

In depth: How to become more aero



I want to go faster. My cycling goals throughout my life have all orbited around that one simple target. I'm at my most content when the road is flying beneath me, my speed north of 40kmh.

The art of getting ever quicker, though, is about more than just pounding harder on the pedals and buying a more expensive bike. The quest for increased velocity is a long and complicated journey.

'Your velocity is determined by your power output and your drag,' explains Dr Barney Wainwright, research fellow at Leeds Beckett University and founder of Veloptima coaching (veloptima.co.uk). 'To increase speed, you need to optimise power production and improve your position on the bike to reduce drag.

'The lower you go, the lower your drag and the faster you'll go.' Sounds simple enough, but as anyone who's tried descending in an aero tuck will know, getting low on the bike while pedalling hard is far from easy.



More speed

To conduct my experiment in velocity, there is only one platform that makes sense – that purest pursuit of speed, the time-trial. A solo race against the clock, unassisted, is the one pursuit that isolates the speed of a rider more than any other.

I've done time-trials before, but even on top-of-the-range TT bikes I've never been truly fast. Good time-triallists tend to travel very quickly indeed, and even at amateur level specialists at the discipline are capable of reaching surreal speeds.

This summer, Marcin Bialoblocki of One Pro Cycling clocked the fastest-ever time for a 10-mile TT at a favourite course on the British TT circuit – the V718 near Hull. His time of 16min 35sec meant his average speed over the course was a staggering 58.5kmh.

Bialoblocki may be a professional, but many on the British amateur scene

approach similar speeds. By contrast, my own fastest time for a 10-mile TT is a woeful 22min 40sec, at an average of around 42.5kmh.

So is it just that riders topping 50kmh are producing superhuman power output? Well, a look through Strava confirms that riding at 50kmh does indeed take considerable horsepower, but the numbers aren't all that different from what I know I can do. Where, then, am I going wrong? My first instinct, of course, is to blame the bike.

Fitting the picture

As a certain infamous Texan once said, it's not about the bike. But if your goal is ultimate speed, having the right bike can definitely help.

With that in mind, I settle on a Giant Trinity Advanced Pro for the purposes of my test. It's the favoured steed of time-trial specialist Tom Dumoulin and every bit on trend when it comes to design and component integration. I select the rest of the componentry and kit to match the fastest on the scene.

The result is a bike that's undeniably rapid, and when I get it out on my 10.35-mile local course it feels like I'm blazing along. But in the end I only manage to trim a dozen seconds off my best time when what I need is minutes.

Could the secret to unlocking more speed be as simple as improving my position on the bike?

It's clearly not the bike itself that's holding me back, which leaves only one other possibility – me. Could the secret to unlocking more speed be as simple as improving my position on the bike?

'It's funny. People always think there's some sort of best position,' says Simon Smart, an aerodynamicist who has worked with many top brands and cyclists at the Mercedes Wind Tunnel in Brackley. 'In reality it depends heavily on your physiology, how flexible you are, the size of your limbs, and so on,' he explains.

Among his clients, he's found that very different things work for different people. A session in the wind-tunnel costs thousands of pounds, though, and I'm nowhere near the level to make the most out of it. First on the agenda, then, is a bike fit. It may seem that jumping from a road bike to a TT bike is really just a movement of the arms from drop bars to tri extensions, but that change affects every part of the fit.

'To enable your upper body to get into the right position, we have to rotate your whole body forwards around the bottom bracket,' says Lee Prescott, bike fitter at Velo Atelier.

The right position

Prescott is helping me to find a powerful and efficient position in fit terms before I begin putting the position to the test aerodynamically. 'It's all too easy to just slam the bars down low and think that's a great aero position,' he says. 'There are some vital arteries that run through the front of the pelvis, and if you go too low for too long the upward leg stroke can cause damage by consistently cutting off blood flow.'

Video taken from the front, side and rear contribute to a picture of stability and power that provide quite a shock for me. Firstly I find that moving forward and dropping the bars immediately make for a more stable position, as I'm able to rest more weight on my shoulders and my hip angles are healthier.

Prescott points out that my head is jutting unfavourably above my body, and predicts this will be a key point for reducing my drag. For now, though, I need to adapt to a new position and see if I can generate power. The type of power I'm generating may also need to change, too.

'Power readings are so useful for time-trialling,' Wainwright advises. 'You need to be aware of training zones, and what pace you'll realistically be able to sustain for a race, which can be a matter of trial and error.'

In terms of training, I quickly become conscious of certain zones that I'm weaker in. Taking Wainwright's advice, I work on my threshold pace and

watch it elevate gradually back towards what I'm capable of on a road bike. It's my maximal VO₂ max pace that is the hardest to achieve on the TT bike, though, as my new position makes it difficult to apply my highest intensity of power.



As the weeks go by, and over numerous 30-second, 60-second and five-minute intervals, it gradually comes together. My figures are now on a par with those scoring sub-20 minute times for a 10-mile TT, or under 52 minutes over 25 miles. Yet I'm still not nearly as quick as some of them. It's time to return to Wainwright and really delve into the detail.

What a drag

I make my way to Derby Velodrome, where Wainwright has set up a system to measure my drag while I ride. At first the mechanics of it have my mind boggling a little.

'We're getting both your velocity and power sent to a transmitter on the seatpost,' he says. 'That data gets pushed onto a wifi network and collected into a software package and sampled every second.'

So because we know the power output you're generating and we're measuring the velocity you're creating around the track, plus we know the barometric pressure, we can effectively back-calculate your coefficient of drag area.'

Coefficient of drag area (or CdA, as the initiated like to call it) is the key number in determining how aerodynamic a rider is. Past around 20kmh, aerodynamic drag accounts for 70% of our resistance, and can be expressed as the formula $\frac{1}{2}$ air density x CdA x velocity of air in the direction of travel squared.

Put simply, for every 1% of CdA reduced, that's 1% less air resistance we need to fight. It's a big deal, and a figure quoted with pride among seasoned time-triallists. The job now is to see how low I can get mine. I do several runs and it quickly becomes apparent that, quite simply, I'm not very aero.

'For the position you can get into, you're certainly one of the higher CdAs we've seen,' he informs me none too gently. 'I put it down to the fact that you've got relatively broad shoulders. That's always going to be a limitation to some extent.'

Aero gains

My original CdA score is 0.273, and that's after having fine-tuned my position in the bike fit. To put that into context, the best on a national level will be well below the 0.2 mark. That's a whopping 36% extra drag I'm carrying around. Suddenly the minutes between my time and the blazing speeds of the top riders makes a little more sense. I'm simply throwing my power into the wind.

'To a point, some riders can tuck a large set of shoulders out of the wind,' Wainwright consoles me. 'In a sport that uses the upper body so heavily it's counterintuitive, but you actually want floppy shoulders so you can roll them inwards.'

World-beaters such as Tony Martin have this position down to a tee, and a

straight-on glance gives the appearance that he has no shoulders at all.

Wainwright doesn't stop there, though, as there's still plenty of room for further improvement. We drop my front end and begin to work on my tuck. As well as my shoulders, my head is generating a lot of drag – as Wainwright has already pointed out. In this case, though, it can be helped.

'You need to drop your head between your shoulder blades,' he instructs me. He pushes me into the right position, with my neck dropping down like a vulture and my eyes still fixed ahead. It hurts like hell, but on the first run, my speed is way up, and my CdA way down.

'We're getting your head close to your shoulders, and that's reducing your frontal area as well as the difference between your helmet and your body. That makes the airflow much smoother,' he says. We tinker a little more with the front end and saddle height, and what begins as a drop down to 0.261 trims down further to 0.251 with a couple of tiny kit changes and a slight tuck of the shoulders.

Instant improvement

The hike in speed is palpable. While my first 3km run averaged a little over 43kmh, I'm now sitting north of 45kmh at the same power. Where I felt I was pushing through treacle, I'm now slicing through the air like a hot knife through butter. Wainwright slightly checks my enthusiasm, though. 'It's going to take some time before you can hold that for a whole race,' he warns me.

As soon as I return home, my revelation in the power of aerodynamics has me fixated on position. I spend my evenings scrolling through photos of top amateur and international time-triallists, observing a private masterclass in an art I previously failed to comprehend.

Images of withered, caved-in and tiny shoulders fill me with reverence and respect. Over dinner, I stare at my girlfriend's shoulders, envying their sheer narrowness.

More importantly, I feel I now have a realistic target on the horizon of an ideal position. That's only a part of the picture, however, as I need to be able to hold that position while delivering sufficient power.

In the balance

'It's all about that balance,' Smart tells me. 'The best time-trialist isn't necessarily the most powerful or the most aerodynamic.' Smart, whose clients over the years have included World Champions Tony Martin and Taylor Phinney, has found the aero position isn't just about staying low.

'I think that's one of the things you learn in the wind-tunnel. During the runs we move things like head and hands to give you a clear idea of just how sensitive those changes are. It's important almost to not produce as much power and hold that position.'

With my power numbers sitting in a healthy range (though still quite a bit lower than my usual level on a road bike), I know my ultimate success against the clock will depend on how well I keep my position, how stable I keep my hands, and how close I can get to my perfect tuck. I decide on three rides to put this to the test: my local 15-mile evening course; an open 10 miles on the road; and an open 25-mile TT on a fast dual carriageway course.

Taking on my moderately quick 15-mile local course, it's a challenge from the outset to even sit comfortably with my head down, never mind round my shoulders. I remember Wainwright's advice: 'You don't have to hold the position the entire time at first, but you can view it as more of a boost or a chance to save some energy in a headwind.'

Helping hand

So I juggle trying to keep my power up in a more comfortable way with tucking my head down and focusing on position. With my head down and shoulders tucked in, it feels as though I have a hand on my back, pushing me from behind, so significant is the difference in resistance.

My discomfort costs me, and my power is low, but I still nail a PB – my time of 33min 31sec over 15 miles works out at an average of 43.3kmh, comfortably my fastest TT effort to date. Clearly position is everything.

Looking at my profile I can pick out the exact moments where I was tucked down, as my speed would shoot up at the same power output. In the past I would have looked at my results and convinced myself that I needed to tweak my fitness. Now I know that position is the main thing worth worrying about.

I return to the same course two weeks later for a 10-mile TT, having spent the time in between practising my position as much as possible – on short blasts, long Sunday rides and on rollers opposite a mirror. My speed is up to 44.5kmh and my time down to 21min 41sec. There's still room for improvement, though. My neck ached so much that I became dizzy (a not uncommon issue, apparently) and needed to sit up for 20 seconds and take a drink.

But the more I do it, the easier it gets. The following week I take another 40 seconds off my PB at my local course, topping 45kmh. My final challenge is to see if I can improve on my 25-mile best.

Against the wind

A TT over this distance requires careful pacing, so I meticulously scroll through my recent rides to devise a realistic target wattage. I settle on a target, but on race day there's a spanner in the works – a howling wind.

'In a headwind it's a good idea to put extra effort in there, rather than when the wind is behind you. In the same way as cutting time on a climb, cutting the amount of time you're fighting a headwind should increase your speed overall,' Wainwright recommends.

'You must never go too high above your threshold, as you haven't got too much time to recover in the tailwind or on the descent.' I keep that in mind as I complete my first leg into the wind, counting down the minutes and assuring myself that the turn would bring copious effortless speed. When I

have the wind on my back, suddenly my work on position becomes all the more important.

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The shadow of my body cast in front of me is a reminder to tuck my shoulders in and keep my head low. With my speed sticking at around 53kmh when my position is dialled in, I'm almost putting more effort into squeezing my shoulders and neck than I'm squeezing out of my legs.

A combination of dizziness and fatigue from my first lap takes its toll as I turn into the wind a second time, and I'm overtaken by a rider who seems somehow immune to the onward gale. With virtually no energy left when I take the last turn, I attempt intervals during which I get as low as possible, despite my upper body shrieking and my groin going numb.

I clock a time of 55min 14sec, a PB by well over a minute, in conditions where I would have struggled to get under an hour in my less aero days. Comparing my effort with those finishing around me, I believe that on the right course on the right day, I could get near the 53 minute mark. That said, talk is cheap, and stopwatches don't lie, so it's up to me to prove it next season.

I'm still a long way off the best in the field, but I now see the enormous chunk of time between us differently. Each minute now seems like a cluster of seconds, and a little more shoulder flexibility here, or five watts of power there could chip them away. I realise that if I take care of the seconds bit by bit, the minutes should take care of themselves.