



Feeding behaviour of slaughter pigs (*Sus scrofa*) kept in a Swedish conventional system

Slaktgrisars beteenden i samband med utfodring i ett svenskt konventionellt system

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1. Abstract

The management and keeping of slaughter pigs are normally highly controlled and achieving a good feed efficiency is one of the pork industry's main goals. When being kept in a conventional system the pigs do not have a good opportunity to perform natural feeding and foraging behaviours which could lead to frustration and a negative welfare. Pigs are as well commonly kept at a high density and therefore have difficulties keeping a distance to each other. This could also lead to increased frustration and aggressive encounters during feeding. Twelve pens were liquid fed three times a day, with observations made during their lunch feeding. The actual feeding had a short duration in all pens with a maximum time of approximately five minutes. Results show that pigs were lying down and being inactive during the main time of the observations. Other commonly performed behaviours were substrate explore, fixtures explore, nosing pig, walking, eating and head throwing. In correlation with feeding the three latter behaviours increased, but only walking was significant ($P < 0.05$, $F = 15.52$). A delayed feeding did not seem to affect animals negatively as the pigs in the four latest pens were lying down ($F = 3.30$, $P = 0.103$) and seemed more calm in comparison with the four first fed. When comparing pens being mixed or not, mixed pens performed fixtures explore ($F = 13.28$, $P < 0.002$) more often and lying ($P < 0.05$, $F = 32.44$) to a less extent. The mixed pens also had a higher average slaughter weight ($P < 0.05$, $T = 2.91$). More research considering long-term effects of mixing pigs should therefore be prioritized. Belly nosing was performed frequently in all pens and since this behaviour could be an indicator of stress, it should be further analyzed. Inactive behaviour demonstrated to highest extent by all pigs could be a result of different causes. Though, the author believes that is caused by boredom and not having access to perform other behaviours. This is why more effort should be put into prolonging the feeding time and keeping the pigs occupied during a larger part of the day.

1.1 Sammanfattning

Hur slaktsvin hålls och hanteras är normalt sätt högt kontrollerat och att ha en effektiv foderomvandling är ett av de viktigaste målen att uppfylla inom fläskköttindustrin. I ett konventionellt system har grisarna inte goda möjligheter att utföra ett naturligt födosöksbeteende, vilket kan leda till frustration och en negativ djurvälstånd. Grisarna hålls också vanligen under hög densitet och har därför svårt att hålla avstånd gentemot varandra. Det kan leda till ökad frustration och att aggressiva konfrontationer uppstår under utfodringen. I studien användes 12 boxar som blötutfodrades tre gånger per dag, med observationer utförda endast under lunchutfodringen. Födointaget hade i alla boxar en kort duration och uppvisades under cirka fem minuter. Resultaten visar att grisarna var inaktiva och låg ner under största delen av tiden. Andra vanligt förekommande beteenden var undersöker bottenstrukt, undersöker inredning, nosar på annan gris, går, äter och stångar med huvudet. I samband med utfodringen ökade de tre sist nämnda beteenden, men endast går var signifikant ($P < 0.05$, $F = 15.52$). En fördröjd utfodringen visade sig inte påverka djuren negativt eftersom att grisarna i de fyra sista boxarna verkade mer lugna och låg ner i högre grad ($F = 3.30$, $P = 0.103$). Vid en jämförelse av boxar med grisar antingen blandade

från olika kullar eller inte, utförde de i blandade boxar utforskande av inredning i högre utsträckning ($F=13.28$, $P<0,002$) och låg ner under kortare perioder ($P<0.05$, $F=32.44$). Blandade boxar hade även en högre medelslaktvikt ($P<0.05$, $T=2.91$). Mer forskning med fokus på hur grisar påverkas över en längre tid av att blandas borde prioriteras. Magnosning var ett annat beteende som utfördes frekvent i alla boxar. Eftersom att beteendet kan påvisa stress, borde det analyseras och utforskas i högre utsträckning. Ett inaktivt beteende uppvisades i hög grad hos alla individer och kan ha många olika orsaker. Dock, tror författaren att beteendet är ett resultat av leda och att grisarna inte har möjlighet att utföra andra beteenden. Därför behövs mer resurser läggas på att utöka tiden för födointaget och att hålla grisarna sysselsatta under en större del av dygnet.

2. Introduction

Feeding is probably the most important event of the day for slaughter pigs (Carlstead, 1986) and therefore are the management of importance to minimize stress. The feeding of pigs is commonly highly controlled and is divided into phases with different diets which changes as the animals grow (Loyon *et al.*, 2009). There are different purposes for the feeding of pigs in different stages of their lives, but the main objective for the pork industry is to achieve a good feed efficiency (Colpoys *et al.*, 2016). The wild boar is an opportunistic carnivore and studies have demonstrated that they eat vegetables in first place and secondary feed of animal origin (Schley & Roper, 2003). Pigs used in the pork production are mainly fed grains, legumes and by-products derived from the oil and grain industry (Stern *et al.*, 2005). This is provided either as liquid or solid diet (Loyon *et al.*, 2009) and in Sweden approximately 70% of all pigs are being fed a liquid diet (Persson *et al.*, 2008).

Under natural conditions wild boars spend approximately about six till eight hours per day performing foraging and feeding behaviours (Ewing, 2011). Though, the common practice in the conventional pig production is to feed the finishing pigs two till three times per day, where it takes the pigs approximately 15 minutes to finish the meal (Persson *et al.*, 2008). Zoric *et al.*, (2015) even noted as low feeding times as four minutes when giving pigs liquid feed. Though, Gustafsson *et al.*, (1999) found that the feeding behaviour in slaughter pigs probably has evolved through domestication as a result of not having to perform a lot of foraging behaviours. I could therefore be that domesticated pigs do not have the same needs as wild boars.

Domesticated pigs, similar to wild boars, do most activities together and that includes foraging (Ewing, 2011). Though, one difference considering their feeding behaviour is that wild boars have less interactions during feeding which probably is a result of having access to a larger area (Jensen & Wood-Gush, 1984). Feeding pigs in a trough without free access to feed creates a high competition (Thomsen *et al.*, 2010). It has been noted that pigs having to feed in close proximity to each other increases aggressive interactions (Thomsen *et al.*, 2010). This is probably due to sub-ordinate pigs not being able to register aggressive signals from dominant individuals (Thomsen *et al.*, 2010).

Since the feeding event is of importance for slaughter pigs are the predictability of when the feed are going to be provided crucial for the pigs to not create frustration (Carlstead, 1986). On a farm there are normally something that signals the feeding, for example sounds from the machines preparing the feed or hearing the other animals eating (Carlstead, 1986).

If there are unreliable signals in the stable and the pigs are not able to predict the feeding it could lead to increased aggression, feed competition and also a greater difference in weight gain (Carlstead, 1986).

3. Background

3.1 Pig production in Sweden and Europe

There are approximately 1100 pig farmers in Sweden and 2.6 million pigs are being slaughtered annually (LRF, 2014). Though, this is only one percent of the total amount of pigs slaughtered in the EU and there has been a decrease in both pigs slaughtered and in the number of pig farms in Sweden (LRF, 2014). Instead the import of pork meat, mainly from Germany and Denmark, has increased (LRF, 2014). In the European Union the number of pigs slaughtered in the year of 2014 were approximately 150 million and the countries with largest production of pork meat were Germany and Spain (Eurostat, 2016).

Pigs in Europe are commonly kept indoors at high density (Stern *et al.*, 2005). The growing/ finisher pigs are mainly kept in five different systems: fully- slatted floor, partly-slatted floor, solid floor without or with some bedding, deep litter system and outdoor/ semi- outdoor rearing on earth or concrete (EFSA, 2007). The system dominating is partly-slatted floor, but in, for example, Denmark and Belgium fully- slatted flooring is most commonly used (Loyon *et al.*, 2009). In Sweden the animal welfare regulation says that the pigs must have a lying area that does not drain the feces, which means that you are not allowed to have a fully-slatted floor (3 kap. 9§ Statens jordbruksverks föreskrifter och allmänna råd (SJVFS 2010:15) om djurhållning inom lantbruket m.m.; Saknr L 100). In EU most fattening pigs are kept in groups with less than 20 animals, though in some countries larger groups up to over 100 animals occur (Loyon *et al.*, 2009).

3.2 Behaviour of pigs

An animal's motivation to perform certain behaviours is mainly affected by internal stimuli, not by the environment or because it has learned how to do it, which was previously claimed by scientists (Friend, 1989). The animal is commonly acting by instinct or as an effect by genes and the need to perform certain behaviours could increase with lacking ability to display it (Friend, 1989). It is probably not necessary for animals to perform all natural behaviours to experience a good welfare (Špinko, 2006). Though, providing animals with the ability to perform a natural behaviour is commonly a reliable way to improve the wellbeing of the animal (Špinko, 2006).

According to Boissy *et al.*, (2007), you can divide all animals' behavioural needs into two different categories. The first category are behaviours which are connected to a direct physiological consequence, for example eating and drinking (Boissey *et al.*, 2007). The second category are behaviours that will be beneficial for the animal and its offspring in a longer perspective such as reproduction (Boissey *et al.*, 2007). Hemsworth *et al.*, 2011 performed a Y maze test to evaluate which resources that are most important for a pig to access after being deprived from them. They found that social contact with another pig was favored before feed, which in turn was favored before access to straw.

3.2.1 Exploration

Exploration is of importance for the survival of wild animals (Wood-Gush & Vestergaard, 1989). It is claimed that the pig has a need for performing exploration considering finding information about their environment and information about new objects (Studnitz *et al.*, 2007). There are three types of exploration: extrinsic, intrinsic and inquisitive. Extrinsic is when the animal is investigating something which is of biological value such as feed or a nesting site and this is commonly a response to a stimulus (Wood-Gush & Vestergaard, 1991). When an animal is prevented from performing this type of exploration it could result in animals experiencing frustration (Wood-Gush & Vestergaard, 1989). Intrinsic exploration is described as when the animal is exploring something that is commonly not important for the animal's survival, for example a new object in the pen (Wood-Gush & Vestergaard, 1989). Inquisitive is described as when the animal explores to change its environment and indicates that it has a higher degree of curiosity in comparison with animals not using this exploration. In a study where piglets were kept in a pen with a large amount of straw, they would leave it and go to a testing area containing a novel object (Wood-Gush & Vestergaard, 1991). The authors believe that this indicates that pigs use inquisitive exploration and that new, unfamiliar objects is reinforcing for them. If pigs do not have the possibility to explore in, for example straw, it will instead redirect it against other individuals and equipment in the pen (Studnitz *et al.*, 2007). This could also be an indication of pigs having a high need to perform exploration. It is also common that the pig use explorative chewing to gather nutritional information in its environment (Day *et al.*, 1996). This foraging behaviour is of importance since the pig get in contact with different feed stuff and then are able to evaluate if they are suitable to eat (Day *et al.*, 1996).

3.2.2 Factors affecting feeding behaviour

Research have demonstrated that the type of housing system pigs are kept in have a potential to change their feeding behaviour. Morrison *et al.*, (2003) found that pigs kept on a deep straw bedding had fewer but longer feeding bouts in comparison with those kept in a conventional system. The pigs housed on deep straw bedding were kept on a larger area and the authors therefore believe that the pigs had a better ability to perform other behaviours besides feeding. Results demonstrated by Presto *et al.*, (2008) as well confirmed that pigs in a conventional system would show more feeding behaviours in comparison with outdoor kept pigs. The authors' hypothesis is that they would this to keep themselves occupied, when having less access to for example root.

Increasing or decreasing the number of pigs in a pen could as well cause a change considering their feeding behaviour (Nielsen *et al.*, 1995). When pigs are kept in a group with more than 20 animals the competition increases and the pigs adjust their behaviour to be able to get enough feed (Nielsen *et al.*, 1995). They do this by eating less often, but faster and eating a larger amount at a time. The pig is a diurnal animal and one study showed that pigs mainly were feeding between 8:00 and 18:00 when housed indoors (Gonyou *et al.*, 1992). When the number of animals increased pigs could demonstrate an abnormal behaviour by instead eating night time (Nielsen *et al.*, 1995).

When practicing restricted feeding and not free access, there could be a problem with low ranked individuals not getting enough feed because they are chased away by high ranked animals (Brouns & Edwards, 1994). Which as well also could result in low ranked animals having to feed during the night. Restricted feeding could moreover also affect the amount

of stereotypies that pigs perform (Terlouw, 1991). A study showed that sows not having ad libitum access to feed demonstrated more stereotypies such as excessive drinking and were manipulating chains, provided to them, to a larger extent (Terlouw, 1991). According to the authors, restrictively feeding affected the sows more in comparison with being tethered.

Thomsen *et al.*, (2010) investigated how different distances between feeding stations would change the pigs' behaviour during feeding. When the feeding troughs were placed next to each other the pigs spent a longer time eating and had a higher intake. Though, they performed more aggressive behaviours and changed position more often. Jensen & Pedersen (2010), as well found that decreasing the size of the feed trough increased aggression among pen mates. Andersen *et al.*, (1999) investigated how barriers between sows when feeding would affect their behaviour. Having longer partitions made the pigs change place less often and the low ranked individuals would not be chased away from their place as frequently. The study also showed that increasing the length reduced the amount of aggressive behaviours such as bites towards head and shoulders.

3.2.3 Liquid feeding

Liquid feeding makes it possible to use liquid rest products from the human feed industry, for example dairy and wheat starch, which decreases feed waste (Brooks *et al.*, 2001). Other advantages considering liquid feeding are less dust that affects the pigs' airways and an increased feed conversion ratio (Brooks *et al.*, 2001). There are some differences in feeding pigs with either dry or liquid feeding. When providing the feed in water, the pigs are able to consume a larger amount and a longer time will pass before the pigs feel satiety (Rasmussen *et al.*, 2006). The liquid feeding will also make the pigs drink the food instead of chewing it and therefore adds up to the pigs not feeling satiety (Persson *et al.*, 2008). Since there is a high amount of water in the feed it will also take the pig a longer time to ingest equal amount of digestible energy in comparison with dry feed (Rasmussen *et al.*, 2006).

Andersen *et al.*, (1999) demonstrated results where sows given wet feed showed less aggressive interactions, compared with those given dry feed. There was no significant difference between wet and dry feed when measuring time spent at the feeding trough, but when being wet fed the pigs would voluntarily change their position at the trough more frequently. Zoric *et al.*, (2015) compared the behaviour of pigs being given either wet or dry feed and noticed that the latter group had a 50 percent longer feeding time. Pigs fed a liquid diet would as well, in addition to the other study, change their position at the feeding trough more often and had a lower feed conversion rate. Manipulation of pen mates such as belly nosing, was also more commonly seen in pigs provided with a liquid diet.

3.2.4 Anticipation/frustration

Anticipation and frustration are not always easy to distinguish from each other and when the other transits to the other. Frustration is commonly a result of an animal being motivated to perform a behaviour, but are prevented to do it by something being either absent or present (Broom & Fraser, 2006). Frustration is more likely to be expressed by pigs when kept in a conventional system due to limited space, social stress and restriction of feed (Arnone & Dantzer, 1980). Pigs have demonstrated to modify their behaviour according to the expected amount of feed they are normally given (Haskell *et al.*, 1996). In a study, individuals used to being fed a larger amount of feed performed a higher degree of

food searching and would move around more (Haskell *et al.*, 1996). Another study where some sows feeding were delayed by either 5 or 15 minutes as well made them move around and vocalize to a higher extent (Haskell *et al.*, 2000). A high vocal response in one pig has also shown to affect other pigs in stable and making them as well using high frequency sounds (Xin *et al.*, 1989). Lewis (1999), as well found that pigs frustrated from not being given feed displayed a higher locomotor activity and increased the oral manipulation. According to Arnone & Dantzer, (1980), frustration in pigs does not commonly lead to animals demonstrating aggression towards each other. Though, there could be a higher risk of aggression to occur if pigs are placed together with unfamiliar individuals when feeling frustrated.

Pigs have been demonstrated to behave differently according to which event they are anticipating to occur (Imfeld- Mueller *et al.*, 2011). This means that they have the ability to connect a sound to a stimuli and can distinguish between them. When anticipating a negative situation pigs more commonly perform high frequency sounds and tried to avoid an experimental box with an aversive stimulus, in comparison with a positive situation (Imfeld- Mueller *et al.*, 2011). Another study by (Imfeld- Muller & Hillman, 2012) where pigs were trained to connect a certain signal with being given an enrichment also demonstrated a change in behaviour. When the pigs would hear the sound their movement would increase and the pigs as well became more attentive.

Reimert *et al.*, (2013) also investigated if pigs would behave differently when anticipating an aversive or positive experience. When the trained pigs heard the sound signaling the aversive event they would move the ears more and keep them in a position backwards, which is demonstrating a negative feeling in pigs. When instead anticipating the positive event the pigs would nose the door containing the reward to a larger extent and have their heads pointing at the door to the start box (Reimert *et al.*, 2013). The authors believe that this could be because the pigs were waiting for a person to come through the door to give them a reward.

3.2.5 Social behaviour and communication

Under natural conditions, related sows normally form large groups where they keep a strict linear ranking order (Christiansen, 2005). The most dominant sow in the herd usually gets the best resources such as feed and the best place where to farrow (Ewing, 2011). Boars and sometimes also gilts, leave the herd when they reach sexual maturity at approximately six months (Christiansen, 2005). The boars are the largest part of the year living solitary, but join the sow group during the mating season (Christiansen, 2005). Arey, (1999) found that a higher ranking individuals in a group of sows were correlated with high body weight at weaning and if the sow have had many litters. Another study also confirmed that a higher body weight were correlated to a higher dominant ranking (Drickamer *et al.*, 1999). The authors also noticed tendencies towards high ranking sows having high ranking offspring.

Pigs seem to recognize each other mostly by smell, but they also use visual, tactile and audible signals when they communicate (Christiansen, 2005). Social nosing is used in recognition among pigs and can give them information about the health and reproductive status of the recipient (Camerlink & Turner, 2013). This behaviour does not seem to be correlated with dominance and in one study pigs demonstrated this behaviour with almost every other individual (Camerlink & Turner, 2013). Vocalization is also of importance in the pig communication and they are mainly using four different sounds: grunt, bark, squeal

and scream (Deen, 2010). Pigs are grunting when they hear a familiar individual or in association with some activities, such as exploring (Deen, 2010). Barks are produced when being frightened, squeals when being excited and screams when the pig experience pain (Deen, 2010). Pigs' sight is not that developed and they are less able to notice small visible cues in comparison with humans (Zonderland *et al.*, 2008a). They are able to see in a wide angle and can easily detect movement in front or beside them (Velarde *et al.*, 2015). Though, they are lacking in the ability to estimate distances and depth (Velarde *et al.*, 2015).

3.2.6 Aggression in pigs

When comparing entire males with females and castrated males, entire males have been demonstrating more aggressive behaviours such as mounting and causing skin lesions in other individuals (Bünger *et al.*, 2015). This was also demonstrated in a study by Colson *et al.*, (2006), where castrated males more often were initiators of fights when being kept together with females. Though, another study when mixing groups of castrated males and entire females showed no differences in aggressive behaviour between sexes (Meese & Ewbank, 1973).

A higher mixing proportion in boxes with piglets at weaning have demonstrated to cause more fights, skin lesions and also a lower weight gain as an effect of stress (Mei *et al.*, 2016). Though, when putting a new group of pigs together for the first time the dominance hierarchy is commonly established within 24 hours, but aggressive interactions is declining even after one hour (Deen, 2010). Besides sex, is size commonly the characteristic which will determine the dominance order (Deen, 2010). Where a higher weight will cause more aggressive and dominant individuals (Mei *et al.*, 2016). D'eath & Lawrence (2004) also noted that a cause for pigs becoming aggressive as adults could be a result of high competition in a large litter, with piglets having to fight to be able to suckle.

Samarakone & Gonyou (2009) conducted a study where they investigated if the pigs' behaviour would change when being kept in a group with various or less individuals. The pigs that had been housed in a group containing fewer individuals acted more aggressively compared with the other groups. This was also confirmed in another study where groups of 6 or 12 individuals had higher coincidences of aggressive encounters, in comparison with groups of 24 pigs (Andersen *et al.*, 2004). The authors believe that the pigs change their behaviour due to the decreasing probability to win all fights and therefor creates a defensive strategy.

The earlier mentioned study by Jensen & Wood-Gush (1984), were they observed outdoor free- ranging sows, presented results with less aggressive interactions in comparison with studies observing sows kept in-doors. Even though the sows did not know each other previously and probably not had made up a ranking order, there was a low amount of aggressive interactions between the individuals. Instead there was an "avoidance order" where the subordinated animals performed different behaviours such as flight, which probably managed to keep the low amount of aggressive interactions down. The larger area that the animals were kept on most likely as well decreased aggressive interactions as the sows had the possibility to keep a distance from each other (Jensen & Wood-Gush., 2009). McGlone, (1986), conducted a study where he tried to evaluate how deprivation of resources would increase the sum of aggressive behaviours. The results showed that the deprivation did not increase agonistic behaviours after regaining resources.

Meese & Ewbank (1973) observed different aggressive behaviours when grouping slaughter pigs, both castrated males and entire females. The most common behaviour used for creating the dominance order was replacements, followed by threats and attacks. Replacements was described as when one individual would push another away from the feeding trough, to be able to get access to it. Threat was described as when the pig would perform an aggressive behaviour without having physical contact with the other individual. The sniffing and investigating of pen mates increased when the aggressive interactions decreased (Meese & Ewbank, 1973). One behaviour that Jensen (1980) found to be dominance related was “parallel pressing”. This was when the pig pushed the side against another pig, which could sometimes be followed with biting. Other aggressive behaviours observed was when the pig knocked its head against a pen mates head or body and sometimes put its head under the pig’s body and lift it (Jensen, 1980).

3.2.7 Coping personalities

Animal personalities or coping strategies can mainly be divided into two different categories and those are the high resisting (high aggressive) and low resisting (less aggressive), who reacts differently to changes in the environment (Benus *et al.*, 1987). They have probably been developed through evolution when animals have been exposed to different everyday challenges (Koolhaas *et al.*, 1999). The high resisting personalities reacts often by habit and are focusing on reducing the source of stress (Benus *et al.*, 1991). Low resisting personalities have demonstrated to be better at coping with changes in their environment since they are better at modifying their behaviour (Benus *et al.*, 1987). High resisting individuals seems to become more stressed when being placed in a new environment and often acting by habit and for example attack all intruders (Benus *et al.*, 1987).

To able to measure if a pig have one of these personalities you often use a social confrontation test when you write down which behaviours that the pig demonstrates when put it together with other individuals (Hassing *et al.*, 1993). This is then combined with a backtest where you put the pig on its back and note down how many times it tries to escape (Hassing *et al.*, 1993).

The coping style of a pig also seems to affect how the pig acts in an aggressive encounter (Bolhuis *et al.*, 2005). Pigs that are described as “low reactive” or as passive tend to be better at changing their behaviour according to the other individual and if the pig will be successful in the fight (Bolhuis *et al.*, 2005). A “high reacting” pig are seen to be less flexible in their social behaviour and will go into a fight without considering the characteristics of the other pig and how that will affect the outcome of the fight (Bolhuis *et al.*, 2005). The tendency to show aggression have demonstrated to be correlated to the behaviour of pig’s mother (Van Erp-van der Kooij *et al.*, 2000). The coping behavior and tendency to show aggressive behavior has as well demonstrated to be consistent over time (Hassing *et al.*, 1993). Because of this there is a possibility to estimate how the grown up pig will act, by doing behavioural tests on piglets (Hassing *et al.*, 1993).

4. Aim

The aim of this study was to evaluate which behaviours, pigs housed in a Swedish conventional system, perform when they are exposed to the everyday event feeding. There was an extra interest in evaluating to what extent the pigs would demonstrate behaviours associated with a negative welfare such as frustration and aggression. How a delayed feeding would affect the behaviours of slaughter pigs was also of concern.

Questions that will be addressed in this study are:

1. Which behaviours are commonly performed by slaughter pigs in a Swedish conventional system?
2. Is there a difference in the behaviour performed by slaughter pigs before and after feeding starts in the stable?
3. Is there a difference in the behaviour performed by slaughter pigs in relation to how long time they have to wait for their feed?

5. Materials & methods

5.1 Animals and management

The study was conducted between February and April 2016, on a pig research farm in Uppsala which is held by the Swedish University of Agricultural Sciences. The breed of the pigs being observed was either Yorkshire/Hampshire or Yorkshire/Landrace/Hampshire (table 1). They were born on the farm between 26th and 28th of November 2015. Piglets were weaned at five weeks of age and dewormed with Rintal at seven weeks. Male piglets were immunocastrated with Improvac at ten weeks and given a second dose at 14 weeks. After weaning piglets were kept in unity boxes and given piglet feed “Medley” (produced by Lantmännen) and water ad libitum. They were moved to the current stall, where the study was performed, at three months of age. These pens had solid concrete floor with one third of this area being slatted and used as a dunging area. Measurements of pens were 3.60m X 2.20m and housed between six and nine pigs (table 1). The feeding trough measured as well 3.60 m. The common practice on the farm is to keep the litters intact, but sometimes they mix pigs from different litters to even it out (table 1). All pens contained both females and castrated males, but not an equal number of each (table 1). Pens were cleaned every morning manually by the personal and are afterwards given 1.2 kilo of straw/box/day automatically by a straw provider situated in the ceiling. Pigs were automatically fed three times a day with liquid feed “Rio” produced by Lantmännen and provided water ad libitum. As the pigs continuously grew the feed ratio also increased until the pigs reached the weight of 60 kilos. After this pigs were given the maximum amount of 2.8 kg/day until being slaughtered. Each pen received their feed one at a time where pen 1 got feed first and pen 12 last (figure 1). There were approximately 1-2 minutes waiting time between each pen. The temperature in the stall was 18 °C and there was approximately 11 hours light and 13 hours dark every day.

During the observation period one pig had to be euthanized as a cause of lameness. One week after the observations ended all pigs were sent to slaughter.

Table 1. Information about the pigs used in the observations. Column mixed describes if the pigs in the box are mixed from different litters or not

Pen	Number of pigs	Number of males	Number of females	Mixed	Other	Average weight at slaughter(kg)
1	7	4	3	Yes		97
2	6	2	4	Yes		84.5
3	7	1	6	Yes		91.3
4	7	3	4	No	One pig euthanized	87.4
5	8	4	4	No		89.5
6	9	6	3	Yes		91.7
7	8	4	4	Yes		92.4
8	8	5	3	No		84.7
9	7	5	2	No		86.6
10	7	4	3	No		84.1
11	9	4	5	No		82.8
12	8	2	6	Yes	Mother also landrace	91.6

5.2 Observations

A pilot study was conducted one week before the actual study started to be able to evaluate the observation method and protocol design. After this, some corrections were made to improve and simplify the observations. There was one observer for all observations. Pigs were four months of age when the observations started and five and a half months when observations finished. One observation occasion lasted between 11.30 and 13.30, which was the time before, during and after feeding. Before the observations started, the pigs were marked with numbers on their backs using spray paint to be able to distinguish between individuals. Continuous focal animal observation with 1-0 registration was used. This means that one animal at a time was observed and behaviours were noted if they occurred or not. If a behaviour occurred more than one time during an interval this was not noted. Pigs were observed during five minutes with one minute as a registration interval. During every occasion two boxes were studied par wise. One pig in the first pen was chosen and

observed. After five minutes had passed, a pig in the second pen were chosen. This was then alternated during the whole observation time. It was also registered if the behaviour occurred before or after the first pen got their feed. Every pen- pair was observed on three different occasions which will add up to a total of 18 occasions. Behaviours registered are described in an ethogram (appendix 1).

Pen 1	Pen 3	Pen 5	Pen 7	Pen 9	Pen 11
Pen 2	Pen 4	Pen 6	Pen 8	Pen 10	Pen 12

Figure 1. How the different pens used in the study were located in relation to each other in the stable. Where pen 1 would receive feed first and pen 12 last.

5.3 Statistical analysis and handling of data

Data were compiled in MS Excel 2013 and statistical analyses were carried out in Minitab 17. Tests used for analyzing the data were balanced ANOVA and Students T-test.

The recorded behaviours during the three observations were grouped into a mean value for every pen, that was used in the analysis. The behaviours were consequently used on group level only. Differences between the groups according to before and after feeding were calculated, as well as differences between groups with mixed and unmixed pigs. When analyzing if the waiting time for feed would affect behaviour, the data from the four pens receiving their feed respectively last were selected and analyzed. A comparison between pens considering mean slaughter weight was also performed. The behaviours lying, walking, fixtures explore, substrate explore, nosing pig, head thrusting and eating were chosen for further analysis and the rest of the observed behaviours were not because of the low number of occurrences during the observations. All values presented in the results is calculated mean values for the proportion of every behaviour in relation to the total observation time.

6. Results

6.1 All observations

Lying was the most common behaviour performed by the pigs both before (0.67) and after (0.51) feeding even if it occurred to a larger extent before (figure 2). However, it was not significant. Nosing pig had almost the same mean value both before (0.4) and after (0.39) feeding and was the second most performed behaviour. Both substrate explore and fixtures explore were performed more often before (0.4, 0.17) feeding than after (0.32, 0.14), when comparing mean values. Walking, eating and head thrusting occurred more often after feeding (0.38, 0.28, 0.16) compared with before (0.32, 0.05, 0.09). Though, it was only walking that was significant ($P < 0.05$, $F = 15.52$).

6.2 Receiving feed first or last

There was a tendency towards that boxes receiving their feed last performed lying to a larger extent ($F = 3.30$, $P = 0.103$) both before (0.76) and after (0.58) feeding compared with boxes receiving feed first (before = 0.68, after = 0.50) (figure 3 & figure 4). This could be compared with the boxes receiving feed first which performed walking to a larger extent both before (0.30) and after (0.41) feeding in comparison with the other group (before = 0.21, after 0.31). Though this was not significant. Analyzing the mean values for nosing pig, head thrusting and substrate explore they were demonstrated to almost or the same extent by both the first and last group before (nosing = 0.38, 0.41; head thrusting = 0.08, 0.08; substrate explore = 0.34, 0.38) and after feeding (nosing = 0.38, 0.38; head thrusting = 0.15, 0.16; substrate explore = 0.30, 0.29). Analyzing mean values for fixtures explore, it was performed more often by the first pigs compared with the last before feeding (first = 0.18, last = 0.10) but nearly to the same extent by both groups after feeding (first = 0.13, last = 0.12). Eating was performed more frequently by pigs being fed first (0.32) in addition to those being fed last (0.19), nevertheless being significant.

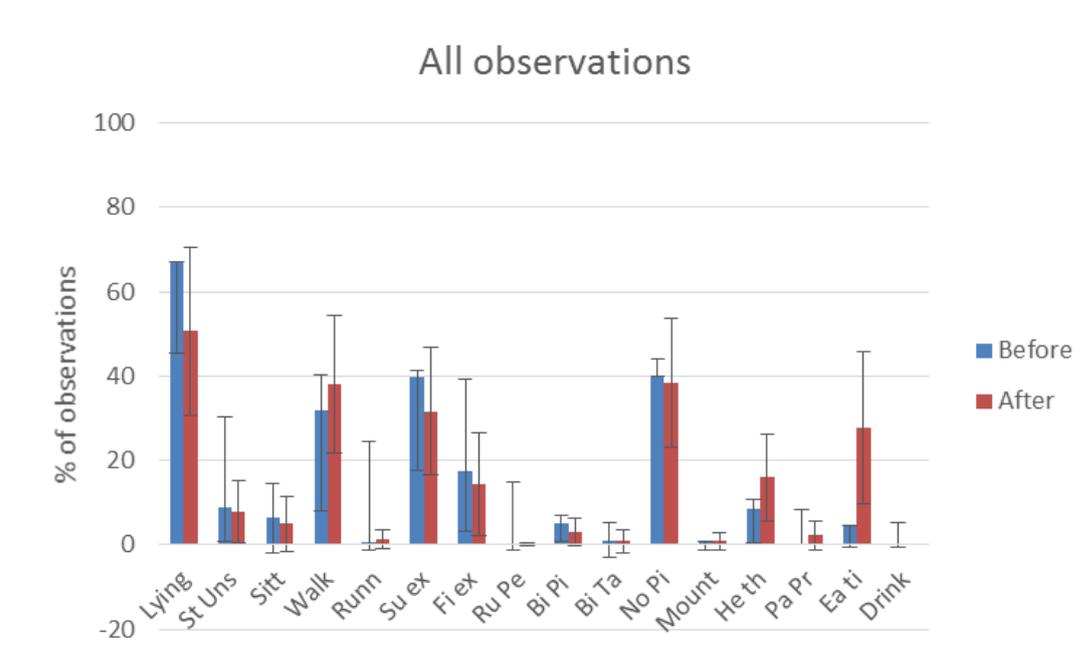


Figure 2. Mean values for all behaviours performed before and after feeding.

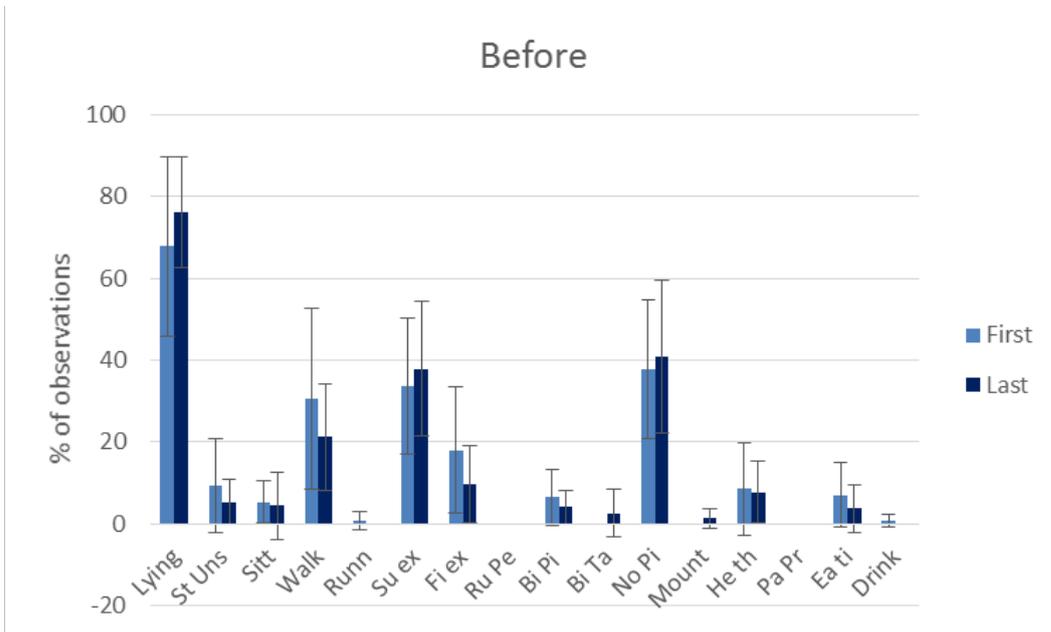


Figure 3. Mean values for behaviours performed before feeding by the four boxes receiving their feed first respectively last.

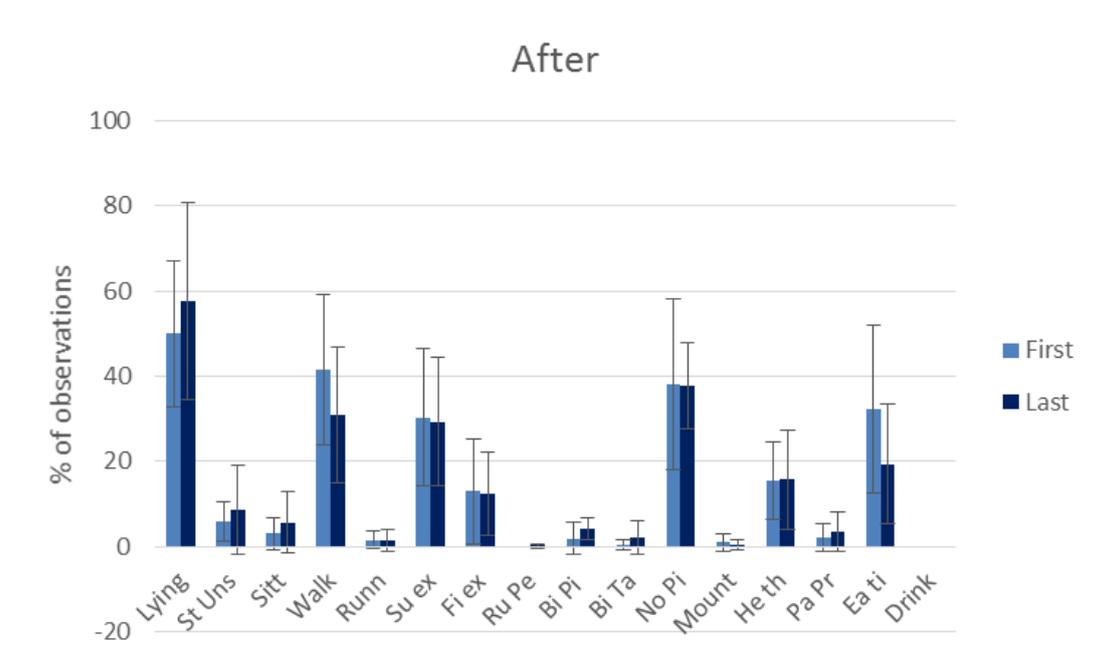


Figure 4. Mean values for behaviours performed after feeding by the four boxes receiving their feed first respectively last.

6.3 Mixed or not mixed

Pens with pigs not being mixed performed lying ($P < 0.05$, $F = 32.44$) to a higher extent in comparison with pens with mixed pigs both before (not mixed = 0.72, mixed 0.58) and after feeding (not mixed = 0.59, mixed 0.42) (figure 5 & 6). The opposite applied to walking which was performed more commonly by mixed pens in addition to not mixed pens both before (mixed = 0.39, not mixed = 0.24) and after feeding (mixed = 0.44, not mixed = 0.32). Though it was no significant difference between groups in performing walking. While comparing mean values, nosing pig was performed to almost the same extent by both groups before (mixed = 0.41, not mixed = 0.39) and after feeding (mixed = 0.38, not mixed = 0.39). The mean values for substrate explore was nearly equally common in both groups before feeding (mixed = 0.40, not mixed = 0.39), but performed more often by the mixed group after feeding (mixed = 0.38, not mixed = 0.25). Fixtures explore was more commonly performed by mixed pens ($F = 13.28$, $P < 0.002$) both before (mixed = 0.23, not mixed = 0.11) and after feeding (mixed = 0.18, not mixed = 0.10). The mean values of head thrusting shows that it was performed two times more often before feeding by pigs in mixed pens (0.12) compared to the other group (0.06). Though, head thrusting had the same mean value after feeding for both groups (0.16). Pigs in mixed pens had a longer eating time (mixed = 0.29, not mixed = 0.25), but this was not significant. It was also noted that mixed boxes had a higher median slaughter weight (84.5-97 kg) in comparison with not mixed boxes (82.8-89.5), which was significant ($P < 0.05$, $T = 2.91$)

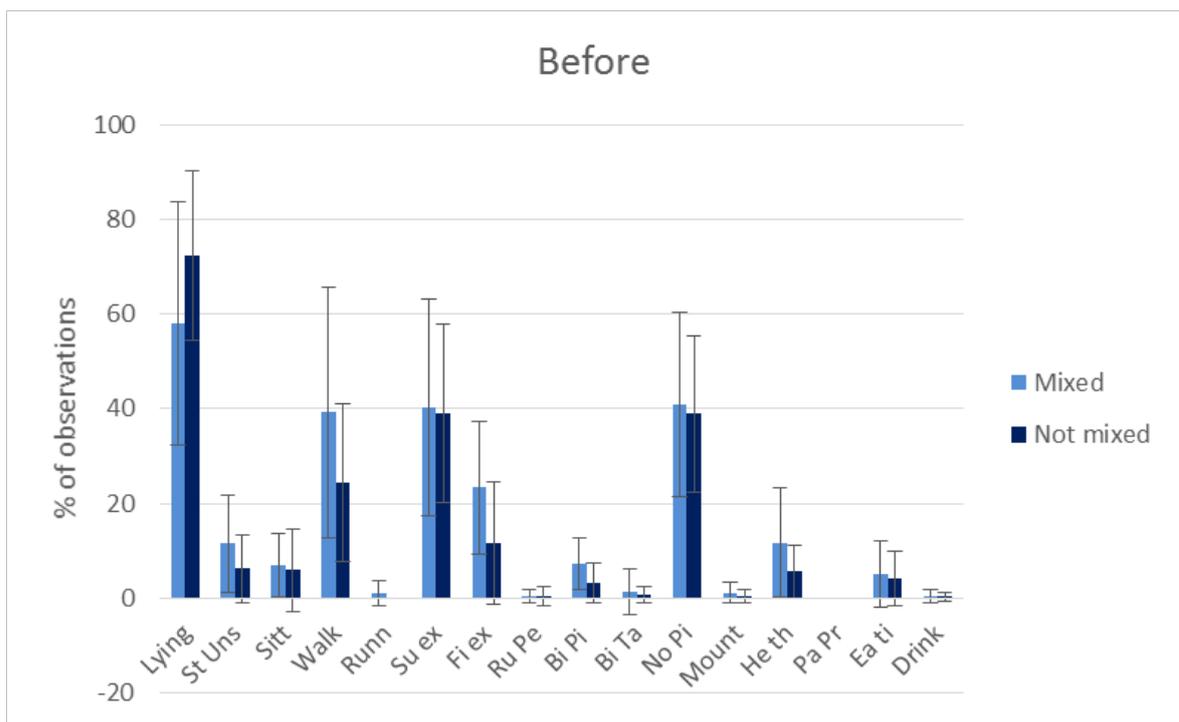


Figure 5. Mean values for behaviours performed before feeding by boxes with pigs either mixed from different litters or litters kept intact.

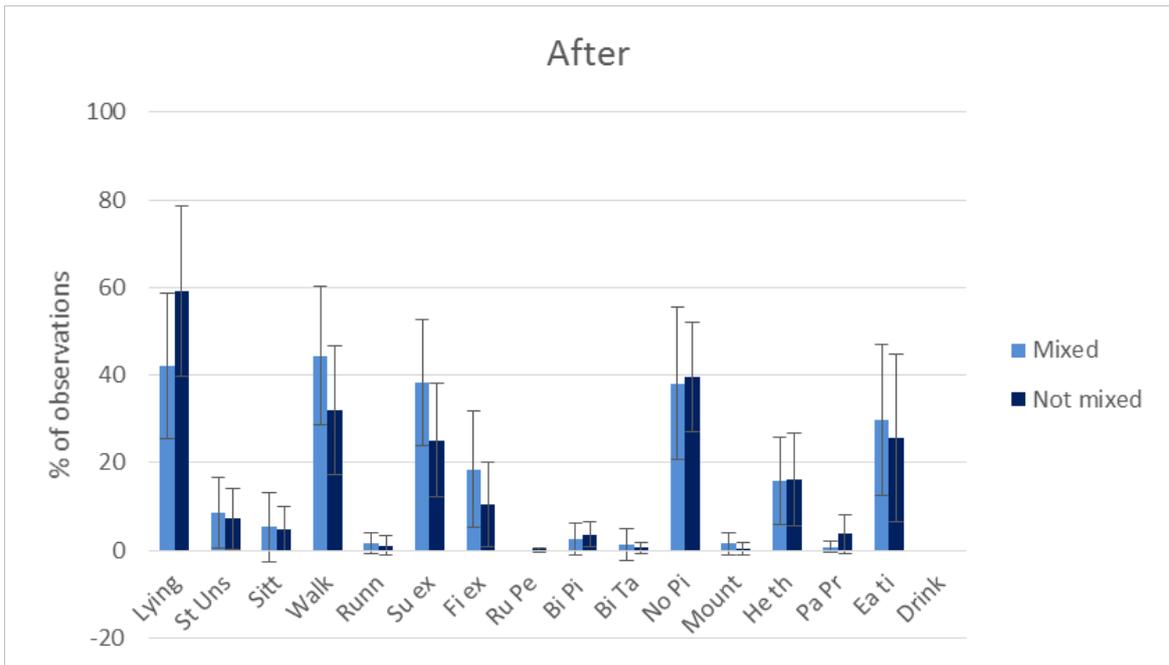


Figure 6. Mean values for behaviours performed after feeding by boxes with pigs either mixed from different litters or litters kept intact.

6.4 Differences between boxes

6.4.1 Before

When comparing mean values for different boxes there are variations in how often behaviours are performed, though no significant differences have been detected (Figure 7 & 8). Pen 10 demonstrated lying to highest extent before feeding (0.83) in comparison with the other pens (0.22-0.79). Pen 7 performed walking before feeding to a higher extent (0.78) in comparison with the other pens (0.13-0.41). Lying and head thrusting were less common in pen 7 (lying = 0.22, head thrusting = 0.23) in addition to the other pens (lying = 0.57-0.82, head thrusting = 0.02-0.15) before feeding. Substrate explore was more commonly performed by pens 7, 8, 11 and 12 before feeding (0.46- 0.61) in comparison with the other boxes (0.26- 0.38). Nosing pig was performed the least in pen 10 (0.2) and the most in pen 11 (0.57) before feeding.

6.4.2 After

There have neither been detected any significant differences between pens after feeding. As mentioned before feeding, Pen 10 as well after feeding, performed lying to the highest extent (0.81) in comparison with the others (0.33-0.65). Though, pen 7 was the only one that did increase lying after feeding. Head thrusting was more demonstrated in pen 5 (0.26) and 11 (0.28) in addition to the other pens (0.05-0.19). Fixtures explore did not increase or decrease much between before and after feeding, though largest variation was seen in pen 5 and 7. In those pens fixtures explore decreased from 0.29 respectively 0.33, to 0.11 respectively 0.18. Nosing pig was most demonstrated in pen 2 (0.59) and the least in pen 3

(0.17) after feeding. The pen that performed the most feeding behaviour after the feeding was pen 3 (0.45) and pen 10 would perform it the least (0.09).

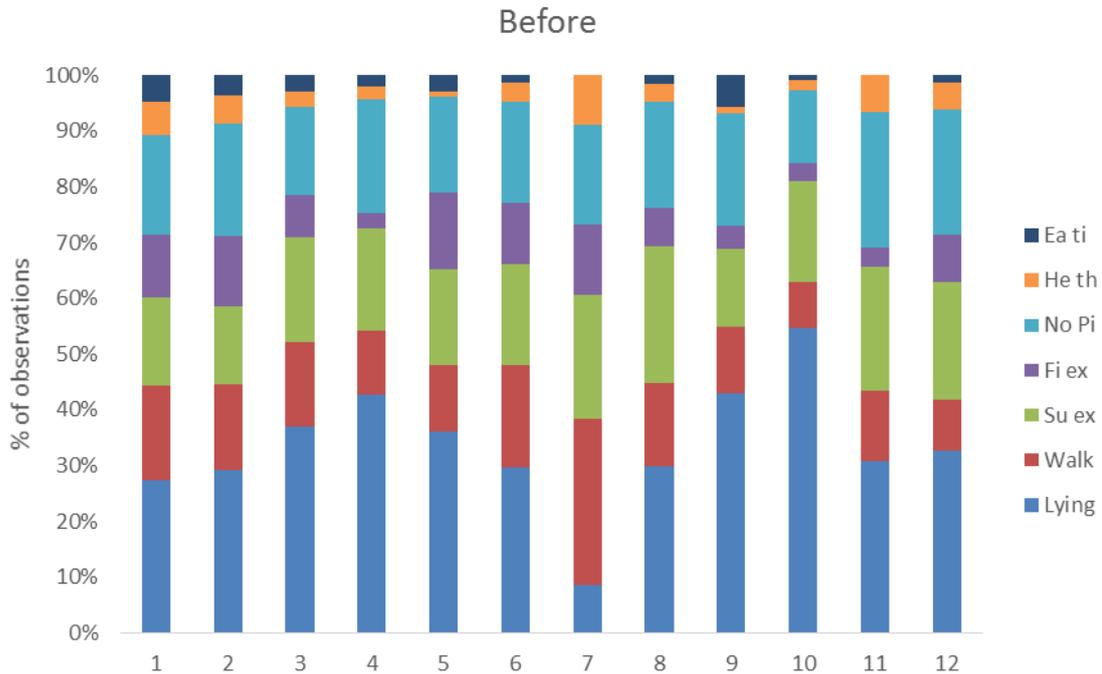


Figure 7. Mean values for the most commonly observed behaviours in the different pens before feeding.

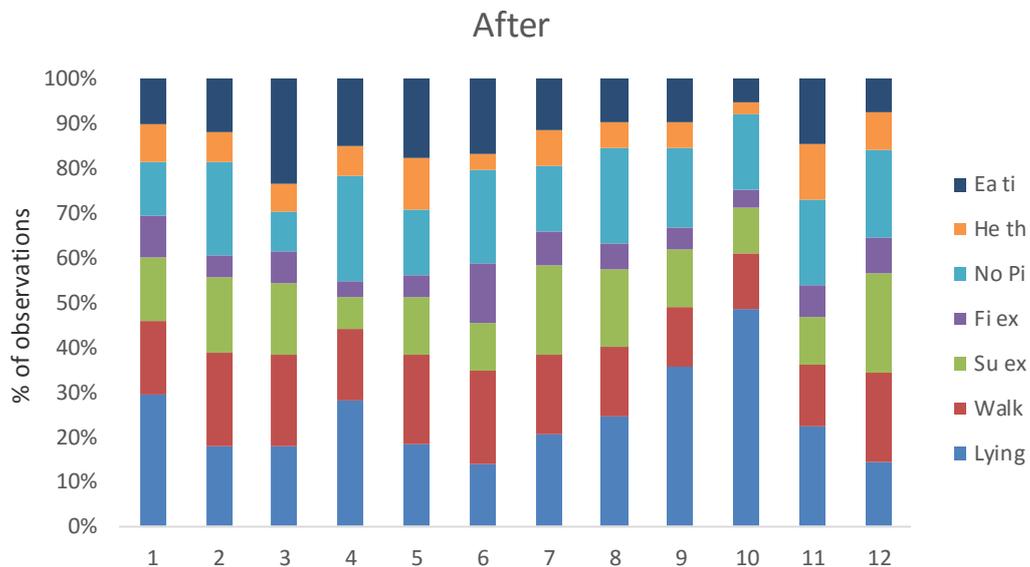


Figure 8. Mean values for the most commonly observed behaviours in the different pens after feeding.

7. Discussion

The results of the study mainly demonstrates differences in activity level considering the behaviours lying and walking. Many of the behaviours in the ethogram were not performed to a high extent and the pigs were noted to be inactive, by lying down, during a majority of the time. It can be discussed whether an active or passive coping style is better and which of them that shows a higher stress level in an animal. This has not clearly been established and needs further investigation. Pens being fed last were less active in comparison with those being fed first. This could be indicating that a delayed feeding do not create a frustration and that the pigs have learned that there will take some time to receive the feed. Belly nosing was noted to be a frequently performed behaviour during a large part of the observations and could possibly be an indication of stress. There were some differences in behaviours of pigs being cross-fostered or not and also when comparing average slaughter weight between these two groups. More research considering the long-term effects of cross-fostering should be of interest.

7.1 Lying and walking

Lying was the most commonly performed behaviour both before and after feeding. The same result was presented by another study, where lying was the most frequent behaviour demonstrated by both tethered, stalled and loose housed sows (Blackshaw & Mcveigh, 1984). Ekkel *et al.*, (2003) as well found that pigs kept indoors spent around 85 % of their time lying down and this time increased in line with increased live weight. The pigs in the study performed more walking after feeding. As earlier mentioned, is feeding one of the most important events in the life of slaughter pigs (Carlstead, 1986). Therefore it is relevant to believe that they would increase their activity when the first pen receives their feed because of anticipation and later walk around more when performing feeding behaviour. This is also confirmed by Schneider *et al.*, (2010), who saw an increased activity in slaughter pigs when increasing the number of feedings per day. Other studies have also shown that increasing the waiting time for feed could result in an increased locomotor activity (Lewis *et al.*, 1999; Haskell *et al.*, 2000). The increase in walking after feeding also confirms the rise in activity. The low activity could also be an indication of pigs practicing a low resisting coping style, which will be discussed more in detail later in the discussion.

7.2 Nosing pig

During the observations it was noticed that nosing pig could in turn be divided into two different behaviours: social nosing and belly nosing. Sent is the most important sense in recognition between pigs and social nosing is mostly used in that context (Christiansen, 2005). Social nosing was not demonstrated to a high extent probably due a low number of pigs in the pen and they therefore did recognize each other well. The second behaviour belly nosing is described as when a pig are rubbing its snout against another pigs belly (Fraser, 1978) and is demonstrated as a result of an early weaning of piglets (Worobec *et al.*, 1999). This is probably because the need to suckle are not being fulfilled (Torrey & Widowski, 2006). This behaviour was frequently seen in all pens and often with a long duration time. The pigs in the study were weaned at five weeks of age, which could be compared with a natural weaning which will be a gradual process during 16-18 weeks (Jensen & Recén, 1989). The explanation behind the behaviour could there for be an early weaning.

Belly nosing has also been noticed to be performed when providing a liquid diet in comparison with dry feeding (Zoric *et al.*, 2015). Which could as well be applied on the pigs in this study. It is important to mention that belly nosing has not been determined to be a result of pigs experiencing stress, though it has been observed to a higher extent in pens with high density (Gardner *et al.*, 2001). How a high level of belly nosing on a pig farm affects the pigs and, the reason behind and how to reduce the behaviour should be further investigated in the future. Since the behaviour has shown to affect the slaughter weight negatively it should also be of interest for the pork producers. Nosing pig had almost the same mean value before and after feeding and therefore seems to be important for the pig to perform at all times.

7.3 Exploring

The need to perform exploring behaviour is of importance for the pig (Studnitz *et al.*, 2007). Not only for biological reasons such as finding feed, but also another type of exploration used to change the environment (Wood-Gush & Vestergaard, 1989). Rooting in the straw was performed to a larger extent, than exploring fixtures in the pen. Since the pig is naturally spending a big part of the day foraging keeping the snout in the ground (Ewing, 2011), it is not strange that the pig still has a need and continues to do this when housed in a pen (Brouns *et al.*, 1994). Manipulating the straw is also something that the pig can easily do while lying down. The pigs are not being provided a large amount of straw and since they are manipulating and also ingesting it, the straw fast declines in quantity. Pedersen *et al.*, (2014), found that a lower amount of straw would increase the occurrence of oral manipulation against pen mates. I believe that an increase in manipulation of the pen could probably also be the result of a low straw amount. Pigs have shown to perform bar biting as a result of frustration caused by a short feeding time (Jensen, 1988). Which could also be an explanation for the occurrence of pigs manipulating fixtures such as walls and slatted floor in this study.

7.4 Feeding

As previously mentioned is the feeding time for slaughter pigs kept in a conventional system substantially shorter in comparison with non- domesticated pigs kept under natural conditions (Persson *et al.*, 2008). A short feeding time was also observed in this study and it was normal that the pigs would feed during approximately five minutes or sometimes even less. Increasing the number of feedings could maybe be an alternative to increase the feeding time. Though, Persson *et al.*, (2008) showed that increasing the feedings for slaughter pigs from three till nine, would cause a lower daily weight gain and also increase the occurrence of gastric ulcers. The authors believe that this is a result of stress caused by increased competition more times during the day. This is why another alternative has to be considered. Pigs having free access to feed have demonstrated to increase daily feed intake and interacting less with enrichment (Colpoys *et al.*, 2016). Which the authors believe indicates less feelings of hunger. Though, free access also increases the fat percent which is commonly not desirable for consumers (Colpoys *et al.*, 2016). Feeding a more crude fiber dense diet could be another solution and has proven to decrease frequency of oral stereotypies and increases the feeding time (Brouns *et al.*, 1994). Millet *et al.*, (2012) also found that a high fiber diet with large particles would help to decrease numbers of gastric ulcers in finishing pigs. Though, their results also demonstrated a lower feed conversion ratio and slaughter weight in pigs fed a high fibrous diet, which is not wanted by most pig farmers. At the moment it seems to be difficult to please consumers, pork producers and

pigs at the same time when choosing a feeding management. I believe that is of essential importance to perform more research in future to fulfill the pigs' needs.

Pigs are commonly housed at high density (Stern *et al.*, 2005). The limited space makes it more difficult for pigs to keep a distance from each other and aggressive encounters are more likely to arise. The feeding management used on the farm in the study forces the pigs to eat at the same time during a short period to be able to get reach of feed. The observer noted that some pigs would change position often during the feeding and some would stay in the same place. There was also an increase in the aggressive behaviour head throwing at and during feeding. Thomsen *et al.*, (2010) as well noted that feeding pigs in a closer distance would increase both aggression and change of feeding place. Single space feeder is also used in the pork industry and makes the pigs able to eat separated one at a time (Gonyou & Lou, 2000). This decreases competition during feeding, but will still create a short feeding time because of having to wait for their turn.

7.5 Aggressive behaviours

The most commonly performed aggressive behaviour was head thrusting. Biting tail or other parts of the body and mounting were only performed by a few individuals, which the observer perceived being the high- resisting individuals. When mixing pigs together the ranking order is commonly fast established (Deen, 2010). Since the pigs had been kept together for a long time this is probably the explanation behind the low frequency of aggressive behaviour. There were also no entire males that participated in the study which probably affected the result. Arnone & Dantzer, (1980), found that frustration in pigs do not have to cause aggression between pigs and that could also be a reason for low performance of those behaviours.

7.6 Receiving feed first or last

It was noted that the pigs in the different pens behaved differently in relation to how long time it would pass before their pen would be fed. One hypothesis before the study started was that the last pens would show more behaviours related to stress and frustration, due to the delayed feeding. When comparing the four pens being fed first respectively last, some differences could be seen. Previous research have shown that pigs experiencing frustration caused by delayed feeding, would move around and vocalize to a larger extent (Lewis *et al.*, 1999; Haskell *et al.*, 2000). The present study showed the opposite where the first fed pigs walked around more during the whole observation time and demonstrated fixtures explore more commonly before feeding. They would also vocalize to a larger extent.

Imfeld- Mueller *et al.*, (2011, 2012) have demonstrated that pigs are able to combine a signal with a certain event. This was also noted during the observations when pigs in other pens, excess the first receiving feed, often started to vocalize and move around more when hearing the others being fed. Though, the pens situated to be fed last did not react as strongly and would commonly lie down and rest. These pens most commonly waited until the closest pen had received their feed and then started to react. One theory is that those pigs had learned that it will take longer time before they receive their feed and therefore kept being calm. Špinka *et al.*, (1998) let 12 gilts choose between being in a crate for 30 minutes or 240 minutes, where the majority of them chose the shorter time. Which indicates that pigs have the ability to perceive time and therefore confirms the hypothesis.

Though, maybe it could be that the pigs would remember the feeling of discomfort, rather than perceiving the time.

7.7 Mixed or not mixed

What was mainly noted when dividing all pens into two groups, whether the pigs were kept in pens with pigs from more than one litter (mixed) or not, is that the mixed pens housed more active pigs. They demonstrated walking and would manipulate fixtures in the pen to a larger extent. Head thrusting, manipulation of straw and eating were also more frequently performed in mixed pens in comparison with unmixed ones. Even though the difference was not significant. A higher mixing ratio has demonstrated to cause an increased level of fights and aggressive behaviours in a group of pigs (Mei *et al.*, 2016). Though, studies show that when mixing pigs, a ranking order is usually set up within 24 hours (Dean *et al.*, 2010). Based on these facts the ranking order in the mixed pens should already have been established and an increased activity level should not have been a result of social stress. Though my own hypothesis is that pigs in mixed pens are being more stressed due to being cross-fostered. Most studies found in this area are focusing on the immediate effects when mixing pigs and not under a longer period. Based on the results from this study I believe that it is of importance to, in the future, perform studies focusing on the long-term effects of mixing pigs from diverse litters.

7.8 Differences between pens

The differences found between pens are mainly: number of pigs, distribution of females/males, waiting time for feed and being cross-fostered or not. How all of these components will affect the behaviour of the pigs is not that easy to predict. Pigs seem to be quite adjustable considering group size and a higher number of pigs have not demonstrated to cause more aggressive encounters (Andersen *et al.*, 2004). Based on this and that there were no large differences between pens in quantity of pigs, the hypothesis is that this had not a large impact on the result.

The different distribution of females and males in the pens might be a cause for variation in behaviour. It has been demonstrated that entire males are more prone, in comparison with females, to behave aggressively and being the initiator of fights (Bünger *et al.*, 2015). Though, there are different opinions whether castrated males would behave more aggressively than females (Meese & Ewbank, 1973; Colson *et al.*, (2006). The results does not show any large differences correlated to this distribution, maybe because of many pens being almost equal. Waiting time for feed and being cross-fostered or not have been discussed previously.

7.9 Behaviour affecting weight

Pigs being exposed to high amount of belly nosing have been correlated with gaining less weight in comparison with other pigs not being exposed (Camerlink *e al.*, 2012). Probably as a result of being stressed from being exposed. When adding the mean values before and after feeding separately for each pen, it was noted that pen 2 and 11 with the highest mean values for nosing pig also had two of the lowest median slaughter weights (84.5kg respectively 82.8kg). There is too few animals observed in this study to make any strong assumptions and more research is needed. Though, if there is a correlation between the behaviour and the slaughter weight, this would probably be of interest for pig producers.

It was also noted that pens with pigs from more than one litter (mixed), had higher median slaughter weight in comparison with pens with pigs from only one litter. This could be applied to all pens besides one. This observation contradicts the result of another study where pigs in mixed pens had both less daily weight gain and lower final body weight (Hyun *et al.*, 1998). So called cross-fostering is a common practice on pig farms and is mainly used for two reasons: Giving each sow the number of piglets that she can manage to rear or to create groups of piglets with similar birth weight (Straw *et al.*, 1998). On this farm the common practice is to give piglets to another sow to create an equal number of piglets in all litters. They are also striving to have an even size between piglets in one litter. The reason for mixed pens to have a higher median slaughter weight is not established and further research handling long term effects of cross-fostering should be considered.

7.10 Inactive versus Active

There are different ways for an animal to cope with a certain situation and it differs between individuals how they manage this (Broom, 1988). As earlier mentioned are animal personalities divided into two different categories, low resisting and high resisting (Benus *et al.*, 1987). These different personality types react differently when coping with changes in their environment and with stress. During the observations most pigs seemed to handle their environment with low-resisting behaviour by being inactive and the most commonly performed behaviour was lying. Though, there were a few pigs that would walk around and manipulate fixtures and manipulate other pigs and coping with their environment in an active way. This is believed to be the high-resisting individuals.

The inactive behaviour can be divided into different sub-groups which are displayed in different situations and are not always easy to distinguish from each other (Fureix & Meagher, 2015). Since the behaviour can be performed when the animal is relaxed such as rest or when it is stressed, for example apathy, you cannot simply say that the animal is experiencing a certain level of welfare without further analyze (Fureix & Meagher, 2015). When observing free ranging wild boars in Italy the daily activity level was observed to be 65% in a 24 hour period and the median home range size was 33.20 hectare (Russo *et al.*, 1997). The observations made in the current study were not during a 24 hour period and therefore, assumptions cannot surely be drawn that the lying behaviour would continue to be the most commonly performed. Though, Ekkel *et al.*, (2003) observed pigs in a conventional system to be lying 75% of the day. Which probably also can be addressed to this study. Since the pigs are not able to move on a large areas as in wild life and cannot perform the natural behaviours, the inactivity could probably be a result of boredom or distress.

7.11 Errors

After the pilot study had been carried out it was decided that a focal animal observation would be more convenient to perform instead of scanning all pigs in one pen. This was because of difficulties in registering all pigs' behaviours when they were moving fast. Though, this also means that there are behaviours not being registered which were performed by others than the focal pig. In the future it could be beneficial to use video cameras to not miss out on any behaviours and be able to observe the pigs from different angles. Even if the pigs would most commonly behave in a synchronized pattern. To not only include behavioural observations, but also physiological parameters such as blood samples could also be considered.

What was discovered early during the observations was that the behaviour nosing pig could be divided into two sub- behaviours: social nosing and belly nosing. Since they are performed in different contexts and there are different underlying reasons for them to be performed, they should have been differentiated in the ethogram and registered separately. Now, there is only the observers own personal perception of often each respective sub-behaviour occurred.

One thing that should be highlighted is that some behaviours are not possible to be performed at the same time, for example walking and lying. Therefore will the increase of one behaviour give an automatically decrease of the other. Though, most other behaviours were possible to be performed during lying and for example substrate explore and nosing pig was commonly observed in correlation with lying.

The personal at the pig farm were instructed to provide the pigs with straw every day some time before the observations started, to make all observations consistent and to not create a higher degree of frustration behaviours. Though, at a few observation days some technical problems with the automatically straw provider arose and the observer then had to provide the pigs with straw by hand. Since this was done just before the observations started it created a higher amount of substrate explore. At some occasions during the observations the personal had to enter the stable, for example euthanizing one ill pig. This made the pig more alert and they would move around. Since the most commonly performed behaviour still is lying, it is believed that the interruptions would only make the behaviour being performed to an even higher extent.

Some articles used both in the introduction and the discussion have been conducted in countries where slaughter pigs are not entirely kept under similar conditions as in Sweden. It could therefore be discussed if their conclusions could be applied on the the pigs in this study. Even if this could be questioned, I still believe that they are worth mentioning to be able to connect the results to previous literature. I have also refered to some studies where, for example sows, have been used instead of finishing pigs. As in the previous case there could be differences in performance of behvaiours in comparison with the pigs in this studies.

8. Conclusion

The most commonly performed behaviours during the observations were lying, walking, nosing pig, fixtures explore, substrate explore, head thrusting and eating. Concerning these behaviours walking, head thrusting and eating increased after the onset of feeding. Head thrusting is an aggressive behaviour, which could indicate pigs feeling stressed in correlation with the situation. There was also an increased vocalization when the feeding procedure would start, which could be a result of an increased stress level. Though, this behaviour was not registered. A delayed feeding between 10-15 minutes did not seem to affect the pigs in a negative way. The hypothesis is that they have learned the everyday practice of waiting and therefor are coping by lying down and not being stressed. It is therefore probably not of importance to change the procedure. Many interesting observations were made during this study, but not many of them were significant and they need to be further analyzed. The high degree of inactivity has been discussed a lot and the causes for it to appear. As previously mentioned does the author believe that the reason is boredom and the low ability to perform other behaviours in this type of housing system. If it is beneficial that the pigs are coping by being active or passive could be discussed.

Though, finding ways to keep the pigs occupied during larger part of the day is believed to increase the pigs' welfare. Significant differences were unexpectedly found between mixed and unmixed pens in terms of behaviour, but also slaughter weight. It could therefore be of interest to make further research about long-term effects of cross-fostering. Belly nosing as well was a frequently seen behaviour in all pens, but not an alternative in the ethogram. According to previous studies could belly nosing be an indication of stress, but could also affect the slaughter weight negatively. It should therefore also be further analyzed.

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Appendix 1. Ethogram

Behaviour	Description
Lying	Body weight supported by belly
Standing unspecified	Body weight supported by all 4 legs
Sitting	Body weight supported by knees and hind-quarters
Walking	Moving legs at least 2 steps
Running	Moving legs at least 2 steps or hopping at a high speed
Substrate explore	Sniffing, nosing or chewing straw
Fixtures explore	Sniffing, touching, sucking or chewing any object which is part of the pen including slatted floor.
Mounting	Placing front hooves in the back of a standing pen mate
Headthrusting	Ramming or pushing pen mate with head and being the recipient of this behaviour
Biting pig	Nibbling, sucking or chewing ears, legs or feet or being the recipient of this behaviour
Tail biting	Nibbling, sucking or chewing the tail or being the recipient of this behaviour
Nosing pig	Rubbing the body of a pen mate with the snout or being the recipient of this behaviour
Eating	Individual stands in front of feeder with head lowered in feed trough
Drinking	Individual stands, either with mouth touching or holding nipple drinker and swallows.

Parallel pressing	Two pigs stand side-by-side, pressing against each other's shoulder, with one throwing its head against the head or the neck of the other pig
Rubbing pen	The pig rubs the side of its body along a pen fixture

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