Teaching Principles of Behavior and Equipment Design for Handling Livestock

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ABSTRACT: A course is described in which students are taught principles of livestock behavior and how an understanding of behavior can facilitate handling. Some of the principles that are covered in the course are livestock senses, flight zone, herd behavior during handing, and methods to reduce stress during handling. To teach problem solving and original thinking, the students design three different types of handling facilities. Design of restraint equipment and humane slaughter procedures are also covered. Both existing systems and ideas for future systems are discussed. Students are provided with information from both scientific studies and practical experience.

Key Words: Behavior, Teaching, Handling, Restraint


Introduction

To improve animal welfare and reduce stress, there is a need for students to learn about livestock behavior during handling. My course is titled "Livestock Behavior and Handling," and it is offered in the Department of Animal Sciences at Colorado State University. Most of the students who take the course are either animal science or equine science majors. Students taking the course learn the principles of livestock behavior and how they can be used to facilitate handling during truck loading, feedlot processing, veterinary procedures, sorting, and slaughter. Information from both scientific studies and practical experience is presented. A major objective of this course is to stimulate students to think in an original manner. The emphasis is on learning how to use facts rather than reciting them back on an exam.
The major areas covered in the course are livestock senses, flight zone principles, facility layout and design restraint, stress and handling, humane slaughter, and welfare aspects of handling and various procedures. To stimulate problem-solving abilities and original thought, students design three different types of livestock handling facilities and design restraint equipment for a fictitious animal.

**Content of the Course**

**Livestock Senses**

It is important for students to learn some basic information on how cattle, pigs, and sheep perceive the world. All species of livestock have wide-angle panoramic vision (Prince, 1977). This fact explains why practical experience has shown that the use of solid sides on loading ramps, chutes, and crowd pens facilitates handling and reduces agitation (Rider et al. 1973; Grandin, 1980, 1982). Research has shown that sheep have depth perception when they are standing still (Lehman and Patterson, 1964). Hutson (1985a) suggested that there may be a blind area at ground level and sheep may not be able to use motion parallax or retinal disparity to perceive depth. Contrary to popular belief, livestock have color vision (Hebel and Sambraus 1976; Munkenbeck, 1982; Klopfer and Butler, 1984; Gilbert and Arave, 1986).

Observations in the field have shown that livestock will often balk at puddles, shadows, and moving objects (Lynch and Alexander, 1973; Grandin, 1980). Differences in illumination will also affect livestock movement (Lynch and Alexander, 1973; Van Putten and Elshof, 1978; Hutson, 1981; Grandin, 1987, 1989a). Students are shown numerous slides of handling facilities, many taken from a cow's perspective. The slides show both well-designed and poorly designed facilities, and a full explanation is given for each slide. The slides also show things that make cattle balk, such as shadows, puddles, and swinging chains in chutes and alleys. Exposure to many pictures helps students identify and correct problems in the field.

Cattle and sheep are more sensitive to high frequency noise than are humans (Ames and Arehart, 1972). Excessively loud noise is stressful, but animals can adapt to reasonable noise levels (Ames, 1974). Sheep slaughtered in a noisy commercial slaughter plant had elevated cortisol levels compared to sheep slaughtered in a quiet research abattoir (Pearson et al., 1977). During lecture, students are informed about ways to reduce noise in livestock handling facilities. More detailed information based on practical experiences has been published previously (Grandin, 1987, 1989a).

**Flight zone and Behavior During Handling**

It is very important for students to understand the concept of flight zone and point of balance. Knowledge of these principles will enable students to handle livestock safely, humanely, and
efficiently. Students need to learn to stay on the edge of the animal's flight zone. The size of the flight zone is affected by both the size of the enclosure an animal is held in and whether the animal has had previous contact with people (Hutson, 1982; Hargreaves and Hutson, 1990a).

Inexperienced handlers often make the mistake of standing in front of the point of balance at the shoulder and prodding an animal on the head to make it go forward. A complete practical explanation of these principles was described by Grandin (1980, 1987, 1989a) and Kilgour and Dalton (1984). Students are taught flight zone principles with lectures, videotapes, and practice with live animals. Point of balance is taught by confining several cattle or sheep in a single-file chute. Progressing from head to tail, when the student walks past the point of balance of the animal, it will move forward.

All livestock are herd animals and they will become stressed or agitated when they are separated from their herdmates. Students must be warned that a steer that is calm in its home pen with a group of animals may charge and run over them when it is separated from its herd mates. Many serious cattle handling accidents are caused by a lone animal.

Many students do not realize that behavior during handling is affected by previous experiences. Animals remember painful or frightening experiences for many months (Hutson, 1985b; Pascoe, 1986). The author has observed that cattle that came from feedlots with rough handling were wilder and had more bruises than cattle from feedlots with gentle handling. There is also some evidence that sheep can remember specific people who participated in painful surgery (Fell and Shutt, 1989).

Observations by the author indicate that certain individual cattle within a herd may become very agitated in the squeeze chute. Cattle with an excitable temperament should be culled from a teaching program because they are likely to injure students.

For both humane and safety reasons, a college campus must have adequate handling facilities for teaching students. A bare minimum for cattle would be a squeeze chute, single-file chute, crowd pen, and one or two holding pens. For safety, it is essential that the equipment is kept in good repair. Latching mechanisms on the squeeze chute must be replaced when they become worn to prevent accidents. For maximum educational value, a modern facility with a curved chute with solid sides and a round crowd pen is recommended. It is important to expose students to well-designed facilities. Many college campuses are sadly lacking.

**Facility Layout and Design**

In my class, I have students design and lay out three different handling facilities for a packing plant, a feedyard, and a ranch. For added realism, the assignments are based on real projects from my consulting practice. This assignment is given in the middle of the course after the students have been exposed to many different types of facilities in both lectures with slides and
by visiting and critiquing the cattle handling facilities at Colorado State University. During the slide lectures, both poor and good layouts are shown with full explanation. The students are also provided with a book of drawings of layouts of 30 different cattle handling facilities.

Some of the design principles that are taught are the use of solid sides on chutes and crowd pens to prevent animals from seeing out with their wide-angle vision and layout of curved chutes and round crowd pens. A circular crowd pen and a curved chute reduced the time spent moving cattle by up to 50% (Vowles and Hollier, 1982).

Planning livestock flow through a facility is good training in problem solving. Students have to plan sufficient pen space to gather the cattle and then have enough different pens and space for sorting cattle. They are taught to draw a flow chart of the sequence of handling, weighing, and sorting events that will be conducted in the corral and then make sure the system they design will be able to accommodate those needs. Further information on cattle facility layout that can be used in class has been published previously (Grandin 1980, 1982, 1984a, 1989a, 1990a; Midwest Plan Service, 1987; Meat and Livestock Commission [Cattle Handling; Meat and Livestock Commission, Milton Keynes, U.K.]).

It is also important for students to learn behavioral differences between species that should be taken into account when a facility is laid out. Practical experience has shown that funnel-shaped crowd pens with one side straight and the other side at a 30 degree angle work well for directing cattle and sheep into a single-file chute or loading ramp. However, pigs will jam the funnel, and a crowd pen for them should have an abrupt entrance to the chute.

**Restraint Equipment and Use**

Slides are used extensively in the discussion of restraint equipment. Both existing systems and ideas for new systems are covered. The advantages and disadvantages of different squeeze chute designs are reviewed. For example, a curved bar stanchion headgate that is suitable for a chute with squeeze sides is not suitable for use on the end of an alley that does not have squeeze sides. Squeeze sides are required with a curved bar stanchion headgate to prevent the animal from lying down and choking. A straight bar stanchion that does not put pressure on the carotid arteries is safer for use on the end of an alley. It is essential to emphasize to students that if an animal begins to lose consciousness due to pressure on the carotid arteries, the headgate must be released immediately to prevent death (White, 1961; Fowler, 1978). It must also be stressed that an animal should never be left unattended in a squeeze chute. If a hydraulic chute is used, the pressure relief valve must be properly adjusted to prevent serious injuries to the cattle. Experience in the field indicates that a properly adjusted hydraulic chute is safer than a manual chute for both cattle and students. Practical recommendations for squeeze chutes and headgates were provided by Grandin (1975, 1983a). The chapter by Ewbank (1968) contains useful information about animal behavior.

For some procedures, a squeeze chute is not required. Ranchers have found from practical
experience that unruly cows will stand still for pregnancy checking and artificial insemination when they are confined in a dark box chute. The cow is held in a narrow enclosure with solid sides, solid front, and solid top (Parsons et al., 1969). Experiments with poultry and cattle indicate that sight restriction in a dark enclosure reduces stress (Douglas et al., 1984; Hale et al., 1987). The dark box is a good example of the use of behavioral principles to reduce an animal's tendency to resist restraint. There is a constant emphasis throughout the course on using an animal's natural behavior patterns to make handling and restraint more humane and efficient. For example, pigs and sheep can be trained to enter a relatively comfortable restraining device voluntarily (Panepinto et al., 1983; Grandin, 1989b). Pigs will relax and go to sleep in a padded chute that presses on their sides (Grandin et al., 1989). Voluntary acceptance of restraint can be facilitated with food rewards. This is especially useful with research animals. Animals can readily learn to discriminate between an extremely aversive and a less aversive method of restraint in an avoid-avoid choice test (Grandin et al., 1986).

I have learned from practical experience that cattle are extremely averse to nose tongs. Observations indicated that cattle repeatedly restrained for blood testing with a halter were more cooperative during successive blood tests. The use of nose tongs made head restraint more difficult in the future. Students are repeatedly reminded that restraint should be done as gently as possible and the use of aversive restraint methods such as nose tongs should be avoided.

One of the assignments or exam questions I give to my students is to design a humane restraint device for either a fictitious animal with strange behavioral traits or an unconventional animal, such as a jellyfish or tomato worm. Some students have devised very inventive schemes, such as suspending the tomato worm in gelatin.

The purpose of this exercise is to stimulate problem solving and original thinking. It also helps students gain better understanding of the behavior of cattle, sheep, or pigs. Before the assignment, new ideas for improving or replacing squeeze chutes are discussed. One approach is to redesign or modify existing systems that are used in packing plants. Some examples are the conveyorized doublerail restrainer (Giger et al., 1977; Grandin, 1988), V restrainer (Schmidt, 1972), or the upright holding chute that is used for kosher slaughter (Marshall et al., 1963). The kosher chute designed by Marshall et al. (1963) has closed-in solid sides and the author has observed that cattle are often more calm in this chute than in a conventional squeeze chute. A possible explanation is that the solid sides removed the chute operator from inside the animal's flight zone and a solid panel in front of the headgate blocked a view of a pathway of escape. I also encourage the students to invent totally new concepts that are unlike anything used by the industry.

**Reducing Stress**

During lectures I explain that reducing stress during handling provides benefits of both improved productivity and welfare. A major concept that I want my students to understand is that the degree of stress imposed on an animal during handling or restraint can vary greatly,
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depending on factors such as the animal's previous experiences, genetics, tameness, painfulness of the procedure, and skill of the handlers.

Animals can become habituated to nonpainful handling procedures such as weighing of cattle or taking pigs for walks in the aisle during finishing (Peischel et al., 1980; Grandin, 1989d). When an animal first experiences a handling procedure, it may be very stressed because of the novelty and then have little or no stress after it has become accustomed to the procedure. However, animals do not habituate to severely aversive procedures (Hargreaves and Hutson, 1990b; Coppinger et al., 1991).

Livestock that are accustomed to close contact with people are calmer and less stressed by handling than livestock that seldom see people. Ried and Mills (1962) found that sheep that were raised in a barn in close contact with people had a less intense physiological response to handling than did sheep raised on pasture. Students need to learn that isolation is a strong stressor to both cattle and sheep (Kilgour and DeLangen, 1970; Rushen, 1986).

A major point made in my lectures is that gentle treatment of animals is good for both animal welfare and productivity. Reproductive function is especially sensitive to stress. Sows that are fearful of humans and react by withdrawing farrow fewer pigs than sows that are not fearful (Hemsworth et al., 1981). In cattle and sheep handling, stresses were detrimental to reproductive performance (Doney et al., 1976; Hixon et al., 1981). Mistreatment of animals is also detrimental. Occasional mistreatment of growing pigs reduced weight gains (Hemsworth et al., 1987). Handling and transport stresses can also impair rumen function and immune function (Galyean et al., 1981; Kelly et al., 1981; Mertsching and Kelly, 1983; Blecha et al., 1984). The section on stress is concluded with information on the importance of the relationship between humans and animals on productivity and stress. Good reviews on this subject have been published by Seabrook (1984) and Hemsworth and Barnett (1987).

**Slaughter**

Handling at the slaughter plant and humane slaughter procedures are also covered. All procedures involving live animals in a federally inspected slaughter plant are covered by the Humane Methods of Slaughter Act and its regulations (USDA, 1979). Slaughtering is one of the few areas in animal agriculture that has strict regulations to protect welfare.

The regulations require that animals be rendered insensible to pain before hoisting, bleeding, and cutting. The proper use of captive bolt or electrical stunning equipment is essential to ensure instant, painless insensibility. Recommended practices can be found in the Recommended Animal Handling Guidelines for Meat Packers published by the American Meat Institute (Grandin, 1991a) and in the instruction manuals for commercial stunning equipment. Further detailed information on electrical stunning can be found in the publications by Hoenderken (1978), Kirton et al. (1980-81), Blackmore and Newhook (1981), Lambooy (1982), Hoenderken (1983), Gregory and Wotton (1984), Grandin (1985-86), and Gregory (1988). An electric...
stunner must pass sufficient amperage through the brain to induce a grand mal seizure (Croft, 1952). Insufficient amperage will cause suffering. The course also covers design of restraining devices for holding animals during slaughter (Schmidt, 1972; Giger et al., 1977; Grandin, 1980, 1989c, 1990a, 1991b, 1991c).

Animal Welfare

The animal welfare issue is discussed and students are informed that this issue will become increasingly important. Increasing public interest in animal welfare will increase the need for teaching students good animal handling methods. Some of the major points made in the lectures are that the livestock industry must improve some of its practices, and the public must be educated about agriculture. A high percentage of animal welfare problems that occur during handling are due to poor management.

The handling of nonambulatory livestock and how to prevent crippling injuries is a major problem area. Emphasis is put on prevention of downed animals through the use of nonslip flooring, prompt marketing, or euthanatizing of sick or debilitated animals. Welfare concerns about branding, castration, dehorning, and other husbandry procedures are also included in lectures.

The controversial topic of kosher slaughter is also discussed. Religious slaughter is exempt from the Humane Slaughter Act. Based on the author's own experiences in many kosher slaughter plants, the major problem with kosher slaughter is the cruel methods of restraint used in some plants. Because religious slaughter is exempt from the regulation, some plants refuse to spend money on humane restraint devices. Further information on religious slaughter and humane restraint equipment can be found in the publications by Marshall et al. (1963), Giger et al. (1977), Dunn (1990), and Grandin (1990b).

At the conclusion of the course, the importance of good management is stressed. Well-designed equipment provides the tools that make humane handling possible, but the equipment must have good management to go with it. I have observed many cases of animal abuse in good facilities that resulted from the managers' failure to supervise the employees. I tell my students that they are the managers for tomorrow and that they will be in a position to enforce high standards of animal welfare.

Current events involving the actions of people who label themselves "animal rights" proponents are discussed in class, along with case histories of how the industry reacted. Both industry successes and mistakes are covered. Students are encouraged to write letters to the editors of newspapers that carry negative stories and to carry on active discussion in class.

Implications
Educating undergraduate students in the behavioral principles of animal handling will help produce leaders in the livestock industry who recognize both the ethical and the productivity benefits of good animal handling and restraint practices.

**Literature Cited**


