It's the first high school track meet of the season. Boys who have completed no warm-up whatsoever other than to wrestle over the last Reeses peanut butter cup stand, hands dangling like heavy weights, near the start line of the JV 800 meter run. Long of shin and weak of chin, they're inanimate, forcing the starter to blast his whistle and point at each boy individually and then at the spot on the line he should occupy. Brand new size 10-1/2 spikes, puckered around the thin damp flipper inside, flop into position with no prancing, no hint that they'll ever move from that spot again. At the Set command, all eleven bony edifices are vertical, devoid of tension.

The starter's pistol cracks.

Never before has cold clay breathed so quickly. The small but appreciative crowd turns to the flashing knees, the flailing arms, the most calorically expensive dynamism of the day so far. As crowd-pleasing as this blistering first 200 meters is, certain concerned parents begin to wonder how much longer the competitors can keep this pace up. But the lads are untroubled by creeping doubt because, bless their skinny souls, this is the first 800 meter race they've ever run.

Junior varsity boys have other things to do besides listen to their coach drone on about who is running what at the meet, and when to be there and something about a uniform. *Gosh, whatever. This is track. You run as fast as you can. On a track. Duh.* These junior varsity warriors have stepped to the line with no firm idea that 800 meters is twice around the track.

Eight hundred meters sits at the nexus of sprint and endurance events, with the single-lap 400 meters clearly a go-from-the-gun dash, and the next longer race, the four-lap mile (1600 meters in high school), an undertaking that, even to the greenest of track virgins, seems to require careful rationing of energy. That's why the 800 is notoriously demanding, tricky to pace and hurts like the devil. And that's if you've done it correctly.

As the first of our heroes hits the back corner of the first lap, let's take a moment to discuss the awful realities of this scenario with Exercise Physiologist and High Performance Sports Science Consultant Professor Ross Tucker. He's done lots of research on the demands and best strategies of the 800, albeit with world-class subjects.

*There are lots of studies showing that muscle fatigue is physiological, not psychological; that during high intensity exercise, the muscle loses its force generating capacity," Tucker responded via email. "The same doesn't happen when the exercise intensity is lower—you go slower, you avoid the local muscle fatigue (but you do have other potential issues like energy depletion, overheating, etc). So, high intensity exercise (ie, shorter duration) causes a different type of fatigue than low intensity (ie, longer duration) exercise, and the 800 meters seems to be the point where the fatigue changes in nature.*

Tucker found that 800-meter fatigue is the kind in which muscles lose the ability to move the runner forward as quickly, similar to the kind of fatigue experienced in shorter 200 or 400-meter sprints, so you slow down. Training can delay and diminish, but not eliminate, muscles' loss of power. Even a moderate effort over the first lap (400 meters) will cause enough fatigue to ensure a slower second lap. Slowing down happens to current world record holder David Rudisha as surely as it does to the junior varsity athletes, but Rudisha knows it's coming.

The lads' muscles were firing at great intensity right from the get-go, using up oxygen like there was no tomorrow, or no second lap. Aerobic respiration was doing the trick for about 300 meters but greedy muscles demanded more energy than the available oxygen could process, so they turned to anaerobic respiration to burn fuel. Of course, the by-product of anaerobic respiration is lactic acid, a substance which, in excess, is toxic. Lactic acid changes the pH levels in muscles, causing cells to leak good stuff, like calcium and water that are necessary for contraction. Since the runners continue to ask their muscles to contract, the process compounds, creating a cellular environment that impairs muscles' ability to contract as effectively, i.e. with as much force.

Loss of power and the attendant decrease in speed is one protective mechanism. Another is pain. The body's alarm system, nerves, go off in the form of awful searing pain, warning that muscles need a rest, or else—the *or else* being complete muscle failure such that you'd stop and probably collapse.

Efficiency is one of the things David Rudisha hopes to build through training, so his muscles contract more effectively and for a longer period aerobically, putting off anaerobic respiration, which is a short-term fix to energy demands, as long as possible.

*When you analyze how athletes pace themselves [in an 800], they have to balance two opposing forces to achieve maximum performance," Tucker continued. "That is, they must go hard enough to get the best possible time, but not so hard that they cause this muscle-impairing fatigue.*

Ergo, pacing. Pacing, Tucker says, is an essential function of our regulatory system that "ensures that potentially catastrophic derangements to cellular function do not occur." Though they might have used different terms, this is the very thing worrying parents who are watching the JV boys 800. Catastrophic derangements.

The young runners still seem full of fire as they come by the stands the first time, speeding up when a challenger tries to pass, but as they cross the start/finish line and embark on their second lap, a shadow of realization occurs. Some glance over at the far turn which suddenly seems significantly farther. *Was the track always this big?* A few pragmatic competitors entertain the idea of slowing up a bit, conserving for a big finish, but no one seems willing to execute the plan. They recommit to the pace although, even with added effort, their cadence has slowed steadily. Down the long lonely backstretch this maddeningly counter-intuitive process continues—arms pump more dramatically, they get slower, heads bend at odd angles, they get slower, knees are willed to jump up… still slower. Lungs glowing, hands clawing, forearms throbbing, lower extremities oddly detached, the track has turned to soft sand and the pain, oh the pain. Within three minutes 12 seconds, the boys, now men, have learned everything there is to know about the 800.

And they were right about most things. Tucker explained:

*My [opinion](http://sportsscientists.com/2009/10/pacing-strategy-and-limits-to-performance/%22%20%5Ct%20%22_blank) is that the compromised performance at the end of an 800 was an 'allowed' failure of muscle contraction because optimal performance required that the athlete make good while they still could. That is, go hard early on good muscles. Yes, they'll fatigue and lose their force generating capability towards the end, but overall, it's still a better strategy than trying to keep something in reserve, because the intensity of even a conservative effort [in the first lap] is hard enough that this fatigue will happen anyway. You go out with the intention of making good on fresh legs, and then when the physiological payback happens, you hope it's not going to be too costly. If you run an even-paced 800 [both laps the same], you're under-performing. The guy who slows down the least is usually the winner.*



**[Pacing strategy and limits to performance | The Science of Sport](http://sportsscientists.com/2009/10/pacing-strategy-and-limits-to-performance/%22%20%5Ct%20%22_blank)**

Well, I have arrived in Chicago after a great couple of days in Washington, and now the build-up to …[Read more](http://sportsscientists.com/2009/10/pacing-strategy-and-limits-to-performance/%22%20%5Ct%20%22_blank)**[sportsscientists.​com](http://sportsscientists.com/2009/10/pacing-strategy-and-limits-to-performance/%22%20%5Ct%20%22_blank)**

So the JV boys chose the right strategy in rocketing off the line, generously by instinct, but more likely, out of ignorance. The crushing realization that there was another lap to go, as much as physiological deterioration, accounted for the the JV runners' downward pace trajectory.

But pros who are fully aware of the the second lap also choose a positive split strategy, i.e. a faster first than second lap. Tucker studied 26 of the last world record performances in the 800 that happened between 1912 and 1997. Only two of those records, in 1966 by Jim Ryun and in 1972 by Dave Wottle, were accomplished with a faster second lap. In fact, the fastest second lap of a world-record 800 meters was Jim Ryun's 51.60 seconds. By contrast, the world record holder in 1997, Wilson Kipketer, could only manage a 51.80 second lap but still ran over three seconds faster than Ryun. All the improvement in the overall time came by running the first lap faster.

David Rudisha accomplished his amazing [1:40.91](https://www.youtube.com/watch?v=KN7WgImgpbM" \t "_blank) (2012) with splits of 49.28 and 51.63 seconds. Most competitive men's 800s have a split differential of three to four seconds, women as much as six seconds.

According to Tucker, "The precise reasons for the fact that the second lap in 800-meter world records has not improved in 30 years are not clear." He speculates that improvements in shoes and track surfaces might allow runners to cover the first lap faster and more efficiently before anaerobic conditions set in. Another active theory is that world records in the 800 have lately come from runners of African descent, a population with proven better running economy than non-Africans. They may be able to run faster and farther before physiological payback.

Certainly the JV boys overall performances will improve vastly with growth, maturity, increased strength, and training, but the basic structure and flow of the two-lap race will remain similar to their very first experience, including the inevitable "physiological payback," complete with perceived increase in effort and very real decrease in speed.

Tucker found that 800 meters is the tipping point in positive split pacing, after which it's no longer best.

*You can't run an optimal race with even splits in an 800 meter race. Maybe at about 1200 meters, you can [run even splits]. Up to around three to four minutes, the best pacing strategy is to allow a slow down at the end. Go out fast, and slow down. Beyond four minutes it's best to control the pace from the start so that the slowdown is eliminated. By the time you get to 10,000 meters, it's [optimal to employ] even pacing all the way, and the marathon is almost always run with a negative split.*

While experience and training played very little role in the freshman race, another element of race performance figured large—peer pressure. This factor comes into play even at the highest levels of competition.

*In any race, Tucker said, some runners are going to start faster than their physiological capability should allow them to, because there's almost a social pressure to stay with the best runners for as long as possible. So, a guy will start much too fast, and if he's lucky, he'll die a subtle rather than spectacular death towards the end.*

As excruciating as the race was and as spectacular the death for some, most of the JV boys ran faster than they would have in a solo time trial. In fact, this social principle is employed by experienced runners as just one more way—aside from training, nutrition, rest, and recovery—to improve their performance.

Said 1:58.22 two-lap professional Phoebe Wright:

*All my breakthroughs and PRs have been by somehow getting put in a fast race, where I lined up as the slowest person in the field. You take a bite out of the person in front of you's backside and hang on. Once, I was following Gina Gall around and she brought us through in 56 or 57, which is way out my wheelhouse. My PR for 400 was 55 and change, so I was well beyond the red zone. In the exact second I got myself together and regrouped, Gina must have slowed down and I accidentally passed her. I thought,Uhoh, now I have someone on my heels, so I had to keep going so I didn't look like an idiot in front of 50,000 people. Not looking like an idiot can keep you going through the red zone; plus, you absolutely don't want to lose the pack, and you end up running fast. You would be shocked at how ecstatic those fourth and fifth place finishers are.*

As Tucker indicates though, it's a gamble: A faster-than-normal early pace can precipitate earlier muscle fatigue and a significantly slower performance overall.

There's good news and bad news for the 800-meter initiates: This brand of pain and muscle fatigue subsides quickly, but regardless of how proficient they become, it will never go away. And that's the trademark of 800 meters.