Pigs' display of body language

- Associated with emotional states during different situations

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Pigs' display of body language - associated with emotional states during differing treatments

Grisars kroppsspråk – i relation till känslotillstånd under skilda behandlingar

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Abstract

Animals' behaviours are affected by their emotional state, and emotions can affect the animals' welfare and health. Since emotions are subjective and could, at times, be illogical, the subject still has much to discover. Therefore, it is vital to understand animals and their feelings in order to improve their lives and welfare.

This study aimed to investigate whether the body language of pigs changes depending on what type of treatment they are exposed to, the treatments being Pleasant, neutral or Unpleasant. Further on, the aim was also to investigate if the different body positions can indicate what emotions the pig experiences.

The observations were conducted at the Swedish Livestock Research Centre, Lövsta, Uppsala, Sweden. A total of 90 pigs (14 weeks of age) were exposed to three treatments in a cross-over design. The Pleasant treatment provided the pigs with sugar cubes, the Unpleasant treatment presented an up folded umbrella, and in the Neutral treatment the pigs was observed in their pens without added stimulus. The treatments were filmed to be observed later with the help of an ethogram. The recording method used to obtain data for each displayed position during the different treatments was continuous recording and observing a focal animal, where each observation lasted 120 seconds. The focal animal was selected randomly and observed during all three treatments. For the body parts and positions in combination, all body parts positions were recorded as one combination every ten seconds. The first observation started from 0 seconds and continued up until 120 seconds. The position of the following body parts was observed; "Ears", "Tail", "Neck", "Head" and "Body Overall".

The results showed significant differences between the displayed body positions and combinations and in which treatments they occurred. From those results, it could be concluded that body language is complex and that it is not always reliable to observe only one body posture to determine emotional state. Continued investigations are necessary to establish further and understand the connection between pigs' body language and emotional state. Through this, ensuring pigs' welfare would be simplified. This study illustrated the need for further investigation of pigs body language and how it translates to their emotional states.

Keywords: pig, Sus scrofa domesticus, emotions, emotional state, body language, body positions

Preface

“I like pigs. Dogs look up to us. Cats look down on us. Pigs treat us as equals.”

- Sir Winston Churchill

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Abbreviations

ANOVA	Analysis of variance
sd	Standard Deviation
A, C, N, ST	Asymmetrical ears, Curled tail, neck Neutral, Standing
F, C, D, ST	Forward ears, Curled tail, neck Down, Standing
F, C, N, ST	Forward ears, Curled tail, neck Neutral, Standing
F, C, S, ST	Forward ears, Curled tail, neck Stretched, Standing
N, C, D, ST	Neutral ears, Curled tail, neck Down, Standing
N, C, N, ST	Neutral ears, Curled tail, neck Neutral, Standing

1. Introduction

It is known that animals' behaviours can reflect their emotional state. Emotions have been defined as an internal response to a certain stimulus or event, where the response could be subjective, physiological, neural or cognitive (Paul & Mendl, 2018). However, since emotions could sometimes be subjective and illogical, the subject has not been widely studied (Held *et al*., 2009). Further, emotions can affect the animals' welfare. Hemsworth & Coleman (2011) suggested that if pigs are afraid of humans, their growth and behaviours could be affected due to stress. In view of ethical considerations, it is considered important that the animals humans keep should be given such a good welfare and life as possible. It therefore seems urgent to try to understand our animals and their feelings, both for ethical reasons and yield.

An aspect that has begun to develop an increasing interest is how animals' body language might convey information about their emotions. For example, de Oliviera & Keeling (2018) studied dairy cows in their everyday life during different stationary activities and observed the positions of the tail, ears and neck. The study showed that the cows displayed different positions of observed body parts depending on the activity (de Oliviera & Keeling (2018). Therefore, it was assumed that these displayed body positions could indicate different recognized emotions. A few similar studies have been done on pigs, where, for example, different tail and ear positions have been observed during different activities (Kleinbeck & McGlone, 1993; Marcet Rius *et al*. 2018). These studies indicate that pigs' body parts and their different positions could convey the animals' emotional states.

2. Background

2.1 The pig and it's natural behaviours

The pig (*Sus scrofa domesticus*) is a domesticated animal that originates from the wild boar (*Sus scrofa*). It is unclear when the domestication of pigs occurred, but it seems that there have been several separate times in history when pigs have been independently domesticated (Larson *et al*. 2005; D'eath & Turner, 2009). How the pigs have been kept over the years has differed from roaming outside relatively freely, feeding on what nature has to offer, to being confined indoors, where food scraps for a long time were the primary source of feed (D'eath & Turner, 2009). Additionally, D'eath & Turner (2009) discuss how the late and relatively fast changes in housing and management of pigs have occurred in context to the history of pigs' domestication process. Due to this change, welfare problems might arise due to a disparity between the behavioural needs of the pig and the pig's environment.

Pigs are curious animals that want to explore their environment and its elements, where foraging is a big part of the pig's exploratory need (Špinka, 2009). Whereas, in a commercial setting, one way to satisfy the need is to provide the animals with manipulative material. Foraging can also function as a tool to still a need of hunger and suffice the pig's appetite (Studnitz *et al.* 2007). However, if this need is not satisfied, the pigs might redirect their unmet exploratory behaviour towards other nearby pigs' body parts, such as ears and tails, where the biting results in an overall negative welfare for the pigs (Lahrmann *et al*. 2015).

2.2 Pigs' emotions

Emotions are defined as subjective reactions, including behavioural responses to a specific stimulus (Boissy *et al.* 2007). An affective state, whether positive or negative, is instead a persistent state over a longer time, where emotions are examples of affective states (Mendl & Paul, 2020). For animals, Paul & Mendl (2018) describes several ways to define and describe how animals might experience emotions. As an example, that emotions could be responses to different situations

and have evolved to handle behavioural and cognitive functions. Another example is that emotions could be a state to convey goal-directed learning, and that the emotions are obtained through rewards or punishments.

According to Held *et al.* (2009), studies regarding pigs and their emotions are few and scarcely studied. It could be argued that it has changed since then, where the interest of both emotional and affective states from a welfare aspect have increased. There is however still more to explore and study. Furthermore, previous studies often focus on investigating negative emotions, such as stress, aggression and frustration, and their effect on the animal's welfare (Held *et al.* 2009). For example, aggressive behaviour can lead to fighting and cause skin lesions (D'Eath, 2005; Schrey *et al.* 2018), while frustration can lead to bar biting (Swan *et al.* 2018) or tail- and ear-biting (Lahrmann *et al.* 2015). In contrast with negative emotions, positive emotions are rarely the focus when pigs' emotional states are studied.

In a study by Zapata Cardona *et al*. (2022), it was revealed that pigs exposed to harmonic music showed different emotional responses depending on the composition of the music. It was found that consonant music often led to positive emotional responses, while dissonant music led to negative emotional responses. The author's concluded that music could potentially be used as environmental enrichment for pigs.

Reimert *et al.* (2017) investigated emotional states in pigs after both a positive and a negative event and whether these states would affect the pigs' pen mates, like emotional contagion as the authors referred to it. It was found that after a pig had been exposed to negative treatment, the pig was negatively affected, by showing increased cortisol levels and behaviours previously connected to negative emotions, freezing as an example of behaviours. Furthermore, the negatively affected pig seemed to affect its pen mates, who had not been exposed to the stimulus, emotionally. This means that if at least one pig feels negative emotions, those negative feelings could transfer to its pen mates, making them experience negative emotions as well. However, it could not be determined if emotional contagion from the positive treatment occurred, but the positive treatment positively affected the individual pigs.

There are different methods used to measure animals' emotional and affective states. One way is to measure it by using physiological parameters, often used to study stress but also implemented to investigate animals' emotional states (Paul *et al.* 2005). At the same time, Krugmann *et al.* (2020) suggest that the method of behavioural observations is a more practical way to measure animals' affective states. Boissy *et al.* (2007) suggest that animals' vocalizations and play behaviour could be signs of positive emotions. Different postures of different body parts could also indicate an animal's different affective states (Reefman *et al.* 2009; Camerlink & Ursinus, 2020; Krugmann *et al.* 2021).

2.2.1 Body postures

Ear postures

Ear postures have been used as indicators of affective state in animals. Boissy *et al.* (2011) examined sheep's (*Ovis* aries) ear positions and how they related to emotional states. They concluded that the sheep ears were mostly directed backwards during Unpleasant and uncontrollable situations, and asymmetrical ears were primarily observed when exposed to something unexpected. Reefman *et al.* (2009) performed a similar study where they concluded that asymmetrical ears were most frequently shown during negative situations. Horses' (*Equus ferus caballus*) ears that are directed forward indicated positive emotions (Stomp *et al.* 2018).

Studies of pigs' different ear postures are scarce, and some of the results have been hard to interpret. Krugmann *et al.* (2020) examined whether tail and ear postures could be suitable indications of pigs' affective states. While tails seemed to work as good indicators, the results of ear postures were more complicated to interpret especially in correlation to the tail postures. However, Marcet Ruis *et al*. (2018) could conclude that a high frequency of ear movement may indicate decreased positive emotions compared to a low frequency of ear movement. Göransson (2016) found that during the experience of pain, the pigs' ears were directed backwards or held asymmetrical when describing the pig pain face. In contrast, ears held upright were seen more frequently in a control situation than in a pain-induced situation. A study by Czycholl *et al.* (2020) found that pigs who lived in an enriched environment more often directed their ears forward compared to pigs who lived in barren environments. Further on, they discussed that ears directed forward imply a positive, or at least neutral, emotional state. In contrast, Camerlink *et al.* (2018) found that pigs often had their ears directed forward in aggressive situations, and this links ears directed forward to meaning a heightened vigilance or fear.

Tail posture

The tail and its movements and postures are a common component among several different species (Kiley-Worthington, 1976). For example, warthogs (*Phacochoerus africanus*) raise their tails in a vertical position for several reasons, such as fleeing, being excited or being startled (Kiley-Worthington, 1976).

Most research regarding tail positions focuses on their relation to tail biting. Kleinbeck & McGlone (1993) observed that pigs who kept their tails down were more likely to be affected by tail biting than pigs who held their tails in another position. Similarly, a study from Zonderland *et al.* (2009) concluded that the tail posture does affect the occurrence of tail biting, where a curly tail was less likely to be bitten whereas a hanging tail was more likely to be bitten. Similar studies have implied that hanging or tucked tails often could indicate an impending tail-biting

outbreak (Ursinus *et al.* 2014; Lahrmann *et al.* 2018). However, it has not been studied whether the tail gets bitten because it is hanging, or if it hangs because it has been bitten. Additionally, little research has focused on why pigs keep their tails in specific postures to begin with.

Tail postures and tail movements have increasingly begun to be seen as indicators of different indicators of pigs' emotional states (Camerlink & Ursinus, 2020). Some studies investigate whether tail posture or tail movements could be linked to affective or emotional states. Kleinbeck & McGlone (1993) concluded that a tail positioned down can be linked to a negative experience of heat stress, while a tail up was mainly shown when a familiar person was touching the pigs in an affectionate way. Similar conclusions were drawn by Krugmann *et al.* (2020), who suggested that raised tails and curled tails could be indicators of positive affective states. In contrast, Reimert *et al.* (2012) suggest that a curled tail not necessarily is an indicator of an emotional state but instead a neutral posture. Whereas other tail postures from the default curled position could indicate other emotional states, such as tail wagging indicating positive emotions. Reimert *et al.* (2012) continued to describe that tail wagging or movement instead could be indicators of positive emotions. Similarly, Marcet Rius *et al.* (2018) imply that high-duration tail movement could instead be an implication of positive welfare. Similarly, hanging tails seems to be associated with negative emotions (Reimert *et al.* 2012; Krugmann *et al.* 2020).

Neck and head posture

Not many studies have focused on the pigs' neck and head postures and their effects on emotional states. However, it has been studied on other species. A study performed by De Oliveira & Keeling (2018) focused on dairy cattle's (*Bos taurus*) body language and analyzed neck positions in relation to different affective states. The authors concluded that due to the variation of showed neck postures with other body postures, it seemed essential to in future research investigate this to further understand the emotional connection to body postures. Cows stretching their necks have previously been linked to positive emotional states (Proctor & Carder, 2015).

It has also been common to investigate horses' neck and head positions in relation to their emotional states. Corujo *et al.* (2021) investigated if an intelligent system could detect a horse's emotional states through closer inspection of different body parts, such as head and neck postures. In their ethogram, they described how alarmed horses would have their necks held above the parallel of the ground and head higher up than the back, while annoyed, curious and relaxed horses usually held their neck parallel to the ground, but that it could differ.

Studies where pigs head positions were studied, have often been in relation to playing and fighting behaviours. Weller *et al*. (2019) had several head positions in their ethogram describing different playing behaviours, such as using their heads

for pushing or knocking other pigs. Donaldsson *et al*. (2002) investigated play behaviours as well, where head moving from side to side was a locomotor play behaviour. Animals playing behaviour of sorts is widely debated of its meaning, but it has been suggested that playing makes animal feel pleasure (Trezza *et al.* 2010). Apart from studies focused on playing behaviour, to this author's knowledge, no other studies focusing on head positions and their emotional meaning have been done.

2.3 Aim

This study aimed to investigate whether the body language of pigs changes depending on what type of treatment they're exposed to, the situations being positive, neutral or negative. It was aimed to investigate if the different body positions can indicate what emotions the pig experiences. To achieve the aim, the following scientific questions were formed:

- Do pigs display different body positions depending on if the pigs are exposed to a Neutral, Pleasant or Unpleasant treatment?
- Are some body positions related with other body positions or emotional states?

3. Material and Method

3.1 Animals and housing

The observations were conducted at the Swedish Livestock Research Centre, Lövsta, Uppsala, Sweden. A total of 90 pigs with intact tails were kept in the stable that was used. All pigs had blue markings across their backs. Sick or injured pigs had an additional pink marking. The injured or sick pigs was deemed healthy enough to remain in their pens and could participate in the treatments, though they were not to observed for the analysing part. Pigs that had obtained a pink marking during or before the first day of observation were excluded from the project. Thus, these pigs were to be excluded from the observations, but their pen mates would not be excluded from the observations. They were not moved from their pens since it was deemed that neither their presence nor absence would affect the observations. One pig was excluded due to being tail-bitten and being lame.

The observed pigs were approximately 14 weeks of age when the test was conducted. The breeds of the pigs differed between the pens. In six of the pens, there were Yorkshire and Hampshire crossings, while in five of the pens resided crossings of Yorkshire, Landrace and Hampshire breeds. In one pen, there was a group of pure-bred Yorkshire. Each pen housed 6-10 pigs.

There were twelve pens in the stable. All pens had concrete floor (3.60×2.20m) and a separate area with slatted floor (3.60×1.00m). Each pen held a group of 6-10 pigs. There were also two smaller pens in the stable, used to separate animals if needed. The smaller pens had concrete floor (1.80×2.20m) and a separate area with slatted floor (1.80×1.00m). These pens were not in use during the observation period.

Each pen was every day provided with chopped straw from a rail suspended robot over the concrete flooring area. The pigs were provided with the feed “Opti Finish” produced by Svenska Foder three times a day. Water was provided ad libitum in each box, through a water nipple located in the slatted area.

3.2 Pilot study and ethogram

The different body postures were recorded according to an ethogram (Table 1), based on previous research and a pilot study.

The pilot study was executed three weeks prior to the observations to test the different treatments, the reactions to the treatments and observe which body postures that was displayed to make sure the ethogram was sufficient. The pilot study was conducted on the same farm but in a different but similar stable, on another batch of pigs, than the one used for the actual observations. The pilot study tested where two GoProHero 5-cameras would capture most of the pen, done by setting up the camera at different angles to the pens and the observer standing in different positions with the cameras strapped to the observer's body and head. For a negative experience, it was to be tested if an umbrella would be perceived as an adverse treatment. The pigs' reaction to folding up an umbrella and approximately how long it took for them to approach it, was therefore estimated. The pilot study also included, testing the pigs' reactions when sugar cubes were thrown into the pens, which was suggested to be a positive treatment. It was found that the pigs required to be taught to eat the sugar cubes prior to throwing them into the pens. However, after getting adjusted to the sugar cubes, it was considered being a positive experience being fed sugar cubes.

After the pilot study, the ethogram was tested with the video recordings from the pilot study and further developed subsequently.

Table 1. Ethogram of the different body parts and their respective behaviour and descriptions.

Body part	Behaviour	Description
Ear	Backwards	Ears are directed backwards for more than one second (Göransson, 2016).
	Forwards	Ears are directed forward for more than one second (Camerlink *et al.* 2018; Czycholl *et al.* 2020).
	Changes	Flipping ears backwards and forward for at least one duration (Marcet Rius *et al.,* 2018).
	Neutral	Ears being positioned in a neutral position for more than one second.
	Asymmetric	One ear is directed forward and the other ear is directed backwards for more than one second (Reefman *et al*., 2009; Göransson, 2016).
Tail	Curled	Curled tail for more than one second (Reimert *et al.* 2012; Krugmann *et al*. 2020).

	Erect	Tail being uncurled and held straight out from the body, either horizontal or vertically (Kleinbeck & McGlone, 1993).
	Hanging	Tail is hanging motionless for more than one second (Kleinbeck & McGlone, 1993).
	Wagging	Tail is moving from side to side at least twice (Marcet Ruis *et al.* 2018).
	Tucked	Tail being tucked between hind legs for more than one second (Krugmann *et al*., 2020).
	Straight up	Tail is directed upwards for more than one second (Kiley-Worthington, 1976).
Neck	Stretched	Neck stretching up for more than one second (Proctor & Carder, 2015; Corujo *et al*. 2021).
	Neutral	Neck held horizontally with body for more than one second.
	Down	Neck directed toward the floor for more than one second.
Head	Head tossing	Neck being curled backwards in a rapid motion and head being angled towards body.
	Bobbing	Neck moving in an up-and-down manner continuously for at least two repetitions.
	Neutral	Head held neutral.
Overall	Frozen	Standing motionless in one position more than one second.
	Fleeing	Moving quickly away from stimulus more than one second.
	Lying down	Lying down.
	Standing	Standing upright.
	Sitting	Sitting down more than one second.

3.3 Experimental design

This cross-over study and its treatments were carried out mid-March 2022. All treatments were performed between 12.00 to 15.00 every day. The treatments were three in total and were labelled as “Pleasant”, “Unpleasant” or “Neutral”. The pigs were subject to these three treatments in order to see how the body language and emotional state changed during different situations. All pens were exposed to all three treatments once each. It was decided that the first pen was to be exposed to the Pleasant treatment, the second pen were to be exposed to the Unpleasant

treatment and the third pen were to be exposed to the Neutral treatment. The treatments were then performed according to a schedule (Table 2).

Table 2. Schedule for the treatments, Pleasant treatment, Unpleasant treatment and Neutral treatment, and which day they were performed in each pen.

	Day 1	**Day 2**	**Day 3**
Pen 1	Pleasant	Neutral	Unpleasant
Pen 2	Unpleasant	Pleasant	Neutral
Pen 3	Neutral	Unpleasant	Pleasant
Pen 4	Pleasant	Neutral	Unpleasant
Pen 5	Unpleasant	Pleasant	Neutral
Pen 6	Neutral	Unpleasant	Pleasant
Pen 7	Pleasant	Neutral	Unpleasant
Pen 8	Unpleasant	Pleasant	Neutral
Pen 9	Neutral	Unpleasant	Pleasant
Pen 10	Pleasant	Neutral	Unpleasant
Pen 11	Unpleasant	Pleasant	Neutral
Pen 12	Neutral	Unpleasant	Pleasant

Prior to the treatments, on the first day of testing, the pigs were habituated to a tripod, on which a GoPro-camera would be attached, which were to be used for the neutral treatment. The observer placed the unfolded tripod in various spots in the stable, allowing the pigs to habituate to the tripod before slightly moving it again. The pigs were also habituated to eating sugar cubes, which were used in the Pleasant treatment. This was done by the observer, encouraging the pigs to eat sugar cubes, done by nudging the sugar cubes into the pigs' mouths as well as scattering sugar cubes in the pens until the pigs understood how to eat the sugar cubes (approximately 5 minutes). This was also done on the test day. Prior to the observations, the observer also practiced unfolding and folding the umbrella, both at home and during the pilot study, so that the motions would be as similar as possible during the treatments.

The Pleasant and Unpleasant treatment was executed similarly, with the observer positioned outside the pen while giving the treatment. The observer was positioned in the outmost corner across from the threshold to the slatted area (Figure 1). The observer had one GoPro®-camera strapped to her head and the other one attached to her chest. Before the treatment, the observer habituated the pigs to her presence, until they paid no attention to her (approximately 5 minutes). The observer was not present in the stable for the Neutral treatment. Instead, one of the GoPro®-cameras, attached to a tripod, recorded them. Each treatment was recorded for two continuous minutes.

Pleasant treatment

The Pleasant treatment consisted of, after having started the GoPro®-cameras for recording, the observer throwing approximately 50 sugar cubes (3.6 g each) into the pen until they were evenly distributed on the solid part of the pen floor. After that, the observer stood positioned in the same spot for two minutes. The time was managed through the recording time from the GoPro-camera attached to the observers chest. When two minutes had passed, the observer stopped the recordings and moved on to the next pen and treatment.

Unpleasant treatment

The Unpleasant treatment consisted of, after having started the GoPro®-cameras for recording, the observer lowering a black umbrella into the pen, as far down as possible to obstruct neighbouring pens from seeing the umbrella. The observer then unfolded the umbrella with a swift move and kept it unfolded for one minute. Then, with another swift move folding it in again and keeping it lowered in the pen for another minute. When the second minute had passed, the umbrella was removed from the pen. The observer stopped the recordings before moving to the next pen and treatment.

Neutral treatment

The neutral treatment consisted of setting up the tripod with one of the GoPro®-cameras attached to it. The tripod was positioned outside the pen, in the outmost corner across from the threshold to the slatted area (Figure 1). The observer then left the stable and through the "GoPro Quik"-application, started the recording via a mobile phone. The recording lasted for two minutes before the observer stopped the recording and entered the stable again. There was no human present in the stable during the treatment.

Figure 1. Picture from where the position of the GoPro-camera recorded during the neutral treatment.

3.4 Analysing the recorded material

All recordings from the two GoPro®-cameras were transferred over to a computer as video files. The recordings were then sorted based on the day of recording, treatment, and pen. All observations were performed by the same observer.

The recording method used to obtain data during the different treatments was continuous recording and observing of a focal animal that was to be observed for all three treatments. The focal animal was selected randomly after each pig in each pen was given a number between one to the number of pigs in the pen, from the recordings. The number of pigs per pen was between six to ten individuals. For this study, a total of 12 focal animals was studied for all observations. A random number generator (https://slumpgenerator.nu/), selected which pig to observe. The selected pig's appearance was then thoroughly studied so it would be recognized throughout all the three treatments.

3.4.1 Individual body part

For the individual body part analyses, only one body part at a time was observed for the focal animal, according to the ethogram. Each behaviour and position were recorded as durations, with both the start and end of each instance of behaviour. The numerical value for these observations was translated to percent of the observation time, which was calculated by dividing the total amount of seconds a behaviour or position had shown during the observation by the total observation

time, 120 seconds. This making it the percent of the time the position was performed during each observation.

3.4.2 Body parts in combination

For the body parts and positions in combination, every ten seconds, all body parts positions, being “Ears”, “Tail”, “Neck”, “Head” and “Body overall”, were recorded as one combination. The data consisted of 36 video recordings, each two minutes long, for each treatment and pen. Every ten seconds within two minutes, the video was paused and each body part was analysed from that frame, on the focal pig. The first observation starting from 0 seconds and continuing up until 120 seconds. The number of all combinations of body part and position was registered and the frequency as number per time unit was analysed.

3.4.3 Statistical analysis

The data analysis was carried through by analysing the percent score of the different “Ear”, “Tail”, “Neck”, “Head” and “Body Overall” positions using Microsoft Excel® and RStudio (RStudio Team, 2020). The editing of the raw data mainly occurred in Microsoft Excel® before being loaded into RStudio, where the data further was sorted before being analysed.

The analysis included determining the means and standard deviations for all body positions displayed in the treatments for each focal animal, where each animal acted as their own controls and experimental units. The data was sufficiently normally distributed. Furthermore, to determine whether there were any significant differences between the means of displayed body positions during the treatments, a one-way analysis of variance (ANOVA) was then performed to determine any significant differences in the displayed body positions during the different treatments, with the combination of treatment and individual as factors. Pair-wise comparisons, Tukey’s HSD, was performed on the body positions where it was determined if there were significant differences between the treatments.

The tail-position “Straight up” was eliminated for the statistical analysis due to no occurrence.

4. Results

4.1 Individual body positions for individual pigs

The data consisted of 36 video recording, each two minutes long, for each treatment and pen. Each recording was analysed five times since each body part was analysed separately by the same observer. The different body positions were measured in frequency of displayed position. Each of these frequencies were then calculated to a percent score used for the analysing.

4.1.1 Ear positions

Ear positions from the 12 observed pigs during the three treatments were measured in percent scores of displayed positions (Figure 2).

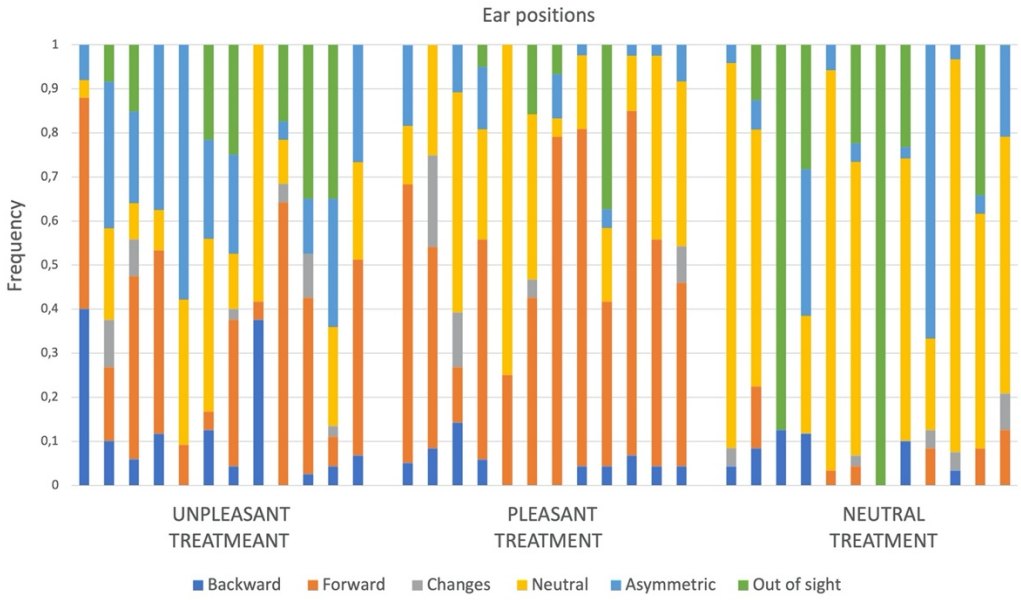

Figure 2. Displayed ear positions in frequency, percent of the time each position was displayed, where each chart represents one individual from each observed pen and how the ear position differs between treatments.

The percent scores for each position in each treatment were summarised in means and standard deviation (Table 3). The ear positions Forward was displayed in all three treatments, but most frequently in the Pleasant treatment.

Table 3. Table describing ear positions means and standard deviations (sd), compared between the separate treatments.

Body part	Position	Unpleasant mean±sd	Pleasant mean±sd	Neutral mean±sd
Ear	Backwards	0.113±0.135	0.047±0.039	0.041±0.050
	Forwards	0.295±0.204	0.503±0.210	0.042±0.052
	Changes	0.032±0.042	0.038±0.067	0.019±0.027
	Neutral	0.200±0.167	0.295±0.198	0.513±0.325
	Asymmetric	0.229±0.160	0.061±0.061	0.126±0.195

The ANOVA showed that there were no significant differences in the ear positions Backwards or Changes. The ear positions Forward ($p=<0.0001$), Neutral ($p=0.05$) and Asymmetric ($p=0.05$) all showed significant results that there were differences between the different treatments (Table 4). The pair-wise comparison for the Forward position showed that there were significant differences between all three treatments. The Neutral position showed significant between the Unpleasant treatment and Neutral treatment, where the Neutral position was more frequently shown in the Neutral treatment. The Asymmetric position showed significant differences between the Unpleasant treatment and Pleasant treatment, where it was displayed more in the Unpleasant treatment.

Table 4. Pair-wise comparison between the different treatments for displayed ear positions.

Body Part	Position	Treatments	p-value
Ear	Forward	Neutral - Pleasant	<0.0001
		Unpleasant - Pleasant	0.05
		Unpleasant - Neutral	0.05
	Neutral	Neutral – Pleasant	0.083
		Unpleasant – Pleasant	0.596
		Unpleasant - Neutral	0.05
	Asymmetric	Neutral – Pleasant	0.542
		Unpleasant – Pleasant	0.05
		Unpleasant - Neutral	0.228

4.1.2 Tail positions

Tail positions from the 12 observed pigs during the three treatments were measured in percent scores of displayed positions (Figure 3).

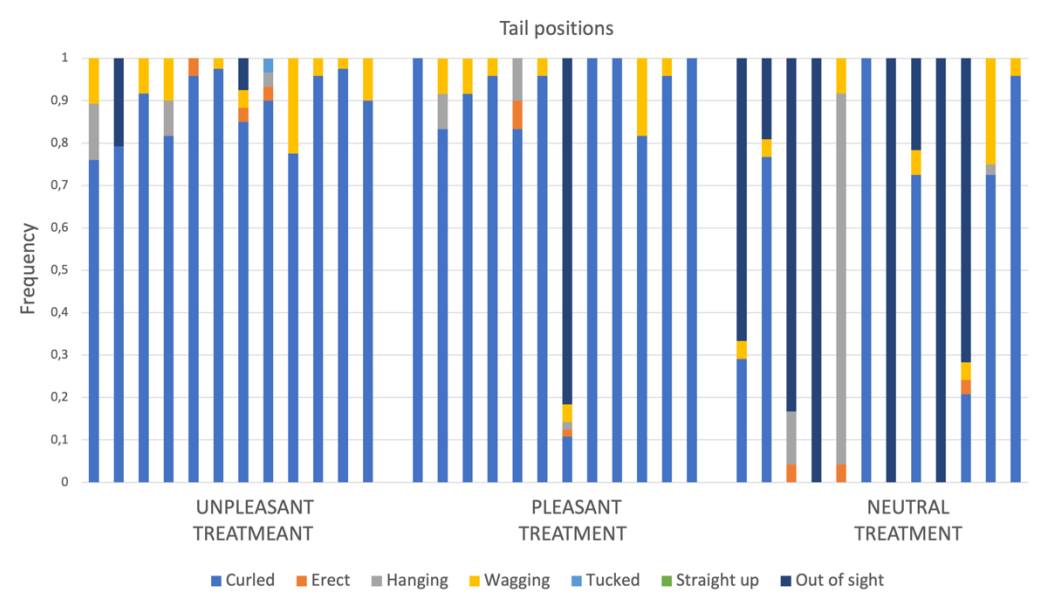

Figure 3. Displayed tail positions in frequency, percent of the time each position was displayed, where each chart represents one individual from each observed pen and how it differs between each treatment.

The percent scores for each position in each treatment were summarised in means and standard deviation (Table 5). Tail position Curled was the most displayed tail position through all the treatments, whereas Tucked was almost not displayed at all.

Table 5. Table describing tail positions means and standard deviations (sd), compared between the separate treatments.

Body part	**Position**	**Unpleasant mean±sd**	**Pleasant mean±sd**	**Neutral mean±sd**
Tail	Curled	0.881±0.080	0.865±0.248	0.389±0.411
	Erect	0.009±0.016	0.007±0.019	0.009±0.017
	Hanging	0.021±0.043	0.016±0.035	0.085±0.251
	Wagging	0.062±0.065	0.043±0.053	0.046±0.069
	Tucked	0.003±0.009	0.000±0.000	0.000±0.000

The ANOVA showed that there were no significant differences between the treatments for the tail positions Erect, Hanging, Wagging or Tucked. A significant result was found for the tail position Curled ($p=<0.0001$), meaning that there are differences between the treatments. The pair-wise comparison for the Curled position showed that the curled tail position was displayed significantly less in the Neutral treatment in comparison to the Pleasant and Unpleasant treatment. There was no significant difference between the Unpleasant and Pleasant treatment (Table 6).

Table 6. Pair-wise comparison between the different treatments for displayed tail positions.

Body Part	Position	Treatments	p-value
Tail	Curled	Neutral - Pleasant	0.001
		Unpleasant - Pleasant	0.988
		Unpleasant - Neutral	0.001

4.1.3 Neck

Neck positions from the 12 observed pigs during the three treatments were measured in frequency of displayed position (Figure 4).

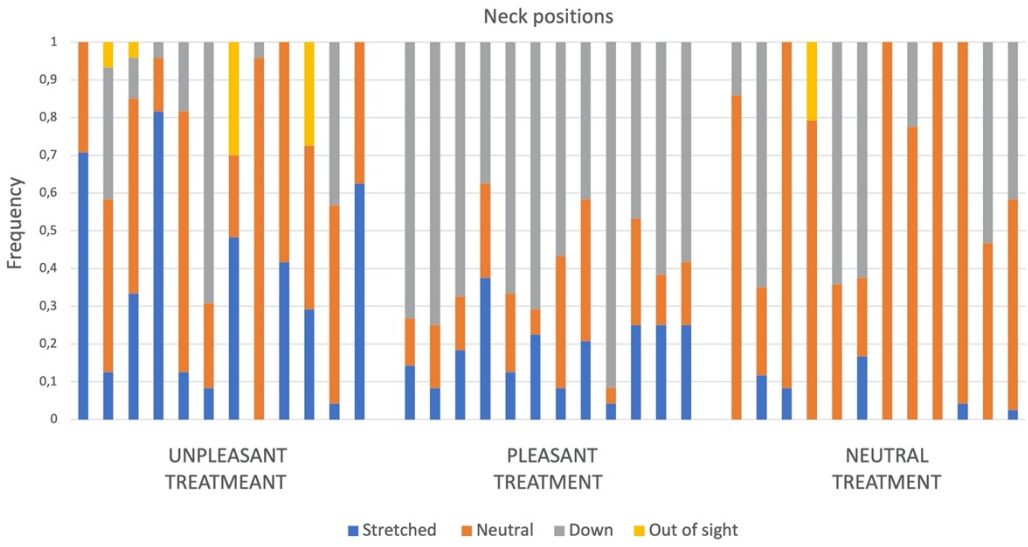

Figure 4. Displayed neck positions in frequency, percent of the time each position was displayed, where each chart represents one individual from each observed pen and how it differs between each treatment.

The frequencies for each position in each treatment were summarised in means and standard deviation (Table 7).

Table 7. Neck positions means and standard deviations (sd), compared between the separate treatments.

Body part	Position	Unpleasant mean±sd	Pleasant mean±sd	Neutral mean±sd
Neck	Stretched	0.337±0.275	0.184±0.094	0.036±0.056
	Neutral	0.451±0.228	0.192±0.104	0.677±0.298
	Down	0.154±0.224	0.623±0.153	0.270±0.284

The ANOVA showed that there were significant differences for all the different neck positions, Stretched (p=0.001), Neutral (p=<0.0001) and Down (p=<0.0001). Neck positioned Down was displayed more in the Pleasant treatment, whereas neck Stretched was displayed more in the Pleasant and Unpleasant treatments. The pair-wise comparison for the display of Stretched neck showed that there was a significant difference between the treatments Neutral and Pleasant (Table 8). There were significant differences between all three treatments for the display of Neutral neck position. The pair-wise comparison showed that there was a significant difference of neck Down being displayed in Unpleasant treatment and Pleasant treatment, where neck Down was displayed more in the Pleasant treatment. There was also a significant difference between the Unpleasant treatment and the Neutral Treatment.

Table 8. Pair-wise comparison between the different treatments for displayed neck positions

Body Part	Position	Treatments	p-value
Neck	Stretched	Neutral - Pleasant	0.001
		Unpleasant - Pleasant	0.087
		Unpleasant - Neutral	0.100
	Neutral	Neutral - Pleasant	0.05
		Unpleasant - Pleasant	0.05
		Unpleasant - Neutral	<0.0001
	Down	Neutral - Pleasant	0.432
		Unpleasant - Pleasant	<0.0001
		Unpleasant - Neutral	0.001

4.1.4 Head Positions

Head positions from the 12 observed pigs during the three treatments were measured in frequency of displayed position (Figure 5).

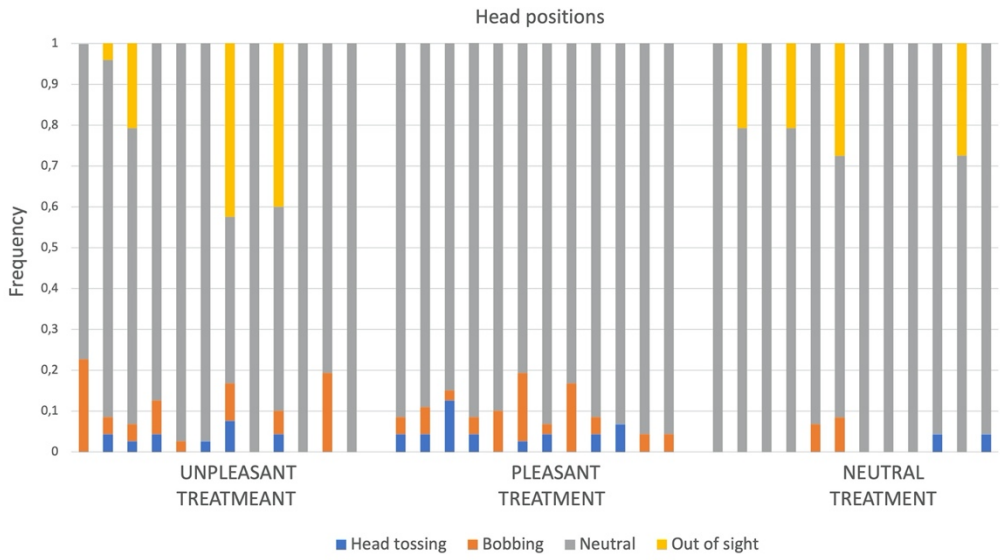

Figure 5. Displayed head positions in frequency, percent of the time each position was displayed, where each chart represents one individual from each observed pen and how it differs between each treatment.

The frequencies for each position in each treatment were summarised in means and standard deviation (Table 9).

Table 9. Head positions means and standard deviations (sd), compared between the separate treatments.

Body part	**Position/Behaviour**	**Unpleasant mean±sd**	**Pleasant mean±sd**	**Neutral mean±sd**
Head	Head tossing	0.021±0.025	0.035±0.036	0.007±0.016
	Bobbing	0.063±0.075	0.063±0.054	0.012±0.029
	Neutral	0.826±0.198	0.901±0.047	0.899±0.127

The ANOVA showed that there was a significant result for all the head position Head tossing (p=0.05), meaning that there are differences between the treatments and their display of Head tossing, where it was less displayed in the Neutral treatment. The head positions Bobbing and Neutral were not significant results between the treatments. The pair-wise comparison for the display of Head tossing showed that there was a significant difference between the treatments Unpleasant and Neutral (Table 10). There were no significant differences between the Pleasant treatment and the neutral or the Unpleasant treatment.

Table 10. Pair-wise comparison between the different treatments for displayed head positions

Body Part	**Position**	**Treatments**	**p-value**
Head	Head Tossing	Neutral - Pleasant	0.428
		Unpleasant - Pleasant	0.391

	Unpleasant - Neutral	0.05

4.1.5 Body overall positions

Body positions from the 12 observed pigs during the three treatments were measured in frequency of displayed position (Figure 6).

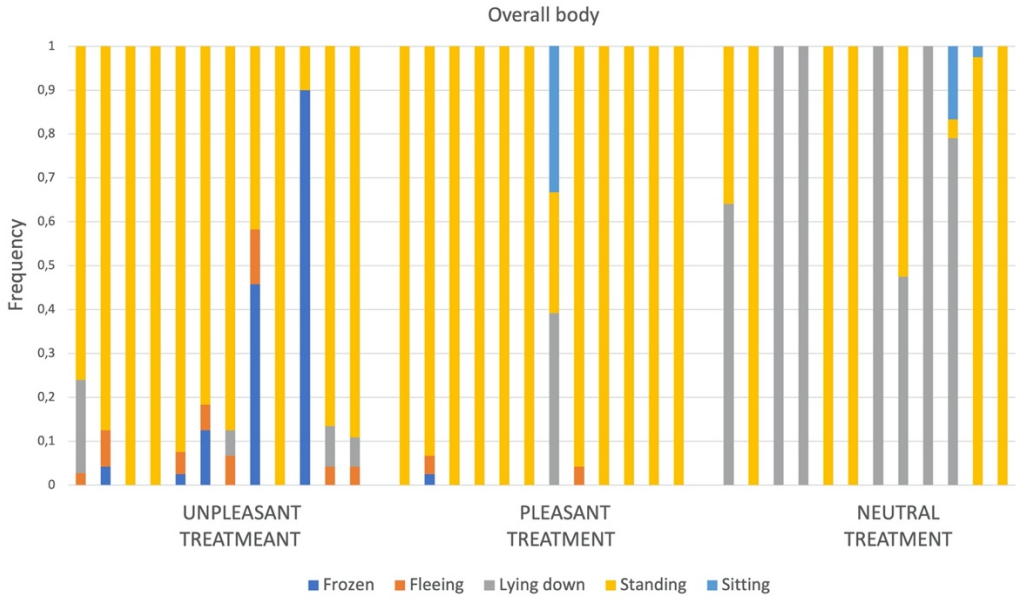

Figure 6. Displayed overall body positions in frequency, percent of the time each position was displayed, where each chart represents one individual from each observed pen and how it differs between each treatment.

The frequencies for each position in each treatment were summarised in means and standard deviation (Table 11).

Table 11. Body overall positions means and standard deviations (sd), compared between the separate treatments.

Body part	**Position/Behaviour**	**Unpleasant mean±sd**	**Pleasant mean±sd**	**Neutral mean±sd**
Body overall	Frozen	0.129±0.276	0.002±0.007	0.000±0.000
	Fleeing	0.041±0.039	0.007±0.016	0.000±0.000
	Lying down	0.035±0.065	0.032±0.113	0.492±0.462
	Standing	0.793±0.269	0.930±0.207	0.491±0.472
	Sitting	0.000±0.000	0.028±0.098	0.016±0.048

The ANOVA showed that there were significant differences in the treatments for the displays of Fleeing (p=0.001), Lying down (p=0.001) and Standing(p=0.05). No significant differences between the treatments for the displayed positions Sitting

or Frozen was found, however Frozen was a tendency and was mainly displayed in the Unpleasant treatment. The pair-wise comparison for Fleeing showed that there were significant differences between the Unpleasant treatment and Pleasant treatment (Table 12). The Lying down position showed significant differences between the Neutral treatment and Pleasant treatment. The same position also showed significant differences between the treatments Unpleasant and Neutral. The standing position showed significant difference between the Unpleasant treatment and Neutral treatment, but not with the Pleasant treatment.

Table 12. Pair-wise comparison between the different treatments for displayed Body overall positions

Body Part	Position	Treatments	p-value
Body overall	Fleeing	Unpleasant - Pleasant	0.05
	Lying down	Neutral - Pleasant	0.001
		Unpleasant - Pleasant	0.999
		Unpleasant – Neutral	0.001
	Standing	Neutral - Pleasant	0.085
		Unpleasant - Pleasant	0.584
		Unpleasant – Neutral	0.05

4.2 Body parts and body language assessment in instantaneous sampling

From the 12 focal animals, a total of 468 observations of 22 different Ear, Tail, Neck, Head and Body overall-combinations was collected. However, 153 observations of these were omitted since at least one body part was out of sight. The body part Head was also omitted since the only head position that was observed was neutral. This left 315 observations of 22 different Ear, Tail and Neck-combinations, whereas 18 of the combinations was displayed at least once

in the Unpleasant treatment (Figure 7). There were seven combinations that was only displayed in the Unpleasant treatment. The combination Asymmetric ears, Curled tail, neck Neutral and Standing (A, C, N, ST) was the most frequently displayed of those seven combinations.

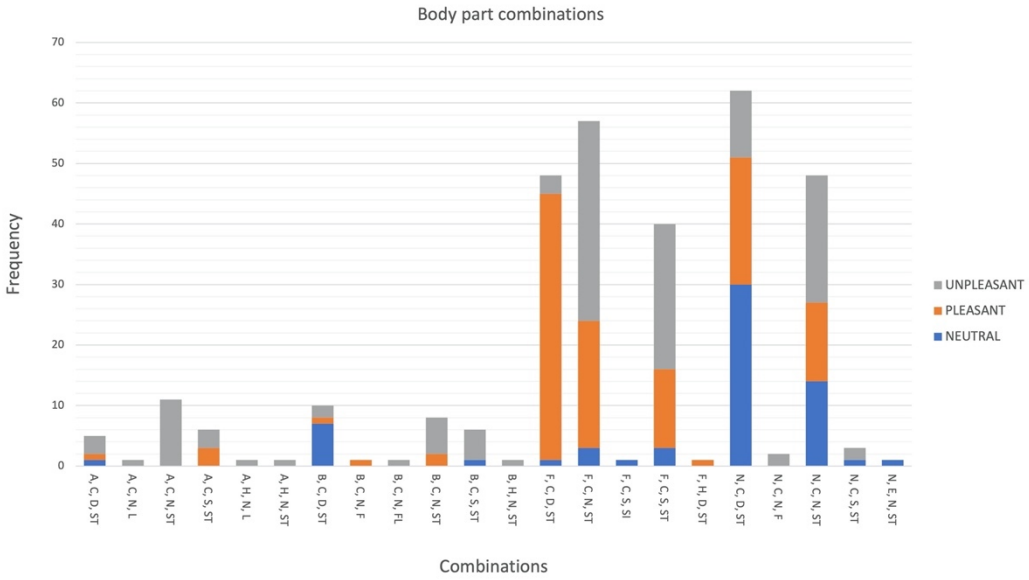

Figure 7. The frequency of displayed body position combinations. Each position is represented with the first letter of the position of each body part on the x-axis. The order of the body parts from up to down is Ears, Tail, Neck and Body overall. The letters representing ear positions are "A" for asymmetric, "B" for backward, "F" for forward and "N" for Neutral. The letters representing tail positions are "C" for curled tail, "H" for hanging and "E" for erect. The letters representing neck positions are "D" for down, "N" for neutral and "S" for stretched. The letters representing Body overall positions are "ST" for standing, "L" for Lying down, "F" for frozen, "Fl" for fleeing and "Si" for sitting. The y-axis represents the number of times a certain pattern was displayed.

From the 22 combinations, only five combinations that were more commonly displayed were analysed. The five combinations analysed were:

- Forward ears - Curled tail - neck Down - Standing (F, C, D, ST) (Figure 8)
- Forward ears - Curled tail - neck Neutral - Standing (F, C, N, ST) (Figure 9)
- Forward ears - Curled tail - neck Stretched - Standing (F, C, S, ST) (Figure 10)
- Neutral ears - Curled tail - neck Down - Standing (N, C, D, ST) (Figure 11)
- Neutral ears - Curled tail - neck Neutral - Standing (N, C, N, ST) (Figure 12)

The frequencies for each analysed body part combination in each treatment were summarised in means and standard deviation (Table 13). It showed that the most

displayed combination for the Pleasant treatment was “F, C, D, ST”, while “F, C, N, ST” and “F, C, S, ST” were numerically most displayed during the Unpleasant treatment.

Table 13. Body part combinations means and standard deviations (sd), compared between the separate treatments.

Body Part Combinations	Neutral mean±sd	Pleasant mean±sd	Unplesasant mean±sd
F, C, D, ST	0.083±0.288	3.667±1.922	0.25±0.452
F, C, N, ST	0.25±0.621	1.75±1.288	2.75±1.544
F, C, S, ST	0.25±0.621	1.083±0.900	2±1.279
N, C, D, ST	2.5±2.907	1.750±1.815	0.833±1.749
N, C, N, ST	1.166±1.466	1.083±1.729	1.916±2.108

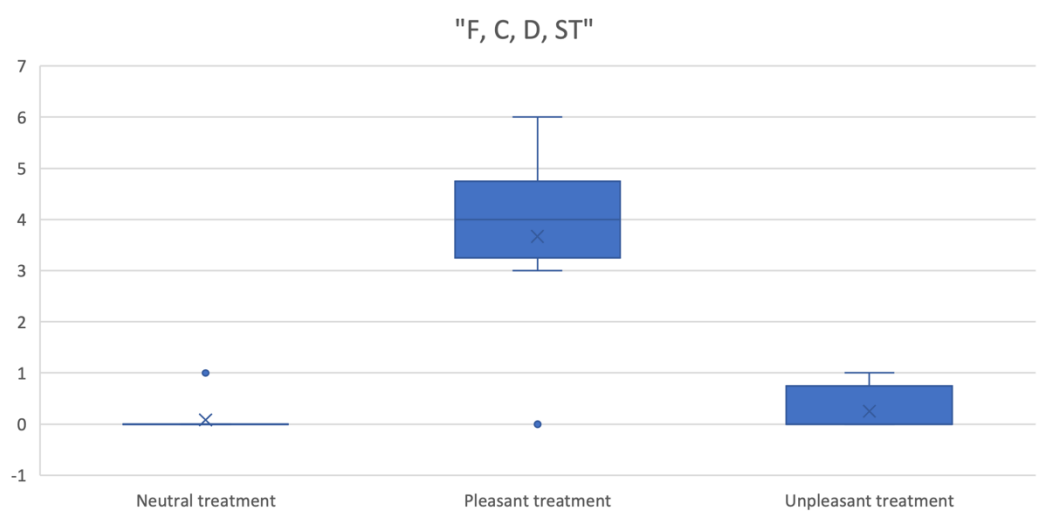

Figure 8. Distribution of displayed body position combination ears Forward, Curled tail, neck Down and Standing (F, C, D, ST) in frequency for the Neutral treatment, Pleasant treatment and Unpleasant treatment. The Y-axis represents the number of times the combination was displayed.

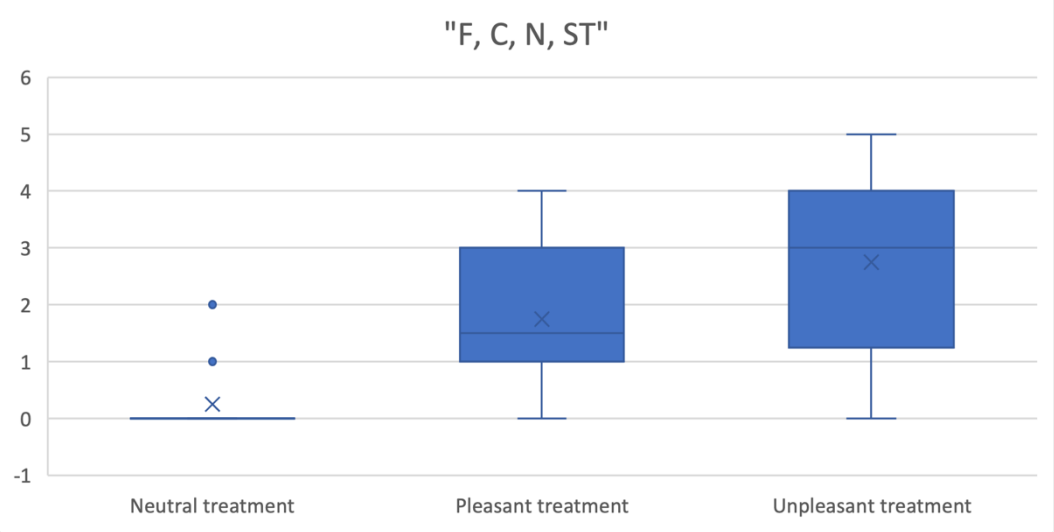

Figure 9. Distribution of displayed body position combination ears Forward, Curled tail, neck Neutral and Standing (F, C, N, ST) in frequency for the Neutral treatment, Pleasant treatment and Unpleasant treatment. The Y-axis represents the number of times the combination was displayed.

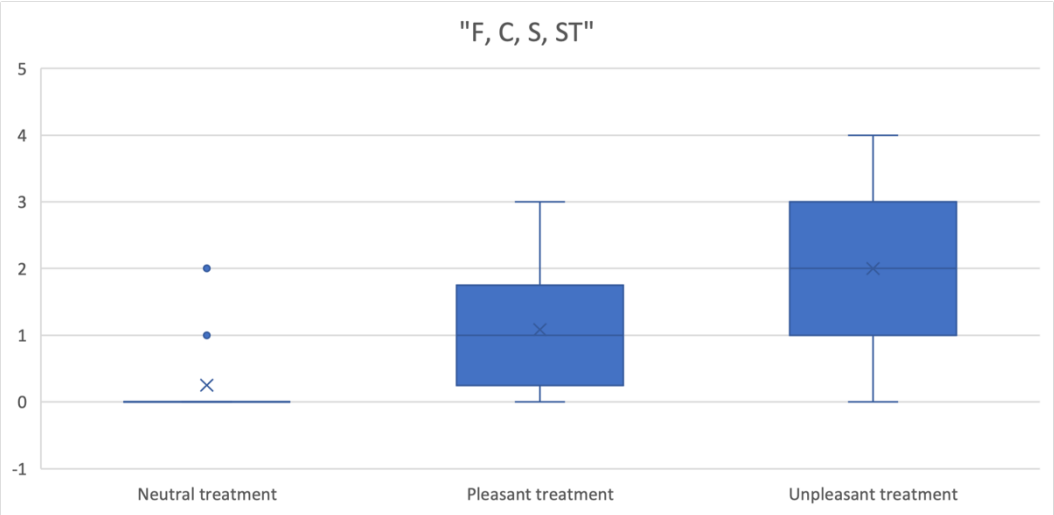

Figure 10. Distribution of displayed body position combination ears Forward, Curled tail, neck Stretched and Standing (F, C, S, ST) in frequency for the Neutral treatment, Pleasant treatment and Unpleasant treatment. The Y-axis represents the number of times the combination was displayed.

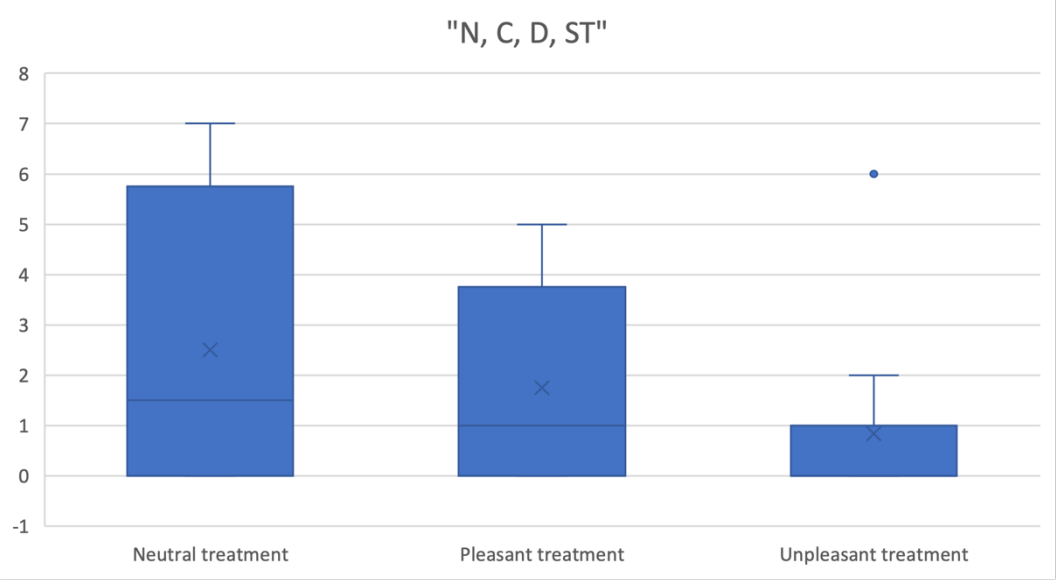

Figure 11. Distribution of displayed body position combination ears Neutral, Curled tail, neck Down and Standing (N, C, D, ST) in frequency for the Neutral treatment, Pleasant treatment and Unpleasant treatment. The Y-axis represents the number of times the combination was displayed.

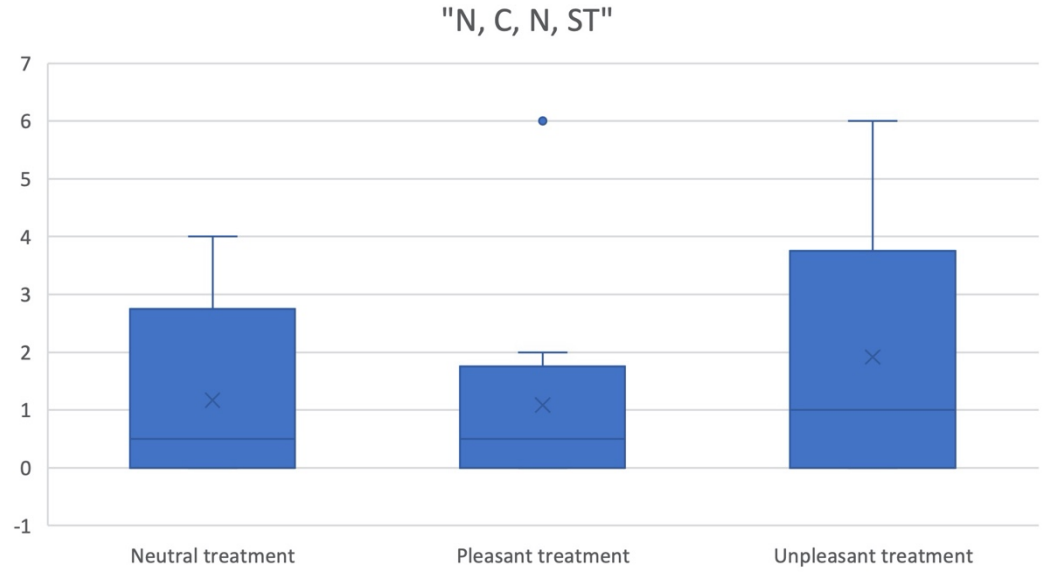

Figure 12. Distribution of displayed body position combination ears Neutral, Curled tail, neck Neutral and Standing (N, C, N, ST) in frequency for the Neutral treatment, Pleasant treatment and Unpleasant treatment. The Y-axis represents the number of times the combination was displayed.

The ANOVA showed that there were no significant differences in the treatments for the body position combinations “N, C, D, ST” or “N, C, N, ST”. Significant differences between the treatments were however found in the body position combinations “F, C, D, ST” (p=<0.0001), “F, C, N, ST” (p=<0.0001) and “F, C, S, ST” (p=0.001). The pair-wise comparison showed that there were significant differences between the display of body part combination “F, C, D, ST” in the

Neutral treatment and the Pleasant treatment, as well as the Unpleasant treatment and the Pleasant treatment (Table 13). For the combination "F, C, N, ST" displayed, it showed significant differences between the treatments Neutral and Pleasant, and between Unpleasant and Neutral. The pair-wise comparison showed that there was a significant difference between the display of body position combination "F, C, S, ST" in the Unpleasant and the Neutral treatments.

Table 14. Pair-wise comparison between the different treatments for displayed body position combinations.

Body Position Combination	**Treatments**	**p-value**
Ears Forward, Curled tail, neck Down, Standing	Neutral - Pleasant	<0.0001
	Unpleasant - Neutral	0.933
	Unpleasant – Pleasant	<0.0001
Ears Forward, Curled tail, neck Neutral, Standing	Neutral - Pleasant	0.05
	Unpleasant - Neutral	<0.0001
	Unpleasant – Pleasant	0.124
Ears Forward, Curled tail, neck Stretched, Standing	Neutral - Pleasant	0.105
	Unpleasant - Neutral	0.001
	Unpleasant – Pleasant	0.068

5. Discussion

This study aimed to investigate whether different body positions could indicate what emotions pigs experiences during different situations. The formed questions were to clarify this issue and focused on whether different treatments would result in different displayed body positions and if certain body positions would show simultaneously during different treatments.

5.1 Displayed body positions

5.1.1 Ear positions

The results indicated significant differences in ear positions displayed in different treatments.

The treatments affected the ear position forward. Particularly in the pleasant treatment the pigs had their ears directed forward. But also in the unpleasant treatment the ears were directed forward to a larger extent than in the neutral treatment. Previous studies have indicated that ears directed forward are signs of positive emotions or emotional states (Stomp *et al.* 2018; Czycholl *et al.* 2020). In contrast, ears directed forward could also imply vigilance, fear or aggression (Camerlink *et al*. 2018). Ears directed forward are, therefore, more complex than just indicating a single emotional expression and could signify several different emotions, depending on the situation or treatment. On one hand, it could be assumed that the forward position indicates positive emotions in the Pleasant treatment. On the other hand, it cannot be excluded that the pigs might have eventually felt positive emotions during the Unpleasant treatment. Some of the pigs probably found the umbrella an enjoyable stimulus since most of them often bit and investigated the umbrella, leading to the first umbrella being destroyed and replaced.

Both the positions “Backward” and “Changes” were displayed during all three treatments, but no significant differences between the treatments could be found. Ears held backwards have previously been indicators of pain or that the animal interprets a situation as Unpleasant or uncontrollable (Boissy *et al.* 2011; Göransson, 2016). Similarly, increased movement of ears translates as a decrease in positive emotions (Marcet Ruis *et al*. 2018). Since some frequency of both

Changes and Backwards occurred in all three treatments, it is difficult to conclude what it indicates when these ear positions are displayed. Ears held Backwards could be a way to display cautiousness since the treatments include objects the pigs usually do not have in their everyday lives. However, it could also imply that a situation is Unpleasant and derives from something that is not the treatment, such as a strange sound or a pen mate. What Changes imply is uncertain, considering it could be a response to something happening in the stable.

Asymmetrical ears were displayed during all the treatments but was significantly more displayed in the Unpleasant and the Neutral treatment, compared to the Pleasant treatment. Previous studies have concluded that asymmetrical ears can be displayed when the animal is in pain (Göransson, 2016), when being exposed to something unexpected (Boissy *et al.* 2018) or in what the animal perceives as a negative situation (Reefman *et al*. 2009). Therefore, it could be assumed that when ears are displayed Asymmetrically, they most likely perceive their situation as somewhat negative or unexpected. Due to the diversity of displayed ear positions in different treatments, it seems like ear positions could have significance in pigs' ways of displaying perceived emotions.

5.1.2 Tail positions

The results regarding tail positions indicated that there were significant differences between the treatments for the curled tail position. The curled tail was displayed during all three treatments but significantly less during the neutral treatment compared to both the Pleasant treatment and the Unpleasant treatment. This could be explained since the tail was frequently out of sight in some of the observations, and thus there were missing observations. Previous studies have had conflicting conclusions regarding what a curled tail conveys. Krugmann *et al*. (2020) imply that a curled tail indicates a positive affective state, whereas Reimert *et al.* (2012) suggest that the curled tail position is the neutral state for the tail for growing pigs. The displayed curled tail was displayed in similar frequencies in both the negative and the positive treatment. It is possible that the Pleasant and Unpleasant treatments could be perceived as positive situations for the pigs and that the curled tail is an indicator of positive emotions. However, my results seem to be in line with Reimert *et al.* (2012), where the curled tail could suggest that it is the neutral state for the tail, at least in healthy pigs.

None of the Erect, Hanging, Wagging or Tucked tail positions were significantly affected by the treatments. The tucked tail position was only displayed once by one individual in the Unpleasant treatment, whereas the other positions were at least displayed once in each treatment. Previous studies have suggested that hanging and tucked tails have been indicators of tail-biting (Ursinus *et al.* 2014; Lahrmann *et al.* 2018). However, hanging or lowered tails could also be indicators of negative

affective emotions (Kleinbeck & McGlone, 1993; Reimert *et al*. 2012; Krugmann *et al.* 2020). Since there were no significant differences between any of the displayed tail positions in the different treatments, it could be assumed that none of the treatments was remarkably distressing and that they were mainly surprised by the treatments. On the other hand, the interpretation of tail movement has previously had conflicting results, whether it is a sign of positive emotions (Reimert *et al*. 2012) or that it might be a sign of decreased positive welfare (Marcet Rius *et al.* 2018). This study is consistent with previous findings regarding the meaning of tail movement, being that it is unclear what it means. An erect tail position, which was displayed a few times in each treatment, has previously been described by Kleinbeck & McGlone (1993), who could observe it during several situations but could not explain what it could mean.

The results of this study could indicate that different tail positions occur during different situations. However, there is a need to investigate tail positions further and understand if tail positions are connected to different emotional states.

5.1.3 Neck positions

The results of the different neck positions showed that there were differences between the display of the positions in the different treatments. The neck directed downwards also were significantly affected by the treatments and was mainly displayed in the Pleasant treatment. Neck bent downwards could be explained by the sugar cubes provided were scattered over the floor. Hence, that the neck is directed downwards could, in this study, be assumed to be because of exploratory behaviour.

Neck stretched was displayed in all three treatments but were significantly affected by the treatments Neutral and Pleasant, meaning that stretched neck showed less during the Neutral treatment in comparison to the Pleasant treatment. There were however no significant differences between the Neutral and the Unpleasant treatments, which could be explained due to the big standard deviation between the individual pigs for display of stretched neck in the Unpleasant treatment, since the individual pigs reacted differently to the umbrella. Studies regarding pigs' neck positions and how they connect to emotional states are, to this author's knowledge, non-existing. Cows have previously shown positive emotional states when stretching their necks, while horses do it when alarmed (Corujo *et al.* 2021). The stretched neck in this study was displayed during all three treatments, but what it means is still not entirely clear. It could be that they were alarmed by a new stimulus, such as the treatments or something occurring in the stable. However, it could also be curiosity due to the curious nature of pigs, or a combination of both. However, drawing a specific conclusion about the emotional connection to the posture is complex and would benefit from further studying.

5.1.4 Head positions

The results indicated a significant difference between the treatments Unpleasant and Neutral for Head tossing. Head tossing was observed during the pilot study and therefore included in the ethogram. Head tossing was displayed in all three treatments and was significantly affected by treatment. Head tossing was more frequently displayed in both the Unpleasant and Pleasant treatment than the Neutral treatment. Donaldson *et al.* (2002) have previously described head tossing as play behaviour. Play behaviour could be assumed to affect an animal's emotional state positively. One could then speculate whether head tossing then could be an indication of positive emotions. Head tossing was displayed during both the Pleasant and Unpleasant treatment, and as previously discussed, some pigs seem to find the umbrella interesting, investigating and eventually destroying it. Head tossing could therefore be an indicator of positive emotions, but further studies are required to further conclude it.

There were no significant results for bobbing, and it was displayed during all three treatments. It is, therefore, challenging to interpret what the display of bobbing indicates in pigs' emotional states and further studies might interpret what the behaviour indicates.

5.1.5 Body overall positions

The results indicated significant differences in the overall body positions displayed depending on which treatment to which they were exposed.

Fleeing was not displayed during the Neutral treatment. However, it was significantly affected by treatment and was in comparison to the Pleasant treatment displayed more frequently during the Unpleasant treatment. Fleeing mainly occurred during the beginning of the treatments, indicating surprise and the treatments perceived as fearsome. Fleeing from an object could suggest that the animal reckons the situation as stressful since they escape from it. This indicates that feeling is a negative emotional state.

Sitting and Frozen were not affected by treatment. Both lying down and standing were displayed during all three treatments but were significantly affected by treatment. Lying down was significantly more displayed during the Neutral treatment, while standing was significantly more displayed during the Unpleasant treatment in comparison to the Neutral treatment. This could probably be explained by the fact that nothing out of the ordinary happened during the neutral treatment. Therefore, the pigs could rest. Whereas in the other two treatments standing up was performed for the ability to move around.

5.1.6 Body language

Krugmann *et al.* (2020) found that ear postures were more complicated to interpret in correlation to tail postures. Some body postures are ambiguous, whether it be because it is not yet decided what the position indicates or that it might depend on the individual situation what a position means. Therefore, to interpret what different body part positions tells of pigs' emotions, mainly looking at one body part at a time is not always reliable. For that reason, studying more than one body part when trying to determine what emotion the pigs might experience is a reasonable concept if one wants to determine what emotions the pigs are experiencing.

The results showed significant differences between the displayed body position combinations depending on treatment to which the pigs were exposed. However, the combinations that were affected by treatment had common combinations of certain displayed positions, which was ears Forward, Curled tail and Standing. The three neck positions were the differing body part in these combinations. Whether the neck position is crucial or unimportant for these combinations and what emotions they convey, is hard to tell. Further research is required for the ability to draw conclusions.

The combination ears Forward, Curled tail, neck Down and Standing ("F, C, D, ST") were significantly affected by treatment, showing that this pattern was mainly displayed during the Pleasant treatment. This could probably be explained since the treatment included sugar cubes being spread over the floor, and to reach the sugar, the standing (ST) pigs needed to angle their neck downwards (D), while the ears directed forward (F) and curled tail (C), as previously discussed, could imply positive emotions. This combination might therefore indicate some sort of positive emotions.

The combination ears Forward, Curled tail, neck Neutral and Standing ("F, C, N, ST") were significantly affected by treatment and the combination were less often displayed during the Neutral treatment in comparison to the Pleasant and the Unpleasant treatments. As previously discussed, ears directed forward (F) and curled tail (C) could indicate of positive emotions. However, ears directed forward could also indicate that the pigs are alerted. Why this combination occurred more during the Pleasant and the Unpleasant treatment could be due to something out of the ordinary was happening during these treatments, since it was unexpected. Furthermore, it could also indicate positive emotions if the umbrella from the Unpleasant treatment was perceived as something positive or exciting happening.

The combination ears Forward, Curled tail, neck Stretched and Standing ("F, C, S, ST") showed significant differences between the treatments Unpleasant and Neutral, where it was displayed more in the Unpleasant treatment, but no significant differences between the Unpleasant or neutral and Pleasant treatment were found. Regarding the fact that that the combination was most frequent in the Unpleasant treatment, the combination could imply the pigs being vigilance of their new

situation. Although, as already discussed, the combination could also suggest that positive emotions could be involved, since there were no significant differences between the Unpleasant and the Pleasant treatments. Further studies are required to draw a definite conclusion regarding this combination.

Not all 22 displayed body position combinations were analysed using the ANOVA. A total of 17 observations was not analysed, due to lack of time. It would have been interesting to analyse the other combinations if there were any interesting results to be found. However, 18 of the combinations were interestingly displayed at least once during the Unpleasant treatment, where seven of them were solely displayed in the Unpleasant treatment. Some of those combinations included body postures, such as ears asymmetric and fleeing, which previously suggested to imply negative emotions. On the other hand, body position combinations that would imply positive emotions, such as ears Forward, Curled tail, neck Stretched and Standing ("F, C, N, ST"), were also displayed during the Unpleasant treatment. Likewise, it has previously been discussed that the Unpleasant treatment might not have been experienced as an adverse treatment by all pigs since some even seemed to enjoy interacting with the umbrella.

5.2 Method and execution

Several factors might have affected the results. On the third day of observations, the pigs destroyed the umbrella, which was the first pen to receive that treatment that day. Therefore, a new umbrella had to be purchased and the rest of the observations were carried out the following day. The pigs that destroyed the umbrella did not receive a new treatment since the umbrella was no longer a novel object. This led to a shorter observation interval compared to the other pens, which might have influenced the results. However, since the umbrella was destroyed, it could be assumed that the pigs of that specific pen probably found it to be an enjoyable treatment, since they interacted with the umbrella intensely.

In the beginning of the development of the study, I wanted to investigate different emotional expressions and states within pigs. To achieve that, the pigs needed to be exposed to different situations. Thus, the three different treatments were decided to be suitable to accomplish the aim. For the Unpleasant treatment it was decided that a novel object would be suitable, since novel objects could be perceived as something scary or negative. Therefore, after being tested in a pilot study, it was decided that the umbrella was to be used. The Pleasant treatment was decided quickly to involve something edible to the pigs, since it is often used in other similar studies, where the edible objects are often perceived as something positive for the animals (Held *et al*. 2005; Reimert *et al*. 2013). The Neutral treatment was decided to act as a control for the two other treatments, since nothing out of the ordinary would occur during that treatment. However, in the aftermath of

execution, the three decided treatments might not have been the best choices, since it cannot be ensured that all pigs interacted with the Unpleasant or Pleasant treatments. On the other hand, it was the pigs themselves that decided if they wanted to interact with the treatments or not. Even though it can not be read from the results, most pigs at least paid attention to the treatments.

All the pens got to experience each treatment one time, where it circulated which treatment they were to experience on what day. This was a way to reset the pigs each day, making them their own controls, where they would not know what to expect. However, there is a risk that some of the pens was habituated to some of the treatments ahead of time since the neighbouring pens would experience them beforehand. This especially applies to the Unpleasant treatment, since some of the pigs even seemed curious of the umbrella. Even though the observer tried to obstruct the other pens from seeing the folded-up umbrella, the other pens could have sighted it beforehand. This situation could hardly have been avoided since umbrellas are often sizable objects. In the early process of designing the study, other situations were considered as the Unpleasant treatments. One of them was to separate the observed pig from its pen mates and isolate it since it deems that social contact is something pigs value (Hemsworth *et al*. 2011). The other option was to separate one of the pigs, but it would also be fixated. Both options were ultimately decided against these situations since the two other treatments would be performed in their groups, which probably would affect the result and make comparisons more difficult. Therefore, the Unpleasant treatment was decided to be performed in group. It was decided that the treatment would be the unfolding of an umbrella, since the first initial reactions to the umbrella in the pilot study were mainly perceived by the observer as negative. The length of all the observations was decided in accordance to the Unpleasant treatment. This was due to the interest of the umbrella grew over time and in an attempt to keep it from breaking it was decided to let the observations be two minutes.

The selection of observed pigs was randomized, meaning that it was the same twelve pigs that was observed during every observation, acting as their own controls. Some individuals were less active than other pigs which might have affected the results. Likewise, the pigs also had different physical attributes, where some individual body parts were easier to interpret than others. The observations could also have been influenced by the human factor, some body parts were from the observer's point of view more difficult to interpret, ear positions being especially difficult to distinguish from certain angles or if the individual pig had slightly hanging ears. This could have been avoided using an intra/inter reliability test, but due to lack of time it was not done. While discussing the human factor, the observer could have executed the treatments differently among the pens, even though I had trained beforehand on how to do it similarly for each pen, which might

have affected the results. This was on the other hand was controlled for this since it was a cross-study and the treatments differ between the pens in the stable.

The fact that the pigs were of different breeds might have affected the results and how they interacted with the Pleasant and Unpleasant treatment. This factor was however not included in the model for the analysis of the observations. Mainly since there were only one pen consisting of pure-bred Yorkshire, while the other pens consisted of cross-bred breeds. However, for this study, which breed the pigs belonged to was not relevant. But, for future studies, comparisons between different breeds and if there are differences between them would be interesting and are therefore suggested by this author. Group as a factor was not included in the model either, mainly since there was only one pig observed in each pen, therefore that single pig was the only representation of that pen. However, if several pigs from the same pens had been observed, it would have been relevant to include "Group" as a factor in the model.

A disadvantage of the study is that there were not many animals observed for this study. Out of 90 pigs, only 12 were observed for the three treatments. This was due to time limitations. Observing more animals often does provide a more credible result (Fitts, 2011). Had there been more time, more pigs could have been studied, which would have led to more data being available, which would have given more reliable results, but also other opportunities would have opened to analyse. As an example, comparisons not only between pens but also internally in each pen could have been done.

For the observations, two GoPro®-cameras were used. This was a strength since it increased the possibility of capturing most of the pen from the observer's position. However, though both the cameras captured most of the body positions performed by the pigs, not everything was captured. In the neutral treatment, there was sometimes restricted sight of body parts. This was mainly pigs laying down or if another pig obstructed the sight of the observed pigs, which was to be reckoned with. However, during the negative treatment, the umbrella mainly restricted the sight of ears, head, and neck positions. One solution could have been positioning one of the cameras on the other side of the pen, opposite the observer, using the tripod. Then, the camera might have captured some of the slatted floor areas where the pigs sometimes hid if this had been done. The separating wall in the slatted floor area sometimes also made it more difficult or obstructed the sight of the pigs.

Some changes could have been made regarding the ethogram and the chosen positions or behaviours. For example, the tail position "Straight Up" did not occur a single time during all observations and could have been excluded. While the behaviour of fleeing did occur, it could instead have been modified to "Avoidance". Fleeing has short duration, whereas avoidance could continue for a more extended period. It could also have reported how quickly they started investigating or interacting with the sugar or the umbrella. Maybe some conclusions could have

been drawn on how they possibly perceived the treatments. From this study, with observations in accordance with the ethogram, it is not possible to see which pens interacted with the umbrella and which did not. It did, however, seem to be a difference between the pigs. Some pigs were bolder in interacting with the umbrella in contrast to the pigs who never even closed into the object. In relation to this, it was shown in Reimert *et al*. (2017) that emotions one pig experiences might transfer to its pen mates. Meaning, that for this study, if one pig perceives the umbrella as something negative, it's negative feelings could be conveyed to its pen mates. Reimert *et al*. (2017) could not in their study prove whether positive emotions was conveyed or not. It is not impossible that one pigs curiosity might transfer to the other pigs as well. To further establish this, more studies on the subject is a necessity.

5.3 Social, sustainability and ethical aspects

From a social aspect, this subject could make animal welfare topics more applicable for people not in direct contact with pigs. Knight & Barnett (2015) performed a qualitative study of people's attitudes towards how animals are used. It was found that there seemed to be a lack of knowledge on how animals are used, for example, in food production. Whether people are urban or rural citizens seems to affect their attitudes toward animal use (Kendall *et al.* 2006). If this type of basic research regarding pig's body language and the possible emotions behind them could be distributed to those people, some of the knowledge gaps would lessen. Making people more aware and knowledgeable about topics concerning animal welfare would probably make people more engaged in the issues and choosing animal friendlier options.

Regarding the topic from a sustainability aspect, it could be relevant to discuss keeping healthy animals and its importance to understand them to keep them healthy. Stress is one factor that could arise due to different situations and might affect the animals negatively. Previous studies on pigs have indicated that stress might negatively affect their immune systems (Bacou *et al*. 2017; Schalk *et al.* 2018). Using body language as a tool to further understand what emotions the animal experiences and, from that, conclude whether the animal's welfare is compromised or not. From this, one would be aware of when the animals instead experience positive welfare and could strive to promote it further.

From an ethical point of view, regarding pigs' body language and its connection to emotions would be applicable to discuss whether it is morally justifiable to keep animals, or in this case, pigs, we do not fully understand. In fairness, a complete understanding of animals is something humans will never accomplish. However, working towards interpreting and somewhat understanding the pigs' body language would be a step in the right direction and make it somehow justifiable.

6. Conclusion

It can be assumed that certain behaviours and body language can indicate pigs' emotional state. Specific body postures and combinations of body postures were more frequently displayed during specific treatments than others. From those results, it could be concluded that body language is complex to interpret, since some body postures are ambiguous. To therefore observe mainly one body posture to determine emotional state is not always reliable. Still, there is uncertainty regarding some behaviours and body postures to what extent they are affected by emotional states or not. As an example, ears directed forward could indicate positive emotions, but could also imply fear or vigilance. Continued investigations are necessary to further establish and understand the connection between pigs' body language and emotional state. Through understanding of pig's body language and emotional states, ensuring pigs' welfare would be significantly simplified.

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Popular science summary

Animals' behaviours can reflect the emotional states they're experiencing. The definition of Emotions is a response that happens internally to a stimulus. The response could be subjective, physiological, neural or cognitive. It is known that animals welfare could be affected by their emotions. From an ethical point of view, the animals humans keep must be given such good welfare and life as possible. It, therefore, seems urgent to try to understand our animals and their feelings. There has been an increased interest in how animals' body language might convey information about their emotions.

There have been some studies on pigs and their body language. For example, different ears and tail positions have previously been studied and how the displayed body postures might convey different emotions. There have also been some studies where they've tried to find correlations between other displayed body parts. However, most of these studies have often focused on studying negative emotions instead of positive emotions.

Using three different treatments, labelled as Neutral, Pleasant and Unpleasant, this study aimed to investigate whether the body language of pigs changes depending on what type of treatment they're exposed to. It was also aimed to examine if the different body positions can imply what emotions the pigs might feel during that treatment.

A total of 90 pigs, who were 14 weeks of age, were exposed to the three treatments in a cross-over design. A cross-over study is a study that includes at least two different treatments, where all subjects of the study will receive all treatments but in differing orders. All subjects will, in the beginning, randomly be divided into groups, where the amount of treatment will decide the number of groups. If there are three treatments, as in this case, there will be three different groups.

The Pleasant treatment provided the pigs with sugar cubes, the Unpleasant treatment presented an up folded umbrella, and in the Neutral treatment, the pigs were undisturbed in their pens without added stimulus. The treatments were recorded with GoPro®-cameras to be observed later with the help of an ethogram. The observer observed the following body parts and their positions; "Ears", "Tail", "Neck", "Head" and "Body Overall". The recording method used to obtain data for each displayed position during the different treatments was continuous recording and observing a focal animal, where each observation lasted 120 seconds. The

observer observed the randomly selected focal animals during all three treatments. All body parts positions were recorded as one combination every ten seconds. The first observation started at 0 seconds and continued up until 120 seconds.

The results showed that there were differences between the displayed body positions and body part combinations and in which treatments they occurred. For example, ears held asymmetrical, which is that one ear directed forward and the other backwards, was more displayed in the Unpleasant treatment than the Pleasant treatment. The main conclusion was that body language is complex from the varying results. It's not always reliable to mainly observe one body posture to determine the emotional state since some body positions could imply differing experienced emotions. Continued investigations are necessary to further understand the connection between pigs' body language and their emotional states. Through this, ensuring pigs' well-being would be simplified.

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