The importance of training growing/fattening pigs in automatic sorting systems

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The importance of training growing/fattening pigs in sorting systems

Betydelsen av träning av slaktgrisar i vågstallar

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Preface

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Abstract

The interest in sorter scale systems for growing/fattening pigs has increased during the last years among Swedish pig farmers. In these systems up to 500 pigs are held in each group and in most cases the pen layout forces pigs to pass automatic sorter scale for access the feeding area. The pigs' weight is monitored for every entry to the feeding area. Except for automatic training program provided by the sorter scale manufacturer, pigs can either be manually trained or the farmer can rely up on the pig's own ability to navigate the system. However, if pigs are not able to find the feed there is a high risk of decreased production as well as reduced animal welfare. The domestic pig has a well-developed cognitive ability and has proved to being able to navigate mazes as well as relocate feed. There is a lack of knowledge if there is a need for manual training in the sorting scale system. This study's first aim is to compare trained and untrained pigs in sorter scale systems. This part was compiled using data from a farm with individual Radio-Frequency Identification (RFID) for the pigs. The second part compares the pen design when manual trained pigs soon after moved to the growing/fattening pigs' stables. For this part three farms were visited within two weeks after the pigs were moved to the sorter scale system, the pigs were manually trained by two observers. Results shows that the manual training didn't have a large impact on gate passages, weight gain, final weight or rearing days. Some differences could be seen when comparing gilts and barrows. However, depending on pen design the effectiveness of the manual training differs significantly. Building a funnel-shaped entrance to the sorter scale facilitates the manual training. And building a wall with the possibility to close gates in the middle of the resting area could also be beneficial. Even if the manual training would be considered non crucial the design could have an impact on how easy it is to handle individual pigs for other reasons than training.

Keywords: sorting system, cognitive ability, early life socialisation, animal welfare, pen design, training, growing/fattening/finishing pig, automatic sorting scale

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Abbreviations

Abbreviation	Description
ADS	Adult Directed Speech
CFS	Call for Feed System
PDS	Pet Directed Speech
RFID	Radio-Frequency Identification

1. Introduction

Traditional housing of fattening domestic pigs (*Sus scrofa domesticus*), in the weight range 30-120kg, has for a long time been in groups of 10-15 pigs per pen (Santonja et al. 2017). In recent years, interest in keeping larger groups, of up to 460 pigs, in automated sorter scale systems has grown in Sweden (Karlsson 2021). The reason for the growth in interest is partly the building cost which can be lowered (Harold et al. 2005), but among the benefits are also the possibility to automatically sort out pigs for slaughter (Karlsson et al. 2023). The production goals, as well as the rearing period, are consistent with those in traditional fattening pig systems.

The focus in this study was on sorter scale systems that force the pigs to enter the sorter scale for access to the feeding area. Therefore, learning to navigate the systems is crucial for animal welfare and production. Harold et al. (2005) concludes that it is important to train pigs to use and navigate the sorter scale. Swedish farmers using the system agree on the importance of using the automatic training program to teach the pigs how to navigate the system, even though only one of the farmers found manual training crucial (Karlsson 2021; Karlsson et al. 2023). Depending on the pen layout the manual training could be more or less easy, especially when it comes to pen layout in prior to the sorter scale entrance. According to Brummer et al. (2008) the area in front of the scale should be designed as a funnel towards the scale. However, even though farmers conclude that manual training of the pigs is important, there is no studies showing that the manual training makes a difference.

This study is based on literature on pig's cognitive abilities of spatial learning. It is divided into two parts. The first part is a comparison between groups of pigs with individual Radio-Frequency Identification (RFID) marking, comparing one batch of pigs that are manually trained to go through the sorter scale with untrained pigs. The second part is an evaluation of different stable layouts on farms with sorter scale for growing/fattening pigs to find the design most suitable to manually train pigs to pass through the sorter scale.

1.1 Background to the sorter scale system

The interest in larger group sizes and automated sorting systems originates from decreasing the building cost as well as lowering the demand for manual sorting of the animals (Brummer et al. 2008). Brummer et al. (2008) also describes the advantages as being able to use more accurate phase feeding as well as reducing the stress for the animals.

The sorter scale system

Automatic sorting systems have been used on Swedish farms since 2017 (Karlsson 2021). Layout of the sorter scale system pens vary depending on the farm. The pen includes a resting/playing area, also called loafing area, and one or several feeding areas (Brummer et al. 2008). The sorter scale can be placed either as a passage between the resting and the feeding area or in the middle of one of these areas. In cases when the scale is placed between the resting area and feeding area, pigs need to enter the scale to be able to access feed and one-way gates give the pigs access back to the resting area. The system is used in both conventional and organic production and in both cases outdoor access can be an option (Karlsson et al. 2023). It is possible to install the sorting system in existing buildings, rebuilt from other systems, however this affects the flexibility of the layout (Harold 2005). The lying area in the stables can be either straw bedded or as concrete floor (littered daily), both combined with a slatted floor as dunging area (Brummer et al. 2008). Brummer et al. (2008) continues to describe that water can be provided in both resting and feeding areas. The pen design is flexible, allowing for adjustments and expansion as the pigs grow and therefor utilize the building better (Harold 2005).

Feed and feeding area layout

Feed is given *ad.lib* in the sorter scale systems and depending on farm preferences it can be dry or liquid. Furthermore, different recipes can be provided in the feeding areas depending on weight of the pigs (Karlsson et al. 2023). But it is also possible to feed different genders in different feeding areas when using RFID-marking for the pigs (Brummer et al. 2008). The pig flow in the feeding area should be considered when designing the feeding area (Brummer et al. 2008). Brummer et al. (2008) continues to describe that the one-way gates to the resting area preferably should be placed at the opposite side of the sorter scale in the feeding area. Steinerová (2020) concludes that the amount of feeding places in sorter scale systems for fattening pigs plays a smaller role than the layout of the feeding area when it comes to aggressions, growth rate and feed efficiency.

Sorter scale and automatic training settings

The design of the sorter scale itself, sorter scale software options and settings for the sorter scale differs depending on manufacturer. An optional feature is RFID, it makes it possible to monitor and promote pigs' growth on individual level (Brummer et al. 2008). Automated colour-marking of pigs when inside the sorter scale is another option to get information about if an individual pig uses the scale or not. In general, the scale itself is designed with one entrance gate and three exit gates, a platform with a bar to prevent pigs lying down and weight sensors. The setting principle is that entrance gates close behind the pig when an optical sensor indicates a pig on the platform. The pig's weight is registered, and the pig is sorted to one of three areas opens depending on settings. Settings for the sorter scale can be changed by the farmer. In the beginning of a batch a training program can be activated in the sorter scale. The program design depends on the manufacturer, however, the aim is to teach the pigs to go through the sorter scale, without stress even when gates entrance and exit gates closes around them according to Trøjborg [1] and Stagsted Nielsen[2]. During the training process the doors of the sorter scale can be completely open to allow pigs to explore it. Conclusions from Swedish farmers with sorter scale systems for fattening pigs (Karlsson et al. 2023) is that starting the training program as soon as possible is beneficial from a learning perspective. When the automatic training program is finished it is common to sort every second pig to left respectively right feeding area, as long as no other setting such as gender-dependent feeding is applied.

Advantages

Sorter scale systems make weighing and sorting for slaughter easier, a task that otherwise is seen as one of the most demanding in finishing pig production (Göransson & Lundqvist 2023). The system allows the farmer to monitor daily weight gain, number of passages to the feeding area per day and when the passages occur, on group or individual level depending on the equipment (Karlsson 2021). Building costs can be reduced when building for larger groups (Harold 2005), and buildings can be better utilized when building large pens without alleyways (Brummer et al. 2008). Some economic benefits as well as aspects regarding easier handling can be seen in the automatic sorting systems (Salak-Johnson 2008). Once the finishing weight is reached, the sorter scale can automatically direct all animals of a specified weight to a designated shipping area.

[1] Allan Trøjborg, sales consult, Domino A/S, telephone call 2025-02-28

[2] Kent Stagsted Nielsen, sales manager, Agrisys A/S, telephone call 2025-04-07

Challenges in sorter scale systems

The system is more complex than the traditional pens, hence the pigs must be more active and learn how to navigate the system. When the sorter scale is the only way to reach the feeders, as in most cases, learning how to pass the sorter scale is crucial. Training the pigs soon after arrival to make sure feed withdrawal is prevented, is important to avoid health risks and decreased performance (Brummer et al. 2008). Feed deficiency is one of the causes resulting in tail biting, together with other factors such as stocking density and management (Sonoda et al. 2013). Tail biting is one of the largest animal welfare problems in pig production, and it can also cause economical losses due to reduced growth, veterinary treatment, increased workload, culling and contaminated carcasses (Sonoda et al. 2013). The prevalence of tail biting is also at higher risk when pigs from different litters are mixed (Grümpel et al. 2018). Gilts bite more than barrows; however, the reason is not clear (Sonoda et al. 2013). Grümpel et al. (2018) found that the prevalence of tail biting was lower when less than 7.5 litters were mixed at weaning. Mixing pigs from different litters, especially when done at higher age and if the weight is uniform, can increase the risk for aggressions and hence more welfare problems (Scheffler et al. 2016). Swedish farmers using sorter scale systems for fattening pigs report that when tail biting occurs, the outbreak tends to be more severe due to the larger group size (Karlsson et al. 2023), probably since the availability of blood can attract more pigs to bite (Sonoda et al. 2013). The large group size may hence be an issue if tail biting occurs. However, the group size itself does not necessarily need to be a risk factor for tail biting as Schmolke et al. (2003) could not see any decreases in growth with larger group sizes, in this study group sizes of 10, 20, 40 and 80 pigs were compared. If pigs are exposed to early life socialization with other littermates, this can affect how well large group housing will work. Piglets born in groups with several sows and their litters together, proves to have less fighting when later housed in larger groups (Scheffler et al. 2016).

1.2 Pigs' cognitive ability and learning

Cognitive ability, the functions of which information and abilities are acquired and processed, is both well developed and studied in domestic pigs (Mendl & Nicol 2017). The cognitive ability can affect the productivity indirectly and directly (Held et al. 2002) as impaired cognitive ability can induce general stress and specific difficulties in learning how to locate feed. Learning is dependent on the cognitive ability and can be divided into different categories. Associative learning, and more specific the kind of associative learning that is called trial and error, is when the behaviour of an animal is the result of pairing two events with each other (Pearce 2008). Mendl & Nicol (2017) describes that learning and memory overlaps and can be inseparable.

Spatial memory and prioritization

Domestic pigs have long been used as a model species for studying cognitive abilities due to their suitability for behavioural tests (Gieling et al., 2011). Their spatial memory, which evolved for foraging, plays a key role in their ability to navigate the pens (Laughlin et al., 1999). In semi-natural environments, pigs spend more than half their time searching for food (Stolba & Wood-Gush, 1989), a behaviour strongly linked to both short- and long-term memory (Marino & Colvin, 2015). Cognitive tests on pigs often focus on spatial learning, recognition, and problem-solving. For example, pigs have successfully learned to locate food in mazes (Mendl et al., 2010) and respond to individualized signals in a Call for Feed System (Ernst et al., 2005). They can also be trained to stand still for blood sampling using clicker training (Fiderer et al., 2024) and show preference for more desirable feed options (Held et al., 2005). To enhance their ability to locate food efficiently, pigs rely on various cues. In addition to remembering food locations, they use visual and olfactory signals to guide their foraging behaviour (Marino & Colvin, 2015). Even under artificial conditions, pigs excel at maze navigation, demonstrating their strong problem-solving and adaptability skills (Marino & Colvin, 2015).

Pig learning

Modern systems are dependent on the animals' cognitive abilities to manage the system and find resources such as feed (Held et al. 2002). There are some important aspects during training of the pigs. The learning process can be better if there is a reward that the animals want (Mendl & Nicol 2017), as for the case of search for feed. Held et al. (2005) describes that they have a good ability to remember feed sites and to relocate. When investigating how easy pigs learn how to find feed it has also been found that pigs can learn how to find feed when following each other (Held et al. 2009). In the trial conducted by Held et al. (2009), pigs with prior knowledge of feed locations were not only able to differentiate between two feeding sites with varying amounts of feed but also demonstrated the ability to strategically withhold information from a follower regarding the location of the larger feed source. At the same time Held et al. (2001) investigated the domestic pig's visual perspective and their ability to understand what others can and cannot see, with the result that this ability is quite vague. However, they criticized parts of their own method, partly due to the fact that only one of the pigs fulfilled the criteria's for unbiased analysis and that the pigs might have learned the system (Held et al. 2001). The domestic pig has the ability to forage in areas that are earlier not explored using a win-shift way of foraging, which means that they shift area instead of staying in the same area when they found feed (Laughlin et al. 1999). Even if pigs have a good spatial

memory, common management procedures can disrupt their ability to navigate spatially (Held et al. 2002).

Effect of enrichment on cognitive abilities

Enrichment can be defined in several different ways, according to van der Weerd & Ison (2019) it is used to explain *'Anything that gets added to a captive environment'.* Among the key elements is that the animal may cope with challenges and have better control over its environment when enrichment is added (Westlund 2014). Experiences earlier in life, like housing systems, plays a role in development of cognitive abilities (Weller et al. 2020). One part of this is the animals' earlier experiences. Both physical and social enrichment in the pigs' early life can help the pigs to adopt to novel environments later (Ko et al. 2020). In a trial by Weller et al. (2020) pigs that were socialised with pigs from other litters early in life behaved differently, when exposed to a maze challenge, in comparison with the control group that was not socialised. The cognitive ability for the pigs can be improved when provided enrichment (Grimberg-Henrici et al. 2016). In the study by Weller et al. (2020) the environment, such as available straw, peat, toys or larger area, is also important when it comes to the development of pigs' cognitive abilities. The cognitive ability development is improved when pigs are moved from a barren to a enriched environment (Sneddon et al. 2000). In the trials by Sneddon et al. (2000) pigs reared in an enriched environment showed faster response rates when forced to press a button for feed as well as faster response patterns in maze-tests compared to pigs reared in barren environments.

Welfare aspects

Animal welfare can be defined in many ways and the definition has changed over time (Keeling 2005). The definition of high animal welfare could vary between the importance of keeping production animals in an environment as close to the natural conditions as possible, or the importance of keeping animals in conditions that increases the productivity as much as possible (Fraser 1993). A well-used definition is that *'animal welfare means the physical and mental state of an animal in relation to the conditions in which it lives and dies. An animal experiences good welfare if the animal is healthy, comfortable, well nourished, safe, is not suffering from unpleasant states such as pain, fear and distress, and is able to express behaviours that are important for its physical and mental state'* (WOAH 2018). The cognitive abilities can be seen as a welfare factor. Knowledge about an animals' cognitive ability can inform us about in which type of environment is best for the animals' welfare (Held et al. 2002). Pavlovian conditioning, also called classical conditioning, is when the animals behaviour and response is changed based on the conditions (Pearce 2008). Whereas Pearce

(2008) describes that instrumental conditioning is when the behaviour creates an outcome that will be beneficial for the future. The welfare of the domestic pigs could be enhanced when they are challenged to use their cognitive abilities (Mendl et al. 2010), partly because the animals to a larger extent can control their environment (Clark 2017). In trials with CFS-systems the system itself can be seen as an enrichment for the pigs through offering a challenge which demands cognitive adaptation (Ernst et al. 2005). In those systems each pig has its own sound signal and the response it that feed is given when the right pig reacts on the signal. Tests with CFS-systems have been used to evaluate the pig's welfare through measuring the changes in the opioid expression in amygdala, which can be induced in the system, indicating that the system can be used as enrichment due to the indication of motivation as well as positive reinforcement (Kalbe & Puppe 2010). There are also factors impairing pigs' cognitive ability. For pigs housed on intensive farms, some situations may be more stressful than others, such as changes in environment or mixing with new group members (Grimberg-Henrici et al. 2016). But also new equipment, type of feed and other human handlers may be stressful for the pigs (Grimberg-Henrici et al. 2016). However, stress can also be positive for the learning performance in some cases since the stress can increase the animal's attention as well as memory forming (Mendl 1999). The temporary spatial memory and performance during foraging is to some extent affected by disturbance factors such as unfamiliar pigs, novel environments and confinement in test equipment such as weight crates (Laughlin et al. 1999). Laughlin et al. (2019) found that when stressors were introduced during foraging in a maze, even mild stress could impair the pigs' performance, despite their initial ability to navigate the task successfully. Disturbances, like introducing unknown pig to the group, also affects the performance in relocation tests (Held et al. 2002). The relocation test involved visiting an area for locating of feed, leaving the area and then revisit the area to locate the feed once again. Pigs have shown to be sensitive to other pigs' emotions, and if one pig shows signs of stress the naive pigs nearby will be affected (Marino & Colvin 2015). Parameters such as feed deficiency, poor health and lack of sensory stimuli during the weaning period affects the cognitive abilities later (Prunier et al. 2020).

Adaptation to systems

Forcing the pigs to access feed through entering the sorter scale relies on their ability to adopt to the system and learn how to navigate the pens. Studnitz et al. (2007) describes the domestic pigs as explorative and motivated to explore novel environments. In a trial by Ernst et al. (2005) the pigs learned an individual sound signal to press a button to get feed, showing that they are able to cope with complex automated systems if well designed. Held et al. (2005) concluded that domestic pigs are able to respond adaptively to conditions, such as being

restricted in the foraging behaviour. Held et al. (2005) found that individual differences exist among animals, and some may only be able to return to the more favourable feeding site when they are restricted from visiting multiple sites. The pigs needed less trials to find the preferred feed when they had investigated the maze than when they searched randomly (Held et al. 2005).

1.3 Manual training of pigs

The effect of stress

Pigs experience some situations to be more stressful than others. These can for example be change in housing system, introduction to new groups and handling by humans (Grimberg-Henrici et al. 2016). Their spatial memory can be better when there are no stressors nor disturbances involved (Laughlin et al. 1999). Hence, the training should therefor preferable be performed in a way that eliminates the stress. Manual training to teach pigs how to navigate the system involves human interaction. Pigs have the ability to discriminate between strangers and well-known humans, and the most common cue used for this is to use prior experience (Marino & Colvin 2015). Marino & Colvin (2015) explains that the olfactory sense is surprisingly not the sense most used for discriminating between humans. Studies on humans' behaviour around the pigs have shown that the pigs are highly influenced by the stockman's behaviour (Hemsworth et al. 1989). Hemsworth et al. (1989) studied handlers during their work with sows and it was shown that the reproductive performance was influenced by the fear of the handler. It has also been proven that pigs respond differently based on previous treatment, and a rough treatment can be remembered (Marino & Colvin 2015).

Manual training by farm staff

When clicker training pigs in a study to investigate how blood sampling can be done less stressful Fiderer et al. (2024) found out that the rewards are useful tools for domestic pigs training. Clicker training is a combination of classical and operant conditioning (Pearce 2008). The domestic pigs are well motivated to being trained (Fiderer et al. 2024). Training the pigs could be seen as positive reinforcement depending on how it is performed (Toivonen, 2020). Making sure the sorter scale is a positive experience might be important to minimize the risk for associations of fear and pain. With the ability to recognize *"I feel pain"* the pigs could otherwise avoid the situation later (Mendl et al. 2010). When a large group of pigs are handled there is a larger risk of stress related behaviour among the pigs, but also and a risk of increased negative behaviours by the human handler (Wilhelmsson et al. 2022). However, even if handling the animals is stressful there may be positive effects of the animal training. Successful training

of animals could improve the job satisfaction for the staff (Fiderer et al. 2024), as well as add positive effects for the animals.

2. Aim and hypothesis

The overall aim of this study was to investigate the training process in sorter scale systems for growing/finishing pigs. This was investigated in two steps. The first part was to test if there was a significant difference between pigs that were manually trained or untrained in their willingness to go through the sorter scale to the feeding area. The second part was to explore some of the different designs of the housing to draw conclusions about what parts of the design might be favourable for successfully manual training of pigs. Based on current studies and knowledge three hypothesises were formulated;

- Based on the pigs' cognitive ability the pigs that are manually trained have a better ability to navigate through the sorter scale to the feeding area than those that are not trained.
- With manual training, the pigs they are more likely to pass through the sorter scale without humans involved than without manual training
- Pen design affects the easiness for stockpersons/staff to perform manual training by making the manual training more efficient

3. Material and methods

This study investigated two different parts; Analysed data form one batch of pigs housed in a sorter scale system, with untrained (U) and manually trained (T) individuals to pass through the sorter scale. The second part consisted of practical training of pigs on three farms with differently designed pens. No ethical permission was needed for this study since the procedures involved doesn't differ from normal procedures performed by farmers or staff.

3.1 Comparison of trained and untrained pigs

The comparison between manually trained pigs and untrained pigs was based on collected data for one batch of pig on one farm in September to December in 2024. At the age of 90-93 days 252 pigs were moved from their 20 pens in the growing unit to the automatic sorter scale system. The group was a mix of gilts and barrows and genetically a cross breed between TN70 sows and Norsvin Duroc (Topigs Norsvin) or Hampshire (Scan Sverige) boars. Data was collected throughout the rearing period in the automatic sorter scale system, from a start weight of 41.21(±8.67) kg until the pigs reached 120 kg approximately, at around 72 days in the system. In the growing unit, where 20 litters were housed separately, 60 pigs were randomly assigned to the T-group and 66 pigs to the U-group, all individuals marked using RFID ear tags. During marking of the pigs in group U effort time to attach RFID-ear tags was measured. The remaining non-marked 126 pigs in the group were not part of the focal animals. The T group were further used in another study and a more detailed selection was based on individual weight and gender from 10 pens. In each pen three female and three barrows based on lowest, highest and median weight were selected. Pigs in the U-group were based on litters remaining after selection of the T-group. In total the U-group consisted of pigs from 5 litters.

Pigs from the T-group were trained on three occasions, the first two times in a manual scale and the third time in the automatic sorter scale. Training was performed 2/9-2024, 3/9-2024 and 4/9-2024. Data from RFID-tagged pigs contained information regarding individual passages through the automatic sorter scale. The date, time, weight and in which direction the pig were sorted was registered.

3.1.1 Questions to manufacturer A and B

Companies selling sorter scale systems in Sweden were contacted via email regarding their automatic training programs, followed by a telephone interview with open questions. The respondents from each company were asked following questions:

- How does your training program work?
- In what way can the farmer change the settings for the training program?
- What is the background to the design of the training program?

3.2 Comparison between pen designs

Data collection about pen design was collected on three different commercial farms between October 2024 and February 2025, protocol in Appendix 1. Each farm was visited once during the first two weeks after pigs' arrival to the pen with sorter scale system. The three farms were selected based on being available for the study during the period and having different layouts. They were all conventional reconstructed stables, previously used for traditionally finisher pigs or dry-sows. Information regarding the farm was collected at the visit and compiled in the form in Appendix 2. The questions with a scale between 1 and 10 are based on 1 being the least easy/prevalent and 10 the most easy/prevalent.

Pig training

Two observers manually drove the pigs toward and through the sorter scale, each using a pig sorting panel. The same two persons were observers at all three farms. Pigs were randomly selected by the observers when driven towards the sorter scale. The duration of the driving through the sorter scale was maximum 60 minutes. Trials were ended when the observers assumed that most of the pigs had visited the sorter scale. Neither of the farms had performed any manual training prior to the farm visit.

All pens had both slatted and solid concrete floor. Pigs were fed with *ad.lib* dry feed on all farms. At all three farms, the layout consisted of a single resting area, with short walls dividing littered parts with whole floor, and two separate feeding areas. Access to the feeding areas was exclusively through the sorter scale, while pigs could exit the feeding areas freely via one-way gates at any time. One-way gates, (Figure 1), from feeding to resting area on Farm One and Two are on each side of the sorter scale entrance, hence Farm Two had two one-way gates next to each other. Farm Three had the one-way gates far away from the sorter scale, Appendix 3 for stable layouts. All three farms also had manual gates next to the sorter scale, these are meant to be open before the training program starts (Figure 2). Gate passages per minute were used as an indicator to compare the farms

layouts after manually training the pigs. Recording number of pigs passing through the sorter scale was done through filming. At the first farm pigs were filmed by a person standing behind the scale exit gate filming with a telephone (Samsung Galaxy Xcover6 Pro, model SM-G736B/DS). On the second and third farm pigs were filmed with a camera (GoPro 10 Black) mounted on top of the scales. Pigs passing per minute was calculated from the videos. The sorter scale on Farm Three did not have one-way gates as exit gates, but instead bars that decreased the opening to 25 cm (Figure 2). These were removed so that gate opening was larger during the manual training. This made it possible to go through the gate backwards for the pigs that were in the feeding area. Feeding areas were extended during the manual training to avoid crowding on all farms through opening gates to areas for shipping and/or sick animals. Crowding was considered as a risk for pigs leaving without eating in the feeding areas. Manual training was divided into three sessions on Farm One, lasting 12, 29 and 17 minutes. On Farm Two the manual training was divided into two sessions lasting 14 and 36 minutes. The manual training on Farm Three was performed in one session lasting 55 minutes.

Figure 1. One-way gate from feeding to resting area, defined as in "normal mode".

Figure 2. Left picture shows exit gate from sorter scale at Farm Three when closed. Right picture shows manual gates between resting and feeding area.

3.3 Data analyses

Descriptive statistics were calculated and performed in Microsoft Excel 18429.20158 and statistical analyses were performed in Minitab 21.4.1.

Part 1: Comparison between trained and untrained pigs

Selection of period of analysing included days between 15 and 70 days after pigs were moved to the pen. The first 14 days were excluded due to activation of training program. The last 17 days are excluded due to 30% of the focal animals being sent to slaughter.

Pigs excluded from further analyses contained:

- Pigs entering the sorter scale system late in the study (n=5, 2 from group T and 3 from group U)
- Pigs moved to another pen after 24 days (n=5, from group T)
- Pig with missing data from sorter scale and information regarding death 17 days after moved to the pen (n=1, from group T)

Finish weight is defined as the last weight recorded in the sorter scale due to no other data on slaughter weight being available. Hence, the last weighting in the sorter scale might not be the same day as the pig was sent to slaughter due to the sorter settings for the sorter scale. Days in production were counted as the number of days from when pigs were moved to the pen until the day when they went

through the sorter scale for the last time. The number of gate passages per group (T and U) and hour over the 24 hour period was summarized for the whole period (55 days), to be able to draw conclusions regarding if one of the groups were more likely to eat at a certain time.

Analyses using one-way ANOVA were conducted to compare weight per day between T and U, gate passages per hour during 24 hours between T and U, number of rearing days between T and U and number of rearing days between T gilts and T barrows. Analyses using mixed effects model were conducted to compare gate passages between group T and U, gate passages between T gilts and T barrows, weight between T and U when moved to the pen, finish weight between T and U and finish weight between T gilts and barrows. The fixed effect was the group, T or U respectively T gilts and T barrows.

3.3.1 Part 2: Comparison between pen designs

Data from the three farms (Table 1) were analysed based on pigs passing the sorter scale per minute as well as the characteristics in the stables according to form in Appendix 1. A high number of pigs per minute mean that manual training was more efficient if the number of pigs per minute was low. One-way ANOVA was conducted for comparing the different numbers of pigs passing per minute. Some of the pigs backed out of the sorter scale, they were not calculated as having passed the sorter scale. The characteristics included was:

- If there was a wall to divide the group
- If it was possible to close gates in the groups
- If it was possible to hold a small group (3-5 pigs) in front of the sorter scale
- If it would have been possible to train the pigs alone within reasonable time
- How easy it was to manually train one respectively a group of pigs

Table 1. Information from farms for manual training.

Farm	Farm One	Farm Two	Farm Three
Date of visit	10/10-2024	14/1-2025	17/2-2025
Pigs per pen during the study	200	415	207
Manufacturer	A	A	B
Stable and scale settings at arrival	Sorter scale was open in manual mode. Gates to feeding areas were open.	Sorter scale was in manual mode. Gate to one of the feeding areas was open.	Sorter scale was open in manual mode and exit gate was open to the left feeding area. Gates to and between the feeding areas were open.
Opening to the sorter scale (cm)	22,5	22,5	25
One-way gates position of metal rods	two of the metal rods tied up	One-way gates were in normal mode	One-way gates between feeding and resting area had two of the metal rods tied up.
RFID	60 focal animals	No	No
Days in the stable before visit	4[1)]	10	5

1) *Some of the pigs were born between two batches and older than expected.*

4. Results

4.1 Part 1: Trained and untrained pigs

Gate passages

There was not a significant difference between the T and U groups when comparing gate passages per pig (p=0.531, F=0.39), see Figure 3. The average number of gate passages per pig during the whole rearing period in the sorter scale system were 443.84 (StDev 163.73) for T and 462.70 (StDev 164.55) for U. Per pig and day the average number of gate passages for the whole period was 8.07 (StDev 2.98) for T and 8.41 (StDev 2.99) for U.

There was a significant difference between the number of gate passages per animal when comparing the trained gilts and trained barrows (p=0.001, F=12.19), (Figure 4). The average number of gate passages per gilt was 455.8 passages for the whole rearing time (StDev 180.6) while the same for barrows was 426.1 passages (StDev 143.5). Trained pigs were divided into three weight groups during selection. There was no significant difference in gate passages between the weight groups in the trained group (p=0.384, F=0.96). Gate passages per group and total rearing time (55 days) was 137.54 (StDev 49.54) for weight group 1, 146.05 (StDev 37.40) for weight group 2 and 147.96 (StDev 38.99) for weight group 3. The average passages through the sorter scale throughout the period was compiled by hour, (Figure 5). Group T had significantly less passages per hour when summarized over the whole period of 55 days (1049±21.7) when compared to group U (1209±20.7), (p=0.001, F=13.15).

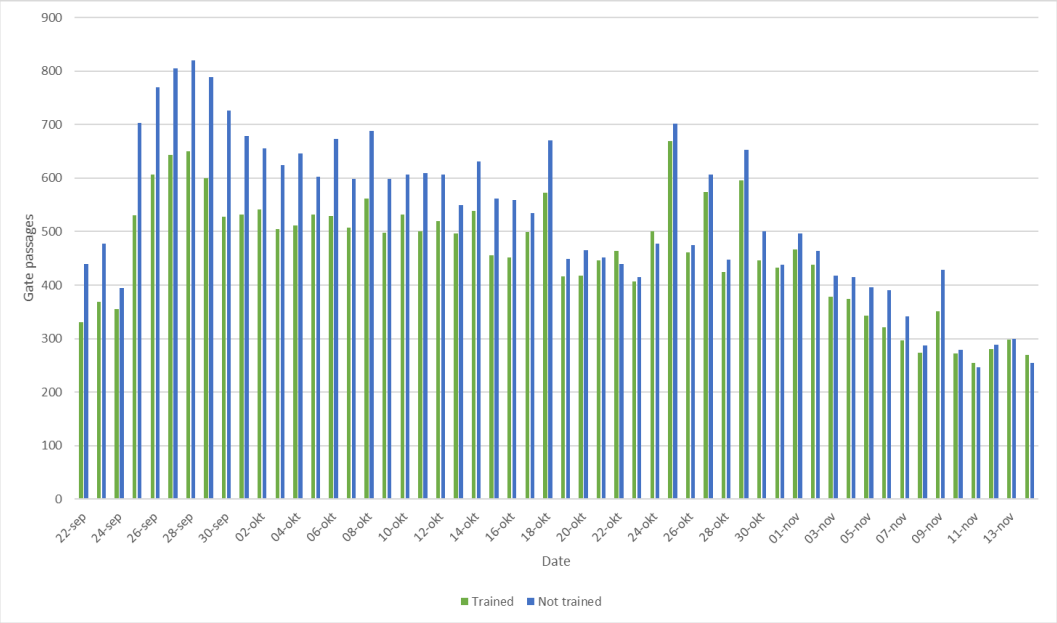

Figure 3. Gate passages through sorter scale per day and group (trained or untrained).

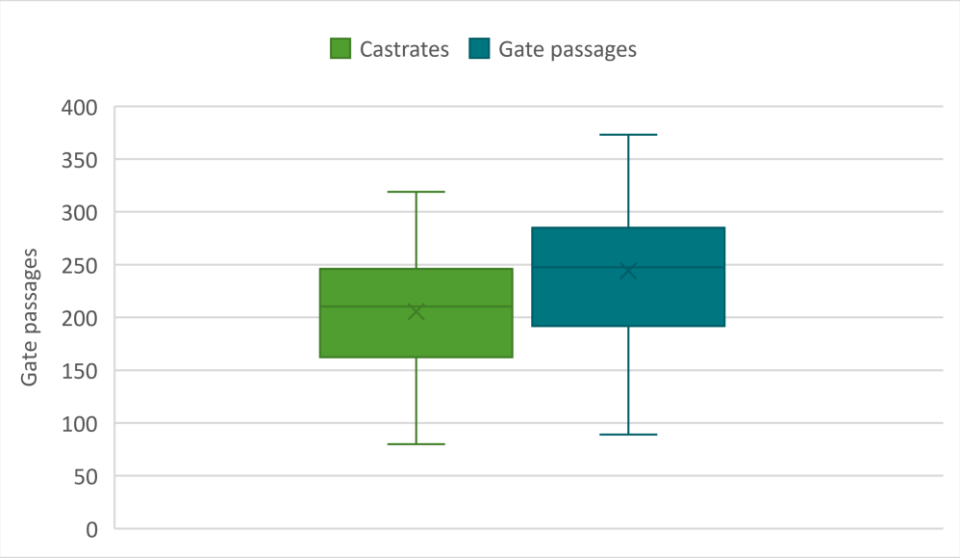

Figure 4. Gate passages for trained gilts and barrows for the whole rearing time (55 days).

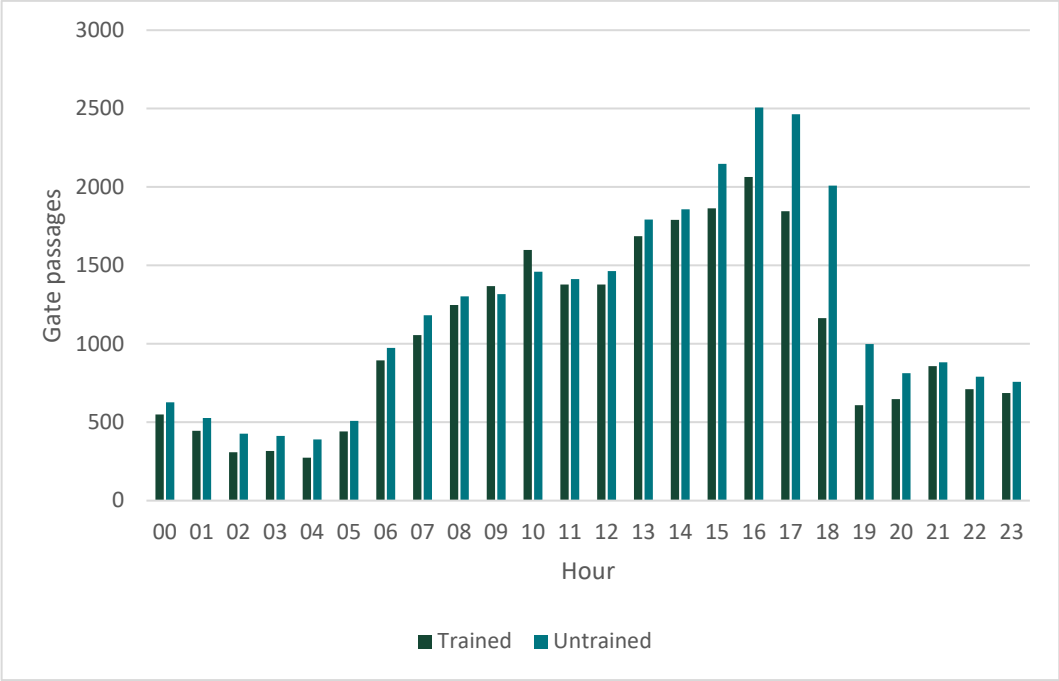

Figure 5. Summarized gate passages per hour during the day for Trained (T) and Untrained (U) pigs, over the period of 55 days.

Weight

Average start weight, at the same day as pigs were moved to the sorter scale system, was 40.5(±9.3) kg for T and 40.6(±9.3) kg for U. Average weight when sorted out to slaughter for T was 119.55(±6.73) kg compared to 120.44(±6.55) kg for U group. There was not a significant difference between T and U in for last weighing occasion in the sorter scale weight (p=0.457, F=0.56). Average last weight for group T was 119.52kg (StDev 6.67) and for group U it was 120.48kg (StDev 6.60). There was not a significant difference between trained gilts and barrows at the last weighing (p=0.363, F=0.84). Average last weight for group T gilts was 111.73kg (StDev 22.36) and for group T castrates it was 116.47kg (StDev 15.65).

Days in production

The average days for T was 77.86 days (StDev 9.33) and for U 78.05 days (StDev 8.46). The last animals were sent to slaughter 87 days after they moved to the sorter scale system. There was no significant difference in the number of days in production between trained and untrained pigs (p=0.949, F=0.00). There was no significant difference in the number of days in production between trained gilts and trained barrows (p=0.275, F=1.22).

4.1.1 Time for marking of pigs

Total time for two persons to mark 40 of the pigs in the U group of pigs was 27:40 min. The average time for one pig to be marked is 41.5 seconds. Time for marking the U group with ear tag is in Table 2.

Table 2. Time for marking Untrained pigs (U) with RFID.

Box	Number of pigs	Time
Box 16	11	6.54 min
Box 15	15	11.49 min
Box 14	14	8.57 min

4.2 Part 2: Manual training of pigs

There was a significant difference between the three farms in pigs per minute during manual training ($p<0.05$, StDev=1.21), see Table 3.

Table 3. Times for manual training of pigs.

Farm	Total video time (min)	Pigs passed the sorter scale(st)	Average pigs/min
1	43:30	226	5.22
2	52:54	440	8.37
3	55:51	142	2.56

4.2.1 On farm experience

Stable design and assessment of feasibility can be found in Table 4.

Farm One, 10/10-2024

Pen design allowed the observers to divide the animals in the main group in two separated groups through a wall placed in the pen together with gates. The division of the main group was only possible in Farm one. The pen consisted of several gates making it possible to close different areas, however the farmer would have appreciated more gates. Handling smaller groups was perceived as more effective. The third session was conducted with the remaining pigs of the group. Across all sessions, some pigs hesitated before entering the sorter scale.

Farm Two, 14/1-2025

On the morning of the test, technicians worked on the sorter scale, which may have temporarily deprived the pigs of feed. This was assumed to cause the pigs to be more eager to pass through the sorter scale during manual training. In both sessions the observers varied between driving small groups of approximately five pigs from close by the sorter scale, respectively driving a large group of pigs towards the sorter scale from the other side of the resting area. About every second time pigs from right and left side of the pen were selected. The pigs were very willing to pass through the sorter scale, however it appeared as if they were more stressed when driven by the observers. Observations from the videos showed when the observers came closer to the sorter scale the passage rate was faster, and the pigs made more noise which might have been caused by crowding in front of the sorter scale. When observers walked away from the sorter scale to fetch another group of pigs, impression was that some pigs walked through the sorter scale by their own, in a slower and calmer way. They seemed more willing to go through the sorter scale the further away from the scale area the observers were.

Farm Three, 17/2-2025

Prior to the visit farm staff visited the pen to clean up and provide straw in the resting area. This seemed to occupy the pigs and might have influenced the interest for the sorter scale or the feeding area. Pigs close to the sorter scale were driven in the beginning of training. Later attempts were made to drive pigs from further away from the sorter scale. In the beginning most pigs close to the sorter scale were willing to go through it, whereas pigs from far off were often afraid to enter the sorter scale. It was not possible, for two persons equipped with sorting panels, to hold more than one pig in front of the sorter scale. A large number of the pigs were too afraid and stressed to be driven through the sorter scale at all, those attempts had to be aborted.

Table 4. Stable design and assessment of feasibility to train pigs to enter the sorter scale, and information regarding current batch.

Characteristics	Farm One	Farm Two	Farm Three
Number of pigs in group	200	415	207
Wall to divide the main group	Yes	No	No
Gates to close and divide the main group	Yes	No	No
Possible to manually keep a small group (3-6pigs) in front of the gate[1)]	Yes	Yes	No[2)]
Possible to prevent pigs from going back from feeding area	No	No	No
Colour marking in the sorter scale	No	No	No
Possible to train the pigs alone	Yes[3)]	No[3)]	No[4)]
How easy it is to manually train a single pig	8	10	2
How easy it is to manually train a small group (3-6 pigs) of pigs	9	2	1[4)]

1) For two persons with panels
2) Maximum 1 pig per 2 persons
3) Not within reasonable time
4) Impossible

4.2.2 Training program

The two manufacturers distributing the sorter scale system to Sweden and represented in the study answered to questions regarding the training program. Both manufacturers have training programmes recommended to their users. Before the training period takes place the scale entrance gate as well as the exit gates to the feeding areas are recommended to be open, regardless of the manufacturer. The manual gates next to the scale should also be opened during this period. When the training program starts it closes the entrance gate to the sorter scale for short period, forcing the pigs to stand still for a time before released to the feeding area. The time for closing the gates will then be extended each day. Manufacturer B had a training program that is divided into five phases and takes place within the first 35 days after introduction of the pigs to the sorter scale system. Described by Stagsted Nielsen[3] the training phases increases the frequency of closing the entrance and exit gates when the pigs enter the sorter scale, to make sure they are used to standing still in the sorter scale. Farmers are, according to Stagsted Nielsen[3], recommended to follow the training program, but they can modify it if they prefer to. Manufacturer A had a training program

[3] Kent Stagsted Nielsen, sales manager, Agrisys A/S, telephone call 2025-04-07

recommended to use from day 4-7 after the pigs moved to the system. Described by Trøjborg[4] the training program can be modified by the farmer but is otherwise 14 days long. The background research to design of the training programs is not provided from either of the manufacturers. Trøjborg[4] also describes that entrance gate to the sorter scale have three different widths to be adopted according to pigs' growth, and that air pressure in the gate will follow the weight of the pigs. During training program activated no performance data from the sorter scale is available.

[4] Allan Trøjborg, sales consult, Domino A/S, telephone call 2025-02-28

5. Discussion

The aim of this study was to investigate the process of training pigs in automatic sorting systems for growing/finishing pigs and what types of design of the pen is more favourable for manual training. The first hypothesis proposed that training would influence the pigs' performance, the result indicated that the impact was minimal. Following was the second hypothesis that suggests that trained pigs are more motivated to pass through the sorter scale than untrained, but the finding didn't support this hypothesis. The third hypothesis suggested that certain pen designs and features would facilitate manual training. For the last hypothesis some characteristics were identified as being more beneficial for the manual training. Methodological concerns were identified in both parts of the study and may explain deviations from the expected results.

Reaching high production goals and maintaining a sustainable production

Proper feed intake is essential for maintaining both production efficiency and animal welfare, but also for maintaining a sustainable production. The production needs to be sustainable in an economic, social as well as environmentally friendly way. An economically sustainable production assures pigs reach the goal weight as fast as possible, keeping the feed intake as high as possible is therefor important. With regards of the economical investment in the sorter scale system keeping as many pigs as possible in the sorter scale pen is desirable. Maintaining a production that is socially sustainable may include avoiding time demanding tasks, such as manually handling animals in difficult ways. When investing in automation, such as the sorter scale system, keeping as many pigs as possible supervised by the scale management program is important. Being able to end the training program as early as possible will get earlier access to performance data. However, making sure that all pigs have learned navigating the system is essential. To maintain a high number of pigs in the sorter scale system minimizing pigs that are moved to other pens due to not being able to navigate the system is a priority.

Training

Sorter scale's training program, as well as manual training, are both parts of teaching the pigs how to navigate the system. Their explorative and curious behaviour combined with their extensive foraging activities in natural environments, suggests that they are capable of actively searching their surroundings for feed. Manual training through driving large groups of pigs together through the sorter scale could result in crowing. Wilhelmsson (2023) found that crowding negatively affected pigs' ease of movement when being

loaded onto slaughter transport. Indicating that manual driving during training could contribute to increased crowding and stress.

Human behaviour during training

Training the pigs to go through the sorter scale can be labour demanding (Steinerová 2020). Human behaviour during training will strongly influence the pigs (Hemsworth et al. 1989). Wilhelmsson et al. (2022) found that handling of negative nature when transporting pigs increase the stress level, in this case by a transport driver, which is an unknown person for the pigs. Maintaining an approach that is as free from stress as possible is the most ethical alternative, at the same time as making sure all animals can navigate the pen and find feed is more ethical than risk feed deprivation. Talking with a pet directed speech (PDS) instead of an adult directed speech (ADS) plays a large role in the attention drawn to the humans for horses (Jardat et al. 2022), indicating that this could be the case also for other animals. PDS is characterised by another pitch, rate, more simple syntax and more repeated words (Jardat et al. 2022). Weather avoiding handling the pigs to reduce stress caused by unknown humans, or if getting used to human handling for later is probably uncertain. In both parts of this study the pigs' might have experienced stress and fear for the humans, which is important to avoid in the practical work with manual training of the pigs.

5.1 Impact of training the pigs in the sorter scale

This study compared trained (n=60) and untrained (n=66) pigs, marked with RFID, in a sorter scale system at a Swedish farm. Parameters used for comparison in this study were gate passages, weight and rearing days. The result showed that the training in general doesn't have a large impact on gate passages, finish weight or rearing days when summarizing the rearing period. One exception was when gate passages per hour over the whole period was compared between group T and U. When observing the difference in figure 3 trained pigs seems to have more gate passages in the first two weeks, hence due to no significant differences in weight gain compensatory growth may compensate for that difference. The number of rearing days in this study was considered important since it is crucial for maintaining a production where animals reach the goal weight as fast as possible. Harold et al. (2005) concludes that manual training of the pigs is important. However, the study does not refer to trials conducted to verify this claim, nor does it explain the principles of training programs available. Interviews with Swedish farmers using sorter scale systems for fattening pigs (Karlsson 2021; Karlsson et al. 2023) concludes that training does have an impact, yet only one of the seven farms use training as a standard procedure. The farm that manually train the pigs is the only among the farms in the study by Karlsson et al. (2021) able to reduce

the training period from 14 to 8 days. Hence, other routines, as well as the pen design, may influence both the necessity of manual training and the duration of the active training program. Assumptions regarding the effect of weight on gate passages could be hypothesised, however no significant difference could be seen among the weight groups. Analyses regarding the first 14 days for the batch was not included. It is therefore not clear how different aspects, such as weight gain and pigs excluded from the group, during these days affected the results.

Necessity to manually train

Farmers may consider manual training crucial to prevent issues such as sorting out underweight pigs. This aspect may be important for controllers as well as consumers. Weather manual training of the pigs is essential depends on the measurement criteria. In this study gate passages were used for comparison, as it is the most used parameter among available parameters farmers have for monitoring the production. However, additional parameters such as weight gain may also be useful. Using gate passages as a measurement, regardless of individual marking of the animals, could have its limitations, as there is no way to be certain on for how long the pigs remained in the feeding area. An alternative routine to ensure all pigs passes through the sorter scale is to manually drive the pigs out from the feeding area once a day. There is also no way to ensure pigs leaving the feeding area, in cases when water is provided in the feeding area pigs could avoid leaving the area. Pigs staying in the feeding area for a longer period of time could deprive others from accessing the feed. There is also a risk that the pigs that avoids leaving the feeding area are selected for slaughter at a higher weight than desired since they manage to avoid passing through the sorter scale as often as intended. Da Fonseca de Oliviera et al. (2023) discuss the possibility of pigs using the feed station to hide from others, suggesting that it can be the same in this study and that pigs uses the feeding area, or the resting area, to hide from others' aggressive behaviour. If manual training is unnecessary it may be time-consuming for the staff. Focus could instead be on making sure the pen design is suitable for pigs spontaneous learning and explorative behaviour.

Manual training

Manual training carries the risk of inducing stress, which could negatively impact the learning process (Laughlin et al. 1999). During farm visit on Farm Two, increased stress behaviours were observed when the observers were near the sorter scale, whereas calmer passages through the sorter scale could be identified when pigs were left undisturbed to pass through the sorter scale. This suggests that the manual training may be a stressful experience which could have a negative impact on the pigs and decrease their capability to navigate the system effectively in the future. Both current and earlier environment will affect the pig's

cognitive abilities (Weller et al. 2020), meaning that navigational success may vary across farms and pig batches. Larger areas could improve the cognitive functions (Grimberg-Henrici et al. 2016), and advanced systems can serve as enrichment for pigs (Kalbe & Puppe 2010). Consequently, maintaining pigs within the sorter scale system may improve their cognitive abilities, potentially rendering manual training unnecessary. This may explain why the trained group did not outperform the untrained group.

Locating pigs

When deciding not to manually train the pigs it is important that staff working in the stables are able to find pigs that haven't found feed. Colour marking in the sorter scale is meant to be a useful tool to detect pigs that hasn't passed the sorter scale; but some Swedish farmers using sorter scale systems for fattening pigs report difficulties in identifying pigs without colour marks (Karlsson 2021). Detecting pigs, in a group of several hundred, deprived from feed is difficult and requires good animal behavioural knowledge as well as time. Being able to find the pigs that have not learned to navigate the system become crucial and a highly ethical aspect. Failure may lead to severe welfare problems, such as tail biting, as well as decreased productivity. Individual marking the pigs using RFID technology can facilitate the identification of animals with low number of gate passages, as well as other deviations, such as poor weight gain. However, marking the pigs is both costly and time-consuming. But at the same time, pigs that avoids leaving the feeding area and there for risk being sent to slaughter later than desired could be avoided when using individual marking since these pigs would stand out.

Gender differences

A gender-related difference was observed among the trained pigs, with gilts having a significantly higher amount of gate passages compared to barrows. Da Fonseca de Oliveira et al. (2023) found that gilts spend less time at the feeding stations than barrows when mixed-genders groups. However, no significant differences were found in initial or final body weight, average daily gain, feed-to-gain ratio or the number of visits per feeder (Da Fonseca De Oliveira et al. 2023). This result corresponds with this study where gilts might have spent less time feeding, however the exact number of feedings is unknown in the sorter scale system. Da Fonseca de Oliveira et al. (2023) also found that barrows initiated more agonistic behaviour than gilts. The increased number of gate passages among gilts in this study, may be explained by barrows displaying agonistic behaviour in the feeding area, potentially causing gilts to revisit the area more frequently. However, detailed observational studies are needed to verify this further. Implementing RFID technology allows for the possibility of separating

genders in separate feeding areas is possible, it might decrease the number of gate passages if gilts experience less agnostic behaviour during feeding.

5.2 Impact of the stable design

Comparison of manual training of pigs in different stable designs were conducted during farm visits to three different farms. The visits took place within the two firsts weeks after pigs moved to the sorter scale pens. During the visits driving of individual pigs through the sorter scale was explored. This study revealed a large difference in the possibility to select and drive individual pigs through the scales. Stables with a funnel-like lay out in front of the entrance gate as well as a wall with manual gates for dividing the area made manual handling of pigs easier.

Building sorter scale systems

Sorter scale systems are flexible and can be designed in various ways, in both new and existing buildings, which makes direct comparisons challenging. Characteristics identified for facilitating the driving is funnel-shape in front of the sorter scale and a wall that divides the resting area with gates that are possible to close. A large difference in the ease of manually training the pigs was observed on the number of days the pigs had spent in the system. Pigs that had been in the pen 10 days before the farm visit had a significantly higher passage rate through the sorter scale compared to those housed for four or five days. Pigs are highly adaptable animals (Sneddon et al. 2000), which may explain why those on Farm Two (10 days in the pen) demonstrated a higher passage rate than those on the other two farms. Being able to hold a small group of pigs with sorter panels next to the sorter scale entrance is facilitated by a funnel-shaped entrance. Brummer et al. (2008) suggested that exit gates from feeding area should be positioned opposite the sorter scale in the feeding area, ensuring pigs eat before leaving the area. Where exit gates are placed may influence the pigs' motivation to revisit the feeding area since feed serves as a strong motivator. Among the three farms in this study Farm Three was the only farm with exit gates on the opposite side from the sorter scale (Appendix 3). However, Farm Three recorded the least pigs passing through the sorter scale per hour, indicating that the exit gate placement had a minor impact in this case. Conclusions regarding the number of pigs passing through the sorter scale per hour needs to take other general aspects into consideration, such as weather the pigs were hungry or not at the time.

Enrichment

Farms visited in this study had differences in the amount of straw and toys available. This could explain the differences in how easy the pigs were to manually train since the cognitive skills depend on the rearing environment (Weller et al. 2020) and enrichment keeps the pigs more occupied (Studnitz et al.

2007). The differences between farms as well as pig batches may be important to consider due to their differences in cognitive ability and experiences. Sorter scale systems during fattening period could ensure enrichment in the last parts of the pigs' life since advanced systems themselves can serve as enrichment.

Handling except from manual training

Regardless of whether a farm chooses to train pigs after arrival, there would probably be situations where manual handling is necessary. Identifying and sorting out sick pigs or those requiring additional supervision is facilitated by a well-designed stable layout. Stable design is there for crucial for the practical work in the stables. If the pigs cannot be handled easy, there could be a risk for impaired well-being by the pigs due to neglection or stressful situations. During manual training on Farm Two pigs were observed as stressed, but they were still keen om being driven through the sorter scale by two persons with sorting panel. However, if the resting area would have been built with a wall with manual gates diving the area in two the manual training could have been performed with only one person and probably with less stress. Göransson et al. (2023) concludes that handling pigs for slaughter, more specific weighing and sorting, is one of the most labour-intensive procedures in fattening pigs' production, tasks that are similar to handling a single pig in the sorter scale systems. Maintaining the manual handling stressless and without disturbances will affect the result of the learning progress (Laughlin et al. 1999), with a well-designed stable the stress could be limited. Manually handling a pig in the system, regardless of if it is for training or other types of handling, is done easier if the entrance to the sorter scale is funnel shaped. This is concluded both in this study and by Brummer et al. (2008). Being able to divide the resting area was also identified as beneficial on the farm visits. However, there is a risk for higher building costs when more walls and gates are added to the system.

Sorter scale design

Sorter scale design impact the feasibility of training. Brummer et al. (2008) describes that the elevated middle positioned floor bar in the sorter scale results in a better throughput, preventing pigs from laying down inside the scale. Video observations showed pigs falling inside the sorter scale, due to slippery floor, resulting in, a most likely painful, fall hitting the floor bar in the middle of the sorter scale. If pigs perceive the sorter scale as aversive, there is a risk of reduced motivation to visit the feeding area. Making sure the pigs dare to enter and pass through the sorter scale is important in the design of the sorter scale. Except from the flooring and design of the bar in the sorter scale, aspects like lighting, prevalence of the sound and being able to see other pigs could have an impact on the pigs' experience of the sorter scale. Comparing with other productions the

sorter scale design could be inspired by the design of milking robots and their selection gates. These equipment's for dairy cows is designed more open and see-through than the sorter scale, and the fear for entering it may be reduced if similar design was applied on the sorter scale.

Other stable designs

The rest of the stable/pen should be designed in a way that make training easier. Harold et al. (2005) describes two different ways of designing the stables according to how to the pigs are supposed to learn the system. The first alternative is having the sorter scale as the only access to feed and teaching the pigs how to navigate by driving them through the system until they learn. In the other alternative, there are several access points to the feed and the sorter scale is one of those. The more used the pigs are to the system less access points to feed area will be open and they will eventually be forced to enter through the sorter scale (Harold 2005). Proper pen design has been identified as crucial for getting all the benefits of the technology (Brummer et al. 2008).

5.3 Methodological concerns

Both parts of this study were conducted on commercial farms, that had some challenges regarding the differences at the farms and the timing of data collection. However, the results and observations are highly applicable to other commercial farms. In both cases of training the pigs the observers didn't use positive reinforcement. Pigs were instead driven with sorter panels towards the sorter scale. The absence of positive reinforcement may have influenced the result, as there is a risk that the experienced fear when forced to through the sorter scale. Fiderer et al. (2024) uses positive reinforcement to train the pigs to stand still during blood sampling, suggesting that a similar method could have been used to encourage the pigs to go through the sorter scale. However, using such a method on commercial farms may be impractical due to time constrains. Breeding program and goals for breeding might influence the behaviour, such as curiosity, among the pigs.

5.3.1 Comparison between trained and untrained animals

Data collection for the comparison between trained and untrained pigs was conducted as part of another project. Limitations in the number of animals and group size are based on the intention of that project. A large proportion of the animals in the same pen were untrained, if the ration of trained and untrained animals would have been similar the result may have been different. The first two training sessions were conducted using a different type of sorter scale due to issues with the sorter scale. This could have affected how familiar the pigs were to

the sorter scale at the third occasion for training. However, in further studies the number of training occasions could be investigated.

5.3.2 Comparison between designs

Data collection for comparison of different designs was conducted at three different farms. At Farm One all animals were not at the same age, a quite large number of animals were born between two batches. Whereas pigs at the two other farms were all at the same age. Farm One and Three housed approximately 200 pigs per scale while Farm Two housed around 400 pigs per scale. Additionally, the number of days since pigs were moved to the pen differed significantly, with Farm Two housing pigs for 10 days prior to evaluation, compared to 4 and 5 days for Farms One and Three, respectively. There is a risk that the level of agnostic behaviour after mixing the different litters affected the training at the two farms shorter acclimation periods. Furthermore, differences in rearing systems prior to the finishing phase could have influenced the behaviour. Grümpel et al. (2018) found that mixed litters exhibited a higher prevalence of tail biting, though this behaviour decreased when litters were mixed at weaning. This suggests that pigs at Farm One and Three may have been preoccupied with other behaviours rather than learning the sorter scale due to the short time since mixing. Meanwhile, pigs at Farm Two were a lot more active, both in passing through the sorter scale and perform play behaviour. It can potentially indicate being more familiar with the system. However, the presence of a technician at Farm Two right before the manual training test may have disturbed their feeding behaviour, although some of the pigs' could access feed while the technician was present.

Filming at the Farm One was performed with a person standing behind the sorter scale, whereas the cameras was mounted inside the sorter scale at Farm Two and Three. Video observations suggest that some pigs hesitated when they saw the person filming, this could be one of the reasons for less pigs entering the sorter scale. There is a risk that the same pigs were driven through the sorter scale multiple times, for Farm Two a higher number of pigs passed the sorter scale than there were pigs in the pen. Not being able to mark the pigs that have passed the sorter scale and not being able to close the feeding area made this unavoidable. However, this method was closer to the reality since one-way gates from feeding to resting area are designed in a way that prevents closure. The placement of the one-way gate significantly influenced the number of that leaved the area in Farm Three. During manual training, the impression was that a lot more pigs left the area on Farm One and Two.

Sorter scale manufacturers differ in design dimensions, which may have influenced pig behaviour. Farms One and Two used sorter scales produced by

Manufacturer A, while Farm Three used equipment from Manufacturer B. At Farm One and Two, two pigs struggled to enter the sorter scale at the same time, resulting in some stressful behaviour, such as high pitch sounds and trying to escape, when they got stuck. At Farm Three two pigs could easily pass each other and no stressful behaviour was observed on the films. If the scale, and the manual training in the scale, is associated with stress and fear there is a risk for avoidance. However, in this study, stress levels were not directly measured. At Farm One and Two, the one-way gate from feeding areas was located near by the sorter scale entrance, which may have resulted in more pigs being manually trained several times. The feeding area quickly became crowded, and some pigs may have left the area without eating. Although feeding area was extended to include areas behind the feeding areas there is still a risk that a lot of pigs left the feeding areas without eating which might have resulted in a less positive experience of the training.

5.4 Practical work in sorter scale systems

The sorter scale system can improve the work in fattening pigs farms in several ways, including improved production monitoring and easier animal sorting. However, ensuring that all animals have their needs fulfilled may require extra workload since locating and manually handling the animals can be challenging. Swedish farmers with sorter scale systems for fattening pigs concludes that it is easy to sort out single pigs' but the number of persons required for the task varies (Karlsson 2021). Manually training all the animals is time-consuming and further minimizing the stress during the training may extend the duration more. While animal training can enhance job satisfaction (Fiderer et al. 2024), integrating reward-based training in the practical work is probably unrealistic and too time-intensive (Toivonen 2020). If the system is not easy enough to work in the investments might not be worth the cost, a well-designed pen would there for be of high importance for the sorter scale system manufacturers.

5.5 Further studies

This study opened up for some future research topics that would be of interest. The economical aspect of either spending time on manually training the pigs or relying on the training program could be investigated. As well as the aspects of RFID-marking when it comes to benefits of monitoring each individual respectively the cost of time consumed and the marks.

Comparing gender differences in productions with RFID-tags and separate feeding areas for gilts and barrows might give other results regarding the training aspect. Studies of weather the training has a more or less significant result when

genders are separated during the training period could result in other recommendations.

Focus has been on three rather different pen designs in this study, however comparisons between even more alternatives for stables is another topic for further studies. Farms with growing/fattening pigs in deep straw beddings as well as outdoor access was not included in the study, however the result could have differed due to the effect of enrichment on the cognitive ability of the pigs. Being able to compare groups on trained and not trained pigs on several different farms could give other perspectives on the importance of training.

6. Conclusion

Domestic pigs have a good cognitive ability and spatial memory, which suggests that they are able to learn to navigate artificial and, for the pigs, novel systems. Additionally, sorter scale systems themself may work as enrichment for the pigs. This study found that manual training of the fattening pigs does not result in increased passages through the sorting scale, increased weight gain or shorter rearing time during the summarized period. Manually trained pigs are therefore not more likely to pass through the sorter scale than those that are untrained. However, stable design that facilitates manual handling of pigs through the sorter scale may be essential for other types of animal sorting. Following features are identified for utilising the handling:

- A funnel-shape in front of the sorter scale
- Walls and manual gates to be able to close parts of the resting area
- Improve the flooring inside the sorter scale to avoid a slippery surface
- Design the one-way gates to be able to lock them, preventing pigs to leave the feeding area during manual training or handling

Well-designed stables and sorter scales may improve passages through the sorter scale, which could improve productivity and animal welfare as well as reduce the workload for farm staff.

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Populärvetenskaplig sammanfattning

Att lära slaktgrisar hitta i vågstallar
-är det verkligen nödvändigt?

Sedan några år tillbaka har intresset för att bygga vågstallar, stallar där grupperna består av uppemot 500 individer vilka kontinuerligt följs upp med hjälp av sorteringsvågar, ökat i Sverige. I de flesta fall behöver grisarna passera sorteringsvågen för att komma åt foder, något som ställer krav på både grisarnas förmåga att lära sig, men även personalen som snabbt behöver identifiera vilka grisar som inte lärt sig. Vågstallarna kommer med många fördelar, så som produktionsuppföljning och enklare utsortering till slakt. Men att manuellt träna grisarna att hitta i stallarna efter insättning kan vara en tidsödande uppgift.

Även om de olika tillverkarna av vågstallssystem har automatiska träningsprogram, vilka de rekommenderar att gårdarna använder, saknas kunskap om behovet av manuell träning. I det här examensarbetet har vikten av manuell träning av grisarna på en gård undersökts. Dessutom har tre gårdar med olika stallutformning besökts för att ta reda på vilken utformning som underlättar att manuellt driva grisarna genom vågen. Den första delen bestod av att jämföra data från tränade och otränade grisar, alla märkta med RFID för att kunna följa upp dem som individer. De jämförelser som gjordes handlade till stor del om grindpasseringar, något som är en av de vanligaste parametrar för produktionsuppföljning i vågstallar. Den andra delen gick ut på att två personer med drivskivor drev grisarna genom vågen under utsatt tid, detta skedde under en av de två första veckorna efter insättning.

Resultaten visade att det inte finns någon skillnad mellan de grisar som tränas eller inte tränas när det kommer till antal grindpassager, vikt vid slakt eller ålder vid slakt utslaget på hela uppfödningstiden. Något som talar för att den tiden som läggs på manuell träning kan vara onödig. De jämförelser som gjordes mellan stallar visade att det var stor skillnad mellan antal grisar som passerade vågen per minut under den manuella träningen. De stallutformningar som stack ut var när området framför ingångsgrinden till sorteringsvågen var utformad som en tratt. Men även att ha en vägg som skiljer av aktivitets-/viloytan, med manuella grindar som kan stängas, underlättar att fösa grisar genom vågen.

Även om manuell träning efter insättning inte anses nödvändig finns det skäl för att bygga stallar där den manuella hanteringen av grisarna kan underlättas. Det kommer alltid finnas grisar som behöver hanteras manuellt, och att kunna sortera

ut dessa från en stor grupp med grisar så enkelt som möjligt minimerar stress för både personal och grisar. Om vågstallar byggs på ett väl genomtänkt sätt finns det stora chanser att den typen av stallar underlättar arbetsmiljön, men även djurvälfärden då djuren får en större yta att röra sig på och ett system som stimulerar den naturliga nyfikenheten hos grisarna. Framtidens slaktgrisstallar kan mycket väl vara vågstallar, förutsatt att stallarna är väl genomtänkta.

Appendix

Appendix 1

Protocol for observers to fill in after manual training of the pigs.

Protocol of stall design

Wall for dividing the resting area YES☐ NO☐

Gates to divide the resting area YES☐ NO☐

Possible to keep a small group of pigs in front of the sorter scale entrance YES☐ NO☐

Possible to keep pigs in the feeding area YES☐ NO☐

Colour marking for observers to use YES☐ NO☐

Possible to train the pigs alone within reasonable time YES☐ NO☐

How easy it is to:

Drive one single pig

1*(easy)* 2 3 4 5 6 7 8 9 10 *(hard)*

A small group of pigs

1*(easy)* 2 3 4 5 6 7 8 9 10 *(hard)*

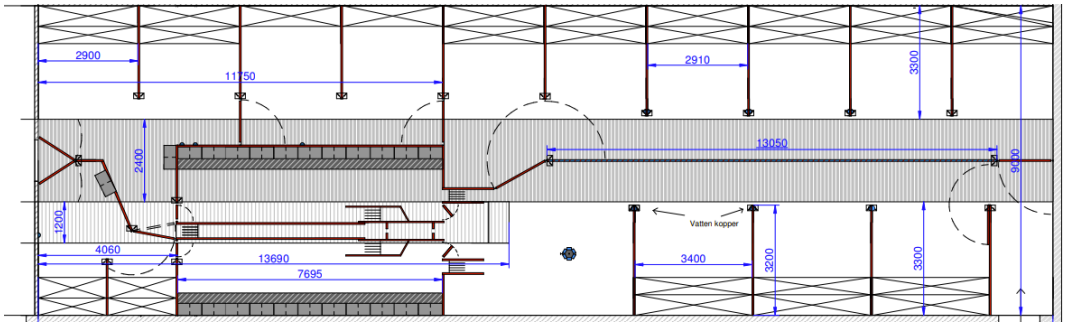
Appendix 2

Protocol over herds and current batch for manual training.

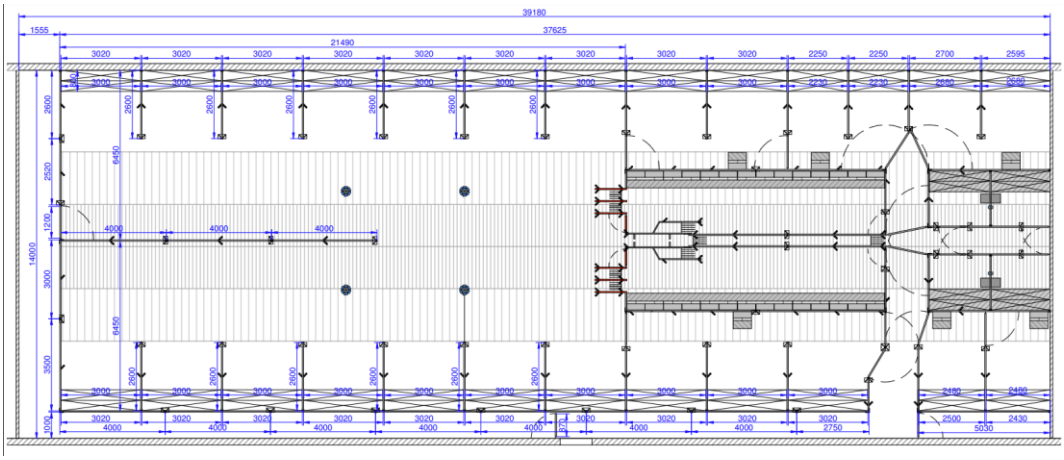
Herd		
Date		
Observers		
Stall at observers arrival		
Equipment for driving the pigs		
Access from feeding to resting area		
Days since insertion		Amount of pigs
Previous experience of the scale		
Manufacturer		
Breed (father)	Hamp	ND DD
Time		
Start		
End		
Time		
Start		
End		
Time		
Start		
End		
Time		
Start		
End		

Appendix 3

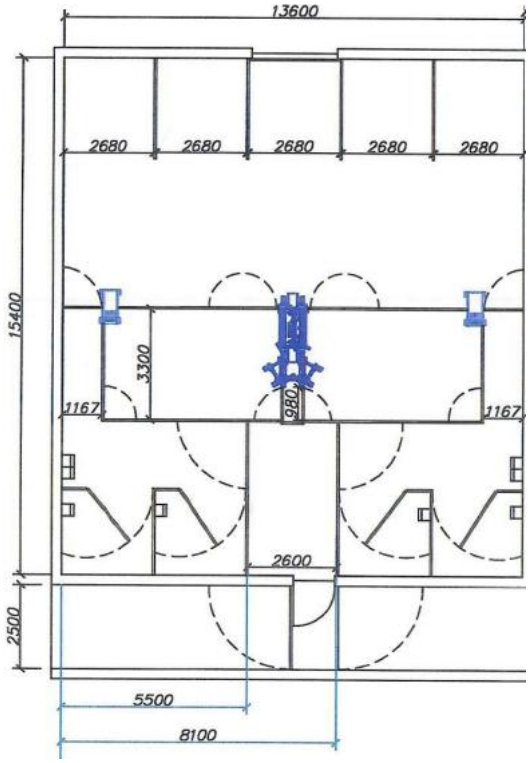
Farm One, layout over one sorter scale pen.



Farm Two, layout over one sorter scale pen.



Farm Three, layout over one sorter scale pen.



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