Facility design in relation to animal behaviour, stress and bruising

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ABSTRACT

An understanding of behavioural principles such as the flight zone, 360 degree vision, sensitive hearing, strong reactions to novelty and effects of pressure on the body will facilitate handling and restraint of livestock. Silencing high pitched noise from hydraulic pumps and motors will reduce stress. Solid fences on races, crowd pens and loading ramps will keep animals calmer by blocking their vision. A curved race to a crush or stunning box will facilitate cattle movement because an approaching animal will not be able to see people at the other end. Wild cattle will stand still in a dark box for AI. Wild cattle in a restraint device will remain calmer if they are unable to see people inside their flight zone or a pathway of escape. It is important to keep vision blocked until the animal is completely restrained. Restraint devices should only apply sufficient pressure to hold the animal snugly in a comfortable position and to make the animal "feel restrained" without any pain or discomfort. Pressure applied with a slow steady movement will keep cattle calmer but pressure applied with jerky sudden movement causes excitement. Handlers and equipment engineers who utilize these principles can move and restrain livestock more efficiently with less stress and carcass damage. Rough handling is one of the major causes of carcass damage.

Keywords: Handling, Restraint, Slaughter, Behaviour.

INTRODUCTION

Knowledge of animal behaviour provides both economic and welfare benefits to livestock production systems. Handling and transportation stresses can lower conception rate and suppress immune function (Hixon *et al.*, 1981; Blecha *et al.*, 1984). Handling sheep with dogs and repeated transport and sorting 11 to 20 days post-mating caused significant early embryonic losses (Doney *et al.*, 1976). Rough handling is a major cause of bruising in all species of livestock. Meat quality problems, such as dark cutting beef and PSE (Pole soft exudative) pork can be reduced by gentle handling. Handlers and facility designers can reduce stress, improve handling efficiency and restrain livestock more humanely if they understand basic behavioural principles. Behavioural factors associated with such principles are: animal sensitivity to high frequency noise; animal withdrawal from, or investigation of novel stimuli; calming effect of blocking an animal's wide angle panoramic vision; calming effect of moderate amounts of pressure applied to the body; the flight zone and point of balance of animals and their propensity to follow and, memory of previous handling experiences.

Sensitivity to noise

Cattle or sheep have acute hearing and are very sensitive to noise. Sheep can hear higher frequencies than humans (Ames and Arehart, 1972). Cattle can hear frequencies up to 21,000 hz, which is well above the range of the human ear (Algers, 1984). Noise is stressful to sheep and cattle. Slaughter in a noisy commercial abattoir compared to a quiet research abattoir was more stressful (Pearson *et al.*, 1977). Observations in the US indicated a high pitched whine from a poorly engineered hydraulic system caused greater behavioural agitation in cattle than a low pitched rumble from a moving conveyor chain. Cattle became calmer when the high pitched whine was eliminated. Other noises, such as air exhausts, metal clanging and banging and people yelling also need to be silenced.

Novel stimuli

Cattle and sheep are prey species and they must be constantly vigilant. When they are calm, they will stop and investigate novel stimuli but when they are excited, novel stimuli will cause a withdrawal reaction. Harsh contrasts of light and dark or changes in flooring texture or type will cause livestock to balk and impede movement. In facilities where dairy cows are handled every day, they will learn to step over a curb or drain. In a slaughter plant or auction market, the novelty of a drain in the alley will cause the lead animal to balk. Odd smells will also impede livestock movement. To facilitate animal movement into the restrainer at a slaughter plant, a localized zone of negative air pressure should be created at the building entrance to prevent approaching animals from smelling strange smells. Many people are concerned about an animal becoming alarmed at the sight or smell of blood. Observations of cattle indicate that most of the time, they balk at a spot of blood on the race floor as if it was a novel stimulus. A piece of paper thrown on the race floor causes similar balking and investigation.

Preliminary observations indicate that blood which came from cattle that were in a state of frenzied agitation for two or three minutes evokes a large fear response, but blood from relatively calm cattle has little effect. This is an area which needs more research. Experiments with rats indicate that

blood from stressed animals may contain an alarm phenomena (Stevens and Gerzog-Thomas, 1977). Observations at many feedlots slaughter plants indicate that when an animal becomes severely agitated, the agitation fear responses spread to other cattle.

Effects of Vision

Cattle and sheep have wide panoramic vision. The visual field of cattle is 360 degrees and in sheep, it varies from 190-306 degrees, depending on the amount of wool on the sheep's head (Prince, 1977; Hutson, 1980). The use of solid fences on races and in restraint devices will help keep animals calmer and facilitate movement through a handling system (Grandin, 1987). A curved race leading up to a restraint device will facilitate the movement of cattle because they cannot see people and motion up ahead. People that are moving seem to be much more threatening to cattle than people who stand completely still. Curved races must be laid out correctly. Cattle and sheep will not enter a single-file race which appears to be a dead end (T Grandin, 1991a). At the race entrance approaching animals must be able to see two or three body lengths up the race, therefore a straight section of race at the race entrance prior to the curve will facilitate entry. Curved races are recommended for cattle and sheep but they provide no advantage for moving pigs. The principle is to allow the animal to see a pathway but block its vision of people and other distractions outside the fence. Cattle and sheep have a behavioural tendency to move from dark to brightly illuminated areas. Lamps can be used to attract livestock into races.

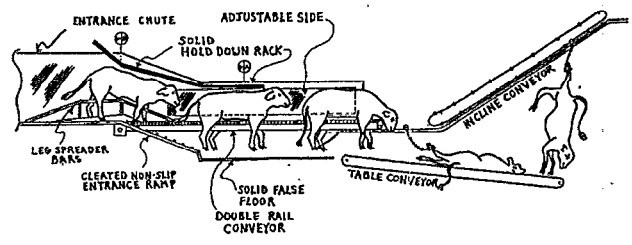
Solid fences are especially important for animals that are not accustomed to daily handling. Wild cattle will stand still for artificial insemination in a dark box race, (a box with solid sides, front and top and no head bail). The cow will stand still because she is in the dark and cannot see people or a pathway to escape. The same principle is also used in dark rooms for deer handling. Hales *et al.*, (1987) found that cattle restrained in a dark box had lower stress levels compared to cattle restrained in a conventional head bail and squeeze crush.

Flight zone is a very important principle in animal handling. Cattle and sheep react by moving away when a person enters their flight zone (personal space) (Grandin, 1987). Deep invasion of the animal's flight zone is one reason why cattle become agitated during restraint in a squeeze crush. The operator of the crush is deep inside the animal's flight zone. Covering the side of the squeeze crush to prevent the animal from seeing the operator will usually result in calmer cattle. The installation of a solid gate about one metre in front of the head bail will prevent cattle from attempting to run through the head bail by preventing them from seeing a pathway of escape.

Blocking the animal's vision can also have a dramatic effect in restraint systems used for slaughter. In a double rail (center track) conveyor restrainer system, cattle remained calmer when their vision was blocked by an overhead hold-down rack until the animal's feet were completely off the entrance ramp (Figure 1) (Grandin, 1991b). It is important for the animal to be completely down on the conveyor before the animal is allowed to see ahead. If the animal's head emerges from under the hold-down rack while its rear feet are still on the entrance ramp, it often struggles. For cattle, extending the hold-down resulted in calm cattle which rode on the conveyor without struggling. This is an example of using behavioural principles to restrain rather than force an animal.

Conveyor entrances should be designed so that animals can walk in without slipping. It is a mistake to attempt to make animals jump or slide into a restraining conveyor. To prevent balking, restraining conveyors should have a false floor to prevent animals from refusing to enter due to the visual cliff effect (Figure 1). Sheep can perceive the visual cliff effect (Lemman and Patterson, 1964).

FIGURE 1: Centre track (Double Rail) restrainer. Note that the hold down over the entrance is long enough so that the animal is fully restrained and off the entrance ramp before it is allowed to see out.

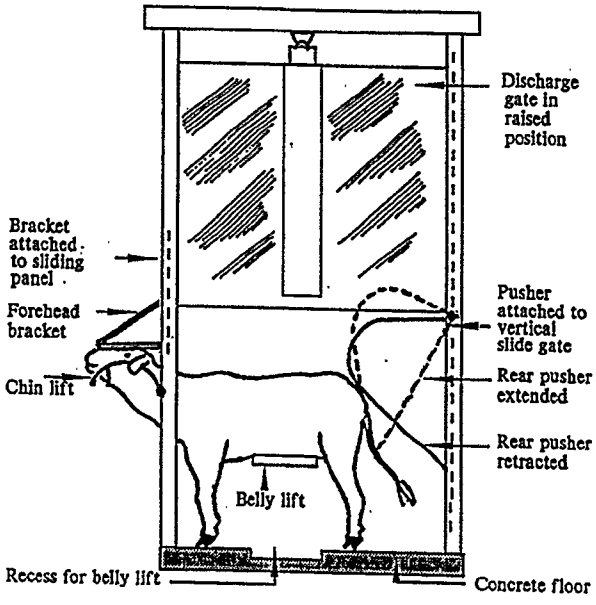


Effects of Pressure

When a restraint device effectively blocks a bovine's vision and it is not able to see people inside its flight zone or a pathway to escape, one can observe subtle effects on behaviour of pressure applied by a restraint device. It is very important to keep the vision blocked until the animal is completely restrained. There is an optimum pressure for animal restraint. A restraint device should apply sufficient pressure to hold an animal in a comfortable position. There should be just enough pressure to make an animal "feel restrained" without pain or discomfort. Excessive pressure will cause struggling due to pain and many handlers make the mistake of applying additional pressure. Sometimes an animal will stop struggling if the pressure is slowly reduced.

A special restraining chute is used for kosher cattle slaughter in the US. It consists of a narrow stall with completely solid sides with a small opening in front for the animal's head. An enclosure around the outside opening prevents the cattle from seeing out. The top of the apparatus is open and not in the dark. The animal body is restrained by a rear pusher gate and a lift supports the animal under the belly (Figure 2) (Grandin, 1992; Marshall *et al.*, 1963). This device had hydraulic controls which enabled the operator to precisely control the amount of pressure applied to the animal by the pusher gate and the belly lift. Most cattle stood still, remained calm and made almost no attempt to resist when pressure was slowly applied to their bodies by the apparatus. However, sudden, jerky movements of the apparatus caused agitation and excitement. If excessive pressure was applied by the pusher gate or the belly lift, the cattle resisted by squirming and struggling.

FIGURE 2: Cattle restraining device with rear pusher gate and belly lift.



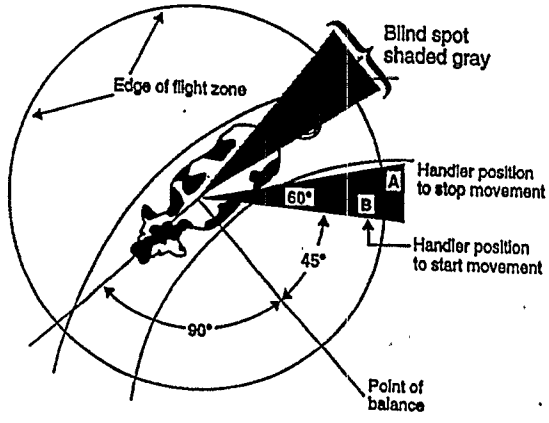
Pressure can have similar calming effects on pigs. Pigs left in a V-conveyor restrainer will often fall asleep. Pressure applied to the sides of a pig in a padded V-shaped trough will induce sleep (Grandin *et al.*, 1989). In a V-restrainer, the calming effect is most likely to be observed in round, plump pigs which are evenly supported. Heavily muscled pigs with wide hams and narrow shoulders often squeal and struggle in a V-restrainer because the front half of the body is not supported.

Use of flight zone principles for gentle handling

Rough handling and agitation prior to entry into a restraint device will negate many of the calming effects previously discussed. The use of electric prodders and ill-trained dogs, therefore, should be minimized. Breeding animals will quickly learn to move before they have to be prodded or have their tail twisted. Handlers should reward the animal when it moves correctly and stop prodding or twisting the tail. Handlers who understand basic flight zone and point of balance principles can move animals with a minimum of disturbance (Grandin, 1987; Kilgour and Dalton, 1984) (Figure 3).

One of the most common mistakes that handlers make is overloading the forcing pen which leads to the race with too many animals. Animals need space to turn. Animals will be calmer and handling more efficient if the race is allowed to become partially empty before it is refilled. This allows handlers to use the animal's natural following behaviour. Conveyor restrainer systems may help reduce stress because animals are never isolated from their herdmates and they have continuous visual and tactile contact. Cattle and sheep can be moved more easily if the handler works on the edge of their flight zone. To make an animal move forward, the handler should be behind the point of balance located at the animal's shoulder. The handler should stand in positions A and B to move the animal forward (Figure 3).

FIGURE 3: Flight zone of cattle and sheep. The animal will move when the handler enters the flight zone and stop moving when the handler retreats.



Memory of previous experiences

Animals have good memories. Cattle and sheep can remember an aversive experience for many months (Pascoe, 1986; Hutson, 1985). Animals that have previous experience of gentle handling will be calmer and easier to handle in the future. Aversive methods of restraint, such as nose tongs and electro-immobilization should be avoided. Stress during restaint is less in animals that are accustomed to daily handling. Wild, extensively raised cattle had higher cortisol levels during restraint compared to tame dairy cows (Lay *et al.*, 1992). Animals can be trained to voluntarily enter a comfortable restraint device. The device should be introduced gradually and rewards of highly palatable feed should be used. Another interaction with gentle, calm handling is genotype. In the US and Australia, there are certain genotypes of pigs which are very difficult to drive. The animals are very excitable, have extreme shelter seeking behaviour and it is difficult to get one pig to separate from the group and move up a race. In cattle, differences in temperament can be very persistent. When cattle were restrained four times at 30-day intervals, they could be categorized into three basic groups: 1) highly agitated every time they were restrained, 2) sometimes calm and sometimes agitated, and 3) always calm. Breeders need to select animals for temperament and avoid breeding animals with stress and handling behavioural problems. To obtain an accurate assessment of temperament, culling decisions should not be based on a single restraint or temperament testing session.

CONCLUSIONS

Restraint and handling can be made more humane and efficient if designers and operators of equipment work with an animal's natural behavioural reactions instead of trying to forcefully overpower animals. Management and employee attitudes also need to be changed. People who have handled animals forcefully are sometimes reluctant to admit that gentler methods are more efficient, less stressful and prevent carcass damage such as bruising. It is possible to greatly reduce stress during handling.

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