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Born to win: top athletes don't share a single talent gene, but hundreds of them

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Andy Murray triumph at Queen's on June 20. EPA

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When this year's Wimbledon tennis championship begins on June 29, British hopes will again be pinned on Andy Murray. Only time will tell if he can kick on from his Queen's Club victory and win the UK's premier tennis tournament for a second time.

But why is he so good at the sport? Is it his training regime? Is it the care and attention that he pays to his diet? Is it the team that advises him on training, technique and strategy for each match? Did he do his 10,000 hours training as a child?

The answer is almost certainly yes to all of the above, yet none of it is enough. Genetic predisposition also plays a massive part in Murray's talents. Some have wondered whether this might be governed by a single talent gene, but the past couple of decades have taught us that the truth is much more complicated – and still only partly known to us.

Sporting talent tends to run in families: Andy Murray's brother Jamie is also a Wimbledon champion; their mother Judy is a top tennis coach and former professional player and their grandfather was a professional footballer for Stirling Albion and Cowdenbeath.

Mixed doubles

Like all families, the Murrays share some of their genes – and their example is consistent with the scientific research. In 2007, for instance, British researchers compared 700 pairs of twins and were able to show that as much as 66% of the differences in our sporting abilities could be explained by our genetic differences. In other words, the sum total of training, diet and all other interventions accounts for less than genetics when it comes to determining sporting talent.

But there is not just one gene for sporting talent. We are all humans, so we all carry the same roughly 20,000 genes. What you do find is different versions of some of those genes in different people within the global population. Genome sequencing projects such as 1,000 Genomes have shown that we are about 99% similar, or almost identical. But the human genome is very large – 3bn letters or bases long. Combine that with our 1% difference and there are actually about 38m bases at which we can differ, resulting in multiple versions of most genes.



DNA sequences behind the human genome. glo.tto

Since the first report of variation in the ACE gene relating to sporting ability came out 17 years ago, we have implicated over 200 more genes to date. These genes are related to sporting performance through a variety of mechanisms, perhaps through involvement in muscle structure or the body's ability to use oxygen. But each of them has only a small influence – and when we combine them, we can't explain anywhere near 66% of the differences between us.

This suggests that many more genes are involved. But how many exactly, and is that all it takes? Recent research has identified nearly 700 genetic variants that are involved in determining height, for instance, although more remain undiscovered – and it is likely that a similar number will be involved in sporting ability. If so, an average person would effectively have around 350 “talented” versions and around 350 “untalented” versions. Some people would have slightly more “talented” versions, making

them slightly different from average – perhaps helping them get into club or county teams. A smaller number still would have quite a few more “talented” versions, making them more extreme, perhaps helping get them into international teams.

The trouble with tests

How then should we identify the next Andy Murray? Should we turn to **internet-based tests** of genetic sporting potential to guide our children on whether to bother trying? Aside from the ethical concerns this raises, it is certainly not worth it at the moment. All of the tests that I am aware of test only a few of the genes known to relate to sport and, of course, we have not identified all the genes involved anyway. So these tests can explain only a small portion of the differences in our abilities – and the information may be misleading. The best way to identify sporting talent in children is still to ask them to play sport.

Similarly, many existing athletes who are not quite winning medals become involved in **talent-transfer programmes** where they are physiologically tested to identify a sport to which they may be more suited. These athletes are often approached by genetic-testing companies who offer to identify their sporting predisposition. But these tests lack predictive power for exactly the same reasons as the ones for children.

Myself and others in the research community are involved in producing a position statement on these kinds of tests, which will shortly be published in the **British Journal of Sports Medicine**. It will be endorsed by **Kamiel Maasse**, a former international distance runner and the holder of the Dutch record for the marathon, now representing the Dutch Olympic Committee – who already warn their athletes not to be taken in by these offers.

In summary, there is no “talent” gene, but many “talent” versions of many genes which collectively help determine sporting talent. While we now understand a great deal about the genetic predisposition to sporting talent, there is more left undiscovered and genetic testing to identify future talent remains science fiction. Genes alone will not take you all the way – this is where the training, nutrition, psychology, strategy and technique all come in. All are necessary; none are sufficient.

There is also a level at which mass participation matters. If the genetically most gifted tennis player in Britain never picks up a racquet, if they are spending their time playing video games or watching television, we won't see the next Andy Murray. If every school child plays tennis, on the other hand, then investing money in those who win junior club competitions will almost certainly include those with the most favourable genetics. If too few play, there will be the risk of merely investing in the best of those that played. But that's where one other crucial factor comes in when looking for those with real genetic talent: such people are rare, so you need to be lucky too.

