
# THE GENETIC EDGE

*GENETICS IN THE MODERN THOROUGHBRED INDUSTRY*

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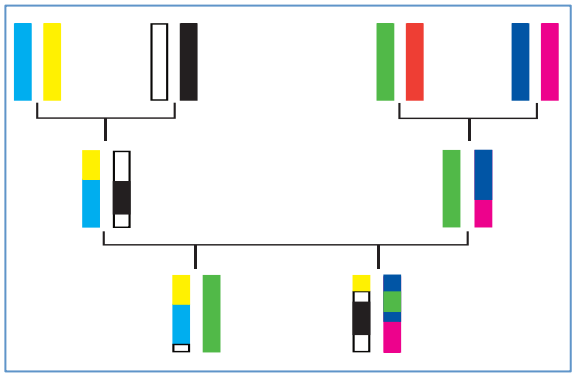
## Introduction

Genetic testing has long been heralded as the next frontier in thoroughbred performance selection. However, in order to comprehend the potential impact of this fascinating new science, it is important to understand the core foundations of genetic testing and the complexities of applying this discipline to the thoroughbred industry.

In one sense, discussing genetics is simply a new method of discussing a science that is old as the sport itself—pedigree analysis. For instance when someone discusses what a horse "got" from another horse in his or her pedigree, really they are postulating what genetic material, or DNA, has been passed along through the family line. The inheritance of this DNA is complex and always subject to random chance, which is what makes pedigree analysis so difficult to accurately assess.

For instance, horse hereditation is subject to a system of recombination by which genes from both the sire and dam are passed to the offspring completely by chance. Figure 1 illustrates this process.

Figure 1: Inheritance of Chromosomes:

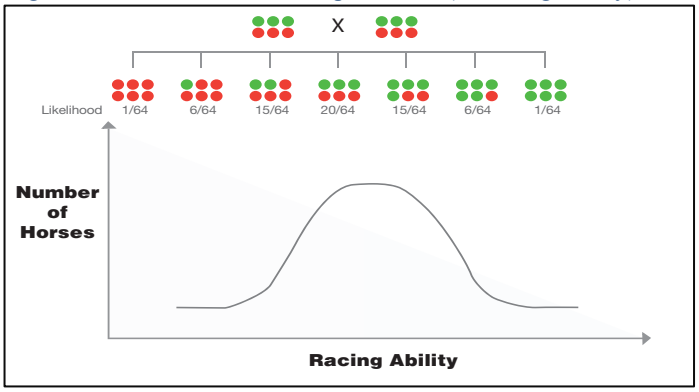


It is evident that the natural variation of recombination makes using pedigree analysis to make decisions on individual horses very difficult. However if we could use genetics to find the "blocks" that genotypically correlate with high performance, we could use some of the same precepts from which the industry was based to create a test that could help our clients identify future top performers.

## Creating A Genetic Test for Performance

In the most elemental sense, the method of our genetic research was fairly simple. Our team collected over 1,000 genetic samples including more than 200 Grade 1 winners. We then ran a complete genome sequence on all of these samples, creating over 30,000,000 genetic data points to reference. These data points where then examined for correlations with elite performance and other metrics. The idea being that a horse with more of the correlating genetic markers would have greater chance of success.

Figure 2: Inheritance of a Complex Trait (IE racing ability)




Of course, in real application the process is considerably more complex than depicted in Figure 2. For one, there are many more than three markers that identify performance. Additionally, while each marker's contribution to performance is additive, the marginal impact of each marker can vary significantly. Complicating things further is the principle of Epistasis whereby seemingly unrelated areas of the genome influence relevant markers.

Finally, the role of the environment can never be overlooked. Our team collected data on hundreds of horses that were classified as poor performers. However, it is impossible to tell if these horses actually possessed the genotypes to succeed but were haplessly withheld by injury or illness.

Despite these challenges, our genetic team worked tirelessly and soon created a test that could help identify the genetic markers that statistically correlated with performance.

## Application

### *Performance Panel*

Once the team discovered the genetic markers for racing potential, our scientists created a genetic test that quickly identifies these prescribed markers. Our test grades each individual with a score of A through D.

Figure 3: Performance Categories Distribution Database Population vs. Grade 1 Population (Colts) *n=2513*

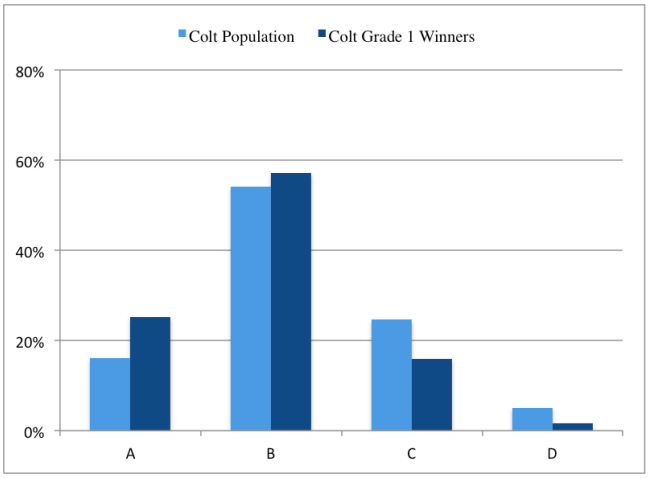
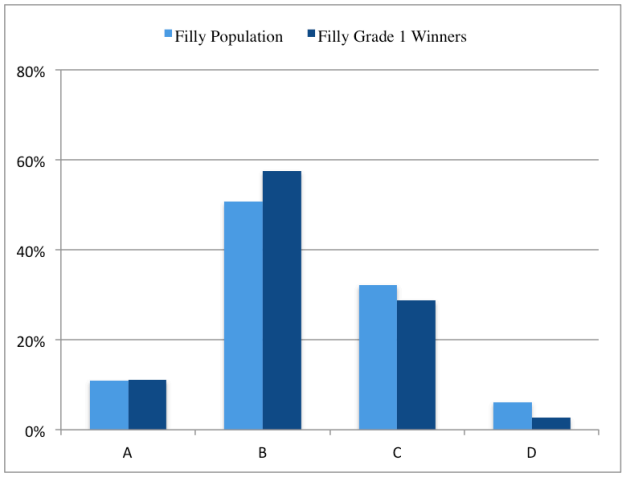



Figure 4: Performance Categories Distribution Database Population vs. Grade 1 Population (Fillies) *n=2402*




While the test is more relevant than for colts than fillies, it is important to note that in both categories that top A and B ratings demonstrate that the individual horse is aided by his genotype. Conversely, horses that have the lower C and D ratings are negatively impacted by their genotypes.

### *Optimal Distance*

Additionally, our team looked to find other markers that would correlate with information that would be useful for the horsemen. One marker was found to correlate highly with the horse's optimal distance. This marker is collocated with the gene that has been established to control Myostatin production.

From this marker our team created a test that breaks down horses into three categories (One Turn, Two Turn, and Stamina) based on their propensity for performing over different surfaces.

Figure 5: Optimal Distance Ratings as Compared to Avg. Winning Distance.

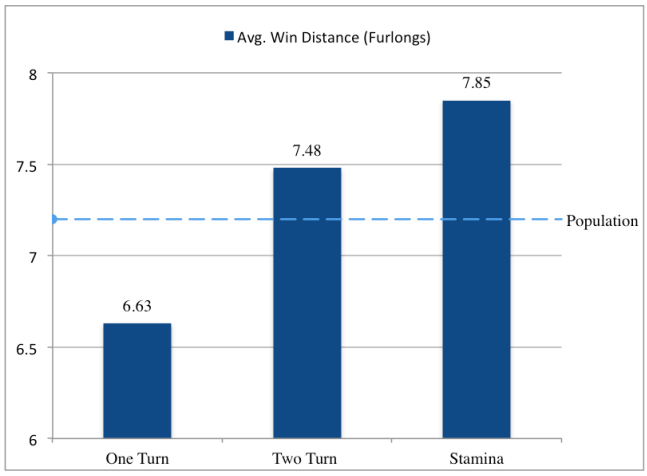
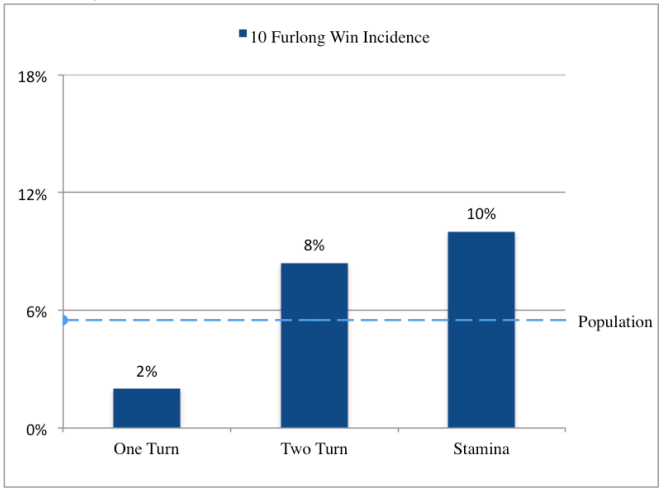



Figure 6: Incidence of Winning Race 10+ Furlongs (Among Winners)

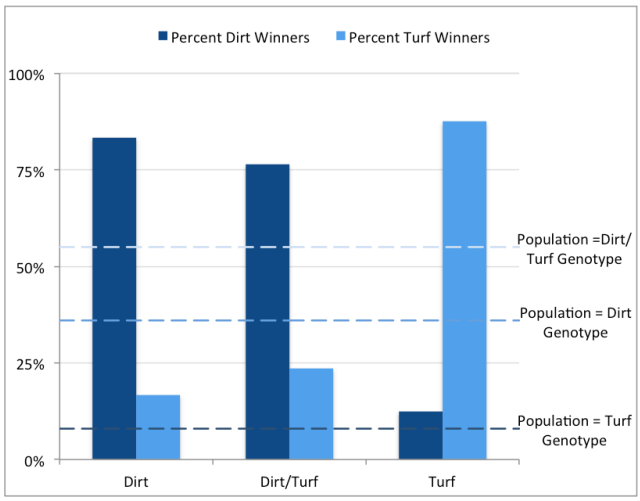



The test provides an accurate predictor of distance potential. For instance horses with the Stamina genotype are 5 times as likely to win over 10 furlongs than horses with the One Turn Genotype.

## *Surface Preference*

Our team also discovered a series of markers that correlated highly with surface preference. The test categorizes horses into three different categories: Dirt, Dirt/Turf, and Turf. Figure 7 displays the incidence of the horse's best performance occurring on dirt or turf in relation to the individuals genotype.

Figure 7: Best Performance (Highest Purse Money Won) Distribution Among Different Genotypes.



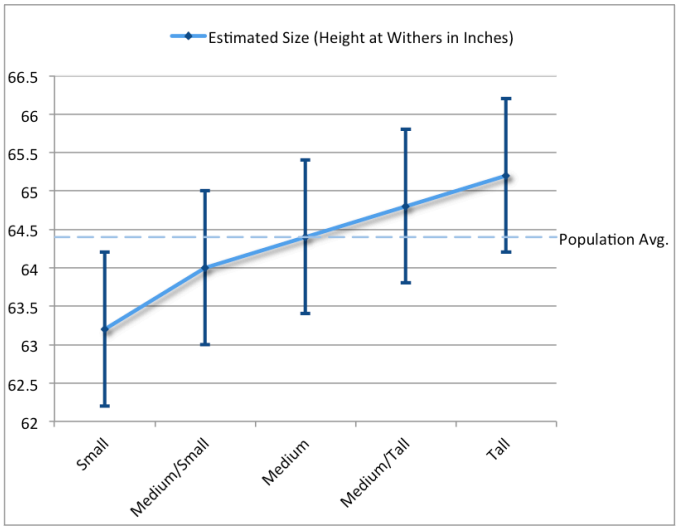

The graph demonstrates that the Turf Genotype has over 5x greater likelihood of having their best performance occurring on a turf surface. However it must be noted that the Turf Genotype is relatively rare among our sample, occurring in less than 10% of the overall population.

*In all our research studies, our geneticists have validated the DNA datasets by re-mapping the bay/chestnut mutation that is known to be at a certain location on chromosome 3 (ECA3). Our team then looked for a statistical association between the known bay/chestnut coat colors of the horse in our dataset and the particular DNA sequence at each genetic marker. The team found a very high correlation between markers only in the vicinity of the known location of the bay/chestnut mutation on ECA3.*

## *Height Markers:*

Through the course of our analysis our team also found markers that correlate with overall height for each individual horse. This tool can help the horsemen as he tries to forecast growth in his developing foal. Figure 8 demonstrates how the tool delineates each horse among 5 different genotypes. The error bars demonstrate 70% error, IE horses in each category fall within the error bar predictions 70% of the time.

Figure 8: Height at Withers as compared to varying genotypes.




## Conclusion

Genetic analysis is a tool that can help our clients make more precise evaluations of their horses. It allows our clients to gain a better perspective on their horses overall performance potential, optimal distance, preferred surface and eventual height at the withers. However, the analysis is best when integrated with a phenotypic testing protocol that is more attuned to environmental factors. Integrating both genotypic and phenotypic testing systems also allows the horsemen to gain a holistic overview of their horses physiology, and thus make more informed decisions that benefit both the horse and their organization's bottom line.