



Slaughter – Not Only About Animals

**An Interdisciplinary Study of Handling of
Cattle at Slaughter**



Sofia Wiberg

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Sofia Wiberg

*Faculty of Veterinary Medicine and Animal Sciences
Department of Animal Environment and Health
Skara*

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Cover: A stockperson about to stun a bull
(photo: C. Berg)

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Slaughter – Not Only About Animals. An Interdisciplinary Study of Handling of Cattle at Slaughter

Abstract

In order to get meat for human consumption animals have to be slaughtered. In Sweden, about 450,000 cattle are slaughtered every year; in 2011 93% of these were slaughtered at the 16 largest slaughter plants. Maintaining acceptable animal welfare standards in the industrial slaughter of animals places great demands on the management and staff. Good animal welfare means that consideration has been given to the animals' biology and subjective experience and to its possibilities to adapt to the environment. Previous research has shown that the interior design in a slaughter plant and the way animals are handled are important for animal welfare.

The aim of the studies included in this thesis was to use an interdisciplinary approach to describe and analyse human-animal interactions around the slaughter of cattle, to identify important factors for the maintenance of good animal welfare. In the first study, pre-defined behaviours of randomly chosen animals and the stockpersons handling them prior to slaughter were recorded. In the second study, data was collected through ethnographic observations at slaughter and interviews with stockpersons and slaughter plant management. Results show that a part of the animals were driven to stunning and stunned without performing or receiving any of the pre-defined behaviours. The behaviours perceived as most detrimental for the animal welfare were observed only a few times. A theme that recurred in the ethnographic observations and interviews with stockpersons and management was denoted work flow, meaning that there was a smooth flow in the work without unwanted interruptions. For management, work flow was important for efficient production and for stockpersons for the feeling of a good working day. Animal flow is crucial for work flow and can have a major impact on animal welfare.

A good planning of the incoming animal transports is an important factor to maintain a good animal welfare. An appropriately designed slaughter plant interior can facilitate the driving of animals and thus promote a smooth and even animal flow and a good work flow. Routines and methods for the driving of animals at slaughter plants need to be further discussed to avoid unnecessarily rough driving.

Keywords: animal welfare, behaviour, cattle, handling, slaughter plant, stockperson

Author's address: Sofia Wiberg, SLU, Department of Animal Environment and Health, P.O. Box 234, 532 23 Skara, Sweden

E-mail: Sofia.Wiberg@slu.se

Dedication

To my grandmothers, Karin and Ingrid. I wish you were here.

I have a dream...

Martin Luther King, Jr.

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List of Publications

This thesis is based on the work contained in the following papers, in the text referred to by Roman numerals:

- I Wiberg, S., Berg, C., Cvek, K., Lunner Kolstrup, C. and Hultgren, J.
Animal and stockperson behaviours associated with poor cattle welfare at Swedish slaughter plants. Manuscript.

- II Wiberg, S., Widell, G., Lerner, H., Gamble, A., Lunner Kolstrup, C., Berg, C., Cvek, K. and Hultgren, J. Handling of cattle at slaughter at four Swedish slaughter plants – a qualitative analysis. Manuscript.

1 Introduction

Put down, euthanize, sacrifice, finish, dispatch, kill. They are all different words for the same thing – killing an animal; often for slaughter and a necessary act to get meat for human consumption. To most of us who don't work in a slaughter plant, it seems like a peculiar type of work place with demanding tasks. Killing something, although “only” an animal, is something that most people avoid if they can. The slaughter plant environment is bloody and noisy, and a person's first visit to a slaughter plant is often overwhelming.

As in any environment, you get used to it after a while. If you are a person working at a slaughter plant, you are more likely to view the environment as an ergonomic work place, from which you have adequate breaks. For the animals though, it's probably a little different. They come to the slaughter plant only once and usually spend just a few hours there. The trip to the slaughter plant may be the first time the animal is moved from the farm and the first time it is transported on a truck. At the slaughter plant, the animals meet unfamiliar conspecifics and stockpersons (animal handlers) and they can be exposed to several stress-inducing factors, such as loud noise, being forced to enter dark driving races or being prodded with an electric goad. These overwhelmed animals are, besides most probably experiencing varying levels of stress, also one of the most important features of the stockpersons' working environment.

When cattle are ear-marked for slaughter, they first need to be moved from the farm to the slaughter plant. The animal is usually transported to the slaughter plant together with other animals in a truck, where it is unloaded and put in lairage. Lairage is the housing facilities at the slaughter plant where animals are kept waiting until they are driven to the stun box. There, they are stunned by a shot to the head and killed by an incision in their throat and chest for bleeding. After stunning and bleeding, the animal goes onto the processing line where the hide and the intestines are removed and the carcass is divided into smaller parts.

Good animal welfare implies that the subjective experience of the animal, its biological functioning and adaptation to its current environment have all been taken into consideration (Lerner, 2008; Fraser *et al.*, 1997). The human-animal interaction around slaughter and its relevance for the animals' welfare is complex. Research has shown that there is a relationship between stockperson attitude and behaviour at slaughter (Coleman *et al.*, 2003) and that attitude and behaviour of stockpersons affect animal welfare (Hemsworth, 2003). Hemsworth and co-workers (2011) concluded in a field study that there is a relationship between handling and stress responses of the animal prior to slaughter, although no causality could be determined.

About 450,000 cattle are slaughtered in Sweden annually, and in 2011 93% were processed at 16 major plants¹. In Sweden, animals spend a maximum of one night after arrival at a slaughter plant, many of them only a few hours. Although this is a relatively short period of their lives, it can have a great influence on the welfare of the individual animal.

As suggested by Coleman (2012), an important part of the human-animal interaction around slaughter is its context. A significant aspect of the context is the slaughter plant interior, and there are studies on the effect on the animals of the interior design of the slaughter plant (Grandin, 1997) and of the interior in relation to organizational aspects (Bourguet *et al.*, 2011). Other contextual factors are the management of the production process and the principles adopted for organizing production. Grandin (2007) concluded that the most important factor for how animals are treated at a slaughter plant is the attitude of management, and that management must become increasingly sensitive to animal welfare. The animals' breed, sex, age and previous experiences also influence their response to stressful stimuli (Broom, 2001; Mormède *et al.*, 2001).

Swedish slaughter plants vary considerably in size and throughput. Of a total of approximately 50 cattle slaughter plants, 16 major plants process 6,100–109,000 head per year, and the smallest registered plant processes only 1 animal per year. The facilities vary in the design of the lairage areas, driving races and stun boxes, and in type of weapon used; all possible determinants of animal welfare. Several plants are relatively old and some have problems relating to basic design. Poor lighting, slippery floors or steep slopes in the driving races have a direct effect on the animals (Grandin, 2007). The interior design of the slaughter plant can also have an indirect effect on the animals, counteracting or discouraging the stockperson from handling the animals in an optimal way. For example, some constructions make it difficult or even impossible for the stockperson to use the animal's flight zone. An animal's

¹ Pers. comm. Å. Rutegård, Swedish Meat Industry Association, 2012

flight zone is an area around it, defined by earlier experience and other animal characteristics (Grandin, 1980). If a person enters an animal's flight zone it will move away. The interior can also interfere with the flow of animals, e.g. causing an unwillingness to enter the stun box thereby demanding more intense driving by the stockperson (Bourguet *et al.*, 2011; Grandin, 2007).

There is thus considerable knowledge about what affects animal welfare in terms of slaughter plant interior and handling. There is, however, still only a limited number of studies focusing on both animal and stockperson behaviour. A field study to investigate the situation in an industrial slaughter environment, also taking the aspect of the slaughter plant as a working environment for the stockpersons into consideration, was designed to broaden our knowledge about important factors to maintain a good animal welfare at slaughter. First when knowing the current state, one can start making improvements. Having the latest, most modern and animal-adapted equipment will not help the animals unless it is managed in a proper way. Also, the persons working at a slaughter plant are just that, persons. Although every person is responsible for his or her actions, in any working situation doing the right thing must be made easy.

Qualitative methods are not commonly used in animal welfare research. Johnson and Onwuegbuzie (2004) launched mixed methods research as the third research paradigm in an effort to progress from the on-going quantitative versus qualitative discussion. For this thesis, a combination of quantitative and qualitative methods was used as a means to widen the perspective on handling of animals and animal welfare in relation to slaughter.

This thesis covers parts of a larger project which investigates relationships between animal welfare and the well-being of stockpersons.

2 Aim

The overall aim of this thesis was, from an interdisciplinary perspective, to analyse different aspects of human-animal interactions at cattle slaughter and to identify important factors for maintaining good animal welfare. The aims for the two studies were:

- Study I: To describe animal and stockperson behaviours and to relate them to animal welfare at commercial slaughter of cattle in Sweden.
- Study II: From an interdisciplinary perspective investigate stockperson behaviour towards cattle in the slaughter plant context, with the focus on animal welfare.

3 Subjects and methods

3.1 Slaughter plants

3.1.1 Study I & II

Data collection for both studies I and II was executed at four commercial slaughter plants in different parts of Sweden, each processing more than 4600 cattle per year.

All animals were unloaded at arrival and kept in indoor lairage facilities at the slaughter plant before slaughter; at three facilities animals were kept in lairage overnight. Lairage consisted either of individual or group pens of varying size, with floors of either solid concrete or slatted rubber on concrete slats, and walls of concrete or metal bars. In all pens the animals had free access to water from automatic drinkers. Driving races varied in length and design between plants; floors were of either slatted or solid concrete with or without rubber mats and walls were of solid concrete or metal bars. Three facilities had manual driving into the stun box, which had fixed walls, while the fourth plant had a hydraulic gate moving horizontally behind the animal to drive it the last meters into the stun box. The gate also worked as an adjustable back wall of the stun box. Two plants had a small gradient of the floor in the stun box to facilitate the animal falling out of the box in the right direction after stunning; one of these also had a sloping wall in the stun box for the same reason. Two facilities had rubber mats on the floor in the stun box and two had concrete flooring. Two facilities had bars on the top of the stun box to protect the staff from being hit by kicking or goring animals. Two slaughter plants used a penetrating cartridge-powered captive bolt gun, one a pneumatic captive bolt gun and one a two-handed rifle with free bullet. The one with pneumatic captive bolt gun restrained the head of the animals, the others did not. Noise levels were measured at all facilities.

3.2 Behavioural observations

3.2.1 Study I & II

Five researchers from different disciplines collected the data; a female veterinarian and PhD student in her thirties, a male ethicist in his thirties, a female agronomist in her forties, a female psychologist in her sixties and a female business researcher in her sixties. The veterinarian observed the behaviour of cattle prior to slaughter and the psychologist, the ethicist or the agronomist observed the behaviour of stockpersons. The veterinarian had visited and collaborated with several slaughter plants before the study, the agronomist had visited several, the ethicist had visited a few and the two others had never been to a slaughter plant before the study commenced.

3.2.2 Study I

Behavioural observations of animals and stockpersons handling them were conducted in 2011. A total of 445 cattle and 15 stockpersons were observed. Of the animals, 132 cattle were observed in the driving race and another 313 in the stun box. Five of the stockpersons were observed both at the driving race and the stun box, seven at the driving race only and three at the stun box only, as a result of the distribution of the staff. At two plants, different stockpersons worked with driving, stunning and sticking animals, and at the two other plants, one person did at least two of the elements of driving, stunning and sticking.

Observations were made at two different steps of the slaughter process; during the last part of driving from lairage to the stun box and during driving into the stun box and stunning. Pre-defined animal and stockperson behaviours were recorded using direct continuous observations (Table 1). For each observation, a focal animal was selected randomly among the animals entering the observation area. All behaviours performed by the focal animal or by any stockperson towards the focal animal were recorded, as well as the time (hh:ss) when the behaviour was shown. The recorded animal behaviours were modified measures of animal welfare identified previously in the Welfare Quality® project (Welfare Quality, 2009). An ethogram of stockperson behaviours assumed to be associated with animal welfare was developed based on earlier experience and preparatory observations before the start of the study. Recording was done using the Interact software (version 9.1.2, Mangold Int. GmbH, Arnstorf, Germany) and two portable computers (Asus, Eee PC 1001PX, Windows® 7 Starter), one for each observer, harnessed onto his/her chest. The computer clocks were synchronized at the start of each observation session.

Table 1. *Pre-defined behaviours observed in focal animals and stockpersons handling them in the driving race or stun box at four Swedish cattle slaughter plants in 2011.*¹

Animal behaviours	Stockperson behaviours
Urinate/defecate	Make noise
Minor slip	Hitting of wall
Major slip	Touch, loose, rear
Vocalization	Touch, loose, front
Run	Tool, loose, rear
Move backwards	Tool, loose, front
Kick	Soft speech
Crowding	Harsh speech
Turn/try to turn	Gate
Minor struggle	Kick
Major struggle	Touch, hard, rear
Fall	Touch, hard, front
Freeze	Tool, hard, rear
	Tool, hard, front
	Tail twist
	Electric goad

¹For definitions and further details please contact the author.

3.3 Ethnographic observations

3.3.1 Study II

Apart from recording of predefined behaviours, the observers described ethnographically what they observed, i.e. what they saw and heard, occurring chains of events and anything else perceived as important for the study. The text was written in the observers' own words by hand in a note book. The main part of the text for a specific day was written after the last observation of that day, although some remarks were written on sheets of paper during observations and later incorporated into the main text. The observers wrote separate texts before discussing what they had written, upon which they could make complementary comments. Data was transcribed *verbatim* from the handwritten notes to two sets of notes: one by the animal observer and one by the stockperson observers.

3.4 Staff interviews

3.4.1 Study II

The ethicist interviewed eleven of the 15 stockpersons (5, 3, 2 and 1 at each slaughter plant) during 2011 and 2012. All stockpersons worked in the lairage and stunning area, i.e. with driving cattle to the stun box and performing the stunning. The interviews were semi-structured, with a few pre-formulated questions and follow-up questions according to the answers from the respondent. The pre-formulated questions were: What does a good day at work look like? When do you consider yourself having done a good job? What in your work affects how you feel? What in your work affects how the animals feel? Has the working environment changed? The interviews lasted for approximately 45 min.

The interviewer made notes of the answers by hand, as the management of the slaughter plants did not allow the use of a voice-recording device. Hence, the spoken words were to some extent analysed and condensed already during the interviews. Later the same day the notes from the interview were re-read by the interviewer and sentences with a lack of words were spelled out in full to improve clarity. In one day, one to four interviews were made depending on the time schedule for the specific slaughter plant.

3.5 Management interviews

3.5.1 Study II

During 2011 and 2012, the management researcher interviewed management representatives at each slaughter plant, i.e. the CEO (chief executive officer), the production manager and/or the purchaser of animals. She also studied documents such as the slaughter plants' annual reports from 2008 onwards, statistics on sick leave, personnel turnover, and the web pages of the studied slaughter plants. The purpose of these interviews and document studies was to learn about the management perspective of the production process and its view on organizational efficiency and finances, including productivity. Especially in focus was the relationship between investment in human resources, i.e. in the welfare of the staff, and investment in animal welfare, and the effects of this relationship on productivity and profitability. Notes from the management interviews were hand written, re-written into a computer and sent to the interviewees for comments. Corrective comments were made on smaller misunderstandings and complementary questions were in some cases discussed by e-mail or by telephone.

3.6 Data analysis

3.6.1 Study I

In study I, behavioural data were edited and analyzed using the JMP® 9 (SAS Institute Inc., Cary, NC, USA) and Excel™ 2010 (Microsoft Corporation, Redmond, WA, USA) software. The number of recorded animal and handler behaviours of each type was calculated for each animal, and minimum, maximum and 50, 75, 90, 97.5 and 99.5th percentiles were calculated for each behaviour. Spearman rank correlation was used to investigate simple relationships between different animal behaviours and stockperson behaviours directed towards the same animal.

3.6.2 Study II

The complete data from all four slaughter plants were analysed together using inductive thematic analysis (Braun and Clarke, 2006), where themes were identified and linked to the data themselves and not to the researcher's preconceived ideas or theoretical interest. The data from the ethnographic description and from interviews with stockpersons and with managers were all interpreted in repeated conversations between four of the five authors who collected the data (excluding the agronomist). For each of the data sets presented above, coding and possible themes in the text were suggested by the researcher responsible for the collection of that data. All relevant codes and themes were presented within the group and the group discussed various interpretations of the material and decided the final themes in consensus. This was done to achieve a higher level of credibility (Graneheim & Lundman, 2004). Consequently, one major theme which seemed to be crucial for all processes at a slaughter plant was agreed upon.

3.7 Ethical considerations

Due to confidentiality reasons, the slaughter plants are not described individually and in detail. The study was approved by the Swedish Regional Ethical Review Board for studies involving humans and the Swedish regional ethics committee for animal experiments.

4 Results

These sections summarize the main results from study I and II. More detailed information can be found in the individual papers.

4.1 Study I

4.1.1 Behaviours in the driving race

Of the observed animals in the driving race, 39 (30%) did not perform any of the pre-defined behaviours and 72 (55%) performed 1-5 behaviours in total (exploratory behaviour excluded). Twelve (9%) animals performed 6-10 behaviours and four (3%) performed 11-20 behaviours. Five (4%) animals performed 21-55 behaviours. The behaviours observed in the highest number of animals were 'moving backwards' and 'crowding'.

Thirty-one (26%) animals had none of the pre-defined stockperson behaviours recorded, 54 (45%) had 1-5, 10 (8%) had 6-10 and 17 (14%) had 11-21 stockperson behaviours towards them (soft speech excluded). Nine (7%) animals had 22-68 stockperson behaviours towards them. For 11 animals, recordings of stockperson behaviours were missing. The behaviours observed in the highest number of stockpersons in the driving race were 'tool, loose, rear' and 'soft speech'.

Of the 121 animals with complete recordings of pre-defined animal and stockperson behaviours, 15 (12%) had neither any animal nor any stockperson behaviours recorded (exploratory behaviour and soft speech excluded). Seventeen animals (13%) with no recorded animal behaviours had 1-11 stockperson behaviours recorded, and for seven animals that showed no behaviours, the recordings of stockperson behaviours were missing. Sixteen animals (13%) had no stockperson behaviours recorded, but 1-14 recorded animal behaviours.

4.1.2 Behaviours in the stun box

Of the observed animals in the stun box, 171 (55%) did not perform any of the pre-defined behaviours, 136 (43%) performed 1-5 behaviours and six (2%) animals performed 6-12 behaviours in total (exploratory behaviour excluded). The pre-defined behaviours observed in the highest number of animals at the stun box were 'moving backwards' and 'minor struggle'.

One hundred ninety eight (70%) animals had none of the pre-defined stockperson behaviours recorded and 72 (25%) had 1-5 (soft speech, gate at one plant and head-restraint excluded). Seven (2%) animals had 6-10, five (2%) had 11-23 stockperson behaviours directed towards them and one animal had 78. For 30 animals, recordings of stockperson behaviours were missing. The behaviour observed in the highest number of stockpersons at the stun box was 'gate' (For one plant, gate was recorded differently than at the other plants due to differences in design and was therefore excluded from analysis).

Of the 283 animals with complete recordings of pre-defined animal and stockperson behaviours at the stun box, 98 (35%) had neither animal nor stockperson behaviours recorded (exploratory behaviour, soft speech, gate at one plant and head-restraint excluded). Forty nine (16%) with no recorded animal behaviours had 1-23 stockperson behaviours recorded, and for twenty four animals that showed no behaviours, the registrations on stockperson behaviours were missing. One hundred animals (35%) had no pre-defined stockperson behaviours recorded, but 1-12 animal behaviours.

Detailed information about the distributions of recorded pre-defined animal and stockperson behaviours at the driving race and the stun box can be found in Paper I.

4.1.3 Noise levels

The measured noise levels during work breaks at the four slaughter plants varied between 60 and 86 dB(A) at the driving race and between 66 and 82 dB(A) at the stun box. The corresponding values at full speed of work were 59-92 and 65-92 dB(A); at shots and unloading up to 115 dB(A).

4.2 Study II

A summary of the results are given in Table 2, which also explains principles of the analysis and gives examples of empirical descriptions from the notes made by the observers and from the interviews with stockpersons and managers. The interpretations of the empirical descriptions, the sub-theme and the over-arching theme show how data are interpreted as being related to each

other. The table is organized according to recommendations by Graneheim and Lundman (2004). The main theme found was denoted “work flow”, as this emerged clearly to be in common for all data from the ethnographic observations and the interviews. Although not addressed here, work flow also encompasses other areas of interest beside animal flow and welfare, which was therefore identified as a sub-theme. The analysis was focused on the sub-theme “animal welfare and flow”.

Below, the results are presented in a condensed form. Quotations are taken from the observer notes or from the interviews of stockpersons and managers, translated directly from Swedish.

All managers said that production was efficient when there was flow. Also, all managers expressed in different ways an inability to plan the production flow and to follow such plans:

“We never plan overtime, but it happens. Last Friday, we got a load of cattle, which resulted in overtime until five in the afternoon. Otherwise, we only clean up on Fridays, and go home at noon.” (*Manager*)

Stockpersons appreciated easily moved animals, few injuries to staff, vehicles arriving on time, reliable equipment and a low risk of ending the day working overtime, all of which influence the work flow. Delayed animal transports seemed to be a crucial factor for overtime. Working overtime seemed to be a more negative experience among the stockpersons than injuries or equipment failures, and something the staff might be faced with on a daily basis. A stockperson described a good day as:

“Everything works. Nothing broken, no disturbances like machines failing or animal transports being late.” (*Stockperson*)

An uneven flow of animals was repeatedly observed. Sometimes there were no animals to slaughter and the staff had to wait for the next animal transport vehicle to arrive at the slaughter plant, or transports had to wait outside as the lairage area was full. At other occasions, animals were seen piling up after sticking, necessitating a forced cease in the stunning of animals for a few minutes.

Table 2. Empirical descriptions (from ethnographic observations and stockperson and manager interviews), interpretations, sub-theme and theme related to work flow and animal welfare found in a qualitative study of cattle handling at four Swedish slaughter plants in 2011.

Empirical description close to the original text (Data source)	Interpretation of the underlying meaning (Code)	Sub-theme	Theme
Often long time passes between shots (Observer)	Uneven animal flow	Animal welfare and flow	Work flow
Finished by lunch (Observer)			
An animal transport needed to wait outside because lairage was full (Observer)			
Hard competition for animals (Manager)			
Manning planned for medium capacity. When full capacity is needed, extra staff is taken in, if available (Manager)			
There can be troubles with transports, which might cause delays (Manager)			
They claim that the cars have problems, but it seems to be the same excuse all the time (Stockperson)			
The animals enter the box relatively willingly (Observer)	Well-working interior or equipment	Animal welfare and flow	Work flow
Same floor as in the driving race, non-slip (Observer)			
Everything works. Nothing broken, no disturbances like machines failing (Stockperson)			
Very high solid walls make driving difficult (Observer)	Problematic interior or equipment	Animal welfare and flow	Work flow
Many animals balk at the entrance to the stun box, most of them are prodded with the electric goad (Observer)			
The weapon sometimes didn't function (Observer)	Calm or neutral handling	Animal welfare and flow	Work flow
You walk behind them not to scare them (Stockperson)			
The animals that have stayed the night are calm; the recently unloaded animals are stressed (Stockperson)			
Are they used to handling then it is easy to get them to move; they act nice and calmly (Stockperson)			
The stockperson is calm, lets the animal sniff and walk in its own pace (Observer)			
Calm movements (Observer)			
Waited for the animal to hold up its head (Observer)			
Worked calmly in spite of delay (Observer)	Impatient handling	Animal welfare and flow	Work flow
Stockpersons seem irritated and fiery before lunch (Observer)			
Moves quickly, shouts, electric goad many times on each animal (Observer)			
Kicks on the side of the stun box to get the animal to hold its head (Observer)			

Several problematic parts of the driving races were identified. The interior had a direct effect on the possibility for the staff to use the flight zone when moving animals. Using the flight zone to move the animals was rarely seen, and was sometimes impossible because of the interior design:

“Very high solid walls in the driving race. Practically impossible to use the animal’s flight zone to move it plus very poor ergonomics for the staff.”
(*Observer*)

At one plant there were some problems with the weapon (a penetrating cartridge-powered captive bolt gun), observed at least twice during the three day observation period. At the same plant, several cases of failed stunning were seen:

“A bull didn’t drop to the floor until after 3 shots. After, I asked the stockperson what happened and he said he missed.” (*Observer*)

Both handling that was perceived as calm and on terms of the animals, and handling perceived as stressful or impatient was observed at the four slaughter plants. The handling of animals varied between individual stockpersons:

“Person A does not position himself appropriately - stands on the side and diagonally in front of the animal and drives the animal holding a stick or the electric goad with his arm extended. Person B is much calmer, uses the flight zone to drive, sometimes the electric goad.” (*Observer*)

In summary, the results indicate that work flow is essential; for the management work flow is essential for productivity and for the staff work flow is important for a feeling of a good day at work. Good work flow is dependent on a good animal flow, which is closely linked to animal welfare. The slaughter plant interior is an important factor to enable an even flow of animals, as well as well-planned animal transports to the plant. The way the animals are handled vary between stockpersons.

5 General discussion

5.1 Work flow

At the four Swedish commercial cattle slaughter plants which were studied during 2011 and 2012, it was found that the work flow was an essential ingredient for management, stockpersons and animals. Work flow can be expected to be important in any profession or industry (Boxall and Purcell, 2008). However, at a slaughter plant, where one of the most important components is the animals, i.e. living and reacting creatures with possibly large effects on the work flow, there is a built-in impediment to a smooth work flow. In this study, an uneven flow of animals into the slaughter plants was repeatedly observed, causing involuntary breaks to wait for new animals to arrive or the need to make arriving animals wait outside.

A smooth work flow starts with having animals available and ready for slaughter at the slaughter plant. A traditional way of managing the slaughter plants, resulting in difficulties in handling the input and output processes and causing an uneven work flow, was identified in study II. The logistics of slaughter transports influence animal welfare and the working conditions of the staff, and it apparently needs to be improved. Modern logistics are applicable in any industry where transportation is an integrated part of the business. The time window for transportation planning for slaughter animals was by the interviewed managers reported to be one week. Moen (2008) considers one week of transportation planning being an eternity in comparison to other industries, and states that the largest hindrance to efficiency gains in transportation to slaughter, in Sweden and other European countries, is traditional management.

5.2 Handling and animal behaviour

The results from studies I and II may to some extent be considered not to be fully consistent. The results from study I indicate that a proportion of animals pass through the system as desired; walking forward without any extra driving by the stockpersons and without performing behaviours associated with impaired animal welfare. In results from study II, many observations of impatient handling were reported. One reason for this difference is that in study I, a focal animal and the stockperson handling that animal was observed, while in study II, the situation as a whole was observed, thus including a higher number of animals and the handling of them, as well as other events going on in the room.

Animals performing only a low number of behaviours could have many stockperson behaviours directed towards them and vice versa. This is reflected in the small number of correlations found between animal and stockperson behaviours in study I, and suggests that events occurring in the vicinity of the animal but not aimed directly towards the animal itself, e.g. noise, unloading of other animals or persons passing the animal, are also important for the animal welfare. This indicates that the behaviours performed by individual stockpersons are not the only thing of importance, and a wider approach of research about animal welfare is suggested. It also indicates that education of staff is not the single solution to improve the welfare of animals at slaughter, but that also improved plant design will inevitably play an important role.

An issue to address is how to drive animals in an animal-friendly way despite shortcomings of the interior, or if it is even possible to do. Stockperson behaviours that are in fact illegal were seen several times in this study; hitting and kicking of animals, tail twisting and repeated electric prodding on some animals. The Swedish animal welfare legislation on slaughter of animals (SJVFS 2007:77) based on the EC directive 93/119 on the protection of animals at the time of slaughter (93/119/EC), state that the animals may not be lifted in their tails or handled in other ways that can cause pain or suffering. It also states that electric goads may be used only in exceptional cases and only occasional shocks with the duration of maximum 1 s are allowed.

Driving animals by repeatedly hitting them loosely (or firmly) using a stick on the rear or front, was observed both in study I, with recording of pre-defined behaviours, and in study II, with ethnographic observations. Why these behaviours are performed may be of interest for discussion, especially when used on the animal's front part. A question that arises is if the stockpersons carry out these behaviours deliberately with a clear and conscious attempt to drive the animals in a decided direction, or if it is merely a habit without much consideration.

Other common behaviours, where the purpose appeared to be to make the animals move forward in the driving race, was hitting the wall with a stick or electric goad, making noise or yelling. Waynert (1999) concluded in a study that noise induces a fear reaction in beef cattle, and that the sound of humans shouting appeared as more alarming than the sound of metal clanging. Grandin (2007) reported that the stress and level of excitement increased at slaughter plants where equipment was noisy and people were yelling. The maximum noise levels measured in this study was 115 dB(A) when animals were shot or unloaded, and 92 dB(A) at full speed of work. The animal welfare legislation (SJVFS 2007:77) states that animals at slaughter plants occasionally may only be exposed to noise levels above 75 dB(A). Besides the risk of stressing the animals, there is an increased risk for hearing damage for humans from about 75 dB(A); intermittent noise being associated with increased risk (Swedish Work Environment Authority, 2012). Reducing the noise levels as much as possible would thus not only be beneficial for the animals but also for the stockpersons.

The daily control of animal welfare at slaughter plants is carried out by the official veterinarian; a person physically working at the slaughter plant but employed by the Swedish National Food Agency (Berg & Axelsson, 2012). Inspection in the lairage area is only one of many tasks for the official veterinarian at the slaughter plant and can only be executed during a limited amount of time. Besides the time constraints, it is a difficult task to inspect your own work place for two main reasons: the person whose actions you are inspecting is your co-worker, and constantly being in a certain environment involves a risk of making you blind to defects. Also, there seems to be a culture related to how to drive animals at slaughter plants which, despite bordering illegal acts, is seldom challenged. Challenge by one official veterinarian at one slaughter plant is most likely not viable, although there are examples which have led to legal action by the authorities; nevertheless the discussion on how to drive animals at a slaughter plant needs to be raised at a higher level.

To conclude, to drive animals in an animal friendly way in a plant with shortcomings of the interior requires plenty of time and patient staff. However, as slaughter is often performed under obvious time constraints, the stockpersons may perceive illegal acts such as tail twisting and excessive use of the electric goad as necessary to keep up the line speed, indirectly – or not – supported by the plant management. Slaughter plant interior not only needs to be adapted to animal behaviour. The interior also needs to be adapted to human behaviour, taking into account that working in a non-ergonomic or tiring position with animals that refuse to walk may be quite frustrating.

An encouraging finding is that the pre-defined animal and stockperson behaviours considered most detrimental to animal welfare, i.e. fall, freeze and major struggle performed by animals and tail twist and electric goad use performed by the stockpersons, seem to be relatively rare in the areas of observation in this study.

5.3 Methodological considerations

Qualitative methods are traditionally not used in animal welfare research. As slaughter is a complex and multidimensional activity, a multidimensional or interdisciplinary approach, which was used in this thesis, seems very suited to the purpose of investigating this activity. In a study on equine welfare, Collins and co-workers (2012) used three qualitative methods; semi-structured interviews, focus groups and a facilitated workshop to combine stimulation of discussion, exchange of information about equine welfare between stakeholder groups and determining if a consensus view might be achieved concerning policy solutions. A similar use of qualitative methods, combining research with exchange of information to both parties, might be very useful for researchers, managers and stockpersons at slaughter plants, as well as for the slaughter industry in general.

Cattle and pigs are, with the exception of poultry, by numbers the most commonly slaughtered animals in Sweden. Cattle were chosen for these studies as they are to a higher degree handled individually and more easily distinguished from one another during observations.

There were some difficulties in recruiting slaughter plants that were willing to participate in the study. Several slaughter plants that were contacted seemed suspicious and afraid of negative attention, and all larger plants in Sweden needed to be contacted to obtain a reasonable number of plants to study. This resulted in studied plants being geographically relatively spread out, which led to some logistical challenges; three of four slaughter plants were not visited prior to the data collection. This resulted in less time to get familiar with the slaughter plant interiors and the employees, to decide on observation locations for the driving race and the stun box and to try out the ethograms and observer equipment.

Finding appropriate locations where the observers could actually observe what was taking place proved to be another challenge. This was a problem for this research project but is in fact a real challenge at official inspections for animal protection purposes. If some of the critical control points for animal welfare are hidden to the inspector, there is certainly a problem. One solution which does not involve major re-construction is to use video surveillance

cameras (CCTV) (Berg, 2012). The plant management is often very reluctant to allow this and it could therefore not be used in this study. Also, the slaughter plants had different types of lairage facilities, driving races and equipment that to some extent made it difficult to carry out the observations in a consistent way.

Although complementing each other synergistically, the behavioural and ethnographic observations may benefit from being separated in time, enabling observers to have full focus on one thing at a time. Several observers were involved in the behavioural and ethnographic observations. For the observations of pre-defined behaviours, more training of the observers might have been beneficial. However, for the ethnographic observations, the combination of observers used to the slaughter plant environment and observers who were naïve would seem like an optimal combination to get different views and minimize observer bias.

There may be an observer effect in the material, the so called Hawthorne effect. The effect describes how test-persons adapt their behaviour to what they assume is expected of them, and is interpreted as the employees, enjoying being noticed by participating in a study, want to do the best they can (Homans, 1941/1999). In our study, the observers were clearly visible to the stockpersons, and the stockpersons may have known exactly when observations were done. This could have altered the behaviour towards a more animal-friendly behaviour and explain why some of the stockpersons were seen handling animals in both a calm and an impatient way. If, and in what way, the observers may have had an effect on the behaviour of the observed persons may vary depending on the age and gender of both parties. All the observed stockpersons were male, and age and gender of the observing researchers are accounted for in section 3.2.1.

6 Conclusion

A good work flow seems to be essential at slaughter of cattle, both for productivity and for providing an acceptable work situation for the stockpersons. Good work flow is dependent on a good animal flow, which is closely linked to animal welfare. To keep an even flow of animals into and within the slaughter plant, there is a need for slaughter plant management to improve the planning of incoming animal transports. Furthermore, it would most likely be beneficial for both stockpersons and animals if slaughter plant interior design was revised to facilitate easy driving to improve animal flow from lairage to stunning. Only a few animals were seen performing or receiving high numbers of the recorded pre-defined behaviours. Behaviours strongly associated with poor animal welfare were rarely seen. A proportion of animals were driven into the stun box and stunned without performing or receiving any of the pre-defined behaviours related to impaired welfare. Nevertheless, an animal performing only few of the pre-defined behaviours could have many of the pre-defined stockperson behaviours directed towards it, and *vice versa*. Methods and routines for driving of animals need to be further discussed and developed to avoid habitual and unnecessary hitting or other rough handling prior to slaughter.

7 Svensk sammanfattning

För att få kött måste man slakta djur. I Sverige slaktas omkring 450 000 nötkreatur varje år; 2011 slaktades 93% av dessa på de 16 största nötslakterierna i landet. Bibehållen djurvälstånd vid storskalig slakt av djur ställer stora krav på utföraren. Med god djurvälstånd menas att hänsyn har tagits till djurens biologiska förutsättningar och subjektiva upplevelse samt att de ges möjlighet att anpassa sig till omgivningen. Tidigare forskning visar att inredningens utformning har betydelse för djurens välfärd. Otillräcklig belysning eller branta nivåskillnader där djuren ska gå kan göra att de stannar, och hala eller slitna golv ökar risken för att djuren halkar. Tidigare forskning visar också att djur kan bli stressade av hantering och att det finns ett samband mellan skötarnas attityd och beteenden gentemot djuren. I vissa fall kan inredningens utformning påverka skötarnas möjligheter att hantera djuren på ett korrekt sätt; höga väggar i drivgångar kan försvåra drivning framåt och skarpa svängar som gör att djuren stannar upp kan göra att skötarna driver djuren hårdare för att alls få dem att gå.

Syftet med studierna i den här avhandlingen var att med en tvärvetenskaplig ansats beskriva och analysera interaktioner mellan djur och människa vid storskalig slakt av nötkreatur, för att identifiera viktiga faktorer för en god djurvälstånd. I avhandlingens första studie observerades och registrerades definierade beteenden hos slumpmässigt utvalda djur och de skötare som hanterade dessa djur på slakteriet. I den andra studien samlades data in dels genom etnografiska beskrivningar, där händelser som involverade djur och skötare beskrevs av observatörerna i fri text, dels genom intervjuer av skötare och slakteriledning.

Resultatet visar att ett antal djur drivs in och bedövas utan att de utför några av de specifikt studerade beteendena eller får några av de studerade skötarbeteendena riktade mot sig. Ett fåtal djur utförde eller fick ta emot många beteenden, men de beteenden som bedömdes vara mest negativa för djurens

välfärd observerade endast ett fåtal gånger. Många av skötarbeteendena utfördes av ett fåtal skötare, och en del olämpliga beteenden såsom upprepad användning av elpåfösare observerades. Ett tema som återkom i de etnografiska beskrivningarna och i intervjuer med skötare och ledning kan beskrivas med ordet ”flyt”, vilket innebar att arbetet flöt på utan några oönskade avbrott. För ledningen var flyt viktigt för effektivitet i produktionen. För slaktarna var det, som i de flesta jobb, viktigt med flyt i arbetet för att de skulle vara nöjda med arbetsdagen. Något som i hög grad påverkar flytet i arbetet är djurflödet, vilket också kan ha stor påverkan på djurvälfärden. Ett ojämnt djurflöde observerades vid flera tillfällen, och många av de observerade beteenden som utfördes av skötarna uppfattades som otåliga.

Slutsatsen är att god planering av inkommande slakttransporter samt inredning anpassad till både djur och människor är viktiga faktorer för en god djurvälfärd. En ändamålsenlig inredning kan förenkla drivningen av djuren samt främja ett jämnt djurflöde och därmed ett bra arbetsflyt. Rutiner och metoder för att driva djur till slakt behöver ses över och diskuteras för att minimera onödig eller hård drivning av djuren.

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*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
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