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Stress, fear, and standard livestock husbandry procedures
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Summary

The purpose of this review is threefold; first, to explain the underlying mechanisms of stress and fear in domestic animals, and how this relates to husbandry procedures and productivity; second, to explain the ability of animals to respond adaptively to stress, if exposed during crucial developmental periods; and third, to discuss science, and animal handling in terms of telos and ethics.

Key words: cattle, fear, stress, husbandry, livestock, telos, ethics, glucocorticoids

Introduction

Animals are exposed to a variety of human inventions such as trucks, needles, nets and squeeze chutes. Food and fiber animals are subjected to husbandry procedures as a means of improving lives. Vaccinations are given to prevent diseases, and medications are administered to the ill. The question of whether the benefits of these procedures out weigh the stress and fearfulness experienced by the animals is often shadowed by the economics of the handling. Vast amounts of studies have been conducted in an attempt to quantify animal pain. The majority of such studies note how the pain, stress and fear experienced affect production. Little to no research addresses the nature of the animal and the rights principal that is to ensure their welfare. Because there is no strong link between specific types of handling and the telos of an animal, the government, administrators, animal handlers and the public have yet to take a firm position on the animal rights/welfare issue as it relates to livestock. This may be in part due to the lack of scientific research to base a concrete decision. However, the public does have a strong opinion about animals used in research. Public support of research declines drastically as animal pain and distress increase. This review was conducted primarily to determine the associative stresses with standard husbandry procedures, and thus the ethics of handling animals.
Summary of Previous Results

Arguments for the use of animals and thus the handling of animals have been discussed ad nauseam. To date there has been no consensus reached regarding whether animals are at our disposal for research, livelihood, companionship, or entertainment.

The Nature of Science

Singer, (1975) justifies animal research if it is for life saving drug technology but not for testing floor waxes and cosmetics. This statement seems to assume that applied science is the only type of science. Science is not this specific. There are hard sciences and soft sciences, applied and basic sciences. These terms are simply the extremes in the continuum of science. Hard sciences refer to fields like chemistry and physics, whereas soft science refers to behavior and biology fields. Applied science is science whose results are readily applicable to a current problem. At the other end of the spectrum is basic science, whose results have no foreseeable application. It is very difficult to have 100% of just one type of science. Basic science is the foundation of applied science and vise versa. Hard and soft sciences are labels that are not very descriptive or useful. Due to these complexities one cannot make the assumption that one type of science is not ethical in regards to animals. If one is going to argue against the use of animals in research, then the argument cannot center on what research is allowable, but must revolve around how the research is conducted. For example, if the toxicity of floor wax is unknown then the question of is it necessary to know the toxicity of floor wax is a valid question. Any question deserves an answer and science deserves the opportunity to answer any question. The reasoning for this is rooted in the telos of humans. It is human nature to seek answers to questions, and in doing so to modify their surroundings. Science is an expression of human telos. Therefore, the toxicity of floor wax must be investigated. The real questions though are how will it be tested and what are the specific toxicity questions to be addressed? Does floor wax have an effect on bacteria found on floors, on the epidermis, on people who package the wax? What are the questions? Once these questions are determined, the 'hows' of testing are addressed. If the question is, how does the eye of a rabbit respond to wax applied liberally, then a liberal amount of wax applied to the rabbit's eye is an accurate test design to address the question. If the question is how the human eye responds to floor wax fumes, then the above test is not the correct test for addressing the question. The correct test would be human eye exposure to wax fumes. In either case, if the test subject does not match the question subject then the experimental design is flawed. This is the basis of scientific design.

The next issue that arises is the unwillingness of humans to test themselves. This brings forth two options. Tests may be conducted on others that do not resemble the tester, or the tester finds another method of accurately addressing the question. The former allows the tester to use subjects that are not like "him". This is quite subjective and may include differences based on social or economic status, religion, race, height, number of legs, etc. The second option challenges the researcher to design an experiment and or a model that specifically tests the hypothesis, but does not use the exact subjects in question. An example of this is the testing of floor wax on human eye tissue, using post mortem eye tissue. Currently, both options are being used in the research community.

Telos and Science

The above explanation of science included a brief mention of telos. Telos is the essence of the life that makes that form of life different than another form. It is the spirit, nature and the "-ness" of the life: humanness, cowness, gnatness. This -ness of life brings
forth the idea of the "rights principle" which states that the life has the fundamental right to exist and operate within its telos (Rollin, 1992). This view places further restriction on the researcher who wishes to use a test subject unlike him. He must now limit either the type of subject or the type of research. If he chooses to limit the type of subject he is in effect choosing a subject whose telos will not be infringed upon during the course of the experiment. By limiting the type of research he eliminates violation of the rights principle for the subject chosen. The above definition of telos and the rights principle, work well for many aspects of animal handling, husbandry, and research.

**Stress and Fear**

Before discussing stress, fear, and homeostasis, these terms must first be defined. Simply put, fear is the expression of distress and stress is the biological response to a stimulus. Distress is "pain or suffering the body, a bodily part or the mind" (Merriam-Webster, 1996). If an animal is unable to respond to a stimulus on a chemical level, fear does not manifest itself. For example, a burning match is held next to the skin, but the nerve endings in the skin are atrophic. The nerves are unable to relay the message to the pain receptors. This results in the animal's failure to pull away from the match. Pulling away from the match is the expression of stress or the fear response generated by the chemical relay of messages from the skin to the central nervous system to the muscles. The chemical relay of the messages is the stress. Although this paper will further define fear and stress, they are often interchanged in the literature.

**Stress**

The term stress is borrowed from engineering jargon and refers to pulling and twisting forces on structural designs. The original definition of stress does not fit perfectly into a biological system. There are many working definitions of stress as it relates to biotic organisms, with no real consensus on one particular definition.

Genetics, previous experience, and the quality of those experiences interact to determine how an individual is going to respond to a particular experience at that moment in time (Grandin, 1997). Genetically, some individuals and species are more prone to flightiness (e.g. are easily spooked) than others. Prior experience influences future interactions between the animal and the novelty/experience. If past experiences, especially if the first experience was frightening, the animal associates all subsequent encounters as frightening. Increased exposure to an experience increases the likelihood of habituation for that animal. This is provided that the experience is not painful. This is a general rule. Not all animals habituate. After having been physically restrained four times, several European Continental-cross cattle failed to habituate to being restrained (Grandin, 1992). This failure to habituate by some individuals and not others reiterates the affect genetics has on stress, fear, and ultimately behavior. Flightier individuals may not habituate to a frightening experience.

The interaction of these variables; genetics, past experience, and quality of experiences form an individual's normal range of behaviors under a "normal" amount of stress. The stressors that may cause one animal to react in a particular manner may not have the same affect on another animal. For example, some cattle defecate while restrained in a squeeze chute and others do not exhibit this or other behavioral indicators of stress.

There are two sources of stress, internal and external stimuli. Stress originating from within an animal's system affects the daily process of homeostasis of that animal. Hunger, elevated pH levels and copper deficiencies are examples of stress to an animal from an
internal source. External stressors are typically environmental factors processed by the sensory system that affect homeostasis. Weather changes, hunting predators and injuries are common types of external stressors.

The mechanics of stress are a cascade of hormone releases and chemical signals. A signal is generated from either the external or internal source of stress, travels to the central nervous system, which relays it to the hypothalamus in the brain. The hypothalamus releases corticotrophin-releasing factor (CRF) that stimulates the anterior pituitary to release adrenocorticotropic hormone (ACTH). This hormone signals the adrenal gland to increase the release of glucocorticoids (Levine, 1971). Stress hormones such as cortisol, norepinephrine, and epinephrine are glucocorticoids.

Acute stress is extremely important animal survival. Animals need to be able to respond quickly to a stimulus without cognitive understanding of the situation. For example, for survival, a rabbit must run for cover the instant it senses a swooping owl. The rabbit’s fear of swooping owls is reinforced by the surge of chemicals that cause the rabbit to run for cover.

To understand how stress can be used positively, we must first understand the physiological sequence of events experienced by an animal in a stressful situation. When a disruption of homeostasis is recognized by the higher brain centers (rabbit senses the owl), the hypothalamus releases corticotrophin-releasing factor, which in turn stimulates the release of adrenocorticotropic hormone (ACTH) into arterial circulation. The adrenal cortex is primarily targeted by ACTH, which responds to ACTH stimulus by releasing glucocorticoids. Circulating glucocorticoids stimulate protein release from the tissues to be used for gluconeogenesis and amino acid and fatty acid oxidation, all of which create a burst of energy (running for cover) in the animal (Hadley, 1996). These responses are effective in the short-term, but are not very energetically efficient, and lead quickly to exhaustion.

Continued high levels of corticoids circulating in the blood interfere with lymphocyte and antibody production can suppress the production of other hormones, such as follicle-stimulating hormone (FSH), luteinizing hormone (LH), various growth hormones (GH) and thyroid stimulating hormone (TSH). This translates into decreased growth, lower milk production, lower conception rates and other metabolic diseases, all of which cost the producer. Adrenal steroid hormones such as glucocorticoid, epinephrine and norepinephrine are crucial in the reaction to acute stress.

Chronic stress occurs when the stressors do not allow the body to rest and replenish itself (rabbit is chased repeatedly). Chronic stress creates a host of problems like high blood pressure and atherosclerosis -- the accumulation of fats, cholesterol and the like in the medium and large arteries (Sapolsky, 1994). Chronic stress has been found to cause atrophy of the hippocampus (part of the brain’s Limbic system which is associated with emotion and behavior) and permanent loss of hippocampal neurons. Chronic stress causes continuous production of these hormones and appears to have a detrimental effect on the hippocampus. Studies on post-traumatic stress syndrome (PTSD) have shown a correlation between these hormones and functioning of the hippocampus (Sapolsky, 1996). Homeostasis is vital to understanding the effects of stress on an individual as well as how the effects can be measured.

**Homeostasis**

The classic definition of homeostasis is "a relatively stable state of equilibrium" (Merriam-Webster, 1996). The word, homeostasis, was borrowed from chemistry and
modified to describe a biological system. Unfortunately, once a biological system has achieved chemical equilibrium, it dies. Equilibrium as defined above is death in the context of biology. Therefore, the meaning of homeostasis is slightly alternated for biological systems. In a behavioral setting, homeostasis follows an activity level over time. It is the normal range of behaviors for a given individual (Smith, 1998). The biological system is comprised of a multitude of activity rhythms: insulin level, fatigue, hunger, etc. Homeostasis is the average of these rhythms. Imagnes multiple small bell shaped curves, one for each activity rhythm, superimposed over a larger curve representing the activity level over time for an individual. The normal range of behavior, homeostasis, is one standard deviation of the large curve. For example, a small shift in homeostasis might be 1.3 standard deviations, and a large shift could be represented as 3 standard deviations. A large shift in any of the smaller activity rhythms would have an affect on the larger curve. And conversely a small shift would have a small affect on the individual.

The maintenance of homeostasis requires energy. Small changes (stressors) shift the activity rhythms slightly, requiring a small amount of energy to re-align the rhythms within their normal range of behaviors. Large stresses cause large shifts, requiring greater amounts of energy to regain homeostasis. If the energy is not readily available, stored energy is used, and bodily functions not crucial to immediate survival, such as digestion, are delayed. Prolonged shifts in homeostasis can result in a compromised immune system. Because homeostasis is affected, the amount of stress that an animal is experiencing can be measured by chemical analysis. Detection of levels of cortisol, a stress hormone, is a commonly used chemical analysis.

**Fear**

In the context of animal handling there are two types of fear: handling and physical. Handling fears are comprised of three subcategories that interact to give a particular behavior for a stimulus at that moment. These subcategories are 1) genetics, 2) amount of previous exposure to people and novelty, and 3) the quality of the contact with people and novelty. Some animals are genetically predisposed to fearfulness. These tend to be preyed upon animals such as antelope, bison and cattle. The amount of time an animal is exposed to people is crucial for the animal to learn the habits and mannerisms of people. This effectively eliminates people as a novel object. Animals are not born with an innate fear of humans. Like all novelties, humans are a curiosity. Fear of humans, manifests after the animal has had a negative human experience. This is not true for hyper-reactive animals. These animals are more likely to elevate novelty to a fear stimulus at the onset of investigation. This is especially true if the novelty is moving, for example, plastic bags blowing in the wind, people walking and low flying helicopters. Allowing the animal to investigate a new experience or novel object results in a decrease of fear towards the experience or object (Grandin, 1997). This leads into the quality of the contact. Novelty that is thrust on the animal will generate a fear memory. There is a significant amount of data establishing that nearly all species -- whether cats or the fruit fly exhibit fear memories due to fear conditioning (forced novelty). Studies suggest fear memories are permanent. Fear memories may result in various neurotic disorders such as posttraumatic stress disorder and stereotypies. The brain’s inability to control fear is confounded by such disorders. Through behavioral modifications and drug therapy, the brain may control fear responses (i.e., tonic immobility, and self-mutilation), but the memory is not erased. ‘ In cats, electrical stimulation of the amygdala (part of the Limbic system which is associated with emotion and behavior) “produces a complex pattern of behavioral and autonomic changes that highly resemble fear” (Davis, 1992). This behavioral pattern can be counteracted with drugs. Benzodiazepines have been shown to have an anxiolytic effect (relieves anxiety) on a stimulated amygdala (Davis, 1992). This process of overriding the fear memory is...
referred to as ‘elimination. It is possible for an eliminated memory to be triggered due to stress, resulting in fear responses long after the fear memory is established (LeDoux, 1994). Research suggests a correlation between genetics and susceptibility to mental disorders. It appears that the more nervous the species, or individual within a species, the greater the probability of suffering from a mental disorder after the emotional memory has occurred (Grandin, 1997).

**Stress, fear and husbandry procedures**

Just as chemical analysis is a method of determining stress, observation of the animal's behavior and productivity are also used to determine and measure animal stress and fear. Changes in normal behavior such as limping, increased vocalizations, spontaneous abortions and unusual sleep patterns are indicative of stress and fear. The majority of research to determine the effect of stress and fear is economically quantified. This theme has been studied for most routine husbandry procedures such as castration, beak amputation and transporting animals. General consensus has been reached that these types of procedures minimize weight gain and normal behavior, increase neurotic disorders, glucocorticoid levels and blood pressure, and suppress the auto-immune system. In affect, standard husbandry procedures, lowers overall profits.

Average daily gain of dehorned feedlot steers is less than that of horned steers (Goonewardene and Hand, 1991). Castration of calves, regardless of their age, by either rubber ring banding or by surgical or Burdizzo procedures, increases abnormal behavior such as foot stamping, head turning, tail wagging, decreased food intake and elevated plasma cortisol levels (Robertson, 1994). In lambs, castration and tail docking results in significantly greater levels of cortisol (p<.01) than in lambs handled but not castrated or tail docked (Kent and Molony, 1993). The latter study found no effect of age on plasma cortisol concentrations. Other studies have produced similar results. Five-day-old lambs exhibited fewer abnormal behaviors to a lesser extent than 21 and 42-day-old lambs (Molony and Kent, 1993). In Molony's discussion, he refers to other studies which found no age effect or no abnormal behaviors after castration in lambs less than one week of age. The younger the animal the less developed its central nervous system resulting in a mitigated stress response.

Common industry practices to minimize intra species injuries (e.g. amputation of beaks and horns) and identification of individual animals and ownership of animals (e.g. ear notching and branding) have been investigated. Several studies have been conducted to assess economic returns of the procedures and to monitor animal stress and fear. Partial debeaking of chickens decreases water intake, preening, beak wiping and other normal poultry activities (Gentle, 1990a). The degree of "insult" to a steer due to horn tipping affects average daily gain. Steers with large horns (>3 inches) that experienced some blood loss during amputation or which required cauterization of the horn stump to control bleeding, gained an average of one pound less per day than steers born without horns. Due to individual differences in performance, a statistical difference was not found (Bartle and Preston, 1990). Ear notching of 2-month-old Holstein calves resulted in a mild startle response. Behaviors such as ear twitching and head shaking were noticeably absent (Friend et al., 1994). The above experiment found ear notching to be relatively painless as measured by behavioral observations and heart rate monitors. Heart rates increased from approximately 92 bpm to 95 bpm during notching but fell to approximately 90 bpm thirty seconds after treatment. Heart rates returned to pre-treatment level around sixty seconds after treatment. Branding is often a required method of determining ownership of cattle and other animals. Hot iron and freeze branding elicits violent escape responses from calves.
Epinephrine, a pre-cursor to cortisol, was higher in hot iron-branded calves than in freeze-branded calves. This suggests that freeze branding does not produce the same level of acute pain as hot iron branding (Lay et al., 1992). Heart rate and cortisol levels were confounded by restraint effects and were not accurate measures of stress.

Monitoring animal vocalizations to assess stress and fear is popular in commercial audits. Vocalizations have been positively correlated to painful and frightening procedures. Castrated piglets’ rate of high frequency calls, greater than or equal to 1000 Hz, is greater than the rate of calls from sham-castrated piglets (Weary et al, 1998). Percentages of vocalization from cattle, pigs and sheep were used to assess the handling stress of animals in slaughter plants. The most common cause of vocalizations was due to excessive electrical prodding, slipping on the floors and being restrained too tightly (Grandin, 1998).

Chickens have a strict social hierarchy. Enforcement of this hierarchy is often accomplished through a pecking order resulting in feather plucking of subordinate birds. It has been observed that the subordinates frequently become immobile in this situation. In a controlled experiment (Gentle and Hunter, 1990b), chickens whose feathers were plucked out entered similar states of immobility and failed to show other outward signs of distress. Heart rates did fluctuate, but not consistently for each bird. All birds had a marked increase in blood pressure. Electroencephalogram (EEG) readings suggested that immobile birds are aware of their surroundings. This study concluded that feather plucking of chickens is painful (Gentle and Hunter, 1990b).

Transportation and relocation are stressful events for animals. Whether being moved from one pasture to another, across country, or into a building from a pasture, animals are bombarded with novelty: new places, truck vibrations, strange noises. Scientists have long studied these effects and how they relate to production and economics. Producers know that if you are selling cattle by the kilogram, it is better to base the price on pre-shipped weights. Buyers prefer to purchase based on post-shipped weights. This is due to weight loss during transport. This is commonly referred to as "shrink." Animals lose weight during shipping. This weight loss is mainly due to the anxiety associated with travel. Pigs may lose 5% of their body weight above expected loss due to food and water deprivation (M’G lone et al, 1993) after transportation. Relocating sheep from a pasture to a barn results in behavioral changes often leading to stereotypies. In one study (Done-Currie et al., 1984), it took sheep up to 31 days to consume their entire diet after being moved indoors. This study found a positive correlation between stereotypies and duration in the barn. Stereotypies included weaving, pen licking, chain chewing and standing on pen bars.

Beef cattle are frequently handled, transported and finally slaughtered. Experiments have been designed to determine if these procedures are stressful and if so, are they equally stressful. Measured as hormone and metabolite concentrations, handling was the greatest stressor followed by transportation and then slaughter (Mitchell et al., 1988). Of particular interest was the finding that these three stressors were not additive in their effect on measured hormone and metabolite concentrations. The data showed two distinct stages of stress response: 1) environmental factors like noise; and 2) stresses originating in the nervous system such as transportation and slaughter (Mitchell et al., 1988).

Desensitizing animals to stress and fear

Regardless of whether an animal is being raised for production, is a companion animal, used for entertainment or is wild, proper husbandry demands at least occasional human interference. This handling inherently causes stress. This is not to say that animals that have no human interaction are stress free. Hunger and thirst are stressors as are
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weather changes and escape from predators. The subject of stress associated with free ranging animals is outside the context of this paper.

Stress is not necessarily detrimental. Used correctly, stress has the potential for affecting an animal's ability to cope with future stresses. This is provided that the exposure occurs during crucial developmental periods. Desensitizing the animal's nervous system to the stress-producing stimuli in a controlled manner can greatly reduce the impact of handling on production. Stimulation of the hypothalamus-hypophyseal-adrenal axis in the neonate can strengthen the animal's response to novel stimuli and reduce response to chronic stimuli (Hadley, 1996). This process is called conditioning or training. Kittens negatively trained (mild electric shock to forearm if they failed to lift leg on command) to lift a forearm on command, had increased dendritic branching in the brain area associated with messages received and processed from that forearm (Spinelli et al., 1980). In effect, training causes increased synaptic pathways.

Minimally, positively, negatively and aversively handled pigs 8-10-weeks of age exhibited differences in weight gain and human-swine interactions (Gonyou et al., 1986). Piglets handled positively or minimally more readily approached novel people than the piglets from the other groups. Negatively and aversively handled piglets showed a marked decrease in weight gain and willingness to approach humans. Moreover, the adversely handled piglets had enlarged adrenal cortices, which correspond to an increased ability to activate the sympathetic nervous system (Gonyou et al., 1986). Evidence for a crucial “socialization” period during which pigs can be desensitized to humans has been found (Hemsworth et al., 1986a). Hemsworth's study (1986b) found significant changes in corticosteroid levels and behavioral response due to handling, as well as decreased reproduction rates in pigs handled aversively. Pigs handled unpleasantly are fearful of humans, regardless of their level of enrichment (Pearce et al., 1989). Provision of an enriched environment (toys in the pen) reduces overall fear of humans, regardless of their handling treatment. Pigs that had been provided toys exhibited more exploratory and play behaviors, while the unpleasantly handled pigs seemed to use resting and sitting as methods of relieving stress (Pearce et al., 1989). Horses handled regularly are more trainable and less excitable (reactive) than horses handled minimally in the 18 months prior to standard riding training (Heird et al., 1986).

Heird et al. (1986) studied the effects of handling at different ages on learning ability in two year-old horses. One group was not handled except to move from one area of rangeland to another. The next was handled for one week at weaning, then not again until it was time to train for riding. The third group was handled for one week at weaning, pastured, and then handled for one week again six months later. The fourth group was handled for one week at weaning, then every six months for two more accumulated weeks of handling. The fifth group was handled continuously for the eighteen months after weaning until riding training began. They then underwent a 30 day trial that measured handling ease, emotionality (excitability/flightiness) and learning ability. All groups achieved some measure of learning by the 10th day, but the groups that were handled more achieved consistently higher percentages of correct responses, and earlier than the lesser handled groups. Group 5 was the least emotional as determined by the animals’ response to a novel stimulus, and received the highest scores for trainability after being ridden.

Increased stimulation provided by environmental augmentation may decrease fearfulness and enhance the ability of animals to adapt to novelty. The Scottish researcher Jones (1981) looked at the effects of early environmental stimulation on 7-day-old chicks in an open field trial and in a hole-in-the-wall test of timidity. Chicks were housed in same sex
groups of 10 in either bare environments (heat, food, water and wood chips) or similar environments containing various objects. In the open field test, the chicks housed with toys and other objects exhibited less fear caused immobility during walking, jumping and feeding, while their non-stress vocalizations were higher than chicks housed in the bare environments. In the hole-in-the-wall test, the bare chicks stayed in the holes, while the object chicks would emerge and explore. Handling significantly increased growth and gain: food ratios in layer chicks examined from hatching to 3 weeks old (Jones et al., 1981). Appropriate handling significantly increases growth and gain in chickens (Jones et al., 1981; Gross and Siegel, 1983).

Jones et al. (1981) also examined testing procedures for using chickens for laboratory animals. They evaluated the hens fear response to an approaching human by observing body postures and responses, as well as using radio telemetry of their heart rates. The timing of both responses were very similar, lending weight to the supposition that they are complementary responses and should be regarded as such, rather than as alternative measurements.

Handling young animals causes significant changes in their physiology and behavior. Unfortunately, conditioning of older animals does not appear to have the same dramatic effects. It has been suggested that rigidity of neural pathways increase with age. Handling of young rats has been demonstrated to reduce their stress levels (Denenberg and Whimbey, 1968; Levine, 1968; Levine et al., 1967) while evoking neuroendocrine changes (Denenberg et al., 1967). Adult behavior can be modified, provided that the conditioning or elimination of the fear memories is done slowly and in very small steps. Adult nyala and bongo (African antelope) have been conditioned to enter a small crate and stand quietly while blood is drawn from their leg (Grandin et al., 1996). Zoos worldwide are conditioning various species to cooperate with various husbandry procedures: blood extraction, daily insulin injections, topical application of medications, foot care and dental examinations.

Conclusion

Regardless of the purpose for which the animal is being raised, proper husbandry demands at least occasional human interference. Stress is not necessarily detrimental, and can be used in a positive manner to affect an animal’s ability to cope with future stresses. Very few techniques or standard procedures are stress benign to the animal. Most of the procedures are invasive as far as the animal is concerned, and therefore evoke a strong response, such as major physiological changes, running and tonic immobility. This response may or may not be visible. Glucocorticoids are elevated during a stress response and thus nonessential functions such as digestion are postponed. This causes animals to stop eating, lowering their ability to maintain weight and health. Through the study and understanding of fear-based behaviors, as well as economic results, producers and handlers hold the tools for maintaining calm animals in stressful situations.

Some of the reviewed procedures are in violation of telos and the rights principle while others may not be. Restraining, ear tagging and vaccinating an animal do not appear to violate telos and the rights principle. These types of procedures may be frightening and stressful resulting in decreased weight gain, but they do not appear to have an effect on the "-ness" of the species or the individual. There is increasing evidence that hypersensitive animals are more prone to stress related complications; this may constitute possible telos violation. Further research is needed in this area. Other procedures like castration, beak amputation and dehorning appear to interfere with the nature of the animal and as such are in clear violation of the rights principal. Further more there is no evidence that these
procedures provide a greater good for the whole, animal or human, than the amount of damage they cause to the animal.

Transportation and relocation are stressful events for animals. Whether being moved from one pasture to another, across country, or into a building from a pasture, animals are bombarded with novelty: new places, truck vibrations, strange noises. Depending on where the animal is being moved to and the duration of the stay, the telos and rights principal maybe violated. Transportation and housing animals overnight in a new environment is probably not in violation of either ethical concern. Housing animals in barren, restrictive or aversive environments does dramatically affect behavior and as such is unacceptable.

Increased environmental stimulation appears to decrease fearfulness and increase the ability of animals to adapt to novelty. This implies that it is possible to protect the animal's nature to some degree. For example, appropriate toys may reduce the number of stereotypies and increase play behavior in pigs. The age in which enrichment and training occur appears to have a direct effect on the ability of the animal to respond favorably. The timing of the stimulation (stress) to provide the necessary hormonal response in the developing nervous system is crucial. This timing allows the developing nervous system to increase sensory pathway via dendritic branching. Dendritic expansion is associated with an increased ability of the animal to cope with stress. Providing an environment rich in variety of surfaces, sights, sounds and human contact can decrease fearfulness and improve the animal's ability to adapt to novelty.

The continued advancement of technology requires further definition of telos. Genetic manipulation, species survival plans, and the decrease in land habitat for animals will soon force this clarification. It may no longer be valid to say that pig "A" and pig "B" have the same telos, pigness. Perhaps both pigs have a common pigness, but pig "A" has his own "-ness" that pig "B" does not have. This leads to the question of when does telos become telos? If telos is fixed for each species, and individual variance does not contribute in defining telos, then the telos is genetically based and is telos prior to the union of gametes. Then the manipulation of an animal's genetics is in direct violation of the rights principle. If telos is a combination of a set "-ness" for a species and individual variation, then telos is comprised of both genetics and environment. Therefore genetic manipulation may not be in complete violation of the rights principle, if the telos of the animal is not developed until certain proportions of environmental factors have been taken into account. This would allow gene splitting, cloning and the like to occur prior to the formation of telos for each individual. The ultimate questions for researchers, philosophers and those involved in the care of any animal are, which develops first, the telos or the individual, and do my actions violate the animal's core essence.

While the questions around telos may never be answered, it is important to continually consider the effect of the stresses we subject animals to on a daily basis. The scientific argument for this consideration is clear.

**Literature Cited**


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