

The Way I See It

The Dangers of Trait Over-Selection

Breeding for specific traits may trigger unwanted, even dangerous, genetic side effects.

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Western Horseman, August 1998, pp. 120-124

IN THE future, some of the most serious health and welfare problems in horses may be caused by continued selection for certain appearance and performance traits. Genetic traits are linked in complex ways and over-selecting for one trait causes corresponding changes in other traits.

Over-selection for appearance traits, such as a lean, fine-boned conformation, extensive white coloration depigmented like an albino, and blue eyes are often associated with neurological defects and nervousness. Likewise, over-selection for performance traits in racehorses and cutting horses causes changes to occur in other traits, such as temperament.

Single Trait Selection

Breeders of dogs, pigs, and cattle know that over-selecting for a single trait can ruin the animal. There are countless examples in the medical literature on dogs with physical and behavioral problems caused by over selection for a single trait. For example, breathing problems in short-nosed breeds, such as Bulldogs or Pugs, are caused by over selection for a shortened nose. Pointer dogs with extreme nervousness are another example. Pointing ability and nervousness are genetically linked traits. Breeders have known for decades that a fine line exists between a good pointer and a nervous wreck.

Horses also can suffer negative effects with over-selection for both physical and behavioral traits. White piebald patches in Paint Horses, conformation and jumping ability in Warmbloods, conformation and speed in Thoroughbred race horses, and cow-cutting ability in Quarter Horses are examples of single traits that, when selected to the extreme, can cause problems in other traits.

Single-minded selection for rapid weight gain in cattle, pigs, and chickens has already caused serious health and welfare problems. Pigs selected for large amounts of lean meat are so nervous that they often have heart attacks and die during handling or transport. Cattle with double-muscle traits cannot birth normally and must undergo Caesarean sections, and chickens bred for rapid weight gain often develop abnormal behaviors, have weak legs, and peck other chickens.

Horse breeders should be careful not to repeat the serious mistakes made with dogs and other animals.

Genetic Traits Are Linked

Genetic traits are linked in complex ways. Over-selecting animals for physical traits often causes changes in behavior. Likewise, over-selection for behavioral traits can cause corresponding changes in physical traits. Here is an example of changes caused by single trait selection.

In the 1950s, a Russian geneticist named Belyaev began a long-term study of selection for tame behavior in foxes. The study was an attempt to domesticate the wild fox and make it behave like a domestic dog. By selecting and breeding the calmest fox pups from each litter with other gentle foxes, in 20 years Belyaev succeeded in turning wild foxes into tame, dog-like animals. In each generation, the selected foxes became tamer and tamer.

But, the changes in behavior occurred simultaneously with changes in ear shape, tail position, and the appearance of a white muzzle, forehead blaze, and white shoulder hair. The white color pattern on the head is similar to many domestic animals. The dog-like foxes looked like Border Collies and would whine and wag their tails when people approached. Unfortunately, the pelts were of little value because few people wanted black and white fur hats.

Although Belyaev found selection for tameness effective, many undesirable characteristics were associated with the tameness. The tame foxes shed during the wrong season, would breed at any time of the year, and the vixens developed neurological problems and began eating their pups. This study illustrates the complexity of genetic changes that can occur when single traits are selected to the extreme.

Hair, Skin, and Eyes

The fact that different domestic animals exhibit similar patterns of physical and behavioral changes has been observed for centuries. Most domestic animals have lost their seasonal pattern of reproduction. They also have changes in their neuroendocrine profiles, have increased fertility, and exhibit piebald white spotting of the hair.

Scientists use the term piebald to refer to areas of pure white hair and pink skin underneath. In horses, this would include both overo and tobiano patterning. When looking at piebald patches, it's important to differentiate white hair and dark skin found in Arabian horses from white hair and pink skin found in true piebald animals such as Holstein cows and Paint Horses.

Socks and blazes are examples of piebald spots in horses. Some animals with large piebald spots on the head and body may have neurological defects similar to the genetic defect known in humans as piebaldism. The piebald condition is linked to defects in both the visual system and in hearing. Although piebald spots do not always signal neurological defects, breeding two Paint Horses who have large areas of piebald spotting (white hair with underlying pink skin) is almost sure to cause problems in the offspring.

Nervousness is also common in animals with large areas of depigmented hair and skin. For example, dairymen report that mostly white Holstein cows are more nervous and difficult to handle for milking compared to more pigmented cows. Also, I recently observed some extremely abnormal behavior in a highly depigmented Paint stallion at a horse show. The stallion was so distressed by the sights and sounds of the show that he was literally eating up his stall. This behavior was in sharp contrast to the normal behavior shown by a frightened horse.

My assistant, Mark Deesing, has had two unusual experiences with highly depigmented Paint Horses. In separate situations involving unrelated horses, when he picked up a back foot the horses leaned away from him and fell to the ground. Horses usually lean on the person picking up their feet, not away from them. Defects in the inner ear are linked to problems with balance.

Blue eyes can also signal neurological defects. It is well known that white cats with blue eyes are deaf. But, white cats with dark eyes, or small areas of pigmented hair, are less likely to be deaf. Although blue eyes in themselves may not always signal neurological defects, breeding two blue-eyed Australian Shepherd dogs together results in pups that have eye, ear, and brain abnormalities. Blue eyes are a warning sign because they are associated with a reduced pigmentation throughout the body.

Blue eyes are also becoming more common in commercial pigs. Again, this may not be a problem in itself, but breeding two blue-eyed pigs together might cause neurological defects and behavior problems in the offspring.

While blue eyes and large areas of depigmentation on most of the body might signal neurological defects, it seems that smaller amounts of depigmentation are linked to calm temperaments and large amounts of meat and milk in cattle. For example, high-producing Holstein dairy cows are partially depigmented with black and white patches. Herefords are a high-producing beef breed that are reddish-brown with a white face and belly. These animals also have mostly calm temperaments.

A certain amount of piebaldism tends to make an animal quieter, but too much might make it nervous. There are many good horses with white socks and a blaze, but every horseman in the last century noticed a relationship between piebaldism and the value of a horse. The old saying goes:

One white foot, buy him.
Two white feet, try him.
Three white feet, be on the sly.
Four white feet, pass him by.

Conformation and Temperament

Conformation is also linked to temperament. Lean animals with fine bone are often more nervous compared to large-muscled animals with heavy bone. In the fox experiments discussed earlier, the tame foxes were stockier with heavier bone than wild foxes.

Nervousness associated with a lean build and fine bone is also noted in cattle and pigs. Compared to the older type of fat pig, lean, fined-boned pigs suffer more stress-related injuries, such as broken legs, during transport.

The conformation-temperament relationship also applies to horses. As a general rule, Arabians are lean, fine-boned, reactive, and spirited. Draft horses are muscular, heavy boned, and have mostly calm temperaments. This is a general principle that also applies to animals within a breed.

At a horse show I recently attended, the conformation-temperament relationship was clear both between horses of a breed and between different breeds. Lean, fine-boned horses were more active in the show ring and had stronger reactions to the public address system compared to muscular, heavy-boned horses.

Performance Traits

Over-selecting for performance traits, such as speed in Thoroughbreds, or cutting ability in Quarter Horses, can have unwanted effects on other traits. The lean, fine-boned conformation of some racehorses may be inadvertently linked to a highly reactive nervous system and extreme fearfulness.

In a study of the effects of fear on race performance, researchers found that three behavioral measures of fear shown by horses just before a race can often predict certain losers. The first variable was the angle at which the horse held his head. Horses that held their heads high with their necks at an angle greater than 45 degrees had increased arousal and were more likely to lose. The other two indicators included the degree of difficulty holding the horse in the saddling

paddock, and whether the horse needed to be held in the gate.

Over-selecting for racing ability may also affect mothering ability. Racehorse breeders report that some Thoroughbred mares become so frightened by their newborn foals that they kill them. A report from a cutting horse trainer also indicates a possible case of obsessive-compulsive disorder. The horse would not stop cutting calves. The only way to stop the horse was to remove the calves. Over-selecting performance traits to this degree often involves dangerous levels of inbreeding. All purebreds are partially inbred, and many are inbred to a degree that jeopardizes the health and well-being of the breed.

Hair Whorls

The brain forms in the fetus at the same time as skin and hair. In our lab at Colorado State University, we provided the first scientifically documented evidence of a relationship between hair whorl positions on the forehead in cattle and differences in temperament. Horsemen have also observed a casual relationship between the position of hair whorls on a horse's forehead and temperament. A hair whorl positioned high above the eyes is said to be related to a flighty temperament.

Cattle also have hair whorls on the forehead similar to horses. We conducted research on hair whorl positions and temperament in cattle because it was easy to find large numbers of cattle with similar genetics and similar early experiences. In a study of 1,500 cattle at a commercial feedlot, we found that cattle with hair whorls above the eyes fought more in a squeeze chute during vaccinations, and were clearly more frightened by restraint compared to cattle. *Selecting Whole Animals*

Genetic selection can either improve or destroy a horse's ability to perform. Horse breeders need to be careful and not over-select for single appearance or performance traits. They need to look at the whole animal.

*An associate professor of animal science at Colorado State University, Temple Grandin is the author of *Thinking in Pictures*, and has appeared on such television programs as 20/20, CBS This Morning, and 48 Hours.*

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