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Genetic Potential

Lon Kilgore

I have kids. One, a six year old, Thomas, loves all things martial arts. Since he was four years old, he's been studying with Harley Elmore, a heavily credentialed and amazing instructor in Jeet Kun Do, Sayoc Kali, Muay Thai, and Silat. Why, as a little four-year-old, did he make a decision to study martial arts? I bet you can guess. TV. I'm not sure but I'll wager that there has been a large upturn in the traffic in any martial arts business with a good kids program due to two cartoons: *The Avatar* and *Naruto*. Both of these shows have engaging stories, interesting characters, and prominently feature fictionalized and/or magical martial arts forms rooted in Chinese and Japanese forms. But this article isn't about martial arts, kids, and cartoons, it's about genetic potential. You'll see the connection soon.

In *Naruto*, the title character, Naruto Uzumaki, lives in a community protected by a revered troop of Ninja warriors. His single-minded purpose in life is to complete Ninja school, become the greatest Ninja of all time, and ultimately become "Hokage," the leader of the Ninjas. To do so he must overcome his orphan status, prove himself in school and in the field, and learn how to deal with an occasionally active supernatural demon spirit that was purposely trapped in his body to save the world (OK, that last bit is weird but it's part of the story). But the lesson I want to address here deals with not Naruto Uzumaki but with a couple supporting characters, Sasuke Uchiha and Rock Lee. Sasuke is the consummate "natural," possessing amazing abilities inherited from his family, and seems to effortlessly and intuitively perform combat skills without instruction or practice. Then there is Rock Lee, a Ninja nerd with absolutely no natural ability but a work ethic the size of Texas and an absolute commitment to never quitting, even if it kills him.

The interesting point here is that the two characters are of the same Ninja rank and level of performance, but the means by which they arrived there were quite different. One, Sasuke, relied on genetic characteristics innate to his family. The other, Rock Lee, is competitive only because his sensei determined that, for him to be able to hang with the other Ninja students, he had to become insanely fit—he had to be able to rely on a tremendous work ethic and superior fitness to carry him further than Sasuke's reliance on natural ability. In the real world, this would be exemplified by the athletic genetic "freak" having his performance matched or beaten by the guy with an average set of genes who just trains smarter, harder, and more diligently (Dominic Rhodes vs. Steve Largent might be an example, in the realm of football).

The term "genetic potential" is usually invoked by people trying to generically describe the difference between winners and losers. A more useful and precise definition of genetic potential is whether an athlete possesses the active genotype to excel in sport; or, in simpler terms, does the athlete have the optimal set of genes and enough of them turned on to be the best in a selected sport. Humans share a great deal of commonality in the genes they possess, but there is variation in both the genes possessed and the genes expressed (turned on). With at least 73 genes associated with fitness and performance, the variations in possession and activation lead to differences in performance potential through a simple biological path: DNA makes RNA, which makes protein, which makes structure, which makes function. If you have more active copies of a performance-related gene than someone else, your performance will most likely be superior to theirs. The bottom line is that genetic potential ultimately has a strong effect on individuals' athletic performance. That's just the reality of it.

A good example of how possession of a specific gene may affect performance is the *actn3* gene, a little segment of DNA that ultimately codes for the synthesis of alpha-actinin, a structural protein in muscle fiber. Possession of certain variants of this gene is strongly associated with elite sprint performance. Three variants of this gene have been identified: RR, RX, and XX. In elite sprinters, 50 percent of the *actn3* variants present were RR, 45 percent were RX, and 5 percent were XX. At the other end of the sport metabolic continuum were the elite endurance athletes. Their profile was markedly different, with only 31 percent RR, 45 percent RX, and 24 percent XX. Given this data, the RR variant has been termed the "sprint" variant and the XX the "endurance" variant, as it seems clear that the possession of those variants in varying ratios affects performance capacity.

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Beyond possessing different performance-related genes, humans also have a degree of genetic redundancy. Within each human's genome there are usually multiple copies of a specific gene, a safety measure just in case one gene gets damaged or malfunctions. But even though we have multiple copies of genes, not all of them are active at any given time. Many or most of the copies are inactive or repressed when the body is unstressed. In times of need, some of these genes can be activated through various biological processes and then allow for large-scale production of important end products that then affect function (performance). The more copies activated, the larger the scale of production, and likely the bigger boost in performance.

This concept is integral to the human condition. Humans are built to be active to survive but the modern sedentary lifestyles lead to inactivation of the genes related to survival (the fitness and performance genes). Even though the genes are still there, they are essentially dormant because the body is not doing anything to cause a physiological adaptation requiring their activation. It is our job as trainers, coaches, athletes, or just people, to stress the body appropriately so we can turn on the set of performance genes to drive fitness adaptation. It's pretty simple: we know exercise is good for us because if we are fit we survive longer than those who do not. This is so because exercise activates genes that promote the ultimate end product of "health," our survival in the face of environmental challenge (whether of viral or social origin).

A pleasant byproduct of being fit to survive is a tendency to "feel" better and be better able to perform a spectrum of tasks (personally, I equate this to a better ability to have fun). We do enter into this endeavor blindly, as it is doubtful that the average trainer or trainee will have access to gene profiling technology, but if we assume a trainee has a number of dormant *actn3* RR genes, for example, we can use high-intensity, low-volume training to activate those genes. This preferential activation will help power athletes attain their fullest performance potential with metabolic efficiency and without the clutter of unnecessary aerobic adaptation. Or we could do the reverse and do larger volume endurance training to activate dormant *actn3* XX genes to build a better marathoner.

But specializing in on or the other of these two approaches of tapping into genetic potential would emphasize narrowly specialized performance (and therefore reduced ability outside that specialty) rather than broad physical capacity. What's preferable for most of us is a broad-spectrum adaptation that will make a better and more functional human animal. To be truly fit to survive, fit to live, fit to work, and fit to play, we need to drive across-the-board adaptations, aerobic and anaerobic, metabolic and structural, and we need a system of training that activates every performance gene in its path. Unlike weight training or traditional endurance work alone, CrossFit-style mixed-mode training capitalizes on an athlete's complete set of performance-related genes and produces a comprehensive fitness adaptation. A CrossFit body may represent the functional expression of the human genotype as it is intended by nature.

There are a few little details we need to consider about genetic potential. Someone who is genetically favored will progress faster in any exercise system and will ultimately reach higher levels of performance. However, everyone responds genetically to training in much the same way; it's just the rate of progression and the magnitude of result that vary. Occasionally we find a trainee who possesses an excellent genetic profile and will show enormous training adaptations and improve beyond expectations. When this happens, revel in their success, but be wary. Although an individual with few copies of a gene, such as *actn3*, may not be capable of reaching the same level of power performance as someone with multiple copies of a specific variant, appropriate programming will still produce impressive results. Frequently, individuals with great genetic potential fail to train appropriately, since success comes easily even with poor programs. So, in too many cases, the programs that exceptionally talented elite athletes use do not effectively move them toward their potential. Failure of the coach to understand the basic science of training (e.g., the workings of stress and adaptation), or cockiness on the part of the trainee that leads to ignoring sound training principles can allow a genetically gifted but improperly trained athlete to be beaten by a less gifted athlete who is receiving proper coaching and programming. Programming must be individualized, as you cannot utilize that same rates of progression and expect the same magnitude of improvement in the guy with the average set of genes and the genetically gifted trainee. Because we cannot, by definition, alter an individual's "genetic potential," we must not fail to individualize our coaching and programming as well, especially when pursuing very specific competitive performance.

So we come back to my son Thomas. Most people just look at the two of us and comment on the physical similarities. It's pretty obvious that he has inherited some of my genetic potential—or lack thereof—for sport. After all, DNA makes RNA makes protein makes structure makes function. Since I was an average wrestler, a decent weightlifter, the world's shortest varsity rower, a fairly uncoordinated student of Sayoc Kali, and a hack at golf, Thomas likely has much more in common with Rock Lee than with Sasuke Uchiha and will unfortunately have to bust his butt to achieve his goal of being a black belt, weightlifter, and world-class snowboarder. Luckily, I think he has a pretty good shot at the first two, with the benefits of hard work and the help of phenomenal local coaches Harley Elmore and Mark Rippetoe. Becoming a world-class snowboarder in Texas, though, may require more than either genes or determination can produce. For that, he might need magic on the level of cartoon fiction.

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