Prepotency: The Breeder's Wild Card

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Prepotency is not something that is treated with Viagra. Rather, prepotency is a quality that a breeder looks for in a stallion or a mare, the ability to pass on desirable characteristics to the offspring. Now is the time of year when broodmare owners are feverishly looking to select that special stallion to breed to their mare. Breeders seek a stallion that will stamp his foals with his best qualities to complement their mare.

I have never bred a horse of my own, but I have always been closely associated with breeding and realized early on the significance of breeding for performance. When I was 15, I began breaking and galloping Thoroughbred (TB) racehorses for local breeders. Most of the time, the two year olds that I was breaking were sired by the three or four stallions that the breeding farm had at stud. After the first year I was well prepared for the next round of youngsters. I remember saying, "This one is by *Impatient Fool*, he won't be easy to break but he will be great to gallop down the track" and "This one is by *TV Commercial*, easy to break, but might be a bit spooky to gallop." Year after year, the subsequent youngsters in training held true to my initial observations. This was my first look at prepotency as I realized many qualities and traits are genetically inherited; passed down from parent to offspring in a predictable and often consistent manner.

Since my breaking and galloping days on the TB breeding farms of New Jersey I have completed a B.A. in Biology, a M.S. in Veterinary and Animal Sciences in developmental genetics and a Ph.D. in molecular genetics. I have cloned and DNA sequenced several genes, hold two U.S. and European patents on genes that I have cloned and share authorship on a publication with a Nobel Prize winner. You would think after all that I should be able to breed some really good horses--but in fact, having the in depth understanding of genetics only makes me realize how difficult it is to breed good horses.

It certainly is possible to take a horse, not bred for the sport and succeed in training the horse for a given discipline. We have witnessed this time and again in the U.S., since for many years the majority of sport horses have been from the TB racing industry. Many successful jumpers, event and even (less commonly), dressage horses have been TBs. For example Hilda Gurney's incredibly dynamic *Keene*, was an internationally successful dressage horse. Even I have had success with an off the track TB, *Nikoli* that I have trained and competed to Grand Prix (Reserve Champion 4th level at Devon in 1993 and USDF median score at Grand Prix, 61% in 2000). But these are more often the exceptions rather than the rule. As a matter of fact, TBs far outnumber the warmbloods registered with the USDF, but the warmbloods far outnumber the TBs in the horse of the year awards. It certainly makes sense to "stack the cards in your favor" when either breeding or buying a horse for a given discipline and to choose bloodlines that have proven to be successful for the sport.

When I embarked on the chore of trying to find my next dressage horse to replace *Nikoli*, I decided to focus on German warmbloods, since they have an outstanding reputation as successful dressage horses. I started my search by learning as much as possible about the bloodlines and by watching and riding as many young horses from many different bloodlines as I could. I began to be able to predict what a given horse would look like, and even how the horse would feel to ride just on the basis of bloodlines. I learned that because of my personal preferences, ability, goals, and riding background certain bloodlines were not appealing to me even though they were often developed into successful dressage horses by their riders. For instance, in general, I do not like horses by the Hanoverian stallion, *Sherlock Holmes*, because although they often look wonderful, they can be too strong for me to ride in the bridle. In contrast, I have always enjoyed riding *Rubinstein I* and *Rohdiamant* offspring that are often light and sensitive.

As a biologist and a college professor of Genetics and Anatomy and Physiology, my mantra is that form begets function. Much of TB breeding is based on success on the racetrack, with little regard to conformation. European Warmblood Verbands (associations) license and approve stallions on the basis of many qualities including conformation, basic gaits, athletic ability, temperament, rideability, trainability, willingness, and in some cases, results from x-rays, endoscopy of the breathing passageways and semen evaluation. Similarly, mare tests are also performed but are generally not as rigorous and are not required for the mare to produce offspring that are eligible for registration. In addition, the verbands carry out extensive and tedious inspections of the offspring that are eligible for registration, so they are well informed on how a given stallion or bloodline is producing and can evaluate the prepotency a stallion or bloodline might have for certain traits or characteristics.

At the genetic level, all of these procedures evaluate the phenotype of the horse in question. The horse's phenotype consists of traits and characteristics that can be observed directly or can be observed by tests. These traits are expressed by the genes that the horse has inherited from its dam and sire. Generally, genes that are expressed and are observed in the phenotype of the horse are dominant genes. However, there are many genes that a horse will inherit and will not express and these are generally referred to as recessive.

Genotype is the term given to the genes that a horse inherits from its sire and dam, whether expressed or not. In some cases, a horse might inherit 2 recessive genes from its parents and without a counteracting dominant gene, the recessive phenotype will be expressed. A simple example is the gene that causes inherited gray coat color in horses. Gray is due to a single inherited dominant gene (G). Since "gray" (G) is dominant to "not gray" (g), recessive, only one gray (G) gene is required to pass on the gray phenotype to the offspring.

Should both parents be some color other than gray, they will only be able to pass the recessive gene to their offspring (g), and the offspring will not be gray. If a stallion is GG or homozygous dominant for gray, all of his offspring will be gray, regardless of the contribution by the mare. If a stallion is Gg, or heterozygous, there will be only a 50% probability that he will produce gray offspring when mated with a non-gray mare. If both parents are gray, but produce any offspring that are not gray, this indicates that both parents are heterozygous for the gray gene, thus carry a dominant and a recessive gene in their genotype (Gg).

In this case, two heterozygous parents for the gray gene will have a 1in 4 probability or 25% chance of producing a non-gray offspring. This shows how a parent can be prepotent for a given characteristic, such as gray coat color. But unfortunately most of the traits we want our sport horses to possess are not so simply inherited. Many of the traits are affected by multiple genes, genes that do not express simple dominant or recessive inheritance and genes that are influenced by the environment, which makes the science of breeding far more complicated.

The art of a successful breeder relies heavily on the "lines" the breeder chooses to entwine. **Linebreeding** is a form of inbreeding where the offspring are closely related to a superior ancestor. Linebreeding is frequently practiced in the breeding of animals for agriculture and sport in order to achieve predictable characteristics and traits in the offspring. For instance certain lines are well known for qualities that they transmit (prepotency): *Cor de la Bryere* is well known for the successful jumpers in the "C" line of Holsteiners (*Caletto I* and *II* and *Calypso I* , *II* and *V*). The legendary "W" line for Hanoverians stemming from *World Cup I* to *Weltmeyer*, is known for their extravagant and elastic gaits. And in Oldenburg, the "R" line from the Westphalian, *Rubinstein I*, is noted for their rideability, type and kind demeanor.

Selecting a stallion for a specific mare can be very difficult, but there are many things that can be done to load the dice to favor the breeder. If the mare is a maiden, it is best to start with a proven, prepotent stallion (a stallion that has well established bloodlines and has shown that he can predictably pass these traits to his offspring), especially if little is known about the prepotency of the mare's bloodlines. After a foal or two it might be possible to determine how the mare affects the genetic background of the stallion. If the offspring are much like the mare, she carries many dominant genes. If the offspring are more like the sire, the mare might have fewer dominant genes and her foals will be more heavily influenced by the sire.

Unfortunately, not all traits can be evaluated in the foal. Some traits will only be observed once the offspring is of riding age. Even the gaits and jumping ability can be different under the rider and cannot be completely evaluated until the offspring have had sufficient training by a competent trainer. All of these qualities take years to be borne out in the offspring and furthermore, it might be difficult to separate training and nurturing from inheritance.

Once the mare's prepotency is surmised, it is possible to breed her to an unproven stallion, one that has no or few offspring on the ground or does not descend from a well established bloodline. It is now that the breeder voyages into uncharted waters! But the results from each breeding should serve as data, as an experiment, to be noted and evaluated for future breedings.

By riding, watching and studying horses of different bloodlines, prepotency will become evident. Certain bloodlines will be more appealing than others and certain bloodlines might be more suitable to your breeding stock than others. There could be no greater satisfaction than to cross your favorite blood lines and breed a really top horse like Rembrandt, or Gigolo or Bonfire or the devoted junior or amateur horse. And yet, even with all of the high tech genetics that we hear about today, horse breeding still remains very much an art and an irresistible gamble.

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