify a beginning aggression.

Keywords: pig, aggression, body position, labelling, precision livestock farming

Zusammenfassung

Ziel dieser Untersuchung war es, Vorzeichen für Aggressionsverhalten sowie frühe Stadien aggressiver Interaktionen bei Schweinen zu identifizieren, zu quantifizieren und zu beschreiben. Die Studie wurde in einem Praxisbetrieb an einer Gruppe von elf männlichen Schweinen durchgeführt, welche im Mittel 23 kg wogen und in einer 4 m x 2.5 m großen Bucht gehalten wurden. Die Schweine wurden für insgesamt acht Stunden innerhalb der ersten drei Tage nach der Gruppierung videoüberwacht. Hierbei wurden 177 aggressive Interaktionen erfasst und im Hinblick auf eine Identifizierung der einer aggressiven Interaktion vorausgehenden Körperstellungen, der Angriffspositionen und der von diesen Positionen ausgehenden aggressiven Verhaltensweisen ausgewertet. Insgesamt

wurden zwölf Körperstellungen als Vorzeichen klassifiziert (P1–P12), sieben davon wurden unmittelbar zu Beginn aggressiver Interaktionen erkannt (P6–P12). Die am häufigsten beobachteten Vorzeichen waren P3 – die Schweine näherten sich einander von Angesicht zu Angesicht gegenüberstehend (24 %) und P2 – der Angreifer näherte sich seinem Gegenüber von der Seite (18 %). In 80 % aller Fälle dauerten derartige Vorzeichen 1–2 s. 72 % aller aggressiven Interaktionen waren kurz (1–10 s). Die häufigsten Angriffspositionen waren P12 – umgekehrt parallel (39,5 %), P7 – Nase an Nase, 90° (19,77 %) und P9 – Nase zu Kopf (13,5 %). Die meisten von diesen Angriffspositionen ausgehenden aggressiven Verhaltensweisen waren Kopfschlag (34,4 %), Drücken (34,4 %) und Beißen (29,4 %). Kopfschlag wurde meist in Relation zu den Positionen P7 und P2 beobachtet, Beißen meist ausgehend von der Position P7. Somit zeigen Schweine spezifische Vorzeichen und Körperstellungen vor der Eskalation aggressiver Interaktionen, die zur Früherkennung aggressiven Verhaltens genutzt werden könnten.

Schlüsselwörter: Schweine, Aggression, Körperstellung, Labelling, Precision Livestock Farming

Introduction

Numerous scientific studies on pigs' behaviour show that under farm conditions pigs tend to maintain the same behavioural characteristics and habits as in nature, including social structures in groups (Frädrich, 1974; Schnebel and Griswold, 1983; Graves, 1984). Under intensive farming, group composition often does not remain stable over a longer period, thus it is much more difficult to establish a fixed social structure. Mixing with unacquainted pigs occurs usually after weaning, at the beginning of the fattening period or in breeding herds with sows leaving to farrow and being reunited after service. This standard practice can result in elevated levels of aggression (Spoolder et al, 2000; Turner et al., 2009). Numerous behavioural studies were carried out in the past with the aim to understand aggressive behaviours in pigs on farms and to describe the fighting mechanisms and the behavioural sequences during the fighting process (Fraser, 1974; Jensen, 1980, 1982, 1994; Jensen and Yngvesson, 1998; McGlone, 1985; Rushen, 1987; Rushen and Pajor, 1987; Rushen, 1988; Turner et al., 2006). These studies reveal that fighting is a gradual developing complex event, often starting with mutual exploring procedures, such as nose to nose interaction, eventually leading to pushing, pressing, head-knocks, jumping on opponent and vigorous biting mostly on the head, ears, and neck (McGlone, 1985; Geverink et al., 1996; Jensen and Yngvesson, 1998; Weary and Fraser, 1999), resulting in numerous skin lesions on the body the longer or more frequent the fight goes on. However, while these studies represent an advance in description of fighting strategies, no particular attention was given to the pre-aggression phase in pigs behaviour in real post-mixing conditions. There are few studies of aggressive behaviour in the resident-intruder test. For the resident-intruder test, a resident pig is placed in one half of its home pen, separated from its pen mates. An intruder pig which is often younger or lighter than the resident pig, is then introduced into the area of the resident pig. Attacks and/or attack latency are recorded (Erhard and Mendl, 1997; Erhard et al., 1997; D'Eath and Pickup, 2002). D'Eath and Pickup (2002) showed the existence of certain behaviours and body positions that pigs adopt during the attack latency period. However, the description of the social behaviours before the aggression in a resident-intruder test, designed for evaluation of individual aggressiveness could not reflect the reality of pre-aggression behaviour of the animals in real post-mixing conditions, where pigs are mixed into new, large groups in an unknown environment. Thus further in-depth studies are needed. Reliable early indicators of aggression could help to predict aggressive interactions and may be used for immediate intervention in the right moment in order to avoid or at least reduce the number and intensity of fighting encounters. According to Parratt et al. (2006) minimizing fighting among pigs alleviates stress, improves welfare of the animals and enhances production efficiency.

The aim of this study was to identify, quantify, and describe the pre-aggression phase and the early stages of aggressive interactions in video images in order to find reliable early indicators to predict aggression under real post-mixing conditions.

Material and Methods

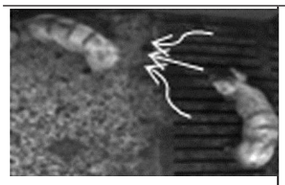
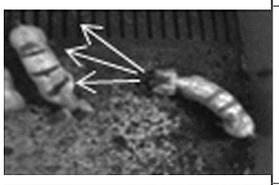
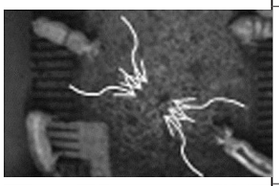
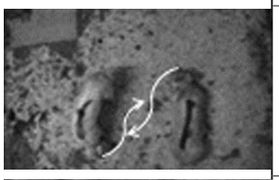
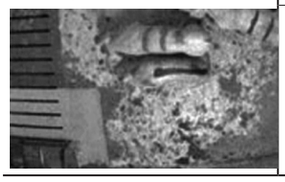
Animals and housing

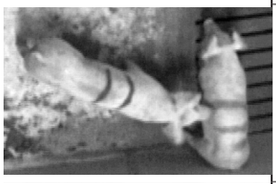
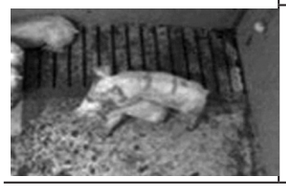
The experiment was carried out at a commercial fattening pig farm located in Heusden, the Netherlands. The experimental pigs (Topigs 20 x Pietrain) were previously housed in stable groups of 11 individuals weaned at the age of 4 weeks. They were kept in pens sized 1.5 m by 1.5 m and fed dry feed ad libitum. At the age of 9 weeks they were transported to the experimental facility in a group of two hundred pigs. From this group, 11 non castrated males pigs weighing on average 23 kg (± 1.31) were randomly selected for the test group. The test pen was 4 m by 2.5 m with partially slatted concrete floors and solid walls; and equipped with a central flow ventilation system (Fancom B.V. – F21). The pigs were fed dry feed ad libitum from a feeder with 2 feeding places using a Fancom B.V. – F71 feeding system. Standard colour spray was applied to the backs of the pigs to identify individuals in overhead video recordings.

Experimental installations

The video recordings were performed using a camera (Allied Vision Technologies®, model F080C) with 4.8 mm lens, placed above the pen in central position at a height

TABLE 1: *Description of Labelled body positions*

Body Positions	Label	Description
Distance positions		
	P1	Starts when initiating pig raises its head to proceed directly to another pig's tail; ends at the first body contact of two pigs at the start of the aggressive interaction.
	P2	Starts when initiating pig raises its head to proceed towards another pig 's body from the lateral side; ends at the first body contact of two pigs at the start of the aggressive interaction.
	P3	Starts when initiating pig or both pigs proceed straightly in direction of each other's head; ends at the first body contact of two pigs at the start of the aggressive interaction.
	P4	Starts when initiating pig or both pigs proceed in parallel but in opposite direction of each other's head ends at the first body contact of two pigs at the start of the aggressive interaction.
	P5	Starts when the pigs move together in parallel facing in the same direction; ends at the first body contact of two pigs at the start of the aggressive interaction.
	P6	Pigs stand side-by-side.

Body Positions	Label	Description
Distance positions		
	P7	Pigs stand with their noses approaching each other, their bodies forming a 90° angle.
	P8	Pigs stand facing each other straight on.
	P9	The nose of one pig approaches the head, ears or shoulders of another pig.
	P10	The nose of one pig approaches the tail of another pig.
	P11	The nose of one pig approaches any posterior body part of another pig.
	P12	The pigs face each other with their shoulders touching.
	P13	The pig jumps from behind with its front legs on the back or lateral side of another pig.

of 2.3 m, that permitted an overhead image of the whole pen. Colour images were captured with a rate of 25 images per second with a resolution of 1032 x 778 pixels. The videos were stored in a computer for later analysis. A non transparent paper wall was installed between the corridor and the pen in order to prevent any distraction of the pigs by human presence. In this way, a total of 8 hours of video recordings were registered during the first 3 days after mixing (day 1: 2 h, day 2: 3 h, day 3: 3 h).

Video Labelling procedure

The video recordings were scrutinized for aggressive interactions between the pigs. An aggressive interaction was defined as a close physical contact in which at least one of the interacting pigs performed head knocking, biting, or pressing behaviours. When an aggressive interaction was interrupted or stopped, e.g. by retreat of one or both pigs, this sequence was interpreted as a finished interaction. Any further attack was counted as a new action. Every single interaction was observed to be able to determine the exact starting time and duration of the aggressive interaction and to describe the behaviour and body positions in the early phase of aggression.

The body positions which pigs adopt prior the aggressive attacks were considered as pre-signs of aggression.

Pre-sign body positions were divided into two categories:

- Distance positions: spatial orientations of the pigs bodies at the moment when the initiator starts an attack from a distance without any contact to the receiver.
- Contact positions: body positions which the two animals adopt at the first contact before the escalation of attack.

In total, 13 body positions of two interacting pigs, were analysed respectively. Of these body positions, five were classified as distance positions and eight as contact positions (Tab. 1). By examining video images, interactions were categorized into those starting immediately or those with pre-sign positions.

TABLE 2: *Description of initial behaviours of initiator pigs*

Behaviour	Description
Body biting	Initiator started aggressive interaction by biting (opened its mouth and closed it on any part of the body of another pig, excluding the front part of the body (head, ear, neck).
Head biting	Initiator started aggressive interaction by biting the head region (except ears) of another pig.
Neck biting	Initiator started aggressive interaction by biting the neck zone and shoulders of another pig.
Ear biting	Initiator started aggressive interaction by biting the ear of another pig.
Head knocking	Initiator used a fast side to side or upwards movement of its head to hit any part of the head or body of another pig. The mouth is kept closed (Jensen, 1980; Erhard et al., 1997).
Jump on other	Initiator starts aggressive action by jumping on the responder pig with its forelegs from lateral side or rear
Push	Initiator starts aggressive action pressing of the shoulder against another pig.

TABLE 3: *Duration of aggressive interactions*

Duration (sec)	Number of interactions	Percent (%)
1–5	73	412
6–10	54	305
11–15	15	84
16–20	7	39
21–25	5	28
26–30	6	34
31–35	3	17
36–40	3	17
41–45	1	06
46–50	2	11
More than 50	8	45

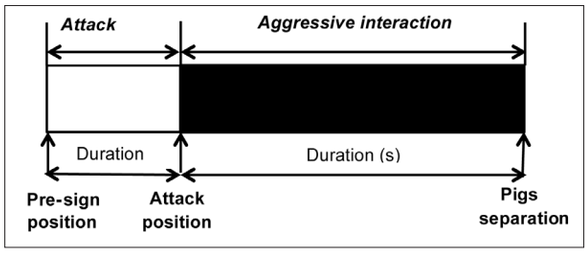


FIGURE 1: *Scheme of the labelling of the aggressive interaction*

The time from the pre-sign body position detection till the beginning of the aggressive interaction was defined as the "attack latency". The contact positions detected at the first body contact of an aggressive interaction were defined as attack positions (Fig. 1). The aggressive acts performed by the initiator pig from the attack position were also analysed and described in Table 2.

The duration of the aggressive interaction was registered from the moment of attack position detection until separation of the pigs (Fig. 1).

The recorded videos were analysed by one observer using the software "Labelling Tool" (Viazzi et al., 2011) developed in Matlab (R2009a, The MathWorks Inc., MA). The labelling procedure is necessary for the identification of every selected behaviour happening during a certain period of time. Each recorded image is visually checked and manually labelled according to the chosen variables image by image (25 images per second).When a body position variable was detected by an observer on the video, the appropriate matching button was selected on the Labelling Tool interface and released when finished. In this way the duration of the attack latency and aggressive interaction were calculated. The information of the behaviours labelled were displayed on the panel (Fig. 2). The Labelling Tool allowed to export the data in excel files for statistical analysis.

TABLE 4: *Number and percentage (%) of observed positions. The labels are the same as those given in Table 1*

Positions label	Freq. of pre-sign positions	% of pre-sign positions	Freq. of attack positions	% attack positions
P0	50	28.3	–	
No pre-sign Distance positions				
P1	4	2.3	–	–
P2	32	18.1	–	–
P3	43	24.3	–	–
P4	8	4.5	–	–
P5	9	5.1	–	–
Contact positions				
P6	3	1.7	11	6.2
P7	3	1.7	35	19.8
P8	6	3.4	16	9.0
P9	3	1.7	24	13.6
P10	2	1.1	7	4.0
P11	2	1.1	12	6.8
P12	8	4.5	70	39.6
P13	4	2.3	–	–

TABLE 5: *Effect of pre-sign position on duration of attack latency (sec)*

Pre-sign position label	Duration LSM ± SE	Significance***
Distance positions		
P1	0.8 ± 1.0	NS
P2	1.6 ± 0.4	***
P3	1.5 ± 0.3	***
P4	1.5 ± 0.7	*
P5	2.8 ± 0.7	***
Contact positions		
P6	1.0 ± 1.2	NS
P7	1. 7 ± 1.2	NS
P8	2.8 ± 0.8	**
P9	2.3 ± 1.2	*
P10	1.5 ± 1.4	NS
P11	0.5 ± 1.4	NS
P12	3.6 ± 0.7	***
P13	13.3 ± 1.0	***

* P ≤ .05; ** P ≤ .01; *** P ≤ .001

TABLE 6: *Effect of pre-sign positions on duration of aggressive interaction (sec)*

Pre-sign position label	Duration LSM ± SE	Significance***
P0 No pre-sign	13.8 ± 2.7	***
Distance positions		
P1	12.3 ± 9.4	NS
P2	12.8 ± 3.3	***
P3	9.4 ± 2.9	***
P4	25.8 ± 6.7	***
P5	19.9 ± 6.3	**
Contact positions		
P6	3.0 ± 10.9	NS
P7	16.0 ± 10.9	NS
P8	14.3 ± 7.7	NS
P9	10.0 ± 10.9	NS
P10	6.0 ± 13.3	NS
P11	13.0 ± 13.3	NS
P12	7.8 ± 6.7	NS
P13	4.0 ± 9.4	NS

* P ≤ .05; ** P ≤ .01; *** P ≤ .001

Statistical analysis

Data were processed through the variance analysis (Proc. GLM; SAS, 2008) to estimate the effect of pre-sign positions on duration of attack latency and aggressive interactions.

The statistical analysis was performed using the following model:

$y_{ijkl} = \mu + T_i + L_k + e_{ik}$

y = independent variable of the attack latency or duration of aggressive interactions
μ = overall mean
T_i = effect of i^{th} observation period in hours (i = 1, …8)
L_k= effect of the k^{th} pre-sign positions (k = 1, 13)
e_{ik} = random residual

TABLE 7: *The transition matrix for the inter-individual interactions. The first value in each cell is the observed number of transitions, the second is the calculated expected value. The pre-sign positions are listed in the rows and the attack positions in the columns. The codes are the same as those given in Table 1*

Pre-sign positions	Attack positions							
	P6	P7	P8	P9	P10	P11	P12	Row totals
P0 No pre-sign	2	11	3	8	2	6	18	50
	3.1	9.9	4.5	6.8	2.0	3.4	19.8	
P1	0	0	0	2	2	0	0	4
	0.2	0.8	0.4	0.5	0.2	0.3	1.6	
P2	0	9	4	7	1	4	7	32
	2.0	6.3	2.9	4.3	1.3	2.2	12.7	
P3	1	4	7	3	1	0	27	43
	2.7	8.5	3.9	5.8	1.7	2.9	17.0	
P4	0	1	0	1	0	1	5	8
	0.5	1.6	0.7	1.1	0.3	0.5	3.2	
P5	3	3	0	0	0	0	3	9
	0.6	1.8	0.8	1.2	0.3	0.6	3.6	
P6	3	0	0	0	0	0	0	3
	0.2	0.6	0.3	0.5	0.1	0.2	1.2	
P7	0	1	0	1	0	0	1	3
	0.2	0.6	0.3	0.4	0.1	0.2	1.2	
P8	0	2	1	1	0	0	2	6
	0.373	1.2	0.5	0.8	0.2	0.4	2.3	
P9	0	2	0	0	0	0	1	3
	0.2	0.6	0.3	0.4	0.1	0.2	1.2	
P10	0	1	0	0	1	0	0	2
	0.1	0.4	0.2	0.3	0.1	0.1	0.8	
P11	0	0	0	1	0	1	0	2
	0.1	0.4	0.2	0.3	0.1	0.1	0.8	
P12	0	2	1	0	0	0	5	8
	0.4	1.6	0.7	1.1	0.3	0.5	3.2	
P13	2	0	0	0	0	0	2	4
	0.2	0.8	0.4	0.5	0.2	0.3	1.6	
Column totals	11	36	16	24	7	12	71	177

The Frequency procedure (Proc. Freq. SAS, 2008) was applied to obtain the occurrence for each of the body positions and aggressive acts labelled. The duration of aggressive interaction was expressed in classes of 5 sec intervals.

To analyse the transition between the pre-sign position to attack position we computed the transition matrices based on single-order Markov chains, with the scores of pre-sign-positions in the rows and those of attack positions in the columns. What was actually recorded was the order in which the behaviours occurred, regardless of the individuals performing it. After examining the observed frequency transition matrix for large differences between cells, the expected frequency matrix was constructed by calculating the expected frequency for each cell according to the formula (Chatfield and Lemon, 1970):

$$\text{Expected frequency} = \frac{\text{row total x column total}}{\text{grand total}}$$

It was assumed that the transitions between pre-sign positions to attack positions are dependent on one another at some level of probability greater than chance. The expected frequency was calculated and the T-Test on these values was performed to estimate significant differences between expected and real frequencies.

Chi-square test (SAS, 2008) was used to calculate the transition frequencies between pre-sign positions and the aggressive act of the initiator pig at the start of an attack and to evaluate the relation of the attack positions and the aggressive act.

Results

A total of 177 aggressive interactions were identified from 8 hours of video recordings. The duration of most of registered aggressive interactions (72%) was short, from 1 to 10 sec (Tab. 3).

The distance pre-sign positions could be noticed before aggressive interactions in 54% of observed aggressive interactions (Tab. 4).

The contact pre-sign positions were observed only in 17.5% of the cases. Most common pre-sign positions were P3 (43 pre-signs = 24%), when pigs approached facing each other and P2 (32 pre-signs = 18%), when the attacking pig approached from the lateral side. Aggressive interactions most commonly began with the animals in inverse parallel position (P12, 39.5% of all bouts), nose-to-nose forming 90° angle (P7, 19.7%) or in perpendicular position with nose approaching to anterior part of the body (P9, 13.5%).

The effect of the pre-sign position on duration of attack latency is shown in Table 5. A significant relation ($P \leq .001$) between the pre-sign position and duration of attack latency was found. It was noticed that pigs attack their opponent at high speed. The attack latency of pigs starting from the distance position was short. Within 1-2 sec the attacking pig bridged the distance to the opponent. The longest attack latency was starting from P5. In this case before an aggressive attack pigs were situated in parallel to each other without contact for 2.8 sec ($P \leq .001$; Tab. 5). The attack latency from the contact positions in some cases lasted more than 2 sec without breaking body contact, the longest were P12, before starting an attack pigs could stay in this posi-

tion for 3.62 sec (P ≤ .001), and P13 (13.3 sec; P ≤ .001), which was corresponding to mounting behaviour and was registered only when led to aggressive interaction.

The effect of the pre-sign position on duration of aggressive interaction is presented in Table 6. Most of the distance pre-sign positions were found to be related to the duration of aggressive interactions, the longest interactions were observed from P5 (19.89 sec; P ≤ .01) and P4 (25.8 sec; P ≤ .001) positions.

The complete transition matrix from pre-sign position to attack position for 177 observed interactions is given in Table 7. Each cell contains 2 values: the observed number of transitions at the top and calculated expected value at the bottom. T test didn't show any significant difference between expected and real transition frequencies. The most frequent attack position P12 (71 episodes) began in particular without pre-sign (18 transitions) or followed P3 pre-sign position (27 transitions). Real values in this last case are higher than the expected ones, but this difference was not significant.

Figure 3 shows the relation of aggressive acts to pre-sign positions. Head knocking behaviour was observed mostly at the start of interactions without pre-sign and those anticipated by P2 pre-sign position. Push was anticipated mostly by P2 and P3 pre-sign positions. Figure 4 shows the aggressive acts that the initiator pigs performed from the attack positions. In relation to attack body positions, the most frequent aggressive acts were head knocking (34.5%) and push or pressing (34.5%). The most frequent attack positions from which head knocking and push were performed were P12 and P7. The bites were particularly directed to the neck (13%) and ears (8.5%). From P12 positions, pigs started aggressive interactions with biting more frequently than from other positions mostly directed towards the neck (Fig. 4). On occasion, pigs bit other regions of the body when they attacked, particularly flanks or back (6.8%).

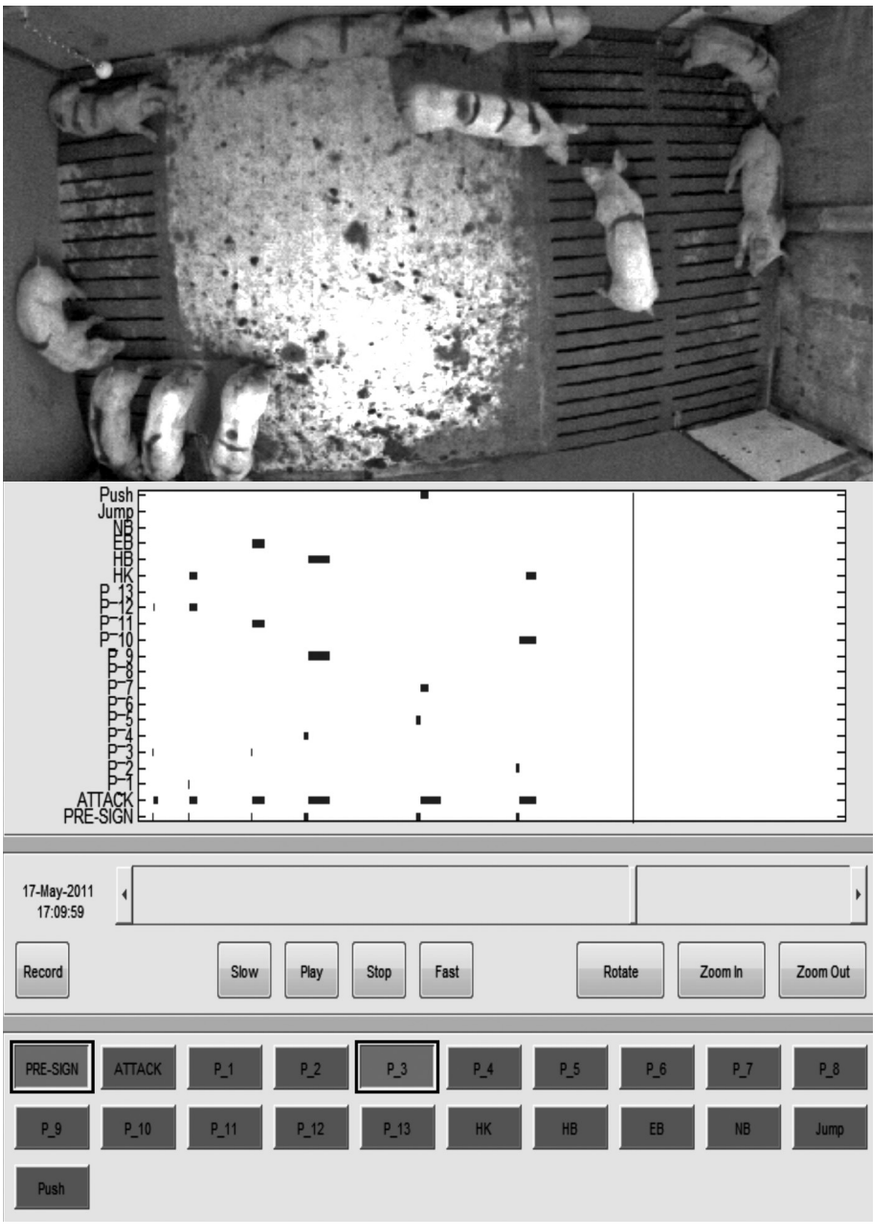


FIGURE 2: *The Labelling Tool interface*

Discussion

The aim of this research was the identification of pre-signs of pigs aggressive behaviour in the pre-aggression phase which can possibly be used for an early intervention before the escalation of aggression.

The results of video labelling showed that in the most of cases (70% of all aggressive interactions) we could observe pre-signs on video images. 54% of all aggressive acts were started from distance pre-sign positions whereas contact pre-sign positions were observed only in 17.5% of cases. It shows, that in a group of recently mixed pigs under real farming conditions, the initiator mostly had no contact with the receiver shortly prior the attack which is in contrast to the results obtained from the resident-intruder test by other authors (Erhard et al.,1997; D'Eath and Pickup, 2002). This difference could be explained by the fact that in our experiment the pre-signs of all the attacks happened during a certain post-mixing period and not only when the opponents first met. The distance pre-signs could also precede the repeated attacks, when the pigs are already acquainted with each other. In fact, some of contact positions are corresponding to those described by D'Eath and Pickup (2002) as social behaviour positions of pigs during the attack latency period. They characterised them as positions adopted during the performance of recognition and assessment behaviour. In their study, aggressors initiated more head-to-head positions and T-position-head. Our results showed P12 corresponding to their

head-to-head position as the most represented among the contact pre-sign positions (5%).

The attack latency in those 80% of the cases when a pre-sign position was detected had a duration of 1 to 2 sec. This means that there is a time span of approximately 1 to 2 sec available for any intervention technology in order to stop the aggressive behaviour before injuring fighting starts. In general, the attack latency from the distance pre-sign positions lasted shorter than from contact positions, ranging between 1 (P1 position) to 2.8 sec (P5 position). Among the contact pre-sign positions the longest attack latency started from P12 (3.6 sec) and P13 (13.3 sec) positions. The considerable difference in duration of attack latency from P13 could be explained by the mounting behaviour performed from this position, which lead to the aggressive interaction, thus it was considered as a pre-sign.

The most frequent distance positions observed were P3 (24% of all aggressive interactions) when an initiator pig arrived directly facing another pig and P2 (18%) when a pig approached the opponent from the lateral side. It was also found that pre-sign positions which pigs adopt before an attack affected the duration of aggressive interaction. Aggression anticipated by P4 and P5 distance pre-sign positions had longer duration (20–25 sec) than from other positions.

By statistically relating each of the pre-sign positions to the attack positions, the effects of each pre-sign on the attacking strategies can be measured. It is very likely that the attack position of each piglet is dependent on its own earlier body orientation. An intra-individual sequence analysis showed that the most frequent sequence for an attack was P3 pre-sign position followed by P12 attack position.

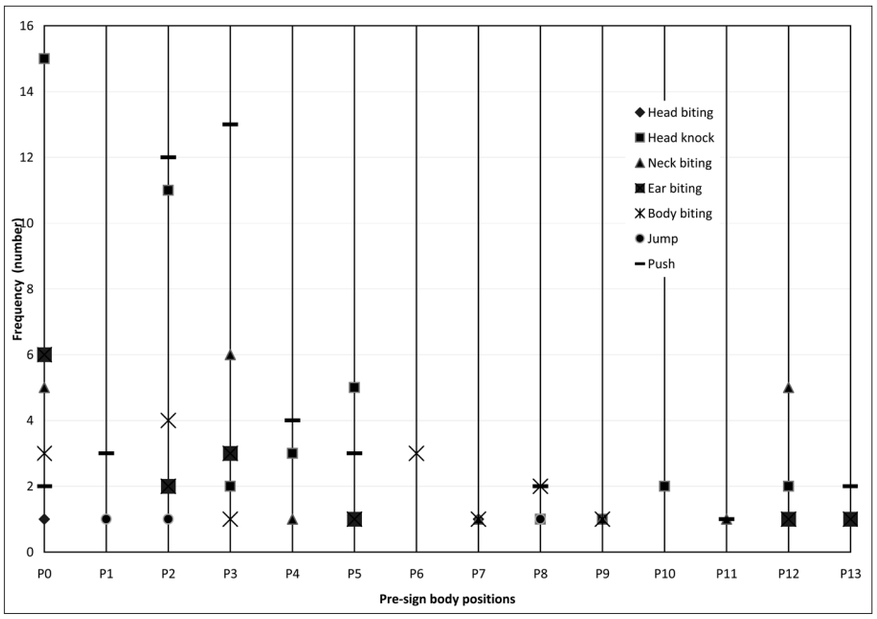


FIGURE 3: *Transition frequencies between pre-sign positions and aggressive act of initiator pig at the start of an attack (The overall Chi-square value indicated a difference (***P≤ .001))*

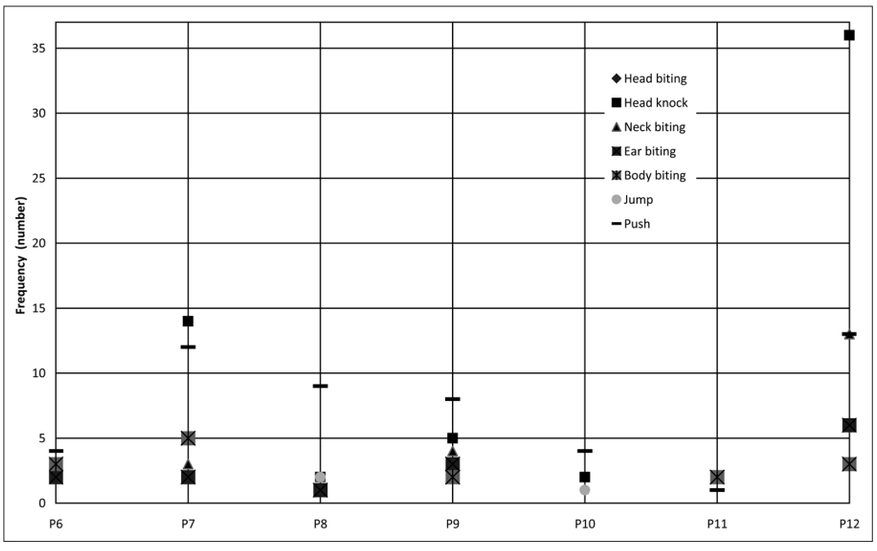


FIGURE 4: *Aggressive acts of initiator pig performed from attack positions (The overall Chi-square value indicated a difference (***P≤ .001))*

To the best of our knowledge, this is the first study which identified early signs of aggressive interactions among pigs in post-mixing conditions. Some authors describe typical fighting positions in pigs when fighting has already begun (e.g. Jensen,1980; McGlone,1985; Rushen and Pajor ,1987; D'Eath and Pickup, 2002). T-position-head was found by Rushen and Pajor (1987) to be the most effective offensive move during fights, allowing a pig to attack with minimal risk of the intruder retaliating. Head-to-head position was thought to be more reciprocal, allowing both pigs the chance to attack the head region of the opponent. In fact, in our study, P12 position (head-to-head) was the most frequent attack position (39.55%) which confirms the results (37% of all bouts) of Rushen and Pajor (1987). In the study of D'Eath and Pickup (2002) most attacks occurred from T-position-head (P9 and P7). Our study showed that attack positions P12, P7 and P9 were represented in 72.7% of all interactions. This opens opportunities to focus on these positions for monitoring the onset of this type of aggression.

Rushen and Pajor (1987) stated that the motivational significance of special positions adopted during fights reflects simple physical mechanics of delivering bites to particular target areas. Numerous studies of aggressive behaviours showed that ears, neck/shoulders and head are the main target zones for bites during the fights (e.g. McGlone, 1985; Rushen and Pajor, 1987). Our results agree with these studies, since at the start of the aggressive interactions the bites were directed mostly to the neck and ears. From P12 position

pigs started aggressive interaction with biting more frequently than from other positions, mostly the neck was bitten, as this target zone was the most achievable for the bites from this position. However, the most frequent aggressive act was the head knock, mostly from P12 and P7 positions. Our findings are similar to those of Jensen (1982), who found that after nose-to-nose position (it was considered in our study as P7 and P8 positions) head-to-head and head-to-body knocks are the most frequent behaviours at the start of fights.

Conclusions

In 70% of 177 investigated aggressive interactions of young fattening pigs pre-signs of aggression could be detected by the used video labelling technique.

Two distance positions (P3 and P2) and three attack positions (P12, P7 and P9) are dominating and could be used for early detection of aggression.

In 80% the attack latency had a duration of 1 to 2 sec depending on the pre-sign position.

Our results indicate that there is a potential for early intervention before the escalation of aggressive acts among pigs. This intervention as well as the detection of the early signs of aggression could be done automatically. Further research is needed to reach this goal and to develop adequate automatic monitoring and intervention systems which could enhance animal welfare preventing pigs from suffering aggressive attacks and injuries.

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