Pen-rotation scheme for growing pigs: effects on pig aggression and social affiliation

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Box rotationsschema för växande grisar: effekter på aggression och social tillhörighet

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Abstract

This master project aimed to assess if a pen-rotation scheme mitigated the effects of reuniting pigs after temporal separation. Six groups of crossbred (Yorkshire and Hampshire) growing pigs, (8 - 10 littermates per group) aged between 12 – 13 weeks, were video recorded separately in their original home pens for 2 h before a temporal separation to undergo the pen rotation scheme in pairs for 3 days. Each litter was video recorded once again after reuniting the paired littermates in their home pen. Behaviour was thus recorded before and after pigs were exposed to temporal separation, through a rotation scheme, based on an ethogram including aggression and social affiliation. Pig aggression was recorded in frequency of occurrence of the elements of aggressive behaviours over the 2 h period within the litter groups considering behaviours such as ear bites, head-anal-knocking, face bites, parallel push, head-to-head-knocking, head-to-side push, head-to-under push, head-to-shoulder push, levering, neck bites and shoulder bites. Social affiliation was also studied over the same period regarding behaviours such as anal-genital sniffing, nosing of other body parts, lying/resting in groups, back-scratching with snout, mounting and exploring in groups. This study found that pigs showed aggression and social affiliation before and after undergoing a pen-rotation scheme. Although some exceptions can be identified, there appears to be a resemblance between pig aggression and social affiliation before and after the temporal separation of littermates. A pen-rotation scheme may be applicable on pig farms to mitigate stress related to reuniting littermates after temporal separation, but this needs further testing with larger sample sizes, and with proper controls. If proven efficient, a pen-rotation scheme could be useful for scientific studies in need of splitting and later reuniting litters, as well as for commercial pig production when temporal splitting is needed.

Keywords: aggressive, affiliative, fighting, littermates, behaviours, reuniting

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Abbreviations

AGS	Anal-genital sniffing
BSS	Back scratching with snout
EB	Ear bites
EG	Exploring in group
FB	Face bites
HAK	Head-anal-knocking
HHK	Head-to-head knocking
HShP	Head-to-shoulder push
HSP	Head-to-side push
HUP	Head-to-under push
L	Levering/Lifting
LRG	Lying/Resting in groups
MO	Mounting
NB	Neck bites
NBP	Nosing of other body parts
PP	Parallel push
ShB	Shoulder bites

1. Introduction

In rearing pigs under the conventional production system, the animals lack access to free-range areas, with pig production being mainly indoors along with limited space. In the modern pig farming business, the pigs are normally regrouped several times in the growing-finishing stage for different management or production reasons such as weaning periods, transport to slaughterhouses etc. (Rydhmer et al., 2013). Aggression among pigs in groups is a major challenge in pig production that is of much concern for animal welfare. As part of the natural behavioural repertoire, aggressive behaviour is part of almost all species of animals, and the behaviour is considered an extremely functional form of social interaction targeted to actively control the biological community (Koolhaas et al., 2013). This behaviour is known to be intrinsic in most animals (Uemura & Morimasa,1994), not excluding the pig. In pig production, some behavioural activities shown to be aggressive in earlier studies include parallel pressing, levering (head lifting), chasing, bites, head knocking, etc. (Verdon et al., 2017). As conventional pig farms are faced with some conditions such as limited space and feed supply, putting pigs belonging to separate litters into a group after weaning or from the onset of the finishing period is important (Chen et al., 2019). This may encourage production efficiency. It is not uncommon for familiar animals (Kelley, et al., 1980) or unfamiliar individual pigs to display either aggressive behaviours (Arey & Edwards, 1998; D'Eath et al., 2009; Oczak et al., 2013; Turner et al., 2017) or social conflict (Camerlink et al., 2014) when regrouped. Even in most conventional farming systems where resources for pig production are fully met, some form of aggression exists among the pigs (Séguin et al., 2006).

Aggressive behaviour has been part of the social life of pigs, where hierarchical order develops especially when pigs from different litters are weaned in a group (Oczak et al., 2013). The development of hierarchy among pig groups is probably important for the social organization, to ensure orderliness in the pig groups. However, Oczak et al. (2013) mentioned that the establishment of this hierarchical order could result in division among pig groups, leading to severe aggression. Physical injuries inflicted on farm animals because of aggressive behaviour such as fighting among pigs stay a cause of interest (Fraser & Rushen, 1987). Some of these aggressive behaviours are predominant after or during the mixing of pigs and may be severe, resulting in wounds, jowl abscesses, and even death (Kelley, et al., 1980).

It is also documented that stress is often associated with aggression when individual pigs are grouped (D'Eath et al., 2009), negatively affecting reproductive physiology and thereby reducing productivity (Arey & Edwards, 1998). Not only do the victims of an aggressor suffer from the stress connected to aggression and physical clashes but the aggressor also suffers from the related harmful effects (Koolhaas et al., 2013). Additionally, Jensen (2017) stated that relationship dominance is less stable in pigs compared to cattle. This, within groups, brings about chaos in fighting back for positions and harassment of individuals, especially subordinate groups (Jensen, 2017). These activities have huge effects on the well-being of pigs, reduce the economic revenue of the production, and thereby pose a risk to the sustainability of the production (Oczak et al., 2013).

In pig farms where aggression occurs among pig groups, efforts best targeted to increase animal welfare and economic benefits are very vital for the pig industry. There is evidence that grouping acquainted or familiar pigs minimize the level of aggressiveness among the pigs compared to an intermingling of unfamiliar ones (Hoy & Bauer, 2005). The intensity of aggression among pigs depends on varying situations or circumstances, for instance, the level of familiarity, variations in body weight or allowable space for group sizes (Stukenborg et al., 2011). Some efforts have been made in describing the mechanisms involved when aggression occurs, including the investigation of strategies to modulate or control aggression aimed at preventing potentially adverse effects among animals (Koolhaas et al., 2013). Research on pig aggression includes the use of sedative means (Jensen, 1971), feeding strategies (Kelley et al., 1980), genetic selection (D'Eath et al. 2009), time budgets (O'Malley et al., 2021), space allowance (Turner et al., 2000) and regrouping of pigs at night (Ison et al., 2018) as well as application of odour masking agents (Jensen, 1971). These studies have been tried without much success in the complete elimination of aggressive behaviours such as fighting among pigs in a group.

An insight into reducing pig aggression stays a top priority in the pig production industry (Verdon et al., 2017). Despite the various management strategies to improve the situation of pig aggression, including regrouping of pigs in farms, the situation is still a challenge among the animals, emphasizing the need for approaches to solving the problem (Camerlink et al., 2014). Attention still needs to be given to strategies to modulate the aggression of both the aggressor and subordinate pigs. Though there could be limited resources such as the availability of extra pens in pig barns, none of the studies considered a strategic pig rotation to allow group members to remain in contact while being moved between pens. Also, for scientific purposes, it is highly relevant to test means to avoid regrouping aggression when the same litters are split and then regrouped after a certain period, as this often comes along when testing pigs in various scientific test paradigms e.g., ethological studies, and cognitive studies. This master project aimed to investigate

if a pen-rotation scheme mitigated the effects of reuniting pigs after temporal separation. Hence the research question was:

- How effective is the pen-rotation scheme in lowering aggressive behaviour among temporally separated and reunited littermate-growing pigs to ensure social cohesion?

1.1. Literature Review

After weaning pigs in most commercial settings, it is common to notice aggressive behaviours in growing pigs due to a lack of social training during lactation (Turner et al., 2017). It is in light of the aggressiveness in pigs that more time and resources have been spent in the past years on various experimental studies including several intervention measures put in place concerning animal welfare. From the literature, several factors count to affect aggression and social behaviours among pigs. A few of these factors have been elaborated on below.

1.1.1. Natural social behaviour of pigs

The wild boar (Sus scrofa) from which the domesticated pigs originate, is a species that has adjustable abilities to different natural conditions in the direction of its way of life. It points to the fact that a notable genetic variation occurs in the species of Sus scrofa in the wild, domesticated, and feral forms (Špinka 2017). Pigs in nature are liable to form groups comprised of closely related females and their offspring, though matured males often are solitary or sometimes found living in all-male groupings (Jensen, 1988).

The mixing of unfamiliar pigs changes the group dynamic and triggers dominance-correlated aggression as a new hierarchy is formed (Špinka 2017). Notably, Drickamer et al (1990) in their study on the prediction of social dominance among gilts observed that the weights of the piglets at weaning influenced the behaviour of social dominance. This could mean that as the piglets are weaned in groups, the heavier ones likely dominate the group with the trend to become more aggressive. One or two dominant animals normally account for most of the fights (Verdon et al. 2016), which usually involve biting, pushing and head-to-head knocking (Špinka 2017). First-hand defence is usually to escape from the aggressor by the submissive animals, but if that is not successful, e.g., because of inadequate space, then the assaulted animal will often try to turn its forebody from the aggressor and absorb the attack with the centre and rear body parts (Turner et al. 2009, Špinka 2017). Generally, pigs are known to be social animals that keep dominant hierarchies (Camerlink et al., 2021) and within a stable group, fighting can occur (Špinka 2017). However, several positive social affiliative behaviours can be shown among

pigs in groups as well (Brown et al., 2015). Positive social behaviours among littermates may encourage intimacy among the pigs, which brings them together. McGlone (1985) in a study concluded that developing strains of pigs could help modulate pig aggression and mentioned that the genetic and environmental dynamics can be manipulated to perfect animal production if animal behaviour is well understood. However, Drickamer et al. (1990) were not able to elucidate any breed influence or impact on social dominance among pigs probably due to a smaller sample size.

It is essential to understand the pigs' behaviour for welfare issues, especially how pigs behave to seemingly unpleasant aspects of husbandry practices in pig production (Fraser, 1974). In conventional production set-ups, the piglets are detached from the sow just after the weaning process. In captive situations, pigs are restricted to only allowable areas or space, and usually to a specified group of partners. Social interactions with unfamiliar persons including situations such as cruel handling during the movement of pigs and exposure to a different environment put fear in pigs (Stephen & Perry, 1990). A change in the emotional states of pigs is found in the animal´s behaviour in a new environment (Stephens, 1988). Verdon and Rault, (2018) reported that the composition of the group including experience in the time of lactation coupled with mixing pigs during weaning and at the growing-finishing phases has a higher impact on pig aggression compared to pen features and management factors. Pigs when mixed under production conditions, usually fight, especially with strangers, and there is a solid correlation between size and the attainment of a dominant position in a group (Jensen, 1994). Lack of previous alliance among pigs regrouped may result in aggression between unfamiliar pigs. Regrouping pigs concerning genetic similarity may not significantly reduce pig aggression but a mutual relationship in time overcome unfamiliarity among the pigs (Stookey & Gonyou,1998). Similarly, the results of the study by Rydhmer (2013), revealed that pigs moving to the growing-finishing pen have a much lesser rate of recurrence of aggressiveness among familiar animals reared in an intact group throughout the grower-finishing pig phase.

1.1.2. Experimental setting of behavioural projects

Studies of the behaviour of animals, often need to separate some animals or individuals from their group, in order to have a standardised design, or to increase the sample size (Bateson & Martin, 2021). In pig studies, it may be necessary to split pig groups or litters into smaller groups to be able to examine each pig independently in an experiment. The purpose of the splitting may be to expand the sample size or to reduce any potential social impacts by doing individual-level research. The splitting activity may enable a pig to be tested at a time in a particular paradigm, such as a test of a human approach or a test of a novel object. Most often,

in veterinary treatments or medical studies, pigs are tested individually and sometimes when a piece of equipment is to be used that is only fit for a pig or an animal, e.g., due to body size. The re-mixing after such experiments is usually an issue, as pigs tend to display aggressive behaviour towards each other. Pigs must avoid getting into a lot of fights or aggressive behaviours as a result of the separation as they are reunited or returned to their regular litter or group since this would pose a welfare issue. The pen-rotation scheme is an attempt to get around this issue.

The number of animals within the group with regard to the space available to the animals could have an impact on aggression within the group. Estévez et al. (2007) showed that it is difficult for individual recognition in fairly large group of pigs, and this threatens the basis of the dominance hierarchy structure. Spoolder et al. (2009) pointed out that the size of the group provides more chances for the subordinate pigs to go into hiding, taking advantage of the group size. In group housing of pregnant sows, factors such as the feeding system practised in a production system, the space allowance for the sows and many more factors influence the degree of aggression (Spoolder et al. 2009). Inadequate space during feeding among grouped housed pigs causes competition which results in some agitations among pigs as they compete for feed. It is during those periods that the aggressive pigs show their strengths to the subordinates. The experimental design for behavioural studies is therefore an important item to consider in research activities.

1.2. Aim of the study

This master project aimed to assess if a pen-rotation scheme mitigated the effects of reuniting pigs after temporal separation.

1.3. Objective of the study

The objective of the study was to observe aggressions and social affiliation in the pig groups prior to separation and after reuniting them to evaluate if the pen-rotation scheme mitigated potential reuniting stress.

1.4. Hypothesis

The study hypothesized that pig aggression and social affiliation before the temporal separation of litter groups would resemble post-reuniting aggression and social affiliation.

2. Material and Methods

This study was performed at the Livestock research centre, Uppsala. The piece of work was the second part of a bigger research project currently assessing the olfaction of pigs' interest in non-social odours.

2.1. Animals and the experimental pen (pen rotation scheme)

The animals used in this study were growing pigs from 6 different litters of crossbred pigs (Yorkshire and Hampshire), with 8 - 10 littermates per group between the ages of 12 – 13 weeks. The pigs were reared in their home pens with littermates and were fed with concentrates thrice a day with straw as enrichment. In all, a total of 54 animals were considered in the study but one of them was eliminated before the pigs went through a pen-rotation scheme (Figure 1) due to health issues. The 5 experimental pens were of equal size and the dimension of an experimental pen is 3.35 m x 1.77 m comprising of a solid floor space measuring 1.94 m x 1.77 m including a slatted floor space measuring 1.18 m x 177 m, raised 0.19 m from the solid floor. The pen contained a feeding trough of 0.23 m x 1.77m x 0.24 m and a nipple drinker for ad-lib provision of water. In the experimental pens, the pigs were paired (male/female) from each litter group with consideration to weight balance and put in every experimental pen that is next to each other. The pigs were separated and rotated in the experimental pens within 3 days. During this period, the pair of pigs in each of the experimental pens was rotated (moved) one step ahead into the next pen every day, where a 30-minute odour test (a separate project) was performed on each pair of pigs at a time. This rotation of the pigs (depending on litter size) was done in succession until each pair of pigs was rotated through at least two of the experimental pens according to a pen rotation scheme (Figure 1). Once each pair of pigs was rotated through these experimental pens, the animals are moved back to their home pen the following day.

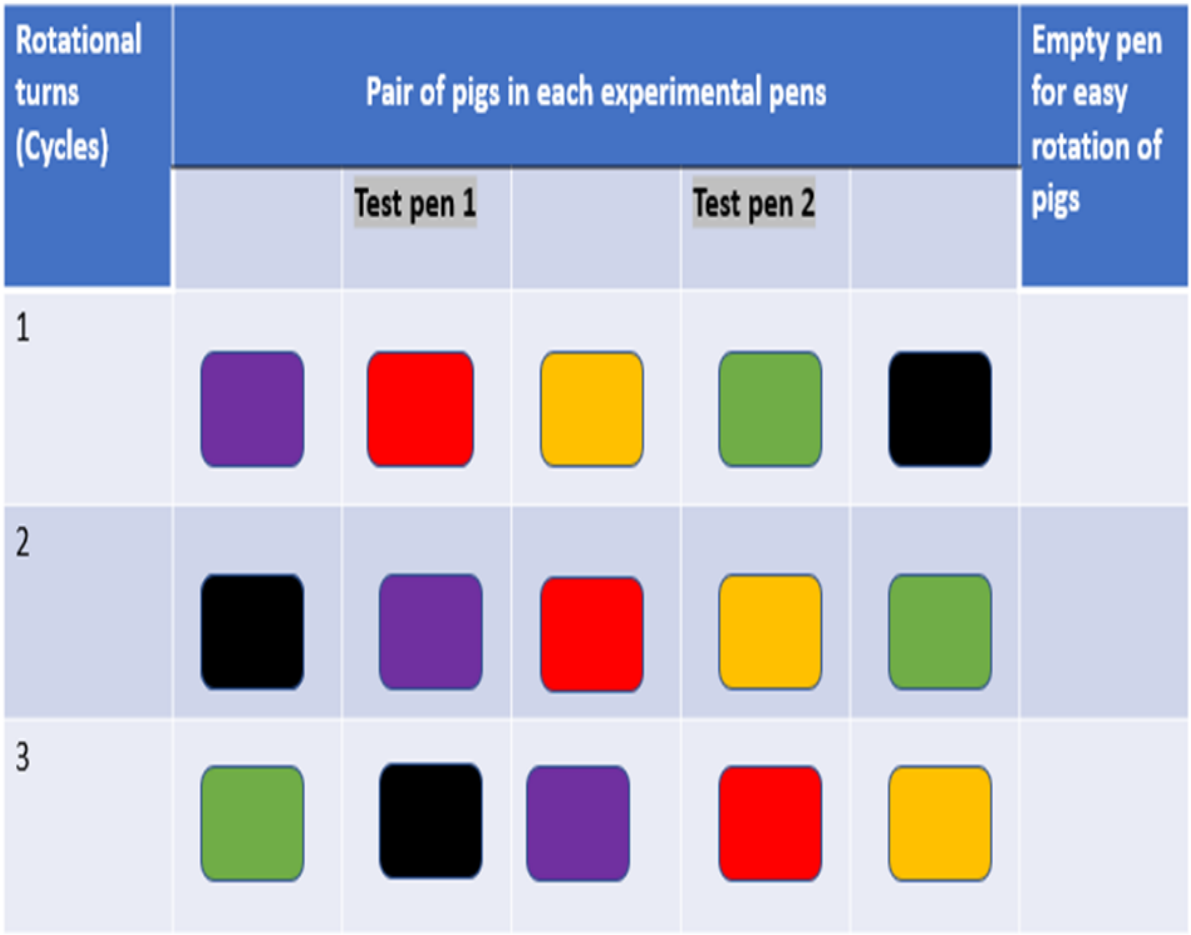

Figure 1. Pen rotation scheme for the pair of pigs. Each coloured shape represents a pair of pigs in the pen during rotation in a sequential order to experiment in test pens 1 or 2 (pens assigned for odour study).

2.2. Home pen and video recording

For this study, each litter group were studied in their original home pen before and after going through a pen rotation scheme. Each week, two litter groups of pigs were moved (walked through a guided area) from their home pens to the experimental pens (distance ≤ 20 m). The dimensions of the home pens for all the litter groups were of the same sizes measuring (3.54 m x 3.29 m). Both experimental pens and home pens were equipped with a feeding trough and an automatic drinker. The behaviour of the animals in each group in their home pens (two separate litter groups at a time) was checked through video recording with two cameras (GoPro Hero 7 camera, 10MP, 4K30) installed in the home pens respectively. All observations or recordings before the pen-rotation scheme were carried out just after feeding in the mornings for 2 hours from 10 am to 12 pm. After going through the full pen rotation scheme, each litter was moved out of the experimental pens

and walked back to the home pen where they were reunited. The pigs´ behaviour was filmed again with the cameras installed for the same 2-hour period, just like before their movement from the home pens to the experimental pens, but filming this time started at 10:30 am (half an hour after reuniting). The behaviours of the pigs were observed using an ethogram (Table 2), concentrating on elements of aggressive behaviours, including, for instance, parallel pushing, head-to-head knocking, biting, and social affiliative behaviours such as nosing, levering, lying in groups etc.

2.3. Questionnaire and interview

Within three days after finishing the pen rotation scheme, a semi-structured interview was conducted with two staff members of the pig facility at the Swedish Livestock Research Centre. The staff members were asked questions about any form of aggressive and social affiliative behaviours they experienced or noticed among the pigs after reuniting them to their original home pen (Table 1). The purpose was to find out about their views and what they had noticed about the aggression and social affiliative level of the pigs after going through the pen rotation scheme outside the observation period used for the behavioural observations in this study. The interview was thus conducted to check if the behavioural observations correspond to the staff's view on pigs' aggression and social affiliation after the reunion.

Table 1. *Questionnaire for the staff of the pig facility regarding observation of littermates that have undergone the pen rotation scheme.*

Question number	**Question.**
1.	What new or strange observations have you made after reuniting the pigs?
2.	What observation have you made in comparing the level of aggression before the temporal separation of litters to go through the pen rotation scheme and after the pigs have been reunited?
3.	Have you noticed any change in the social affiliative behaviour before and after the pigs were taken through the pen rotation scheme?
4.	Do the pigs fight before, after or during feeding periods?
5.	Which social affiliative behaviours have you observed to be more frequent among the litters just after they have been reunited?

2.4. Development of ethogram

The behaviours of the pigs were observed in line with an ethogram (Table 2). These behaviours observed have been classified into elements of aggressive behaviours and positive social affiliation (non-aggressive behaviours). These behaviours were carefully considered and worked through the data (video footage) image by image, irrespective of whether the behaviour was displayed through the same or other littermates. From the video footage, a subsequent behaviour (same or new behaviour) was considered when the performance of a behaviour by a pig was interrupted, or the action stopped for 4 s or more and begins again. The data obtained were analysed based on aggressive behaviours and social affiliation distributions among the litter groups before and after going through the pen rotation scheme.

Table 2. Ethogram of aggressive behaviours and positive social affiliation.

Behaviour.	**Detail/Definition.**
Aggressive behaviours.	
Ear bites (EB) (Jensen et al., 2010).	A pig biting the ear of a pen mate.
Head-anal-knock (HAK).	Knocking off the anal region of a littermate with the head of another pig.
Face bites (FB).	A bite on the face of a littermate.
Parallel push (PP) (Fraser, 1974).	Parallel pushing on the shoulders of two pigs.
Head-to-head-knock (HHK) (Fraser, 1974; Oczak, 2012)	The pigs knock each other with their heads.
Head-to-side push (HSP).	A pig pushing a littermate with the head on the side close to the ribs and loin region.
Head-to-under push (HUP).	A pig uses the head to push the belly part of another pig.
Head-to-shoulder push (HShP).	A pig pushes a pen mate on the shoulder with the head.
Levering/Lifting (L).	Another pig uses the snout to lift a pen mate in a lying or resting position.
Neck bites (NB) (O'Connell, et al., 2005; Oczak, 2012).	Biting of the neck of another pig in time of fights.
Shoulder bites (ShB).	The pigs bite the shoulders of each other during severe fights.
Positive social affiliation	
Anal-genital sniffing (AGS), (Jensen, 1980)	The anogenital region of a pig is sniffed, touched, or rubbed with the snout of other pigs.
Nosing of other body parts (NBP) (Jensen, 1980)	The snout of a pig touching the face, head, ears, belly etc of another pig other than the anogenital region.

Lying/resting in groups (LRG) (Camerlink et al., 2021)	The pigs are in lying or resting positions on the floor in a group or groups with opened or closed eyes.
Back-scratching with snout (BSS)	With the snout, a pig slowly touches or scratches the back of a pen mate several times without causing any skin damage to the recipient.
Mounting (MO) (McGlone 1985; Oczak, 2012),	In a standing position on both hind legs, a pig put the front legs on another pig.
Exploring in group (EG) (Camerlink et al., 2021).	Rooting and sniffing behaviours as expressed by the pigs on the floor, in open places, under the water and in feeding troughs in groups.

2.5. Data Handling and analysis

All the video footage obtained from the home pens before and after the pen-rotation scheme were viewed for analysis. The analysis was done by watching the video footage and counting the frequency of occurrence of each behaviour defined in Table 2 (ethogram). The data obtained for each group have been presented in frequency distribution tables included with the percentage (%) of occurrence of the behaviours. Bar charts on the percentage of occurrence of the behaviours observed were made to enable comparison between litter groups before and after the pen rotation scheme using Excel (Microsoft, 2016). Due to low occurrences of most of the focused behaviours, statistical analysis was not relevant (i.e., due to too low statistical power).

3. Results

3.1. Aggressive behaviours before and after the pen-rotation scheme

Elements of aggressive behaviour as defined in Table 2 (ethogram) occurred in all groups at different frequencies within and across litter groups during the period of observation. A data overview is presented in the below frequency distribution tables including the percentage of occurrence of the elements of aggressive behaviours before (Table 3) and after (Table 4) the pen rotation scheme. Among the litter groups in both situations before and after the pen-rotation scheme, 'head-to-head knocking' appears to be the most common aggressive behaviour that tops in percentage (figures 2 and 3) and with the highest frequencies (Tables 3 and 4). Unlike the head-to-head knocking behaviour across the group, other behaviours across the groups either increased, decreased, or remained the same in frequency after reuniting. For instance, in comparing the frequency of ear bites (Table 3) among groups 1, 2 and 3 before the pen-rotation scheme to after reuniting (Table 4), there was a minor decrease in frequency after reuniting. Except for those of groups 4 and 5 which stayed the same (Table 4), ear bites in group 6 increased by 2 in frequency after reuniting. Considering groups 4 and 5, in both situations before (Table 3) and after the pen-rotation scheme or reuniting littermates (Table 4), the frequency of occurrence of most of the aggressive behaviours observed stayed the same, with a few exceptions. Parallel push behaviour remained at the same frequency across all groups in both situations except for that of group 1, which reduced from 8 (Table 3) to zero (0) after the reunion (Table 4).

Table 3. Elements of aggressive behaviours observed among the litter groups before the pen rotation scheme. Observation time was from 10 am to 12 pm. The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively while for each of groups 4, 5, and 6, n = 8.

Group 1	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequencies	3	2	10	8	62	2	7	2	16	1	4	117
% Occurrence	2.6	1.7	8.5	6.8	53.0	1.7	6.0	1.7	13.7	0.9	3.4	100.0
Group 2	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequencies	6	0	6	0	52	11	1	1	8	2	2	89
% Occurrence	6.7	0.0	6.7	0.0	58.4	12.4	1.1	1.1	9.0	2.2	2.2	100.0
Group 3	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequencies	8	1	28	4	63	12	8	5	9	2	1	141
% Occurrence	5.7	0.7	19.9	2.8	44.7	8.5	5.7	3.5	6.4	1.4	0.7	100.0
Group 4	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequencies	3	0	26	2	52	2	5	4	1	3	1	99
% Occurrence	3.0	0.0	26.3	2.0	52.5	2.0	5.1	4.0	1.0	3.0	1.0	100.0
Group 5	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequencies	4	0	5	1	51	2	2	3	5	0	1	74
% Occurrence	5.4	0.0	6.8	1.4	68.9	2.7	2.7	4.1	6.8	0.0	1.4	100.0
Group 6	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequencies	4	0	5	0	50	3	3	3	5	0	2	75
% Occurrence	5.3	0.0	6.7	0.0	66.7	4.0	4.0	4.0	6.7	0.0	2.7	100.0

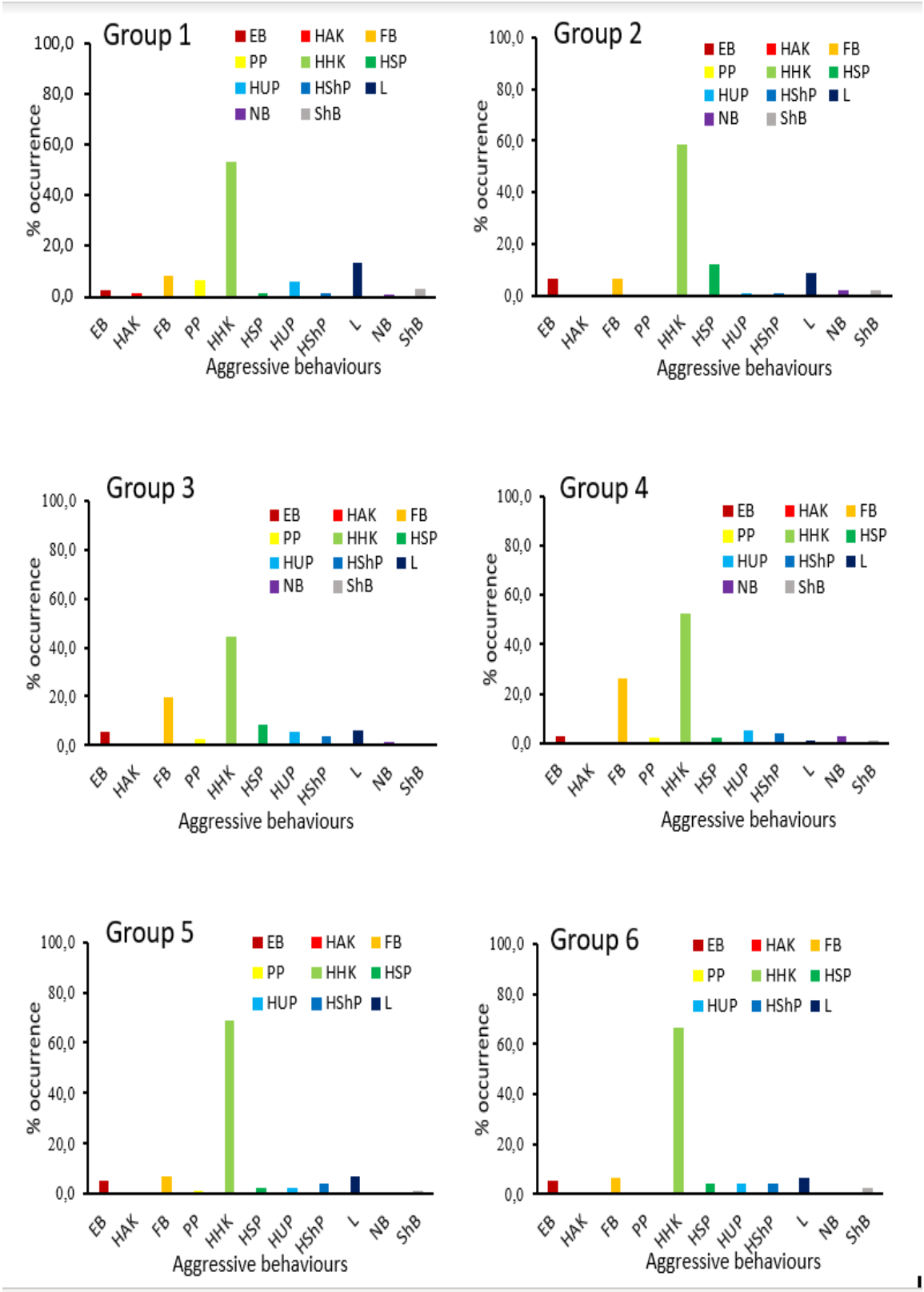

Figure 2. Bar charts on the percentage (%) of occurrence of the elements of aggressive behaviours observed within each litter group before the pen rotation scheme. Observation time was from 10 am to 12 pm., The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively while for each of groups 4, 5, and 6, n = 8.

*Table **4**. Elements of aggressive behaviours were observed among the litter groups after the pen rotation scheme. Observation time was from 10:30 am to 12:30 pm., The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively, for each of groups 4 and 5, n = 8, while with group 6, n = 7.*

Group 1	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequency	1	0	7	0	12	1	0	0	5	1	0	27
% Occurrence	3,7	0,0	25,9	0,0	44,4	3,7	0,0	0,0	18,5	3,7	0,0	100,0
Group 2	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequency	1	0	22	0	30	0	0	2	9	1	2	67
% Occurrence	1,5	0,0	32,8	0,0	44,8	0,0	0,0	3,0	13,4	1,5	3,0	100,0
Group 3	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequency	4	1	15	4	29	10	7	4	8	1	1	84
% Occurrence	4,8	1,2	17,9	4,8	34,5	11,9	8,3	4,8	9,5	1,2	1,2	100,0
Group 4	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequency	3	1	26	2	32	2	5	4	1	3	2	81
% Occurrence	3,7	1,2	32,1	2,5	39,5	2,5	6,2	4,9	1,2	3,7	2,5	100,0
Group 5	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequency	4	0	4	1	15	2	2	3	5	0	1	37
% Occurrence	10,8	0,0	10,8	2,7	40,5	5,4	5,4	8,1	13,5	0,0	2,7	100,0
Group 5	EB	HAK	FB	PP	HHK	HSP	HUP	HShP	L	NB	ShB	**Total**
Frequency	6	0	3	0	25	4	2	4	2	0	0	46
% Occurrence	13,0	0,0	6,5	0,0	54,3	8,7	4,3	8,7	4,3	0,0	0,0	100,0

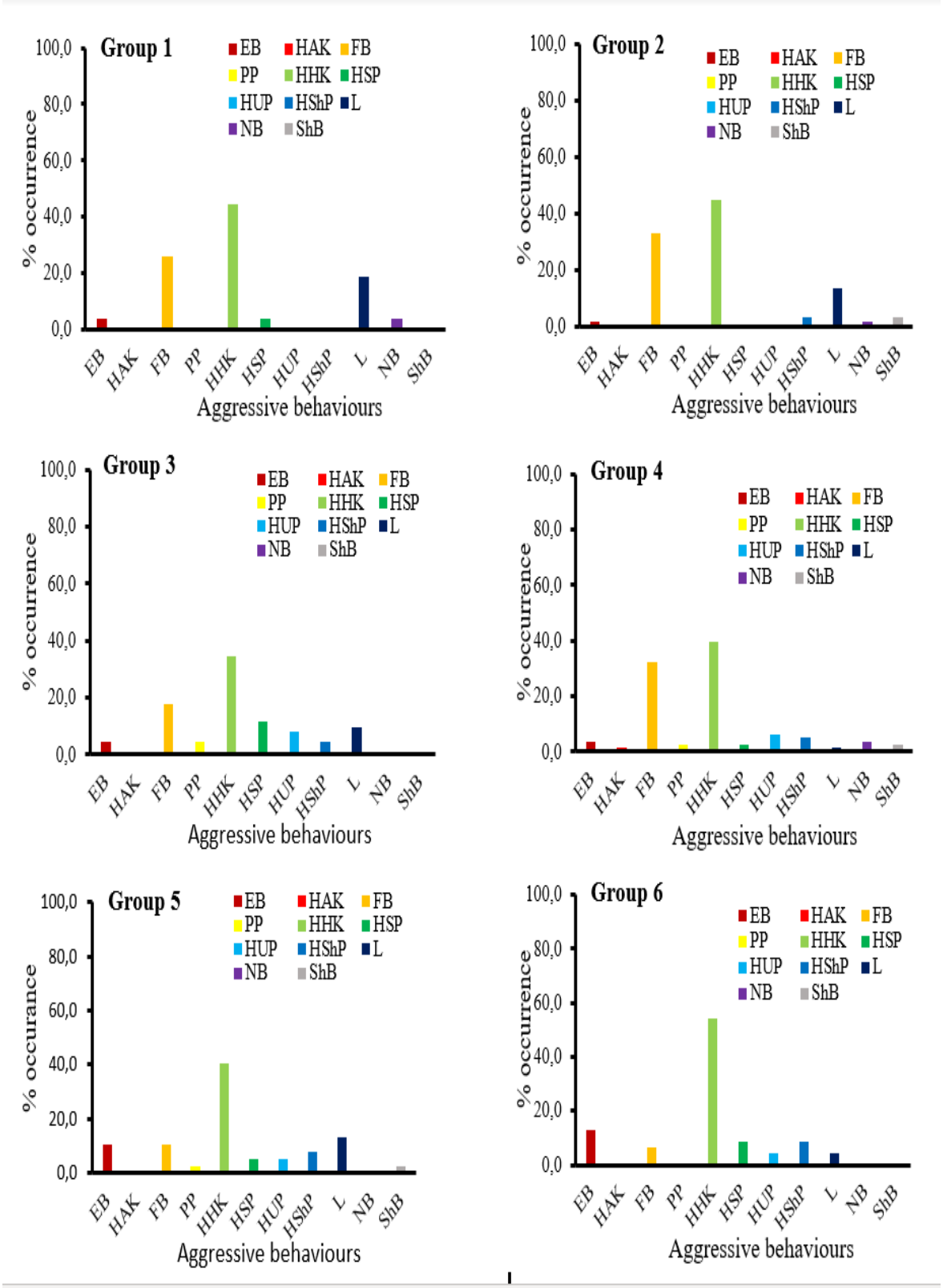

Figure 3. Bar charts on the percentage (%) of occurrence of the elements of aggressive behaviours observed within each litter group after the pen rotation scheme. Observation time was from 10:30 am to 12:30 pm., The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively, for each of groups 4 and 5, n = 8, while with group 6, n = 7.

3.2. Social affiliative behaviours before and after the pen-rotation scheme

The social affiliative or non-aggressive behaviour across the litter groups differs in the frequency and percentage of occurrence before (Table 5 & figure 4) and after (Table 6 & figure 5) the pen-rotation scheme. Notably, almost all the data obtained from the observation on the social affiliative behaviours before the pen rotation scheme were at a lower level compared to after going through the pen rotation scheme (reuniting of the littermates), with some exceptions. For instance, mounting behaviours within group 2 stayed the same at a frequency of 3 in both scenarios, before (Table 5) and after (Table 6) the pen rotation scheme, but in group 1, the behaviour reduced in frequency from 2 to 1 respectively in both situations. Apart from the behaviour of 'back scratching with snout' in group 4 that reduced in frequency from 12 (before the pen-rotation scheme) to 11 (after reuniting), all the other social affiliative behaviours observed increased in frequency after reuniting of the littermates. Nosing of other body parts occurred more frequently among all litter groups and apparently, had recorded the highest percentage across the groups after reuniting (Figure 5). Also, the pigs were involved in more exploratory behaviour and the frequency of group exploration across the litter groups after reuniting littermates (Table 6) increased more than threefold among each group compared to those observed before the pen-rotation scheme (Table 5).

Table 5. Frequency of social affiliative behaviours observed among litter groups before the pen-rotation scheme. Observation time was from 10 am to 12 pm. The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively while for each of groups 4, 5, and 6, n = 8.

Group 1	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	7	20	25	2	2	8	64
% Occurrence	10,9	31,3	39,1	3,1	3,1	12,5	100,0
Group 2	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	20	40	15	0	3	10	88
% Occurrence	22,7	45,5	17,0	0,0	3,4	11,4	100,0
Group 3	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	25	45	25	7	0	10	112
% Occurrence	22,3	40,2	22,3	6,3	0,0	8,9	100,0
Group 4	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	23	35	30	12	2	11	113
% Occurrence	20,4	31,0	26,5	10,6	1,8	9,7	100,0
Group 5	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	6	38	20	5	0	4	73
% Occurrence	8,2	52,1	27,4	6,8	0,0	5,5	100,0
Group 6	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	5	35	25	8	0	6	79
% Occurrence	6,3	44,3	31,6	10,1	0,0	7,6	100,0

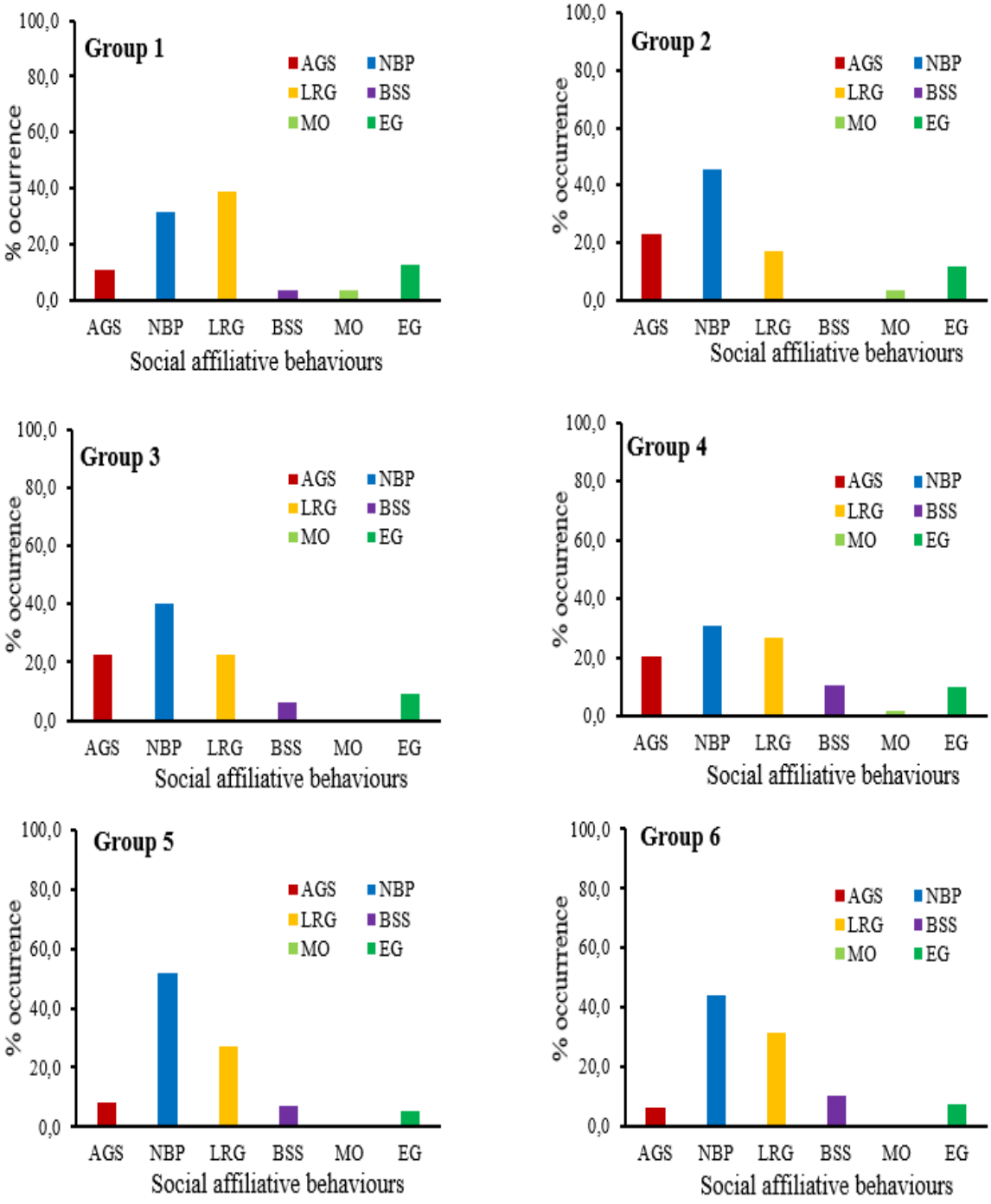

Figure 4. The distributions of social affiliative behaviours observed among litter groups before the pen rotation scheme. Observation time was from 10 am to 12 pm. The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively, while for each of groups 4, 5, and 6, n = 8.

Table 6. Frequencies of observed social affiliative (non-aggressive) behaviours among litter groups after the pen-rotation scheme. Observation time was from 10:30 am to 12:30 pm., The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively, for each of groups 4 and 5, n = 8, while with group 6, n = 7.

Group 1	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	16	114	30	9	1	30	200
% Occurrence	8	57	15	4,5	0,5	15	100
Group 2	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	22	110	40	7	3	32	214
% Occurrence	10,3	51,4	18,7	3,3	1,4	15,0	100,0
Group 3	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	35	106	49	13	2	39	244
% Occurrence	14,3	43,4	20,1	5,3	0,8	16,0	100,0
Group 4	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	30	112	40	11	4	38	235
% Occurrence	12,8	47,7	17,0	4,7	1,7	16,2	100,0
Group 5	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	26	110	42	8	4	27	217
% Occurrence	12,0	50,7	19,4	3,7	1,8	12,4	100,0
Group 6	AGS	NBP	LRG	BSS	MO	EG	**Total**
Frequency	24	105	36	9	2	27	203
% Occurrence	11,8	51,7	17,7	4,4	1,0	13,3	100,0

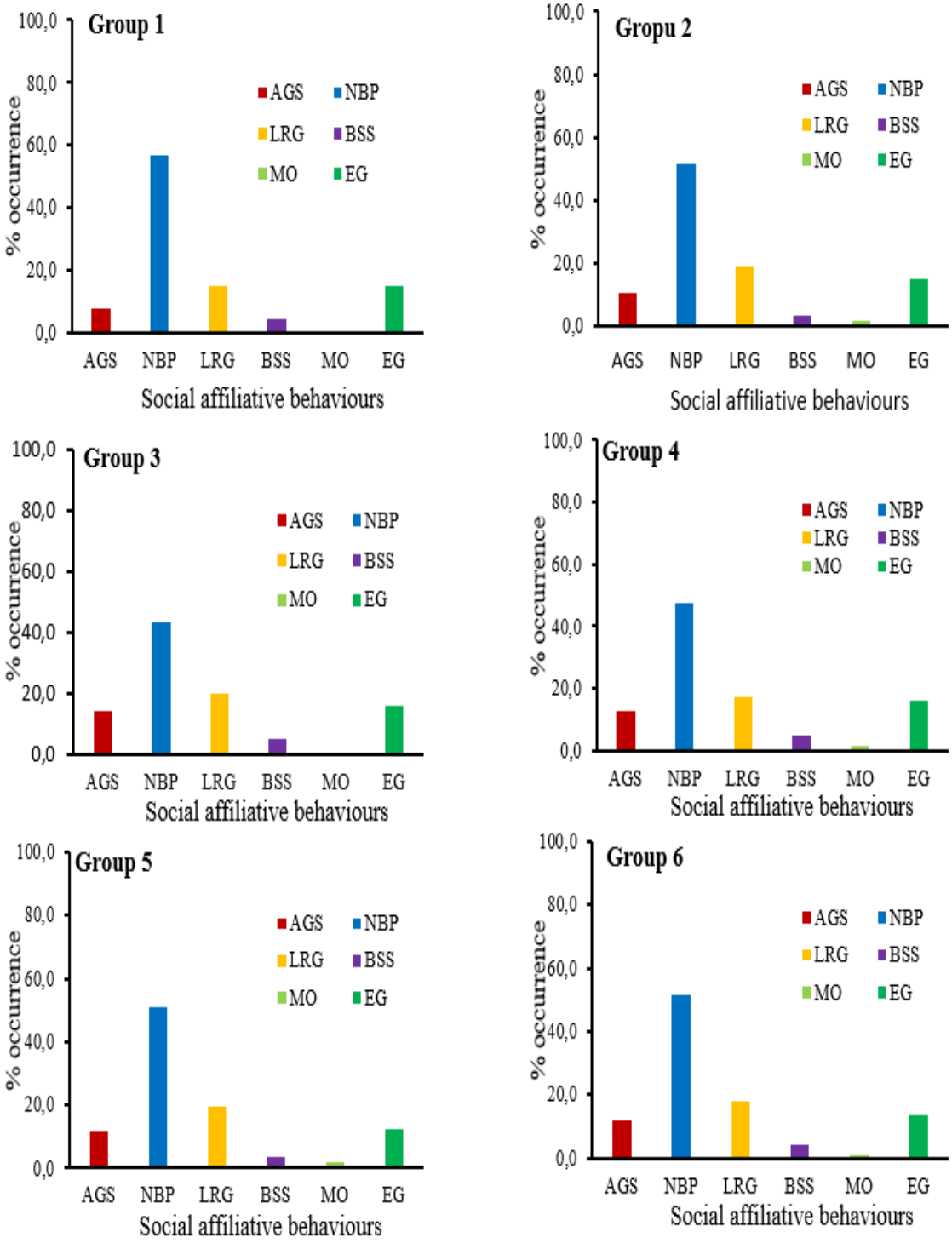

Figure 5. The percentage distributions of social affiliative behaviours observed among litter groups after the pen-rotation scheme. Observation time was from 10:30 am to 12:30 pm., The number of animals (n) in each group differs. For groups 1, 2 and 3, n = 10 respectively, for each of groups 4 and 5, n = 8, while with group 6, n = 7.

3.3. The response obtained from the interview

The response to the interview questions related to the study was received verbally from the staff and conclusions have been drawn from their statements (Table 7). Though both staff members were met separately, their responses to the questions asked seemed to be the same. The staff observed more exploratory and frequent nosing behaviours among the pigs after reuniting compared to before the separation of each litter but did not notice any strange behaviours among the pigs.

Table 7. Answers to the questionnaire to the staff of the pig facility.

Question number	**Answer.**
1.	No new or strange observations have been noticed after reuniting the pigs.
2.	The level of aggressiveness before and after temporal separation for the pigs to go through the pen rotation scheme was almost the same among the litters.
3.	The pigs explored their environment or pen together in groups of 3 or more at a time. More nosing contact or behaviours among the pigs have been observed after the pen rotation scheme.
4.	Some of the pigs do fight before and after feeding.
5.	Frequent or more nosing contact occurs among the pigs after the pen rotation scheme.

4. Discussion

This master thesis aimed to assess if a pen-rotation scheme mitigated the effects of reuniting pigs after temporal separation. Specifically, the study aimed to test if aggression and social affiliation levels were the same before and after the pen rotation scheme, by comparing the pre-and post-levels of aggression and social affiliation. It was hypothesized that pig aggression and social affiliation before the temporal separation of litter groups would resemble post-reuniting aggression and social affiliation but this hypothesis has been partially rejected. Some exceptions were found to support it.

Some behavioural signs of aggression during fights showed a decrease in frequency after reuniting littermates, suggesting a reduction of aggression within the period of observation. For instance, in groups 1 and 2 there were low fighting activities that occurred among the littermates, except for the high frequency of face bites occurring in group 2 after reuniting the pigs into their original home pens. This low fighting activity was noticed within the 2-hour observation period after reuniting littermates, which was within 24 hours. This may in a way agree with the study of Meese and Ewbank (1973), that post-regrouping aggression diminishes within 24 hours. Arguably, since the littermates were not reunited with unfamiliar conspecifics, it was obvious that the pigs knew each other after reuniting, and this increased individual recognition among the pigs. It was in this regard that a conclusion was drawn by Puppe (1998) that pigs that are familiar with each other engage in fewer aggressive behaviours. This could mean that individual recognition has not been impaired and could be assumed to contribute to the maintenance of positive social relationships which in turn may improve social cohesion among pig groups. This may therefore reduce social tension among grouped pigs in production sectors or research settings. The point based on familiarity also agreed with Stookey & Gonyou (1998), who noticed that the recognition that occurs among the animals has elements of previous exposure to each other including genetic relatedness which are confounded when pigs are reunited. There might be a partial breakdown in dominance or no establishment of any new dominance relationships among these littermates that are familiar to each other after undergoing the pen-rotation scheme and have been reunited. The behaviour observed was comparable between the groups, but notwithstanding this, a few differences existed between some litter groups before and after they have undergone the pen-rotation scheme. While the

frequency of some behaviours stayed the same in both scenarios, other behaviours have minor differences in frequency, with the frequencies of some behaviours showing an increase or decrease. The frequency of occurrence of most of the behavioural signs of aggression among groups 4 and 5 in both situations before and after the pen-rotation scheme, seems to be balanced among the groups. This observation was perhaps a result of the equality or balance in terms of size and weight of the littermates in these groups. This may be elucidated by the view that the pigs in these two groups were of similar body sizes that have been in these comparable sizes, which has ensured balance in most of the displayed aggressive behaviours observed.

There seems to be a better or increase in social affiliative behaviours after the pen rotation scheme when the litters were returned to their original home pens compared to before the separation of the littermates. This observation may be argued from the point that the pigs were not reunited with unknown individuals after the short period that they were separated to undergo the pen rotation scheme. The frequency distributions of all the social behavioural categories among the litter groups increased within and across the groups with different occurrences in frequency. The behaviour of "nosing of other body parts" increased the most among the groups of pigs who had been through a pen rotation scheme. As mentioned by Ewbank et al. (1974) pigs newly grouped explore or examine each other closely through the nosing of body parts. In the study of Hafez and Signoret (1969), it was observed that tactile stimuli cum olfaction through nosing behaviour plays a vital role in the social affiliative behaviour of pigs. This could mean that sniffing or nosing behaviour is an examination of each other, as it is generally believed that this behaviour is only displayed towards animals of the same group but not to strangers brought into the pen. This observation is also in line with the study of Bryant (1970), who indicated that this nosing of body parts as behaviour in pigs may be an appeasement.

The interview with two staff members of the pig facility at the Swedish Livestock Research Center also confirmed that more sniffing and nosing behaviour occurred as the pigs examined each other more closely after reuniting. The staff oversaw the pigs, giving the animals daily husbandry practices during the study period and they did not see any great changes in the aggressive behaviour of the pigs after reuniting. The observations from the staff have been reflected in the results, which may be that more positive social affiliations often occur after reuniting littermates for the short period they were taken through the pen rotation scheme. This observation was also confirmed in the study of (Ewbank & Meese, 1971; Camerlink & Turner, 2013), who mentioned that nosing behaviour may promote individual identification and membership and acknowledgement of conspecifics within a pig group. Camerlink et al. (2021), also, in a study supported the theory that nosing of body parts among pigs may be connected to positive effects, but as to whether all nosing

behaviours on parts of the body encourage social affiliation or could also mean a nuisance to individual pigs, is a good study area for the future.
In this study, the exploratory behaviour was observed among litter groups and this behaviour increased slightly across all groups after reuniting littermates. This group exploratory activity or behaviour among the littermates may be increasing their knowledge or become more familiar with the pen environment. During the exploring activities, associations were formed between pigs in pairs, threes, fours, or a whole group moving towards the direction of an object e.g., water, particles of food etc. The number of pigs that formed these associations during exploratory activities might be influenced by the presence of a littermate in an attempt to reach hidden objects in an inaccessible area or particular direction within the pen. In their home pen, the littermates showed more exploratory behaviour, but it may be possible that they could fully display this behaviour if they had access to a larger area. The pigs observed to be exploring groups were also noticed sometimes lying or resting together, probably due to the social relationship between the group or individuals.

4.1. Practical implications of the study

Pigs exhibited both aggression and social affiliation before and after undergoing a pen-rotation scheme (i.e., temporal separation and reuniting). Performing a pen-rotation procedure while pigs are separated to allow pigs to be able to retain identification of littermates in neighbouring pens, may be useful, but this needs further testing with larger sample sizes, and with proper controls. If proven efficient, a pen rotation scheme could be useful for both scientific studies in need of splitting and later reuniting litters and for commercial pig production, when temporal splitting is needed e.g., during veterinary treatments.

4.2. Social and sustainability aspects of the study

The concern for societal demand of the public and acceptability of food production and any cruel treatment that may be meted out to an animal (Buller & Morris, 2003; Kanis et al., 2003; Boogaard et al., 2011) during production and research settings was critically considered before and during this master project. The method in this study might lower stress in the animals hence ensuring better results of the experiment, but also more humanely raised animals for production, which is aligned with the UN sustainability goals.

4.3. Limitations of the study

The study on the aggression and social affiliation of the litters could not be extended for longer observation periods in both situations before and after the pen-rotation scheme when littermates were reunited. Additionally, video recording was done in only the original home pens of pigs and not in the experimental pens during the stage of pigs going through the pen rotation scheme. These limitations were due to limited time and resources e.g., inadequate cameras with batteries that could run longer times for filming than the 2-hour observation period. Consequently, the 2-hour study on each group would overlook a great amount of data. Again, a control group could have been created and subjected to grouping and regrouping without rotation scheme, allowing the effect of the rotation scheme to be compared to separation without one.

5. Conclusion

This small-scale study showed that pigs expressed both aggression and social affiliation before and after undergoing the pen-rotation scheme (i.e., temporal separation, and re-uniting). Although some exceptions can be identified, there appears to be a resemblance between pig aggression and social affiliation before and after the temporal separation of littermates. A pen-rotation scheme may be applicable on pig farms to mitigate stress related to reuniting littermates after temporal separation, but this needs further testing with larger sample sizes, and with proper controls. If proven efficient, a pen-rotation scheme could be useful for scientific studies in need of splitting and later reuniting litters, as well as for commercial pig production when temporal separation is needed, for instance during veterinary treatments.

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Popular scientific summary

Once upon a time, there was a war and peace between pigs

If you were a beginner in pig farming and witnessed fights among your pigs every day, you might be worried about what to do about the situation. Pigs can fight among themselves, causing injuries that can lead to death. This behaviour of pigs can be a worrying situation for the animals, leading to poor performance in a production setting. Despite the fighting, pigs may also exhibit different forms of positive behaviours, such as playing with each other, touching each other with their snouts, sniffing, etc. With good management strategies and research activities, the situation can improve by minimising the fight among pigs, if not total elimination. The study seeks to assess if a pen-rotation scheme mitigated the effects of reuniting pigs after temporal separation. The six groups of pigs that were used in the study were all born to different sows, and therefore formed six different groups. Before a temporal separation of each group into different pens within three days, the behaviours of the pigs were filmed with a camera installed in their home pens for 2 hours the previous day. After rotating the paired pigs in five different pens within three days, they were filmed again in their respective groups. This study found that pigs showed aggression and social affiliation before and after undergoing a pen-rotation scheme. Although some exceptions can be identified, there appears to be a resemblance between pig aggression and social affiliation before and after the temporal separation of littermates. A pen-rotation scheme may be applicable on pig farms to mitigate stress related to reuniting littermates after temporal separation, but this needs further testing with larger sample sizes, and with proper controls. If proven efficient, a pen-rotation scheme could be useful for scientific studies in need of splitting and later reuniting litters, as well as for commercial pig production when temporal splitting is needed.

The study on aggression and social affiliation of the litters could not be extended for longer observation periods in both situations before and after the pen-rotation scheme when littermates were reunited for video recording because of limited time and resources, such as inadequate cameras with batteries that could run longer times for filming than the 2-hour observation period. Consequently, the 2-hour study on each group would overlook a great amount of data.

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