A comparison of transporters' paddle use when unloading pigs at slaughter

En jämförelse av transportörers paddelanvändning vid avlastning av gris på slakteri

Maria Bornhede

Skara 2014

Master in Animal Science

Foto: Bo Algers

Studentarbete **Nr. 527**
Sveriges lantbruksuniversitet
Institutionen för husdjurens miljö och hälsa

Student report ***No. 527***
Swedish University of Agricultural Sciences
Department of Animal Environment and Health

ISSN 1652-280X

A comparison of transporters' paddle use when unloading pigs at slaughter

En jämförelse av transportörers paddelanvändning vid avlastning av gris på slakteri

Maria Bornhede

Studentarbete 527, Skara 2014

Nivå A2E (tidigare avancerad nivå E), 30 högskolepoäng, Master i husdjursvetenskap, Examensarbete i husdjursvetenskap EX0566

Handledare: Maria Andersson, HMH, SLU i Skara, Box 234, 53223 Skara
Examinator: Jenny Yngvesson, SLU i Skara, Box 234, 53223 Skara
Nyckelord: pigs, moving, paddle, welfare

Serie: Studentarbete/Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, nr. 527, ISSN 1652-280X

Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens miljö och hälsa
Avdelningen för etologi och djurskydd
Box 234, 532 23 SKARA
E-post: hmh@slu.se, **Hemsida:** www.slu.se/husdjurmiljohalsa

Abstract

Today, pigs are moved on farm, between farms, between countries and to abattoirs. This movement of live pigs requires handling practices that are designed for the purpose. The objective of this study was to research the use of paddle in moving pigs, to investigate if there were different methods of paddle practice, explore the time efficiency of different kinds of paddle use and if there were any time variations in methods that varied in intensity of touch. This study was done on two Swedish abattoirs for a total of five weeks. A total of 22 transporters working at two different abattoirs where studied during unloading of pigs at the abattoirs. It was registered how the staff used the paddle, the size of each compartment in the truck and the time it took to move pigs out of each compartment. The total number of touches to the pigs, other use of paddle and the force with which these touches were directed was noted. There were differences among staff on time to move pigs and the methods used for moving. Staff differed in frequency of touches to animals, the proportion of paddle use that ended in physical contact with the pigs and the force of touches to pigs. There was a trend towards touches of less force to be more time efficient. The number of touches did increase with time of moving but the frequency did not generally increase with time, suggesting that an increased frequency of touch will not increase efficiency of moving pigs. Transporters were scored for paddle touch intensity and the time to move pigs was compared. There was a tendency towards less intense methods to be more time efficient than more intense methods of moving pigs.

Sammanfattning

I dagens samhälle flyttas grisar på gårdar, mellan gårdar, mellan länder och till slakterier. Denna förflyttning av grisar kräver hanteringsmetoder som är anpassade för uppgiften. Syftet med denna studie var att inventera paddelanvändning vid drivning av gris, att undersöka om paddeln användes på olika sätt av olika transportörer, om vissa metoder av paddelanvändning var mer effektiva än andra och om mindre intensiva metoder av drivning var mer effektiva än mer intensiva metoder. Studien genomfördes på två svenska slakterier under totalt fem veckor. Sammanlagt studerades 22 transportörer på dessa två slakterier. Hur transportörerna använde paddeln, storleken på varje fack i lastbilen och tiden det tog att driva grisar ut ur facket registrerades. Även det totala antalet gånger transportören nuddade grisen med paddel, totala antalet av annan typ av paddelanvändning och kraften med vilken transportörerna nuddade grisarna med paddel registrerades. Transportörerna använde olika metoder för att driva djuren och det tog olika lång tid för transportörer att driva grisar. Olika transportörer använde olika hög frekvens när de nuddade grisar med paddel vid drivning, av den totala paddelanvändningen använde de olika stor andel för direkt beröring av gris och de använde även olika stor kraft när de nuddade grisar med paddel. Det fanns en trend mot att mjuk beröringar av gris med paddel var mer tidseffektivt än hårdare beröring. Frekvensen av beröring (antal beröringar per sekund) ökade generellt inte med tid, vilket tyder på att en ökad frekvens av att nudda gris med paddel inte ökar tidseffektiviteten i drivning av grisar. Transportörerna kategoriserades för nivå av intensitet av drivning och sedan jämfördes tiden att driva grisar mellan kategorier. Det fanns en trend mot att mindre intensiva metoder var mer tidseffektiva än mer intensiva metoder.

Innehållsförteckning

Introduction

Background

Pig industry systems require movement of live pigs from one place to another. Pigs are moved on farm, between farms, between countries and to abattoirs. This movement of live pigs requires handling practices that are designed for the purpose. If handling practises are not appropriate, staff may injure themselves as well as the pigs. Of all injuries on farms, animal handling is the cause of 12-25% and many injuries in the pig industry occurs when animals are moved (Langley and Morrow, 2010). Langley and Morrow (2010) proposes that education is the key to prevent injuries while handling animals. They suggest that farm workers should be trained in methods of handling animals. With increased implementation of good handling practises the labour working conditions improve (Quintiliano and de Costa, 2008). Quintiliano and de Costa (2008) also propose that good handling practices will improve economic profit. It has been presented that aversive handling will adversely influence both growth performance and feed conversion efficiency of young pigs (Hemsworth and Barnett, 1991). Not only will aversive handling have an economic impact on farm, but it will also have an effect out of farm as the level of the stress prior to slaughter will influence meat quality and therefore profit. Highly stressed pigs have lower blood pH (Gonyou, 2008) and this could lead to PSE meat (pale, soft, exudative meat) that is unattractive to consumers. Correa *et al*. (2010) found that during loading to slaughter-transport, pigs exposed to an electric prod as opposed to paddle or compressed air prod was found to have higher occurrence of blood-splashed ham, more scratches and more lacerations on the carcass. Maybe this was due to them overlapping or rushing against walls during handling (Correa *et al*., 2010). These results indicate that handling on farm prior to transport to slaughter influences meat quality. Also Van de Perre *et al.* (2010) and Gonyou (2008) found that there is an adverse effect on meat quality in frequent prod use. In support of this D'Souza *et al*. (1998) found that pigs that received electric shocks prior to slaughter had a higher incidence of PSE meat than pigs that were handled in a gentler manner did. Regarding profit, Whan (1993) in D'Souza *et al*. (1998) found that annual economic losses due to PSE meat in the Australian pig industry amounts to $20 million.

There is legislation covering the animal handling in transport situations in Europe. In the Regulation (EC) No 1/2005[1] of the European Parliament and Council of 22 December 2004 on the protection of animals during transport and related operations, it is stated that it shall be complied that the staff handling animals are trained or competent as appropriate for this purpose and carry out their tasks without using violence or any method likely to cause unnecessary injury or suffering. Furthermore it is said that it shall be prohibited to strike or kick animals; to apply pressure to any sensitive part of the body in such a way that it is causing them unnecessary pain or suffering; use prods or other implements with a pointed end to lift or drag the animals by head, ears, horns, legs, tails or fleece; or handle them in such a way as to cause them unnecessary pain or suffering ((EC) No 1/2005) [2]. Additionally it is said that the use of instruments, which administer electric shocks, shall be avoided as far as possible ((EC) No 1/2005)[3]. In the Swedish animal welfare legislation on transport and slaughter (SJVFS 2012:27, L22. Statens jordbruksverks föreskrifter och allmänna råd om slakt och annan avlivning av djur) it is specified that animals should be handled calmly during moving, if a device is used it should be a paddle or driving board and it can only be used to direct animals". In Sweden a common tool for herding pigs is a plastic paddle filled with small beads that makes a rattling sound to which pigs react.

The pigs' predispositions for movement

There are several factors influencing pig movement. For example, genetics, as ease of handling seems to be a heritable trait and could thus be selected for in breeding (D'Eath *et al*., 2009). Though some behaviours, such as accepting to be touched does not seem to differ much between individuals (Clouard *et al*., 2011) and may not be possible to select for. It is suggested by (Beilharz and Cox, 1967) that breed and sex could potentially influence pigs' response to novel stimuli. Other stimuli such as season also seem to influence pig behaviour as Beilharz and Cox (1967) found that pigs' responses to novel stimuli where not as pronounced during summer. As to social factors, Grandin (1981) found that the first pig in a group of pigs tends to hesitate when herded towards a darker place but when that first animal moves the rest follow. In the same study Grandin concluded that directing the first animal in a group in the right direction as compared to pushing the whole group from behind will have animals move more easily. The risk of moving a large group of pigs from behind is that if it excites the pigs it might cause them to climb on each other (Grandin, 1981). Concerning group size, groups of less than seven pigs are relatively easy to herd and in total just as time efficient than the moving of larger groups (Lewis and McGlone, 2007). With increasing group size, handling becomes more difficult due to leader pigs turning back, and heart rate will increase (Lewis and McGlone, 2007). Although small groups are easy to move it is not recommended to move one pig at a time. It is more difficult to handle one pig than a pair (Lewis and McGlone, 2007). A pig isolated from other pigs will be more active and there is a risk that the pig will try to escape by jumping against fences or walls (Fraser, 1974). This reaction however, seems to depend on the length of isolation as Clouard *et al*. (2011) discovered that individually housed pigs were less reactive to human approach. Social factors, such as isolation, could also influence the fear response as Hemsworth and Barnett (1991) found that aversive handling of pigs individually increases free corticosteroid response to humans more than in pigs aversively handled in group. There are individual differences in how much pigs vocalize (Clouard *et al.*, 2011; Fraser, 1974) and it seems that pigs that vocalize much also engage more in locomotor behaviour (Fraser, 1974). When moving pigs the use of an electric prod instead of paddle will have pigs vocalizing more and longer (Correa *et al*., 2010). Also, the exposure to sound changes the pigs' behaviour. The higher frequency and the higher intensity of a sound, the more the pigs move around (Talling *et al*., 1996). Both uniform and intermittent sound increases active behaviour of pigs when first exposed to suggesting the onset of escape behaviour, however pigs avoid intermittent sound but seem to be able to habituate to uniform sound (Talling *et al*., 1998). Why intermittent sound seems aversive could be due to it being unpredictable and that there is a continual direction of attention to the sound stimuli (Talling *et al*., 1998). In support of findings that loud noises might have a stressful impact on pigs Van de Perre *et al*., (2010) discovered that noise levels during handling prior to slaughter influenced meat quality in an unfavourable way, and as mentioned before this could be an indicator of stress. Adding to this, Grandin (1998) suggests that noise during handling should be reduced as this will reduce both squealing and pigs piling up.

Previous experience of the pig

Previous experiences also influence how pigs react to humans and, accordingly, how they might react to moving. Pigs handled in a pleasant way interact more with humans (Hemsworth and Barnett, 1991; Tanida *et al.*, 1994) and experience of previous gentle handling will make pigs easier to catch than if they have not previously been handled

gently (Tanida *et al.*, 1994). This is possibly an indicator of a decreased fear of humans (Tanida *et al.,* 1994). Pigs increase initiation to body contact with humans if previous initial contact has not been followed by aversive handling (Tanida *et al.*, 1994). This could indicate habituation. Reversely, previous aversive treatment will increase the pigs' fear of humans (Hemsworth and Barnett, 1991). In a study by Day *et al*. (2002) pigs that were handled in a pleasant way as opposed to handled as little as possible took longer to exit their home pen when the handler was in the pen. Maybe this could be due to an increased attraction to handler (Day *et al.,* 2002). However, in the same study there was no significant effect between groups on time on passing a novel object (Day *et al.*, 2002). An interesting notion is that research has also shown that pigs do not discriminate between humans on grounds of previous handling (Hemsworth *et al*., 1994). It could therefore be presumed that previous experiences of pigs influence the pigs' response to handling by any human. Not only do experience of handling but experience of moving affect movement of pigs. Pigs that are used to moving in other environments than their home pen seems to be more willing or more able to move in novel environments (Krebs and McGlone, 2009 and Abbott *et al.*, 1997). This may indicate that the pigs will be more able to cope with pre slaughter stressors if they have previously experienced novel environments (Abbott *et al.*, 1997).

Pigs that have previously experienced navigation around corners, on ramps and through confined areas are easier to handle and moves more quickly than pigs with no experience of these attributes (Lewis *et al*., 2008). The heart rate will decrease in pigs if they are pre-conditioned to stimuli (Lewis *et al*., 2008). Moving pigs from home pen and back will increase their willingness to be moved again with five times as many pigs voluntarily leaving the pen when having had experienced it before (Abbott *et al*., 1997). The longer a pig is kept in a barren environment the more unwilling it will be to leave the home pen (Abbott *et al*., 1997).

Human actions and posture

The actions and postures of humans also influence the movement of pigs. D'Eath *et al.* (2009) suggests that the motivation of moving away from humans is a common factor influencing behaviour. The pigs' fear response is influenced by posture of, distance to, type of movement of and direction of humans (Muira *et al*., 1996). Pigs tend to approach standing humans less than squatting humans (Hemsworth *et al*., 1986) or humans in a quadruped posture (Muira *et al*., 1996). A standing human seems to be threatening to pigs even though only the top half of the human is visible (Muira *et al*., 1996). If a pig sees a human ahead they will be more prone to turn around, balk and refuse to move (Grandin, 1981). They will also be hesitant to enter pens and alleys if humans are standing next to pens or alleys (Grandin, 1981). A non-approaching behaviour of humans increases the approaching behaviour of the pig maybe indicating that interacting humans are perceived more threatening (Hemsworth *et al*., 1986). A human moving away decreases the withdrawal behaviour of pigs (Muira et al., 1996). Sudden movements should be avoided as this might frighten the animals (Grandin, 1998). The area around the pigs were they react to escape when entered by humans is called flight zone. It is recommended by Grandin (1998) not to put continuous pressure on the animals' flight zone. Muira *et al.* (1996) found that when pigs were exposed to approaching humans in an experimental arena most pigs reacted by escape when a human was 40 cm from it. About every second pig reacted with escape when a human was about 80 cm from it (Muira *et al*., 1996). But in a study by Clouard *et al.* (2011) where pigs were studied in their home environment most

pigs did not react much when a human was approaching. The pigs that did react by trying to avoid the human did so only once the human was close to the pig and tried to touch it (Clouard *et al*., 2011). This could suggest that familiar surroundings decrease pigs' fear of humans. Pigs also have a blind spot at an angle of 90° -105°behind them and will not react if entered by a human (Muira *et al*., 1996). Outstretched arms do not seem to influence the approach behaviour of pigs (Hemsworth *et al*., 1986). Though bare hands as opposed to hands in leather gloves increase the approach behaviour of pigs (Hemsworth *et al*., 1986) potentially indicating that there are olfactory cues that pigs react to.

Effect of facilities on movement

Movement of pigs could be impaired if the facilities are not designed properly for the animals. Building design factors influencing pig movement in a negative way are sharp angles, uncovered floor gaps, too steep, too wide or too narrow passages (Spencer and Veary, 2010). Grandin (1981) proposes that corners that impede animal movement are removed and that gates that slide up and down are favourable to swing gates. Imprinted floors make pigs move more easily, however they cannot be deeply grooved as this will make it more difficult for pigs to move (Grandin, 1981). In the same paper it is suggested that animals should not be able to see through, over or under fences. Also, if the pigs can see the pen from where they just exited or see a small opening to that pen they will often try to return to it. Puddles on the floor (Grandin, 1981), dangling chains and air blowing in the face of animals will partially stop pigs from moving (Grandin, 2006). Additionally the lighting influences pig movement as pigs tend to move more easily towards brightly illuminated areas from darker areas, however, this is not the case if the light is directed towards the pigs (Grandin, 1981). The position of lamps and position of sun is to be taken into account when herding pigs. Pigs that have been reared in dimly illuminated buildings will not walk towards direct sunlight (Grandin, 1981). In situations where different levels are common it should be kept in mind that it is easier for a pig to walk one step up than one down (Grandin, 1981). Grandin (1981) suggests that the use of ramps should be avoided. Novel environments will cause physiological responses in pigs (Lewis *et al*., 2008). Furthermore Lewis *et al*. (2008) found that the pigs' fear of ramps and alleys are due to novelty, indicating that these factors may not impair movement if pigs are used to similar constructions. Spencer and Veary (2010) points out that inadequate building design that hinders pig movement also increase staff frustration and rough handling of pigs. Proper design might decrease animal stress and increase movement (Langley and Morrow, 2010).

Devices used for moving pigs

Pigs can be moved quietly without using tools (Gaverink *et al*.,1996). However, there are several devices that can be used for herding pigs. Examples of such tools are electric prods, boards, paddles, compressed air prods (Correa *et al*., 2010), brooms (Geverink *et al*., 1996), flags, rubber sticks (Geverink *et al*., 1996), vibrating prods (Grandin, 2006), bags, whips and rattles made from plastic bottles and coins (Spencer and Veary, 2010). Other stimuli such as noise are also used for herding pigs (Spencer and Veary, 2010).

Electric prods induces escape behaviour in pigs and can have pigs moving forward or running back into a group of pigs (Grandin, 1981). In confined areas this could result in pigs climbing on each other (Grandin, 1981). Correa *et al.* (2010) found that using an electric prod when loading instead of a compressed air prod or a paddle was more time

efficient; the pigs turned back less often and they did not stop as much, but they slipped and overlapped more and, as mentioned earlier, the electric prod had a negative effect on meat quality. The pigs also seemed more fatigued as the incidence of open-mouthed breathing was high and they seemed less responsive to stimuli than other pigs after transport (Correa *et al*., 2010). This suggests that handling during loading influence pig behaviour at unloading. If pigs are moved in a comfortable walking pace with a herding board and only occasionally slapped they seem to be less stressed than if they are moved in a fast walk, shouted at and slapped several times (Gonyou, 2008). When an electric prod is added to the more forceful method the incidence of highly stressed pigs is much elevated and the amount of pigs stumbling and falling increases (Gonyou, 2008). Gonyou (2008) found that the calmer way of herding pigs was not as time efficient as the more forceful methods. As it seems, most research on moving pigs is done on the potential effect of electric prods. However, as mentioned earlier, a common tool for herding pigs in Sweden is a plastic paddle and the research on the effect of plastic paddle on moving pigs is limited. Thus, it is thus important to increase the knowledge of paddle use.

Objective

The objective of this study was to investigate the use of paddle in moving pigs, to investigate if there were different methods of paddle practice, explore the time efficiency of dissimilar kinds of paddle use and to find out if there were any time variations in methods that varied in intensity.

Hypotheses

$H0^1$There are no differences among staff in how time efficient they are in moving pigs

$H1^1$ There are differences among staff in how time efficient they are in moving pigs

$H0^2$ There are no differences in paddle use among staff

$H1^2$ There are differences in paddle use among staff

$H0^3$ Separate methods used in moving pigs are not different in their effectiveness

$H1^3$ Separate methods used in moving pigs are different in their effectiveness

$H0^4$ There are no differences in efficiency between combined intense methods and combined non intense methods of moving pigs.

$H1^4$ There are differences in efficiency between combined intense methods and combined non intense methods of moving pigs.

Material and method

Material

In an attempt to reduce environmental influences on the results, unloading site at abattoirs were chosen for observations. This study was performed on two Swedish abattoirs. The abattoirs selected for this study were chosen on geographical closeness and willingness to participate. Four abattoirs were asked to participate and two were willing to. This study was carried out for a total of five weeks at the two different abattoirs. Data collection in abattoir 1 was carried out during two weeks with average daily temperatures of about 0° C. Data collection in abattoir 0 was carried out during three weeks with average daily temperatures of 10-20 °C. Each transporter that transported animals to the abattoirs these weeks was studied during unloading. Data from a total of 22 transporters were used in the analysis. Each level of the truck and each level of the trailer were considered as separate observations.

Method

An ad libitum recording was conducted to find different behaviours of staff used for moving pigs. Following that, continuous recording was used to record the chosen behaviours of staff. Behaviours noted were touching pig with paddle, touching floors and walls with paddle, waving paddle to direct pigs but not touching pigs, rattling paddle. The force of which the transport staff touched pigs with paddle was categorised into three different categories; soft = movement initiated from wrist, average = movement initiated from elbow and hard=movement initiated from shoulder. For slaughterhouse 1 the force was estimated from notes done during some observations and each transporter was given one score only for all observations. For observations on abattoir 0 the force was, in most cases, estimated during each observation. Thus estimation of force of touching pig is likely to be more accurate for abattoir 0. Time, in seconds, was taken from when the staff first entered each compartment to when the last pig left that compartment. Time was paused when the transporters exited a level to move pigs outside of compartment. The reason for this was that during some observations the transporters had to move pigs outside of compartment for a long amount of time. Also, sometimes the corridors used for moving pigs in abattoirs were full and more pigs couldn’t be unloaded at that time. Time was also stopped when the transporter did something but move pigs, such as manipulation of doors or levels. Thus the time used in the analyses was only from when a transporter was in the compartment and moving pigs. All transporters used a paddle to move pigs. Only one transporter (T14) used a board in addition to paddle. No electric prods were used, therefore the effect of other devices than the paddle was not analysed. The observer was positioned at unloading site behind a screen having full view into the compartment. Usually only the observer's head was visible to the pigs. The compartments were of different sizes and were categorised into two categories; ‘Small compartments’ with capacity of up to 39 pigs and ‘Large compartments’ with capacity for 40 pigs and more.

Statistics

Minitab and R was used for analyses and graphs.

Differences in time to move pigs

For analyses of the variable time in abattoir 0, a general linear model was used to identify the factors that could explain the variation in time to move pigs. The parameters “Power of touch” and “Size of compartment” was added as fixed effect and the parameter “Staff” was added as random effect. In abattoir 1 only one transporter had a truck of a smaller size and each transporter only had one score on “Power of touch”. The data was not parametric; therefor a Kruskal Wallis test was done to determine if time to move pigs differed between transport staff.

Different methods to move pigs

The differences in frequency of paddle use, touches per second, amongst staff (n=22) were analysed using a Kruskal Wallis test, as the data was not parametric. The differences amongst staff (n=22) in the proportion of paddle use that ended in physical contact with pig were also determined using a Kruskal Wallis test. As the force of touching pigs with paddle was collected differently in abattoir 0 and in abattoir 1 the results of each abattoir will be presented separately.

Effectiveness of different methods

For estimation of correlation of time and touches to pigs, and correlation of frequency of touch and time, the Pearson's product-moment correlation tests was used. A general linear model was used to identify the effect of power of touch on time in abattoir 0. The parameter “Staff” was added as random effect and force of touch and size of compartment as fixed effects. In abattoir 1 where force of touch with paddle was not collected on each observation a One-way ANOVA was used to determine effect of force of touch. The time in relation to force of touch is graphically presented with regard to abattoir and size of compartment.

Time to move pigs depending on intensity of touching pigs

Staffs in each of the three groups were scored on how intense their way of moving pigs was. They where scored on their mean frequency of touch and the force of touching pigs with paddle. The lowest median frequency of touch was 0.03 touches per second and the highest median frequency of touches per second was 1.15(Table 2). Three intervals of the same size within that range were created and scores added. A low frequency of <0.40 touches per second acquired a score of 0, a medium frequency of 0.40-0.77 touches per second acquired a score of 1 and a high frequency of 0.78-1.15 acquired a score of 2. As to scoring of force of touching pigs with paddle, soft touch (movement initiated from wrist) acquired a score of 0, average touch (a movement from elbow) acquired a score of 1 and hard touch (a movement initiated from shoulder) acquired a score of 2. These two scores where added together and could range from 0-4. The two transporters with the highest scores were grouped into category ”More intense moving methods” and the two transporters with the lowest scores were grouped into category “Less intense moving methods “. If there were more than two transporters with the same score all within the same score was added to the specific category. Therefore the number of transporters can vary in each group. Due to small sample sizes a power tests were done to determine the chance of finding statistically significant differences if there was one. For the group where power was of accepted value a Mann Whitney test was done to compare time to move pigs between the categories ” More intense moving methods ” and “Less intense moving methods”.

Results

General results

The size of the compartment did have an effect on time to move pigs (p=0.000) with large compartments taking longer to empty. It took significantly longer time (p=0.000) to unload pigs at abattoir 1(mean=121) as compared to abattoir 0 (mean=81). Therefore the results are shown separately for abattoir and compartment. Table 1 presents the data for each transporter studied.

Table 1. Time to move pigs and methods for moving pigs for each transporter and capacity of compartment.

Staff	Number of observations	Capacity of compartment	Abattoir	Time to unload (mean)	Proportion of paddle use that ended in physical contact with pig	Frequency of touches, touch/second (mean)	Force of touch (median)
T1	20	Large	1	131(SE±9)	0.95(SE±0.02)	0.88(SE±0.08)	Hard
T2	24	Large	1	126(SE±7)	0.54(SE±0.04)	0.22(SE±0.02)	Soft
T3	16	Large	1	146(SE±14)	0.92(SE±0.02)	0.80(SE±0.05)	Hard
T4	18	Large	1	103(SE±7)	0.95(SE±0.02)	0.53(SE±0.05)	Hard
T5	16	Large	1	106(SE±5)	0.75(SE±0.06)	0.34(SE±0.04)	Average
T6	19	Large	1	130(SE±9)	0.68(SE±0.06)	0.40(SE±0.04)	Soft
T7	3	Large	1	74(SE±8)	0.85(SE±0.08)	0.69(SE±0.15)	Soft
T8	13	Small	1	121(SE±11)	0.92(SE±0.03)	0.51(SE±0.05)	Hard
T10	16	Large	0	88(SE±7)	0.68(SE±0.05)	0.43(SE±0.06)	Soft
T11	5	Large	0	105(SE±19)	0.72(SE±0.19)	0.13(SE±0.04)	Average
T12	6	Large	0	112(SE±8)	0.79(SE±0.04)	0.47(SE±0.06)	Average
T13	5	Large	0	104(SE±8)	0.97(SE±0.02)	0.51(SE±0.10)	Soft
T14	33	Large	0	107(SE±4)	0.99(SE±0.00)	1.00(SE±0.04)	Average
T15	6	Large	0	115(SE±12)	0.96(SE±0.02)	0.40(SE±0.06)	SoftAver
T16	12	Large	0	76(SE±6)	0.96(SE±0.01)	0.79(SE±0.09)	Average
T17	8	Large	0	90(SE±7)	0.85(SE±0.12)	0.19(SE±0.04)	SoftAver
T18	23	Large	0	99(SE±5)	0.76(SE±0.04)	0.48(SE±0.04)	Average
T19	3	Large	0	77(SE±3)	0.40(SE±0.14)	0.19(SE±0.03)	Soft
T20	4	Large	0	101(SE±9)	0.98(SE±0.01)	1.15(SE±0.21)	Hard
T22	2	Large	0	107(SE±15)	0.99(SE±0.01)	0.72(SE±0.01)	Hard
T23	6	Large	0	93(SE±7)	0.82(SE±0.16)	0.42(SE±0.06)	Soft
T10	6	Small	0	56(SE±12)	0.58(SE±0.13)	0.31(SE±0.08)	Soft
T11	7	Small	0	75(SE±24)	0.92(SE±0.03)	0.31(SE±0.04)	Average
T12	5	Small	0	47(SE±7)	0.92(SE±0.05)	0.50(SE±0.14)	Average
T13	2	Small	0	38(SE±2)	0.86(SE±0.14)	0.22(SE±0.08)	Soft
T14	20	Small	0	45(SE±4)	1.00(SE±0.00)	0.87(SE±0.08)	Average
T15	1	Small	0	16	1.00	0.31	Soft
T16	9	Small	0	38(SE±8)	0.96(SE±0.02)	0.69(SE±0.07)	Average
T18	19	Small	0	57(SE±7)	0.81(SE±0.06)	0.51(SE±0.06)	Average
T19	1	Small	0	90	0.13	0.07	Soft
T20	2	Small	0	69(SE±5)	1.00(SE±0.00)	0.88(SE±0.07)	Hard
T21	4	Small	0	89(SE±8)	0.23(SE±0.08)	0.03(SE±0.01)	Soft
T22	4	Small	0	87(SE±7)	1.00(SE±0.00)	0.93(SE±0.17)	Hard
T23	4	Small	0	21(SE±6)	0.96(SE±0.03)	0.68(SE±0.09)	Soft

Differences in time to move pigs

In abattoir 1 the time to move pigs ranged from 74(SE±8) to 146(SE±14) seconds for large compartments and the transporter with the small compartment had a mean of 121(SE±11) seconds to move pigs (Fig 1). In abattoir 1 there was a significant difference (p= 0.004) between staff on time to move pigs (Fig 1).

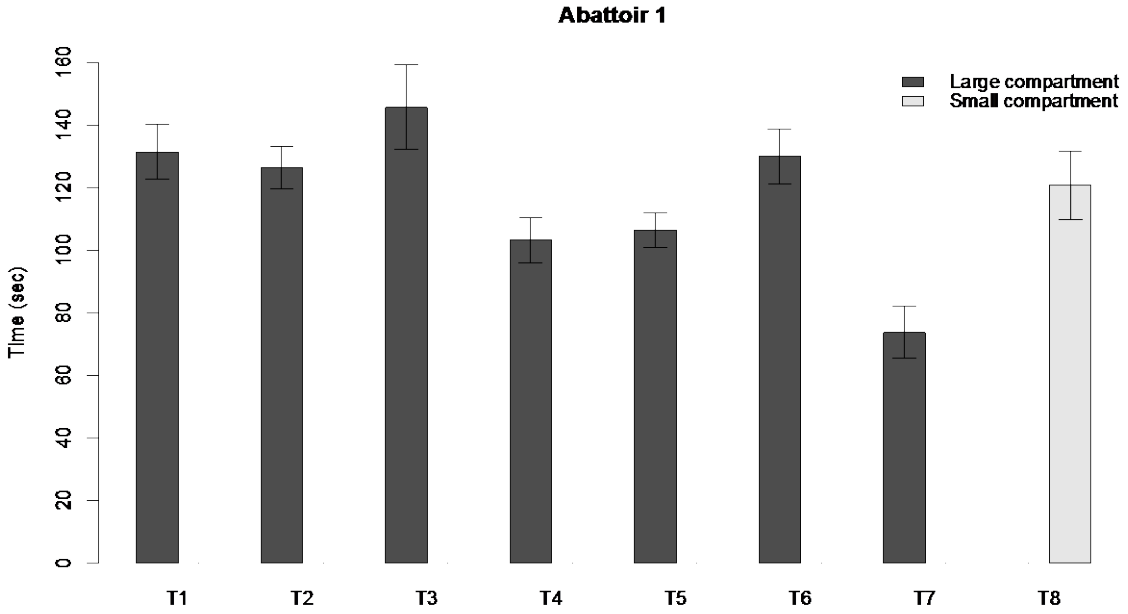

Fig 1. Time it took for each transporter in abattoir 1 to move pigs (mean and standard error).

There was a difference among transport staff on time to move pigs (p=0.003) in abattoir 0 (Fig 2) where mean time to move pigs ranged from 76(SE±6) to 107(SE±15) seconds for large compartments and 16 to 90 seconds for small compartments.

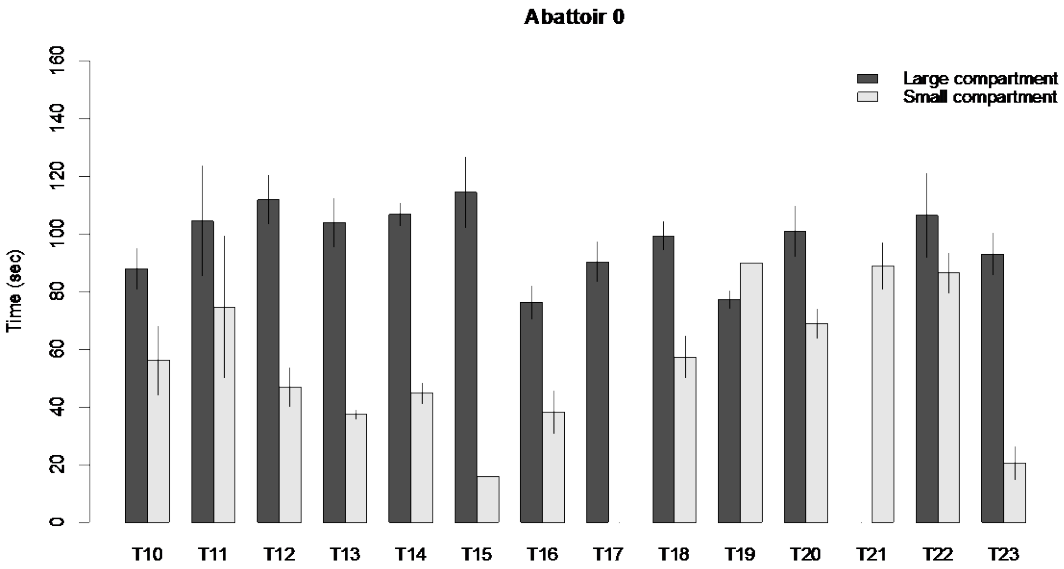

Fig 2. Time it took for each transporter in abattoir 0 to move pigs (mean and standard error).

Different methods to move pigs

There was a significant difference (p=0.000) in the frequency of paddle touches to the pigs by different transporters (Fig 3 & 4). In abattoir 1 the frequency of paddle touches to the pigs ranged from 0.22(SE±0.02) to 0.88(SE±0.08) touches per second. In abattoir 0 the frequency ranged from 0.03(SE±0.01) to 1.15(SE±0.21) touches to the pigs per second.

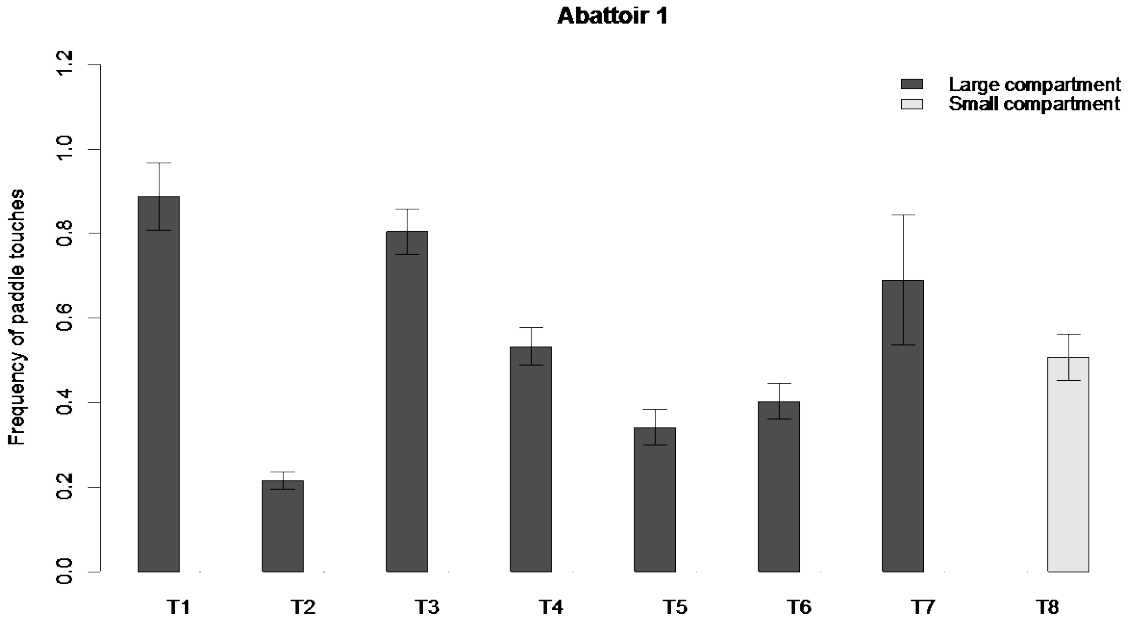

Fig 3. Frequency of paddle touches to the pig, touches per second, by staff (n=8) of abattoir 1 (mean and standard error).

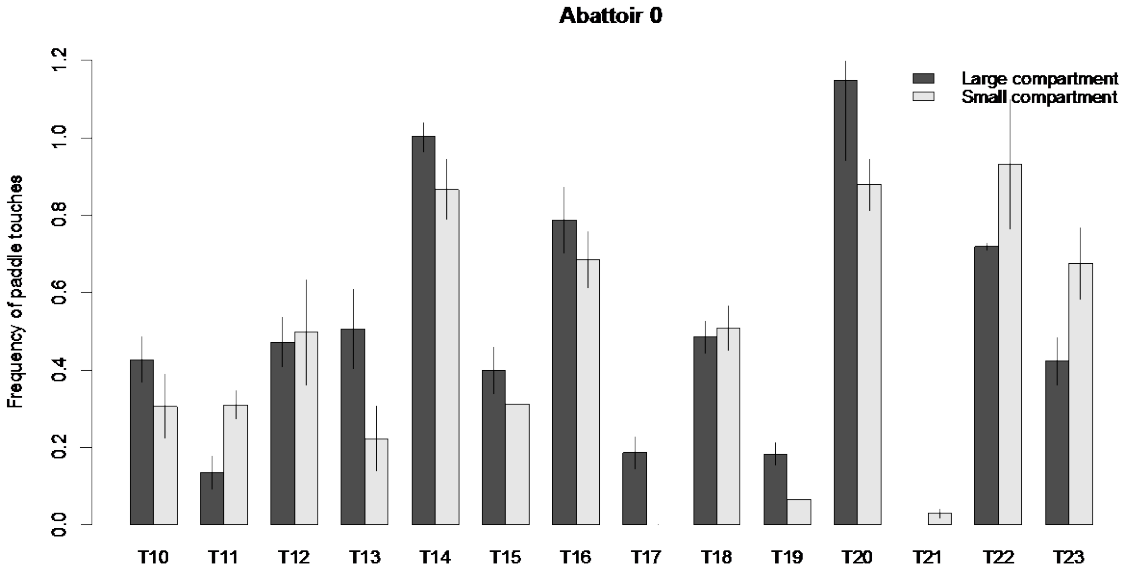

Fig 4. Frequency of paddle touches to the pig, touches per second, by staff (n=14) of abattoir 0 (mean and standard error).

There were also differences (p=0.000) amongst staff (n=22) in the proportion of paddle use that ended in physical contact with pig (Fig 5 & 6). The proportion of paddle touches to the pigs out of total touches ranged from 0.54(SE±0.04) to 0.95(SE±0.02) in abattoir 1. In abattoir 0 it varied from 0.13 to 1.00(SE±0.00) touches to the pigs out of total touches.

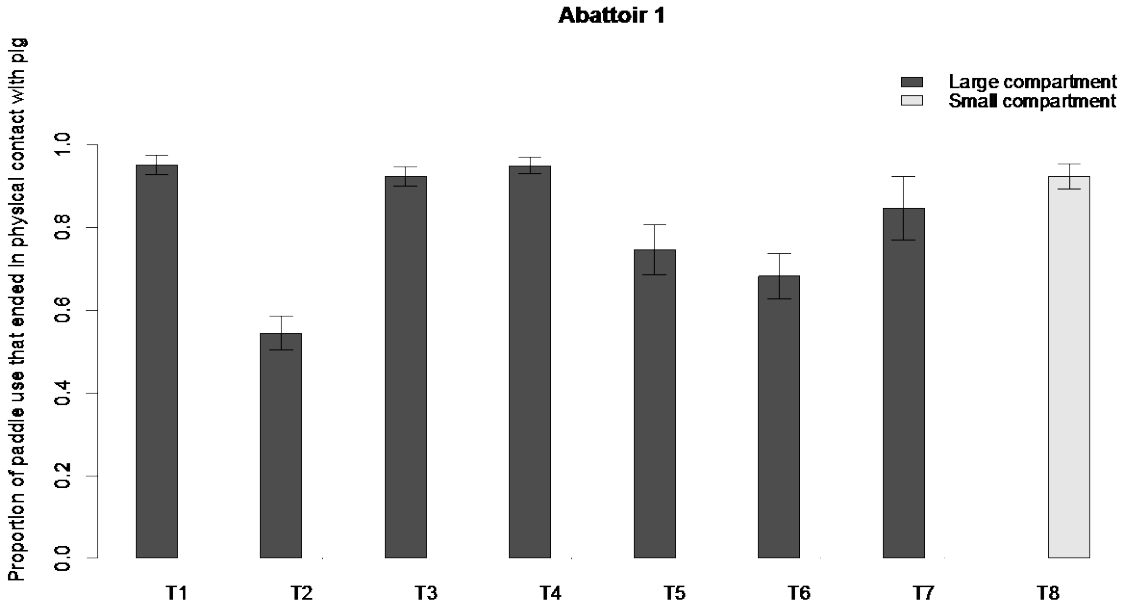

Fig 5. The proportion of total paddle use by staff (n=8) in abattoir 1 that ended in physical contact with pig (mean and standard error).

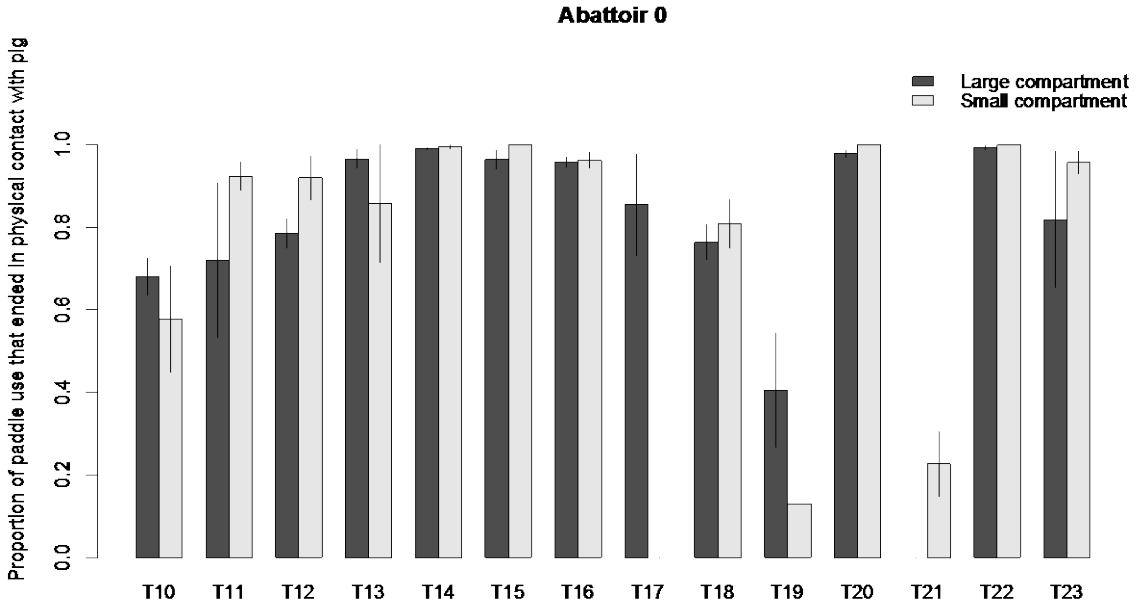

Fig 6. The proportion of total paddle use by staff (n=14) in abattoir 0 that ended in physical contact with pig (mean and standard error).

Staff did also use different force when touching pigs (Table 1). Where some initiated most touches from wrist, some from elbow and some from shoulder.

Effectiveness of different methods

There was no significant effect (p=0.331) in abattoir 1 on force of touching pigs on time to move pigs. In abattoir 0 there was a tendency (p=0.075) for force of touching pigs to affect time (Fig 7). With observations where staff used soft touches being the quickest (Large compartment n=31, mean=90. Small compartment, n=22, mean= 48), followed by observations where staff used average touches (Large compartment, n=77, mean=100. Small compartment, n=46, mean=54) and lastly observations where staff used hard touches (Large compartment, n=18, mean=107. Small compartment, n=13, mean=64).

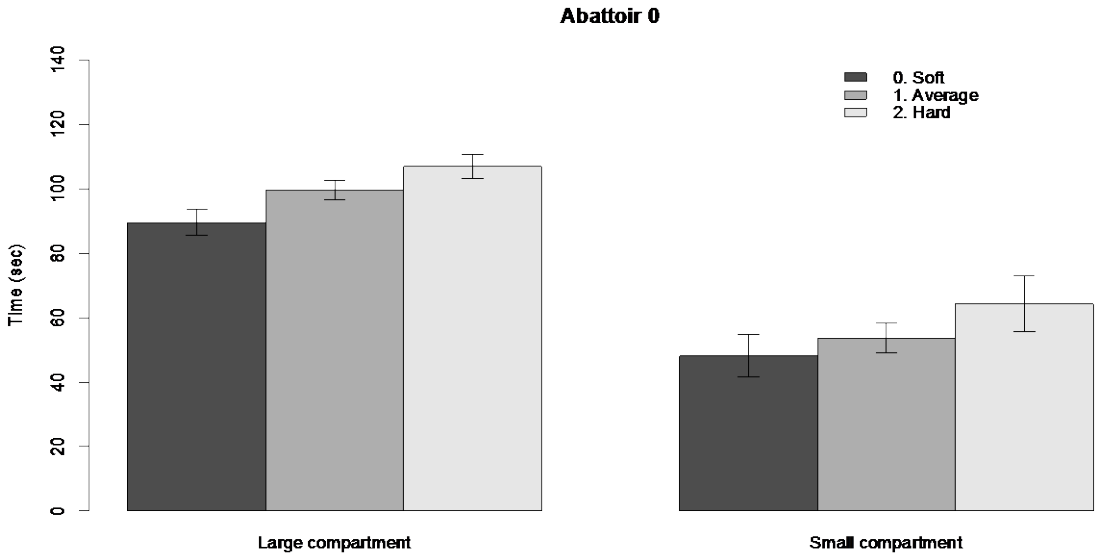

Fig 7. Time in seconds to move pigs depending on the force of touching pigs for staff of abattoir 0, presenting both compartment sizes.

There was an overall positive correlation (r=0.578,p=0.000) between time to move pigs and the number of touches during an observation. There was a positive correlation between time and number of touches to the pigs at abattoir 0 moving pigs out of large compartments (r=0.525, p= 0.000), at abattoir 1 moving pigs out of large compartments (r=0.547, p=0.000) and at abattoir 0 moving pigs out of small compartments(r=0.570, p= 0.000).

There was no overall correlation (r=-0.005, p=0.925) between the frequency of touch and time to move pigs (Fig 8). There was no correlation between the frequency of touch and time to move pigs out of large compartments in abattoir 1 (r=0.082, p=0.380) or to move pigs out of small compartments in abattoir 0 (r=-0.118, p=0.286). However there was a week but significant positive correlation (r= 0,180, p=0.041) between time and frequency of touch for moving pigs put of large compartments in abattoir 0.

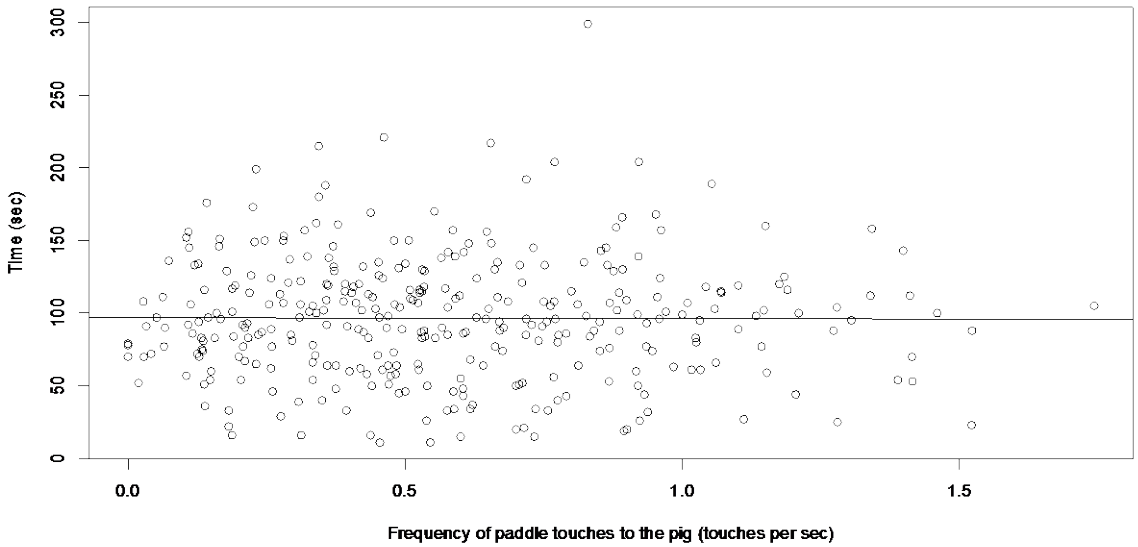

Fig 8. The relation for all observations between the frequency of paddle touches to the pig and time to move pigs.

Time to move pigs depending on intensity of touch

The moving techniques of staff differed in their intensity. Staff that touched pigs with a high frequency and movement of arm initiated from shoulder acquires high scores of intensity and was categorised into the category “More intense moving method”. Staff that touched pigs with a low frequency and with movement of arm initiated from wrist acquired low scores of intensity and was categorised into category “Less intense moving method”. In abattoir 1 T1 and T3 scored highest (scores: T1=4, T3=4) and T2, T5, T6 and T7 scored lowest (scores: T2=0, T5=1, T6=1, T7=1). In abattoir 0, Large compartment T20 and T22 scored highest (scores: T20=4, T22=4) and T17 and T19 scored lowest (scores: T17=0.5, T19=0). In abattoir 0, small compartment T20 and T22 scored highest (scores: T20=4, T22=4) and T10, T13, T15, T19 and T21 scored lowest (scores: T10=0, T13=0, T15=0, T19=0, T21=0). A power test showed that the chance of finding moderate to large statistically significant differences if there was one, in abattoir 0, was to small (Abattoir 0, Large compartment, power=0.17. Abattoir 0 Small compartment, power=0.18). However for Abattoir 1, large compartment power was 0.67. In abattoir 1 there was no significant differences in time to move pigs depending on intensity (p=0.070) (Fig 9).

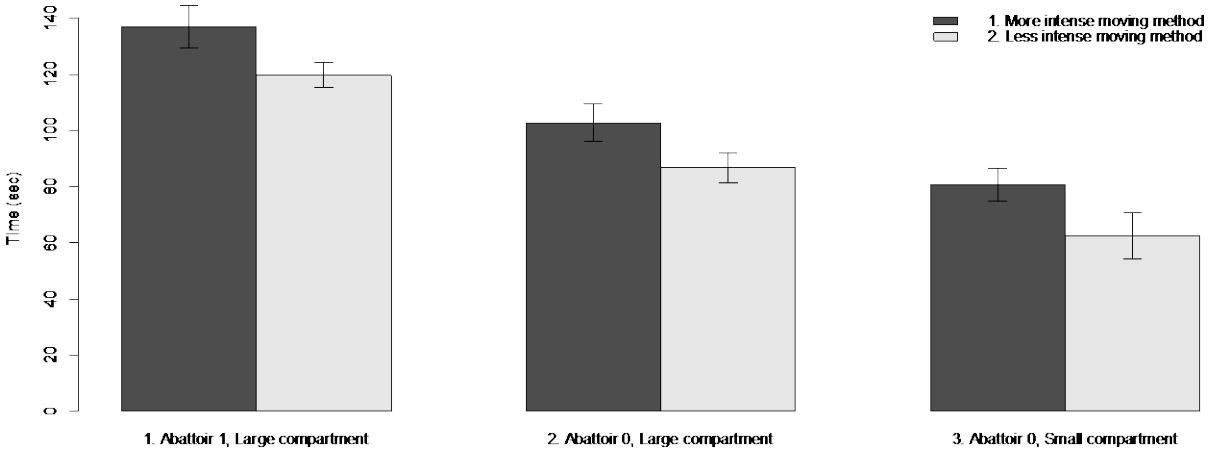

Fig 9. A comparison on time to move pigs between the two categories “More intense moving method” and “Less intense moving method” within groups.

Discussion

It took longer to move pigs in abattoir 1. Previous research has shown that building design influence pig movement (Spencer and Veary, 2010 and Grandin, 1981). Maybe the differences in time were due to differences in the facilities used for unloading. In both abattoirs there was a 90° turn a few meters after unloading site. Abattoir 0 was lighter and the walls were covered after the turn. Abattoir 1 was darker and only one wall was covered, the other side had bars. The bars may have confused the pigs and thus hindered them in movement. The time to move pigs was also significantly lower for staff that moved pigs out of small compartments as compared to large compartments, possibly due to the shorter distance to move pigs, the smaller area to empty and fewer animals to move. None of the transporters used an electric prod at unloading. This is in opposition to a study by Gaverink *et a*l. (1996) where most transport workers in the studied abattoirs in Belgium and Netherlands used electric prods during unloading from lorries. Transporters in the abattoirs chosen for this study said that electric prods were not needed, as pig movement was not much impaired by facility design.

The results show that time to move pigs differed significantly among staff. Transport staff used the paddle in different ways. They differed in the frequency of touching pigs, in the proportion of paddle use that ended in physical contact with pig and the force of touching pigs. It has not yet been investigated how pigs perceive different ways of using the paddle. Transport staff touched pigs with the paddle on the backs, on head, sides and legs. Staff also touched floors, ceilings and walls with paddle. Transport staff used different parts of the paddle when touching pigs. Some used the broad side and some used the edges. Touching pigs with the edge of paddle with the same force as the broad part of paddle, will induce more pressure per area on pig (kN/m^2). How pigs perceive different pressures has not yet been studies. As to frequency in touching pigs there were large differences among transport staff. The maximum mean frequency by a transporter was 1.15 touches per second and the minimum mean frequency was 0.03 touches per second. In one observed unloading the transporter did not use any paddle at all. The transporter that touched pigs 1.15 times per second also used an arm movement initiated from shoulder and the touch was thus categorised as a hard force touch. It could easily be claimed that a frequency of 1.15 touches per second with a movement initiated from shoulder is not compatible with the legislation concerning animal moving. Conversely it could be claimed that the low frequencies of touching pigs and an arm movement initiated from wrist could be compatible with the legislation. There were also differences in the proportion of paddle use that ended in physical contact with the pigs. Other kinds of paddle use seen was using paddle to touch floor and walls and to rattle and wave paddle behind pigs. All these other ways to use the paddle except for the waving of paddle produced a rattling sound. It seemed like some transporters were attempting to direct paddle towards objects rather than pigs when moving pigs, whereas some directed the paddle only to pigs. Transport staff also differed in the force of touch when touching pigs. Potential biases of that parameter could be that transport staff may have used different force within one observation. If done again this measurement should be refined. The reason to why transporters differed so much in the way they moved pigs is not known. It could be due to age, sex, education, previous experience, attitudes towards animals and so on. Attitudes and beliefs of stock people do affect their behaviour towards animals (Hemsworth and Coleman, 2011). As there are animal welfare implications of stockperson behaviour and as there is animal welfare legislation to comply to, it is important that management chooses stock people carefully.

The number of touches that the pigs were exposed to during an observation was positively correlated with time it took to move the pigs. It is unknown if it took longer to move the pigs because the animals were being touched more or if a slower pace initiated more touches by staff. Time to move pigs was not affected or slightly increased (abattoir 0, large compartment) with increased frequency of touching pigs with paddle, suggesting that increasing the frequency of paddle touches to the pigs will not increase time efficiency. The force of touch may affect time to move pigs. In abattoir 0 there was a tendency for force of touch to affect time with soft touches being most time efficient. Yet, in abattoir 1 there was no such tendency. The force of touch was recorded differently in the two abattoirs. As the force of touch was recorded each observation in abattoir 0 but was not recorded each observation in abattoir 1 the results from abattoir 0 ought to be more trustworthy. Abattoirs may well be interested in other effectiveness measurements, such as pigs unloaded per time unit or time to unload one lorry. However this was not the aim of the study and observation site at abattoirs was only chosen in an attempt to standardise the environment in which moving pigs was studied.

The extremes of moving animals in terms of intensity of touch were extracted. One category included transporters that touched pigs softly with a low frequency and the other category included transporters that touched pigs hard and with a high frequency. When these two categories were compared there were no significant differences in time. However there may be a trend towards methods of less intense moving to be more time efficient. These results are somewhat contradictory to the results by Gonyou (2008) who found that moving pigs in a comfortable walking pace using a herding board and only occasionally slapping pigs was not as time efficient as the more forceful moving methods. Though, in that study electric prods were used in the more forceful moving methods. Nevertheless, one important conclusion can be made from the results in this study; there is no increase in time efficiency and thus no economic profit in moving pigs in an intense manner. The reason to why transporters use intense methods could be many. Wickman (2013) showed that the pressure on staff not to cause a disruption in the production line intensified the moving tactics with staff touching animals with more force (striking) and using their voice more.

As these observations were not video taped only a few parameters could be studied. There could be factors that were not studied that could have had an effect on the results. Factors such as previous handling (Hemsworth and Barnett, 1991 and Day *et al*., 2002), previous experience of moving (Krebs and McClone, 2009., Abbot *et al*., 1997 and Lewis *et al*., 2008), the posture of the handler (Muira *et al*., 1996 and Grandin 1986) and the position of the handler (Grandin 1981) are all factors that has shown to have an effect on moving pigs. Several of the transporters mentioned that they found factors such as the pigs previous experience of moving, which farm the animals were from, what feed the animals were fed, what day of week it was, what time of day they were picked up, what size the animals were and what age the animals were to influence movement of pigs. These surrounding factors may have had an effect on the results and are of particular interest when it comes to design of analyses. Each level of the truck and each level of the trailer were considered as separate observations even though it was the same delivery. It was not registered if all the pigs in the same delivery were from the same farm. If the pigs were from the same farm they would have been subjected to the same treatment before arriving to the abattoir and been transported an equal amount of time in the transport vehicle. The last week in abattoir 0, the observer asked staff where the pigs were collected and approximately half of the incoming deliveries had pigs from different farms in the same delivery. Sometimes there were pigs from three different farms in each delivery. Sometimes pigs from different farms

were mixed in one compartment. If done again it is suggested that these parameters are registered and analysed as it might reveal interesting results. Another factor of interest was the use of voice by staff. This was registered during the first days of observation. However as there were too much other noise and as the transporters were beyond hearing distance of observer at times this factor was eliminated from the observations, as it seemed potentially too biased. During some observations where the frequency of paddle touch was very high the observer might have missed some other behaviour of the staff. If done again it suggested that the moving of pigs is recorded on camera. Nevertheless, as studying people working with animals in abattoirs is a delicate matter, recording may not be approved. However this kind of study could also be done on farm and during loading where cameras might be more accepted.

The essence of these results is that intense moving techniques are not more time efficient than non-intense moving techniques when moving pigs. A less intense moving technique should not be seen as something jamming up production but potentially the opposite. Staff working with animals should feel confident that the time set for their work task is enough to finish it. Thus foreman's and managers have a responsibility to make sure there is enough time for set tasks. It is also their responsibility and should be in their interest that non-intense behaviour of staff is encouraged as it more consistent with the legislation in the EU. However, more research on moving pigs is needed to fully understand the complexity of moving pigs.

Conclusion

The time to move pigs is affected by staff handling. Transporters use the paddle in different ways when they unload pigs. A soft touch of paddle seems more time efficient than a hard touch. Increased frequency of touching pigs will not increase efficiency of moving pigs. There seems to be a trend towards less intense moving techniques to be more time efficient than more intense moving techniques, however, this is not significant and more research is needed.

Acknowledgement

I wish to thank the staff of the abattoirs for letting me in to see their operation; the transport staff for letting me study their work; my supervisor Maria Andersson for creative suggestions on work improvement; my examiner Jenny Yngvesson for improvement suggestions; Ulrika Hovmark, and Linnea Pärn-Yngve for support during data collection; Catrine Johansson and Kent Bornhede for editing the text. Lastly I would like to thank to the pigs.

References

Abbott, T.A., Hunter, E.J., Guise, H.J and Penny, R.H.C. 1997. The effect of experience of handling on pigs willingness to move. Applied Animal Behaviour Science. 54, 371-375.

Beilharz, R.G and Cox, D,F. 1967. Genetic analysis of open field behaviour in swine. Journal of Animal Science. 26, 988-989.

Clouard, C., Meunier-Salaün, M-C and Devilles, N. 2011. Development of approach and handling test for the assessment of reactivity to humans of sows housed in stall or in group. Applied Animal Behaviour Science. 133, 26-39.

Correa, J.A., Torrey, S., Devillers, N., Laforest, J.P., Gonyou, H.W and Faucitano, L. 2010. Effects of different moving devices at loading on stress response and meat quality in pigs. Journal of Animal Science. 88, 4086-4093.

D'Eath, R.BD., Roehe,R., Turner, S.P., Ison, S.H., Farish, M., Jack, M.C and Lawrence, A.B. 2009. Genetics of animal temperament: aggressive behaviour at mixing is genetically associated with response to handling in pigs. Animal.11, 1544-1554.

D'Souza[1], D.N., Dunshea, F.R., Warner, R.D and Leury, B.J.1998. The effect of handling pre-slaughter and carcass processing rate post-slaughter on pork quality. Meat Science. 50, 429-437.

Day, J.E.L., Spoolder, H.A.M., Burfoot, A., Chamberlain, H.L and Edwards, S.A. 2002. The separate and interactive effects o handling and environmental enrichment on the behaviour of the pig and welfare of growing pigs. Applied Animal Behaviour Science. 75, 177-192.

Fraser, D. 1974. The vocialization and other behaviours of growing pigs in an open field test. Applied Animal Ethology. 1, 3-16.

Geverink, N.A., Engel, B., Lambooij and Wiegant, V.M. 1996. Observations on behaviour and skin damage of slaughter pigs and treatment during lairage. Applied Animal Behaviour Science. 50, 1-13.

Gonyou, H.W. 2008. Impact of prod use on the incidence of highly stressed pigs. 27th Annual Centralia Swine Research Update, 30 January 2008, Kirkton-Woodham Community Centre, Ontario, Canada. II-35-II-36.

Grandin, T. 1981. Pig behaviour studies applied to slaughter-plant design. Applied Animal Ethology. 9, 141-151.

Grandin, T. 1998. Review: Reducing handling stress improves both productivity and welfare. The Professional Scientist. 14, 1-10.

Granin, T. 2006. Progress and challenges in animal handling and slaughter in the U.S. Applied Animal Behaviour Science. 100, 129-139.

Hemsworth, P.H and Coleman, G.J. 2011. Human –Livestock Interactions. Second edition. CAB international.

Hemsworth, P.H and Barnett, J.L. 1991. The effect of aversively handling pigs, either individually or in group, on their behaviour, growth and corticosteroids. Applied Animal Behaviour Science. 30, 61-72.

Hemsworth, P.H., Coleman, G.J and Barnett J.L. 1994. Stimulus generalization: The inability of pigs to discriminate between humans on the basis of their previous handling experience. Applied Animal Behaviour Science. 40, 129-142.

Hemsworth, P.H., Gonyou, H.W and Dziuk, P.J. 1986. Humans communication with pigs: The behavioural response of pigs to specific human signals. Applied Animal Behaviour Science. 15, 45-54.

Krebs, N and McGlone J.J. 2009. Effects of exposing pigs to moving and odours in simulated slaughter chute. Applied Animal Behaviour Science. 116, 179-185.

Langley, R.L and Morrow, W.M.E. 2010. Livestock handling-Minimizing worker injuries. Journal of Agromedicin. 15, 226-235.

Lewis, C. R. G and McGlone, J.J. 2007. Moving finishing pigs in different group sizes: Cardiovascular responses, time and ease of handling. Livestock Science. 107, 86-90.

Lewis, C.R.G., Hulbert, L.E and Mc Glone, J.J. 2008. Novelty causes elevated heart rate and immune changes in pigs exposed to handling, alleys and ramps. Livestock Science. 116, 338-341.

Marquer, P. 2010. Pig farming in the EU, a changing sector. Agriculture and fisheries. European Statistical Data Support. European union.

Muira, A., Tanida, H., Tanaka, T and Yoshimoto,T. 1996. The influence of human posture and movement on the approach and escape behaviour of weanling pigs. Applied Animal Behaviour Science. 49, 247-256.

Quintiliano, M.H and de Costa, P. 2008. The application of drivning and stunning techniques in South America- Practical experiences in Brazilian Slaughterhouses. Animal Welfare at Slaughter and Killing for Disease Control- Emerging Issues and Good Examples. Hindåsgården. Sweden.

Spencer, B.T and Veary, C,M. 2010. A study of preslaughter pig handling and stunning in selected South African Highveld Region abattoirs. Journal of South African Veterinary Association. 81, 102-109.

Talling, J.C., Waran, N.K., Wathes, C.M and Lines, J.A. 1998. Sound avoidance by domestic pigs depends upon characteristics of the signal. Applied Animal Behaviour Science. 58, 255-266.

Talling, J.C., Waran, N.K., Wathes, C.M and Lines, J.A. 1996. Behavioural and physiological responses of pigs to sound. Applied animal behaviour science. 48, 187-202.

Tanida, H., Muira, A., Tanaka, T and Yoshimoto, T. 1994. The role of handling in communication between humans and weanling pigs. Applied Animal Behaviour Science. 40, 219-228.

Van de Perre, V., Permentier, L., De Bie, S., Verbeke, G and Geers, R. 2010. Effect of loading, lairage, pig handling, stunning and season on pH of pork. Meat Science. 86, 931-937.

Wickman, M. 2013. Kunskap och attityder bland stallpersonal på svenska slakterier. Examensarbete. Sveriges Lantbruksuniversiet. Fakulteten för veterinärmedicin och husdjursvetenskap. Institutionen för husdjurens miljö och hälsa.

Rules and regulations

Regulation (EC) No 1/2005 of the European Parliament and Council of 22 december 2004 on the protection of animals during transport and related operations.

1) Chapter III, Article 3 d
2) Annex 1. Technical rules. ChapterIII (1.8 a, b, d, e)
3) Annex 1. Technical rules. ChapterIII (1.9)

SJVFS 2012:27. Saknr L22. Statens jordbruksverks föreskrifter och allmänna råd om slakt och annan avlivning av djur. Chapter 3, § 4

Vid **Institutionen för husdjurens miljö och hälsa** finns tre publikationsserier:

*** Avhandlingar:** Här publiceras masters- och licentiatavhandlingar

*** Rapporter:** Här publiceras olika typer av vetenskapliga rapporter från institutionen.

*** Studentarbeten:** Här publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

Vill du veta mer om institutionens publikationer kan du hitta det här:
www.slu.se/husdjurmiljohalsa

DISTRIBUTION:

Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens miljö och hälsa
Box 234
532 23 Skara
Tel 0511–67000
E-post: hmh@slu.se
Hemsida:
www.slu.se/husdjurmiljohalsa

Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science
Department of Animal Environment and Health
P.O.B. 234
SE-532 23 Skara, Sweden
Phone: +46 (0)511 67000
E-mail: hmh@slu.se
Homepage:
www.slu.se/animalenvironmenthealth