NOTES FROM

THE LAB

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The right stuff

What your parents gave you counts

In his classic book *Inside Running*, renowned exercise physiologist David Costill writes about the popular movie *The Right Stuff*, which was based on Tom Wolfe's book about the astronaut selection and training program for the Mercury space mission. Costill notes that only certain pilots had the right combination of physical and mental abilities to succeed as astronauts: these traits enabled one pilot to consistently perform better than another. Similarly, scientists have identified several physiological attributes important for success in distance running. Many of these are controlled by hereditary factors, but others can be modified by appropriate training.

***Breath test:** Your ability to use oxygen efficiently is one of the factors that determine how fast you'll go.*

Since the turn of the century, exercise physiologists have associated successful endurance performance with the ability to consume, transport and utilise large volumes of oxygen. In the laboratory, this is measured by collecting expired air samples from an athlete while they run to exhaustion on a treadmill or cycle to fatigue on a stationary bike. The greatest volume of oxygen consumed during a test is termed maximal oxygen uptake (or simply VO_2 max).

Judging by how often it is discussed by runners, coaches and scientists, one might be forgiven for thinking that VO_2 max is the only predictor of endurance performance. Part of this belief comes from early scientific studies that tested runners of vastly different abilities and found that VO_2 max was highest in the best runners. For example, one of the highest VO_2 max values ever recorded for a runner was 85 ml/kg/min for British athlete David Bedford, who ran a world record of 27:30.8 for 10km back in 1973. By comparison, a normal healthy young person would have a VO_2 max of around 35 to 40 ml/kg/min. If you have a VO_2max greater than 70 ml/kg/min then your potential 10km time is 33:00 minutes or faster. However, if your VO_2 max is between 45 and 49 ml/kg/min (most runners) the best you can probably hope to run for 10km is 46:30.

As VO_2 max can typically be increased by only 20 to 25% with training, it is clear that the average runner can train as long and hard as they want and never reach world-class purely because of genetic endowment – or rather lack of it.

But there is hope! Dave Costill was the first physiologist to notice than runners who had the same VO_2 max values often performed quite differently in races. He described the case of two national level distance runners whose best marathon times differed by almost 15 minutes, despite identical VO_2 max scores. Like a good scientist, Costill went back to his laboratory data and noticed that the better marathon runner reached a faster maximal speed on the treadmill at the point of exhaustion. As both runners used the same amount of oxygen, it was clear that the better runner was more efficient at using oxygen than the slower runner. Think of it like this: at the same submaximal running speed, the slower marathon runner was using a greater percentage of his VO_2 max compared to the faster, more efficient runner.

In addition to a runner's VO_2 max, other factors are instrumental in determining performance, such as the capacity to exercise at close to your VO_2 max for sustained periods without accumulating lactate in the blood; the ability to use fat (rather than precious muscle and liver glycogen stores) during exercise, and the ability of the working muscles to resist fatigue during the later stages of a race. However, at the end of the day, it is a runner's VO_2 max that ultimately sets the upper limit on his or her endurance performance capacity. Determining how close you come to reaching that limit is down to you!

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