Adapting Bovine Behavior to Improve Performance

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Introduction

The relationship between a stockman and his cattle will affect productivity. Quiet, gentle handling will reduce stress on animals and improve production. Dairy cattle and other livestock readily adapt to many handling procedures. This paper will review how livestock adapt to handling procedures and ways to reduce handling stress.

Reducing stress is important because stresses imposed during handling can have a detrimental effect on reproduction, milk production, immune function and rumen function. Restraint, electric prods and other handling stresses lowered conception rates.[69,38,70] Transportation and restraint stress reduced the immune function in cattle and pigs.[44,5,53] Rumen function was impaired by transit stress.[19] In the studies conducted by Galyean,[19] Kelley,[44] and Blecha,[5] the stress imposed by transit had a greater detrimental effect on the animal's physiology than the stress of feed and water derivation for the same length of time. Handling sheep with dogs and transport and sorting two to three weeks after mating caused early embryonic losses.[11]

Vision and Cattle Handling

Livestock have wide-angle vision. Cattle have a visual field in excess of 300 degrees.[61] Loading ramps and handling chutes should have solid side walls to prevent animals from seeing distractions outside the chute with their wide-angle vision.[65,21] Moving objects and people seen through the sides of a chute can cause baling or frighten livestock. Solid side walls are especially important if animals are not completely tame or they are unaccustomed to the facility. Blocking vision will stop escape attempts. Sight restriction will lower stress levels.[12,33] The wildest cow will remain calm in a darkened artificial insemination box which completely blocks vision.[57,71]

Livestock have color perception. Numerous investigators have now confirmed that cattle[9,18,72] possess color vision. Handling facilities should be painted one uniform color. All species of livestock are more likely to balk at a sudden change in color or texture.

Adaptation to Sounds

Cattle are more sensitive than people to high frequency noises.[4,46] The auditory sensitivity of cattle is greatest at 8000 hz and sheep at 7000 hz.[3] The human ear is most sensitive at 1000 to 3000 hz. Unexpected loud or novel noises can be highly stressful to livestock. Sheep exposed to exploding firecrackers or noise in a slaughter plant had increased thyroid hormone levels and elevated cortisol.[15,59] A loud ringing bell from an outdoor telephone will raise a pasture raised calf's heart rate 50 to 70 beats per minute (T. Camp, USDA Experimental Station, College Station, TX, personal communication). Animals will readily adapt to reasonable levels of continuous sound, such as white noise, instrumental music, and miscellaneous sounds. Continuous exposure to sounds over 100dB reduced daily weight gain in sheep.[3] However, moderate, continuous background sound can actually improve weight gain in some cases. Ames[3] found that sheep exposed to 75 dB of miscellaneous sounds (roller coasters, trains, horns, etc.), white noise, or instrumental music gained weight faster than controls without continuous background sound.

Dairymen have learned from practical experience that continuous playing of a radio with a variety of talk and music will reduce the reaction of livestock to sudden noises. Providing controlled amounts of continuous but varying background sound may help prevent weight gain or milk production losses caused by unexpected noises.

An interview with a top Wisconsin dairyman revealed the adaptability of dairy cows to sound. On one farm a radio was never played and the cows were disturbed by every little sound. On another farm, the cows stood quietly while children played in the aisle. They had become accustomed to a variety of sounds and activity. When a jackhammer was used in their barn production was not lowered. It is highly likely that the jackhammer would have had a very bad effect on production at the first farm.

Flight Zone

An important concept of livestock handling is flight zone. The flight zone is the animal's "personal space." When a person enters the flight zone the animal will move away.[21,27] Understanding of the flight zone can reduce stress and help prevent accidents to handlers. The size of the flight zone varies depending on the tameness or wildness of the cattle.[21] The flight zone of extensively raised beef cows may be as much at 50m (164 ft) whereas the

flight zone of feedlot cattle may be 2m (6 ft) to 8m (26 ft).[21] The high producing cows at the Purdue University dairy farms are very tame and have no flight zone. The size of the flight zone will slowly diminish when animals receive frequent gentle handling.

Extremely tame livestock are often difficult to drive because they no longer have a flight zone. These animals should be led with a feed bucket or halter or trained to a handling routine. A good example of training cows to a handling routine is entering and exiting from a milking parlor. The size of the enclosure the livestock are confine in my affect flight zone size. Sheep experiments indicated that animals confined in a narrow alley had a smaller flight zone compared to animals confined in a wider alley.[40] Approaching an animal head on will increase flight zone size (Bud Williams, personal communication).

When a person enters an animal's flight zone it will move away. If the handler penetrates the flight zone too deeply, the animal will either bolt and run away, or turn back and run past the person. When the flight zone of group of bulls was invaded by a mechanical trolley, the bulls moved away and maintained a constant distance between themselves and the trolley. The best place for the person to work is on the edge of the flight zone.[21] This will cause the animals to move away in an orderly manner and help reduce stress. The animals will stop moving when the handler retreats from the flight zone.

Many people make the mistake of deeply invading the flight zone when cattle are being driven down an alley or into an enclosed area such as a crowd pen. If the handler deeply penetrates the flight zone, the cattle may turn back and run over him.[27] This is especially a problem with cattle with a large flight zone. If the cattle attempt to turn back, the person should back up and retreat from inside the flight zone. The reason why the livestock attempt to turn back is because they are trying to escape from the person who is deep inside their flight zone. Cattle sometimes rear up and become agitated by a person leaning over the chute and deeply penetrating the flight zone.[23] The animal will usually settle back down if the person backs up and retreats from the flight zone. Inexperienced handlers sometimes make the mistake of attempting to push a rearing animal back down into a chute. The animal will often react to this be becoming increasingly agitated. Both the handler and the animal have a greater likelihood of being injured.

Deep penetration into a cow's flight zone during milking may explain this odd finding. Calves reared in stalls where they are visually and tacitly isolated from other calves give more milk when they mature compared to calves which are reared in stalls which provide visual and tactile contact with other calves.[75] Isolated calves which only see people have a much smaller flight zone than calves that have had some contact with other calves.[8] The isolated calves do not appear to be more socialized to people. In an open field test they do not have a greater tendency to approach a stationary person compared to the other calves. However, when the person moves towards them, the isolated calves are less likely to move away.

Animals that are unaccustomed to human contact have larger flight zones. Lyons and Price[50] reported that goats raised by people had a smaller flight zone compared to goats raised by goats. Goat raised goats remained far away from a standing person and had a lower heart rate than human reared goats that remained closer. "Wild" animals are not stressed if they can maintain a large flight distance between themselves and threatening animals or people. Possibly, procedures which reduce flight zone size such as petting may be beneficial for dairy calves. Both visual and tactile isolation of calves was stressful. The isolated animals had higher cortisol levels than controls which had limited visual and tactile contact with other calves.[8]

Herd Animals

Cattle are herd animals, and they are likely to become highly agitated and stressed when they are separated from their herd mates. Physiological changes which occur during isolation may affect productivity.

Isolation is a strong stresser. Restraint an isolation in a small box reduced immune response in pigs.[53] In sheep and cattle isolation was highly stressful.[45,66,14] A dairy cow left alone in a stanchion had increased leucocytes in her milk.[49]

During handling, isolated large animals that become agitated and excited are likely to injure handlers. Many serious cattle handling accidents have been caused by isolated frantic cattle.[27] If an isolated animal becomes agitated, other animal should be put in with it.

Cattle and sheep are motivated to maintain visual contact with each other.[13] Animals will readily follow the leader. Skillful handlers allow livestock to follow the leader and do not rush them. If animals bunch up, handlers should concentrate on moving the leaders instead of pushing a group of animals from the rear. Trained sheep can be used to lead sheep through a handling facility[6] and experienced cows will lead new heifers into the milking parlor. Groups of animals that have body contact remain calmer.[14] A tame heifer cow will keep a wild cow calm during artificial insemination. The wild cow will stand quietly while maintaining tactile contact with the tame cow.[27]

Genetic Differences

Genetic factors affect an animal's reaction to handling. Brahman and Brahman cross cattle are more excitable and hard to handle than English breeds. Angus cattle are more excitable that Herefords, and Holsteins move more slowly than Angus or Herefords.[73] When Brahman or Brahman cross cattle become excited they are more difficult to block at fences.[73] Visually substantial fences built with planks or a wide belly rail should be used with these breeds.[27] Brahman cattle will seldom run into a fence that

appears to be a solid barrier.

Effect of Environment and Experience

The previous experiences of an animal will affect how it will react to handling.[25] An animal's stress reaction to a handling procedure such as transportation or restraint, depends on three important factors. These are as follows: genetics,[10] individual differences,[63] and previous experiences.[35,48,43] Facility design can have strong influence on previous experiences. Poor design will increase stress.

Sheep raised in a barn in close contact with people had a less intense physiological response to handling than sheep raised on pasture.[64] Cows that calved in close association with a person displayed fewer flinch, kick, and step responses during the first two weeks of milking.[37] Hails[32] reported that calves lost less weight the second time they were transported. Hens which were not accustomed to being caught and handled had lowered egg production. Egg production, however, was not affected in hens accustomed to frequent handling.[39]

Experiences at a very young age will affect an animal's reaction to handling later in life. Piglets accustomed to repeated gentle handling by people approached a strange person readily at 24 months of age.[35] Touching a newborn foal all over will make it easier to perform a veterinary examination when it grows up because it will be desensitized to touch.[54] Dairy calves which were removed immediately from the cow and rubbed down by a person were calmer in the milking parlor, than calves which remained with the cow for 72 hours.[2] However calves which remained with the dam gave more milk. Maybe, the most beneficial effect could be obtained by rubbing down the calf and then putting it back in with the dam for 3 days.

Environmental Stimulation

When a barn full of veal calves or hogs hits the ceiling when a door slams, the animals may be showing signs of sensory restriction. The animals are not receiving enough stimulation for proper operation of the nervous system. Veal calves may attempt to create their own stimulation by engaging in stereotypes such as tongue rolling. Dairy cows normally receive enough stimulation during milking to prevent sensory restriction effects.

Sensory restriction sensitizes the central nervous system to external stimulation. An animal in a restricted environment becomes increasingly sensitive to stimulation in an attempt to achieve an optimal level of arousal.[74]

Sensory restriction leads to electroencephalographic changes. Dogs housed singly in kennels develop abnormal electroencephalograms. The EEG's are still abnormal six months after removal from a restricted environment.[51] Deprivation of sensory input increases tactile sensitivity. Placement of a small cup over a person's forearm to block tactile sensations for one week, increases tactile sensitivity on the opposite unshielded forearm.[1] This effect is quite persistent. Three days after the cup is removed the other arm is still more sensitive.

Trimming the whiskers of a baby rat causes the areas of the brain that receive sensory input from the whiskers to become more excitable.[67] This effect is also persistent. The receptive fields are still enlarged three months after the whiskers regrow.

Excitability

Sensory restriction makes animals more reactive. Pairs of young dogs kept in barren kennels become more excitable and distractible.[51] In young animals, the detrimental effects of environmental restriction is long lasting. Ten to twelve months after release from a kennel, sensory restricted dogs are still more excitable than dogs raised with a family.[51] Kennel dogs confronted with a novel object such as an opened umbrella, become extremely excited. Unlike normal dogs, sensory restricted dogs do not habituate to novel stimuli.

When livestock are subjected to sensory restriction, a high percentage will become more excitable, but relatively few animals will perform stereotypes.

Nervous system sensitization induced by sensory restriction, should not be confused with a generalized stress response. Sensory restriction actually lowers thresholds to incoming stimuli. Animals that live in a barren environment sometimes have increased cortisol levels, but the neural mechanisms that lower sensory thresholds probably do not operate along traditional stress pathways.

Veal calves in stalls are most likely to tongue roll when they expect to be fed. There is a large variation in calf excitability. Some producers have excitable calves and others have calm calves. Calves which jerk away as people walk by are probably understimulated. Playing a radio and some extra contact with people help. I predict that weekly grooming during the 16 week growing period would help prevent abnormal behavior. Providing extra stimulation will not hurt weight gain if it is done gently and carefully and there is a possibility it may improve performance.

Providing additional environmental stimulation will reduce excitability. Pigs raised in a windowless building with hanging rubber hose toys and weekly petting were less excitable compared to pigs raised with no extra environmental stimulation.[27,28] Pigs raised outdoors with a variety of playthings and daily petting were more willing to approach a strange man and walk through a narrow chute compared to pigs raised indoors in small, barren pens with minimal contact with people.[27,28] Loading pigs into a vehicle was more difficult when confinement reared pigs were handled. Pigs reared outdoors were easier to load.[76]

Our experiments also illustrate the different effects of environmental stimulation under different conditions. In the first trial, environmental stimulation for pigs housed in a windowless building consisted of hanging rubber hoses and weekly petting. The stimulation made the animals easier to drive through a chute and less prodding

was required.[26,27,28] In the second trial, the animals were initially very tame and both the control and extra stimulation pens were washed twice weekly with a hose. There was a tendency for the controls to be easier to drive because the petted pigs approached people for petting. Frequent pen washing provided environmental stimulation and may have helped to calm the controls. Tame animals should be led with a feed bucket or lead rope.

Previous Handling Experiences

Animals remember painful or frightening experiences. Excitement and fear during rough handling may be more stressful to cattle than a surgical procedure. Fell[17] reported that cortisol levels after castration in calves accustomed to restraint and handling were similar to cortisol levels after transport.

Research by Hutson[42] and Pascoe[58] indicated that dairy cattle and sheep could remember an aversive experience for many months. Sheep which had been inverted in a sheep handling machine were more difficult to move through the corrals the following year. Many months later, dairy cattle which had experienced electro-immobilization had elevated heart rates when they approached the place where the shock had occurred. Animals can readily discriminate and make a choice between the less aversive of two different handling treatments.[31,66] Livestock which have had previous experiences with gentle handling will be less stressed when they are handled in the future. Calves accustomed to regular gentle handling had fewer injuries during marketing because they were accustomed to handling.[77] Excitable cattle had lower weight gains.[52] Dogs can be highly aversive to sheep.[45] The use of dogs in a confined space where animals are unable to move away should be avoided. Electric prods should not be used on dairy cattle. Cattle will be easier to handle in the future if they are not allowed to rush out of corrals back to pasture. Cattle should be accustomed to walking slowly past a handler when they exit the corrals (Bud Williams, personal communication).

Cattle handled roughly in poorly designed facilities had higher heartrates compared to cattle handled calmly in well designed facilities.[68] Chickens handled gently had lower plasma corticosterone levels compared to chickens handled roughly.[7] The author has observed that cattle restrained with nose tongs become more difficult to restrain in the future. Further observations indicated that when a halter is used to hold the animal's head for blood testing, restraining the head becomes easier with successive tests. Cattle blood tested with halter head restraint will learn to turn their head to expose the jugular. Cattle that have experienced nose tongs will often fling their heads about to avoid attachment of the tongs.

Animals Feel Threatened

If an animal perceives a handling procedure or contact with a person as a threat, stress may increase. Sows that withdrew from a person's hand farrowed fewer piglets than sows which readily approached a person's hand.[34] When extra human contact is provided the handler must be careful not to intimidate the animals. He should squat down in the pen and allow the fearful animals to approach. He must never chase them. In our experiments, weight gains were not adversely affected by petting pigs in the pens or a weekly walk in the aisles. However, if the pigs feel threatened or are hurt, weight gains will be reduced. Gonyou[20] found that a looming, threatening person approaching the animals reduced gains. Animals can readily adapt to handling, such as daily weighing with no effect on weight gains.[60] Animals can adapt to psychological stress, but it is more difficult for them to adapt to procedures or events which are physically stressful. Salivary cortisol levels were lower in a smooth riding truck.[17] Stress responses to handling do not have a uniform effect across all stress measures. Cattle that are transported repeatedly will lose less weight as they become accustomed to transport. They will also adapt behaviorally. Cattle that have experienced several trips are easier to load and more sure footed in the truck.[17] However, their salivary cortisol levels did not decrease with successive trips. A possible explanation for this finding is that cattle would become less fearful with successive trips, but a bumpy road causes fatigue.

Pumprey[62] reported that calves accustomed to daily handling by people on horses had no difference in weight gain compared to unhandled controls during cool weather. During warm weather, heat stress which occurred due to physical exertion lowered weight gains. Apparently, the animals knew the routine and did not feel threatened.

If a person shocked pigs every few days a chronic stress state was created.[20] Inconsistent handling will cause stress. If a handler occasionally mistreats an animal, the animal is liable to be stressed every time the person approaches. An occasional aversive treatment lowered weight gain and increased corticosteroid levels even though the handler was gentle with the pigs most of the time.[36] The pigs had learned the handler could not be trusted.

Novelty can be a strong stresser. Animals that have been raised in a variable environment are less likely to be stressed when confronted with novelty. In one study veal calves were raised in indoor stalls or in outdoor group pens (R. Dantzer, personal communication, 1983). When the calves reached market weight, both groups were exposed to a new indoor and outdoor environment. Calves raised indoors had higher serum glucocorticoid values when they were put in an outdoor arena. Calves raised outdoors were more highly stressed when they were put in an indoor arena. Both of the new locations were stressful to all calves, but their reactions were influenced to the greatest extent by variance from the type of environment in which they had been reared.

Animals can be trained to accept irregularity in man-

agement.[64] Some slight deliberate variation in routine will help prevent animals from being stressed by novelty. Ranchers have found that changing vehicles and people feeding and tending cows will help get the cows accustomed to novelty. Pigs exposed to a variety of objects approached a novel object more quickly than animals raised in a barren environment.[28] However, pigs which had grown accustomed to a precise routine for bloodpressure testing, responded to a change in routine with increased bloodpressure.[55] Dairy cows that normally enter a parlor easily may balk and be spooked by a novel object such as a coat hanging on a fence. It is the novelty that scares the cows. If the cows saw the coat every day it would not bother them.

In our previously described handling experiment,[28] the pigs initially became highly agitated during the novel experience of pen washing. When they become accustomed to pen washing they walked up to be sprayed. The experience of pen washing was initially stressful but it soon became a pleasant experience that the animals actively sought. A young heifer's reaction to a milking parlor would be similar. When she is first confronted with the hissing, clanking equipment she is terrified, but soon she associates the parlor with the relief of getting milked. Mature dairy cows may act like new heifers if they moved to a different type of milking setup. A herd of stanchion housed Wisconsin dairy cows went absolutely berserk when they were moved onto a Florida farm with a milking parlor. The stress on these animals could have been reduced by having some experienced "parlor" cows to help lead them in.

New Restraint Concept

The idea of training an animal to voluntarily accept restraint is a new concept to some people. Animals that are handled gently can be trained to voluntarily accept restraint in a comfortable device.[26,29,56] Stress on both animals and people will be reduced. Large animals that are trained to walk into a restraint device for veterinary treatment can easily be handled by one person. Cooperative large animals are less likely to injure people or themselves. Feed rewards can be used to facilitate animal movement through a handling facility.[42] Many dairymen do not realize that every time a cow walks into a milking parlor she is voluntarily accepting restraint.

The author has trained sheep to voluntarily enter a squeeze tilt table for a grain reward.[29] Some sheep were squeezed and tilted to a horizontal position nine times in one day. After being released from the squeeze tilt table, the animals rapidly ran into the crowd pen and lined up in the chute.[29]

To train the animals to voluntarily accept restraint, the restraint device must be introduced gradually and gently with feed rewards.[29] At first, the animal is allowed to walk through the restrainer several times. The next step is to allow the animal to stand in the restrainer without being squeezed. On the fourth to fifth pass through, the squeeze is applied gently. During each step the animal is given a food reward of palatable feed. A relatively tame animal can be trained to voluntarily enter a restrainer in less than an hour.

Training animals to voluntarily enter a restraint device is easier and less stressful if the animal is tame and has little or no flight zone. If a wild animal is being trained, it is important to catch it correctly on the first attempt. Fumbling and failing to restrain an animal on the first attempt will result in increased excitement.[14] If an animal resists and struggles, it must not be released until it stops struggling, otherwise it will be rewarded for resisting.[26] Animals that are released while resisting are more likely to resist in the future.[26] The animal should be stroked and talked to gently until it calms down. Animals will not voluntarily accept restraint if the restraint device causes pain. Selection of the right type of squeeze chute and headgate to fit the specific handling requirements is important.[22]

Conclusions

Gentle handling improves the bottom line. Dairy cows that are not fearful of people and have no flight zone will be more productive. Jack Albright, a renowned scientist of dairy cow behavior, reported that one of the top producing dairy cows in the world had no tendency to avoid people. Cattle can become accustomed to varying amounts of stimulation and novelty. Acclimatizing cows to variation may help prevent production losses caused by unexpected novelty such as changes in personnel, a power failure, or unseasonal severe thunderstorms.

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