



The Science Behind the Bike

Physiology

Presenter

Many factors determine how well a cyclist performs. The physical attributes of the rider, physique and physiology are two of these.

Esme Taylor

Physiologist – British Cycling

Physique and physiology are two completely different things. So your physique is what you look like. It's your body shape mostly described as your somatotype. so that could be something like a mesomorph so that's usually muscular; what you usually describe as someone that looks like a sprinter – quite big with big muscles on ... their body.

An ectomorph would be someone that's quite tall and slender and thin.

And an endomorph is someone that's usually a bit rounder in shape and holds a lot of their fat matter around their stomach area. So that's basically what physique is – what you look like on the outside. Your physiology is what's on the inside.

Sarah Storey OBE

Paralympic Multiple Gold Medallist

Well physiological tests for cycling they generally take place on a static bike in a laboratory. But basically they're just looking at power and how much power you can produce. One of them is a six-second max test where you're trying to produce as much power as you can in a short space of time. And the other one is what we call a ramp test and it basically just takes you up on the resistance until you basically fall on the handle bars because you can't pedal any more. So those are the two tests – the sprint test and the what we call max minute test that basically they gave me the base line figures and then also gave me sort of targets really.

Esme Taylor

So during an Olympic time trial or the Hour Record your body will change quite rapidly. As soon as you start your heart rate would rise right up. Your oxygen uptake would go up as well as your body starts to need more energy you need to get more oxygen into your lungs, into your blood stream, to the muscles to be able to produce muscle contractions to actually pedal to go faster. So as soon as that happens your heart rate and oxygen uptake will probably stay very, very high level, almost near maximum for the rest of the duration of the event. A lot of that comes in towards pacing so that the cyclists will have to make sure that their – they know their limits and they will stay within those. If they went too fast off the start their heart rate and their oxygen uptake would go too high. There'd be a build up of lactic acid because there wouldn't be enough oxygen available to produce the energy for the muscle contractions. So they'd actually start to produce a lot of waste products within the body and that will slow them down. So they find their optimal rate that they know they can pedal at as hard as they can for that duration. Heat is actually one of the biggest contributing factors towards you slowing down. As you get too hot then your body will start to shut itself down to protect itself really, just to protect the brain and the heart. So getting rid of that heat energy is one of the most important factors really.

Presenter

The VO₂max test is used in cycling to determine the physical fitness of an individual by showing their ability to transport and use oxygen during incremental exercise. But are genetics and physiques solely responsible for creating an elite cyclist? Or to what extent does training enhance these natural attributes to improve performance?

Sarah Storey OBE

Genetics plays a huge part for any athlete in any sport. You look at Usain Bolt who is a massively gifted athlete and born with the right genes that will allow him to sprint that speed. Fast twitch muscle fibres are far less common in a person than slow twitch muscle fibres and every one has the fibres in between that can be trained to be more type one fast twitch or more slow twitch fibres but generally those absolutely pure fast twitch fibres that allow someone to go 9.5 seconds for a 100 metres on the track is – is very rare to find. And you tend to find the majority of people are somewhere in the middle so you then train those middle fibres to be as fast as you can get them or to work as powerfully as you can get them depending on the event that you're doing.

Chris Boardman MBE

Three times World Hour Record Holder

In my own case relative body proportions I've got a long body and short legs so when you're like this on a bike this bit's hitting the wind so this is the bit that's processing oxygen, getting into the muscles and this is the pistons if you like. That's a good shape to be: short legs, long body. You can't change radically your body shape. That's what you were born with. You have got to work with the ingredients with which you're given.

Sarah Storey OBE

On that ramp test they look at the final minute that you've been pedalling for and look at the average power of that minute. And for me it was a score of over three hundred watts to start with and in the time since I've become a cyclist I've added another hundred watts to that because of the specific nature of the sport and the efficiency of pedalling and things like that.

Esme Taylor

A lot of people think that you're naturally born with that kind of talent to be able to make the bike go fast but sometimes that's not the case because if you don't realise that potential for your training then you'll never get to that level.

Sarah Storey OBE

But if you don't realise that potential for your training then you'll never get to that level. But I think if you're prepared to put the work in and you know you're able to work towards the event that you want to do if you've got sort of a glimmer of talent then that hard work you really can't replace that.

Presenter

When it comes to physiology affecting performance in cycling is there considered to be a marked difference between the sexes?

Esme Taylor

There are certain physiological characteristics of each gender that would mean that they for example a man might keep his strength longer than a woman would. So we might need to alter the time out of the gym slightly differently going into a competition. However it's very individual to the athlete.

Sarah Storey OBE

I think the main differences between men and women are ultimately governed by the events that they do and the distances that they ride. Men are gonna have a slightly greater capacity for training just because they've got bigger muscle mass and naturally lower body fat and ultimately are naturally a little bit stronger. But that doesn't mean to say that there aren't ranges within that so I know men that can you know do a lot less training than I can do but ultimately ride faster at the end of that.

Presenter

In physiological terms what is it like to change sports? Both Sarah Storey and Rebecca Romero made successful transitions to cycling at Olympic level.

Rebecca Romero MBE

Olympic Cycling Champion

I transferred from swimming, which was an endurance power based aerobic based sport so therefore you know I categorised into an endurance cyclist event. For me I was, number one, having to reduce the length of time I was competing at. So for rowing it was an average say six and a half to eight minutes long race whereas the individual pursuit .. pursuit was looking at a target time of three and a half minutes. so I was essentially halving the time the I would have to be racing for. So I had to adapt my physiology slightly so become more of an anaerobic athlete.

Sarah Storey OBE

The engine inside of me was suitable to kind of tone down and hone away from swimming and into a cycling – cycling form as it were. as a swimmer I had much, much bigger shoulders. I've got twelve centimetres across my shoulders and probably about six kilos of muscle in total. Most of that was in my back.

Esme Taylor

Transferring from one sport to the other and being successful like Rebecca Romero and Sarah Storey is an exceptional achievement and both Sarah and Rebecca are exceptional athletes and they were excellent in both of their sports. I think it is achievable for other athletes as well especially if the two sports the one that they are switching from and to are similar in terms of the physical attributes that they have to display to be successful.

Sarah Storey OBE

I think to make a top rider or even a top athlete in any sport I think you need a mixture of a few different things mental attitude and the ability to work hard are probably at the very, very top of that. You do need Mother Nature. You do need a certain level of physiology and natural body composition. If you're naturally carrying weight around your hips or you know around your belly and you want to be an athlete then potentially you're not gonna be able to do that without even more hard work. That's not to say you can't change what Mother Nature's given you. Hard work is at the centre of most things and also a friend of mine used to say there's no escalator to success. You have to take the stairs.