



Large Hearts in Horses
 "X-Factor: Part I"

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Known Large Heart Horses:

- 1764 Eclipse
- 1837 Pocahontas
- 1917 Man O' War
- 1926 Phar Lap
- 1933 Mahmoud
- 1933 Seabiscuit
- 1934 War Admiral
- 1940 Princequillo
- 1970 Secretariat



Phar Lap winning the Melbourne Cup. It is said that his heart was three times the normal size. He shares the nickname 'Big Red' with two other famous horses: Man O' War, and Secretariat. He was a very big horse, standing at 17.2 hands.

Where did the Large Heart come from?

It is not certain. The possibilities include: the evolution of the gene during the ancient development of the Arabian and Barb breeds. Serious hardship was presented by the environment, and caused the desert animals to adapt in order to survive. A distinct pattern of line breeding known only to the instinct of the wild ancient horse perpetuated it in a common way.

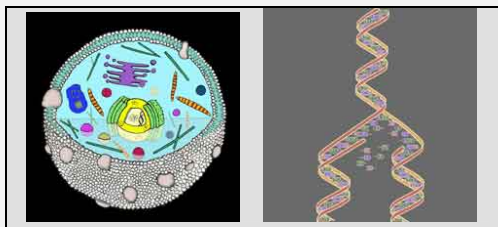
What is the X-Factor?

There are seen and unseen attributes in any individual horse. Although beauty and correctness of conformation are easily appreciated, the unseen components may be what sets this horse apart and makes way for greatness. The spirit, character, temperament and will, combined with unseen physical advantages, produce something extraordinary. With particular emphasis on quantifiable traits, the following article addresses the advantage of a larger than normal heart in Equine Athletes. The larger than normal heart is an inheritable trait, and convincing research shows that this genetic opportunity is passed to offspring by way of the X chromosome. The term 'X-Factor' is used to describe the inheritability of the large heart gene, because of the association with the X chromosome.

Inheritance of the X-Factor

Genes are the code of life. Each gene is found at a precise location on a chromosome, and is responsible for determining a particular characteristic in an organism. This is done by the formation of specific proteins. Proteins communicate events and status, and form essential structures necessary for life. Proteins have an intimate and inextricable relationship with their immediate environment, and subsequently, the surrounding environment. They participate in a very complex and incessant dialog because the micro and macroscopic structure in the body undergoes constant change. Nothing goes unnoticed at this level, and all things are governed by the information given and received by the genes.

Chromosomes which are the organizing structures for the genes, are united in a special way, forming the double helix structure called DNA. DNA is a pair of chromosomes, one from each parent. There are 32 pair of chromosomes that complete the genetic makeup of the horse.

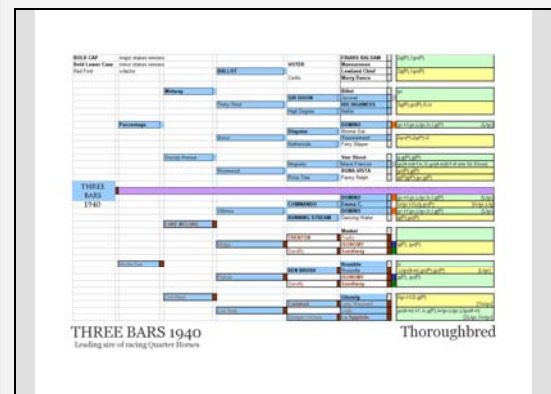


Sex-linked chromosomes determine the gender of the individual. This type of chromosome that has female characteristics is called an X-chromosome, and a chromosome that has male characteristics is called a Y-chromosome. Stallions and geldings have one X, and one Y-chromosome, and mares have 2 X-chromosomes. These two chromosomes, are just one of the 32 pair that make up the horse.

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How do I find it?

Since the trait is carried on the X chromosome, the heart-line is traced from sire to daughter, and dam to son or daughter. If a sire is known to have a large heart, then he definitely passes it to his daughters, but definitely does not pass it to his sons. If a dam is known to be a double copy mare, she definitely passes the trait to all her offspring, both sons and daughters. A single copy mare has a 50% chance of passing the trait to any given son or daughter.



Without direct knowledge of heart size, it is still possible to make a good guess based on highly correlated information. If a sire appears high on the brood mare sire list, it is highly likely he carries the large heart. Also, mares listed as "Reine-De-Course" are also likely to carry the trait. There are exceptions to both these rules, the most notable being Miss Disco, and her son Bold Ruler. Both were known to have normal hearts. Other circumstantial evidence of the large heart is the ability to win races at more than a mile. The evidence is better as the race is longer and tougher. So graded stakes winners at classic distances are a good bet. There is one more factor that is useful as an indicator for broodmares. The produce record of a single or double copy mare should be considerably above average. Plus her produce should have a tendency to go a distance. Her sons are the best indicator, since they can only inherit the large heart from her. Using the above evidence and known large hearted horses can allow one to have a pretty good idea of the odds that a given horse carries a large heart. You can also have a vet use ultrasound or electrocardiography techniques to directly measure the heart size.

Heart size is just one factor that is important for race horse performance. It is however quantifiable and somewhat predictable. Therefore it is a useful factor for prediction of racing and breeding success. Implications for the Sport Horse Industry are clearly closely related.

Domestication resulted in the dilution, and reduction of the genes coming together in the most natural way. The expression of the large heart became less 'common', although Arabians are still outstanding endurance horses. As the Thoroughbred was developing in the late 1600's and early to mid 1700's, the recombination of certain Arabian and Barb blood enjoyed a renaissance. The Large Heart began to express itself through the combinations and rigors being presented at that time.

Another possibility was that Eclipse was the first horse in the history of the world to exhibit the large heart phenomenon, through a spontaneous mutation.

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The X chromosome is larger than the Y chromosome, and therefore has more space for the genetic markers that describe traits. Heart size, based on current research seems to be carried on the X chromosome alone. Thus, a male horse has a single marker for heart size, while a female has two. A male offspring inherits the Y chromosome from his male parent, and one of two possible X chromosomes from his female parent that determines his heart size. A female horse has 2 X chromosomes and can have one, both, or neither that carry the large heart.

For Example:

Secretariat, a known large heart horse, would not pass an X chromosome to any of his sons but he would pass it on to his daughters. His daughters in turn, pass either their X chromosome from him, or their X chromosome from their dams, on to either their sons, or their daughters.

In the case of a female, one X chromosome will generally be dominant, so it is possible for the trait to be carried, but not exhibited. The term "double copy" mare is used to describe a mare that carries 2 X chromosomes with markers for the large heart on each one. These are the mares who are most likely to have exceptional produce records. These are the ones we want in our brood mare band.

The conclusion about heart size being determined by the X chromosome alone explains the pattern of broodmare sires. These are sires who are not, in general a huge success as studs directly, but whose daughters end up superior to the brood mare population in general. All the sire's daughters inherit his X chromosome, and if it carries the large heart, all of them will have at least one, and some of them 2 X chromosomes, that pass on the large heart trait. Thus although he cannot influence his son's heart size, his daughters rate above average. Their offspring will benefit, and thus the sire gains a reputation as a broodmare sire.

Summary

It is known that certain lines within Thoroughbreds are particularly gifted jumpers. There are stamina lines, and lines which produce more substance. There are lines which produce size, and lines that are known for beautiful movement. Each chromosome carries the genetic material of each parent and that is why a study of pedigree is important. Many traits may be enhanced or diluted depending upon the choices we make.

It is also noteworthy that repeating female families seems to be evident in some of the best racehorses and show jumpers of our time. Female families may also be the key to understanding why certain crosses produce outstanding horses. Talent may be looked for in the sirelines of both sire and dam, and the ultimate 'power pack' needed to drive the horse found in superior female families. It makes sense that horses with larger than normal hearts might be more able to perform difficult things with more ease. There are other structural elements that need to go hand in hand with a large heart. Large lung capacity, which includes a deep girth, well sprung ribs, a large windpipe, and large nostrils. If you are going to try to breed a horse with these attributes, it is prudent to breed for fundamentally correct conformation. Don't put a great engine in a bad chassis. The weakest element will be sorely tested.

Definitions:

Reine de Course – "Queen of the Turf".

Only the most influential mares are given this distinction.

Broodmare Sire – The sire of an individual's dam. Maternal grandsire.

Double copy mare – A mare in which both X chromosomes have the 'X-Factor'.

Single copy mare – A mare in which only one of the X chromosomes has the 'X-Factor'.

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