



## Transcript of “Hacking Fatigue with Tim Noakes”

Bulletproof Radio podcast #3



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Co-host: The cool fact for today's podcast is what your brain is made of. It turns out, the average brain is about 77% water, 12% fat, 8% protein, 2% minerals and only 1% carbs. This is one of those reasons that eating 70% of your diet from carbs might not be the best thing you could do for your brain, and is also a reason you should stay hydrated.

You're listening to Episode 3 of Upgraded Self Radio. This is Dave from the Bulletproof Executive Blog, talking about how you can upgrade your mind, your body and your life to levels you've never thought possible.

Today, we have a great interview with Dr. Tim Noakes. He's one of the foremost exercise scientists and has developed one of the most unique theories on fatigue and what's really holding you back from reaching your full potential.

Even if you're not an athlete, you want to hear this. Fatigue applies to us all, even cubicle dwellers who have more work than they can handle. In fact, guys like me. Fatigue is caused by the brain shutting down parts of the body before they can be damaged. This is a system's thinking approach that Dr. Noakes has created for his book. Instead of looking at, say, the lactic acid in the muscles as something that causes fatigue, he's saying that the body is designed to self-regulate and that the brain is part of that challenge.

He also has some really interesting comments about Tim Ferriss's recommendation in *The 4-Hour Body* to use an ice pack. Dr. Noakes explains why this may or may not work as advertised.

Today, we have Tim Noakes, the author of *The Lore of Running*. He's a sports research scientist. He's the head of the Exercise Science and Sports Medicine Research Unit at the University of Cape Town. He's run over 71 marathons and ultra marathons. He's regarded as one of the top experts in sports efficiency and performance, who's as I think I've just said, he wrote *The Lore of Running*, which is one of the definitive books on running and has some extremely unique ideas. Tim, thank you so much for coming on.

Dr. Noakes: My pleasure. Thanks for having me.

Co-host: Cool. The thing I wanted to talk about today mostly was your Theory of the Central Governor Fatigue theory. Could you explain exactly what that is?

Dr. Noakes: Yeah. To give you some background, when I started in Exercise Sciences in 1981, the theory, which was popular then and probably still is popular, is that when you exercise, the reason why you get tired is because your muscles run out of oxygen or glycogen or something else, and they then refuse to work. That's how a fatigue occurs. Over the period of 25 years or so, I realized the problem with that model is that doesn't include the brain. It's a brainless model.

The reality of the human condition is that the brain is there to make sure that we don't get into trouble, that it regulates our behavior. As a consequence of a research we did, it came to me that in fact, what you have during exercise is that the brain is regulating the system to make sure that you don't run into trouble.

The Central Governor model simply says the during exercise, the brain is receiving information from all parts of the body and it modifies your behavior. It slows you down or speeds you up in response to all those inputs. As a consequence, when you finish exercise without collapsing catastrophically, according to the other model.

What we've done is we've just said that exercise is a controlled behavior. It's controlled by the brain and the control start the instant you start the exercise, the brain has already calculated what is safe for you to do under the prevailing conditions. It then shepherds you to the finish, making sure that you don't run into trouble. In a nutshell, that's the idea.

Co-host: If somebody started having a tear in the middle of a run and their legs started to seize up and really hurt, are they neurological response by the brain to try and make sure damage do not occur to the legs?

Dr. Noakes: Yeah, and I'll go even further than that, that all the symptoms you have during exercise are generated by your brain. Now, unique to you and they may be completely different to any symptoms anyone else has. We all assume that we feel the same sensations and symptoms during exercise, but that is not proven.

My view is that the sensations of discomfort are the way the brain regulates the performance. The symptoms are utterly, completely illusory. They are generated by the brain and they have nothing to do with the state of the body at that time. They only are related directly to how close you are to the finish.

Anyone who's run enough or exercised enough in competition knows that your symptoms of discomfort rise as a fraction of how close you are to the finish. It doesn't matter whether you run 10 miles or 100 miles. When you've gone about 60% of the distance, you start to feel really dreadful and you want to start to quit. Therefore, it's not related to the exact distance you've traveled, but to how close you are to the finish.

We gave in further and we think that the best athletes are the ones who make the illusion interfere less with their running. The less good runners, the symptoms are more illusory or worse and they therefore slow you down more than the elite athletes, who are not resistant to the symptoms.

That's what people say, "I'm a great athlete. I don't feel the symptoms." If you're a great athlete, you actually don't generate the symptoms.

Co-host: This explains some of the large discrepancies between basically what makes a pro and what makes an amateur, and their ability to not produce these pain signals allows them to push their body farther and harder.

Dr. Noakes: Yeah, I think it starts the other way, because they believe they're so good and they have faith in their performance and they've learned over the years how good they are. Of course, they have some different physiology. They then, during exercise, don't generate the symptoms at the same rate as the less good athletes.

Let's make a point that you can't take a useless biology and turn it into a champion by changing the brain. What I'm saying is, if you have people of the same biology, there are many very good athletes in the world. The few who stand out, stand out because of the way they use their brains during exercise.

I always say that the difference between the best athletes and the less good or the winner and even the second class, you won't find that in biology. You'll find that in the brain and the way the brain functions.

Co-host: Are there any specific studies looking at that and basically comparing the number one person to the number two person and looking at how the differences in their biology and not finding any difference?

Dr. Noakes: Yeah, absolutely. Because I know marathon running best and I've studied enough marathon runners to know, that if we took the very best runners in the world and stuck them on a thread mill, we couldn't predict whether they could run a 2 hour 3 marathon or 2 and 15 marathon. Their biology would be no different from other runners who are running 2 hours 15. That's at the level which we can currently study.

Either we're not measuring the right biology or the biology we're measuring is not the predictor of the performance and there's something else, for example, the brain. I'm not suggesting we're not, there could be biological, physiological variables that we aren't measuring.

For example, people will tell you that the VO2 Max, the maximal oxygen consumption, is a good predictor of performance. Reality is that the Vo2 Max values measured in the 1930s are no higher or no lower than the best athletes today. The same physiology is producing performances that are substantially better today than they were 50, 60, 70 years ago.

It doesn't look like the biology has changed much with athletes. What has changed is their perception of what they can achieve.

Co-host: Is muscle damage still a factor when it comes to fatigue during a race, like actual tears in the muscle fibers?

Dr. Noakes: I'm not sure. Are we talking about localized muscle tears, which will be a muscle injury or I think they are neurologically based? I don't know if you can just cause those in years. I think what happens when you get a localized muscle injury, which is very common, the muscle cell itself is not deranged. The nervous system is the problem and it causes excessive activation of muscle fibers. They eventually go into spasm and as a consequence, the whole muscle goes into spasm to try to protect the area of damage. I'm convinced from my own experiences over 40 years, that that's a brain-based phenomenon.

If you tear your muscles in a 10K race and you have to stop, I think that is not the muscle tearing because it's weak. It's because the neuromechanisms are at fault, and you need to correct the neuromechanisms.

That's I don't what you're talking about. I think you're talking about a generalized muscle ache and discomforts that you develop after exercise and have lasted for a few days. There, it's obviously most apparent if you run a downhill race. Obviously, one would ask for, "Is it a downhill race?" If so, that would be the explanation. You weren't quite adapted for running downhill. We know that you will have some damage and we also know that the next time you run on the same conditions, your muscles will be more resistant to that damage.

The one thing that this regulated, it doesn't seem to be all the pickup, is that muscle damage because people will run a downhill marathon and the next day, they can barely walk. Why didn't the governor stop them? We don't know but the answer is it can't be able to detect the damage that's happening and tell you to stop for those reasons. It doesn't seem to detect that very well.

Co-host: Do you think a lot of things athletes take for granted as in bonking and that kind of thing or when you run out of energy are really just a manifestation of the brain trying to protect the body?

Dr. Noakes: Indeed. It's developing the symptoms, and depending on how you've overridden the symptoms beforehand so they'll be progressively worse. I use to bonk in marathon races and I actually learned this because I

have far too high of carbohydrate diet. That was the problem. Once you adapted to a high carbohydrate diet, you become so carbohydrate dependent that you need lots of carbohydrate during the exercise.

I discovered that the only way around that was to take enormous amounts of carbohydrates during exercise. In my case, the symptoms I use to get where that I suddenly would think I can't finish this race. "How can I possibly run another 10 miles? It's absolutely impossible." That to me was the symptom that indicated I was allowing to let blood glucose. If I ingest the carbohydrate within about five minutes, the symptoms would disappear and I would recover.

There, what was happening, as I understand it, my blood glucose were dropping or it was threatening to fall. The brain was saying, "Okay, the only symptom that I can get you to slow down is to make you feel terrible and think that you aren't going to finish." That's one example of where the symptoms become very apparent and they seem to serve a good purpose. As soon as you take the carbohydrate, you ... the symptoms very quickly and you can speed up thereafter.

Co-host: What are some of the common explanations for fatigue that you think are probably not accurate? You mentioned muscle soreness and we've talked about bonking. Are there any other generalized themes that a lot of researchers follow that you think aren't necessarily accurate?

Dr. Noakes: I think it's the models, we described models. There are basically three models of exercise, heart regulator. One is the peripheral model, where everything goes wrong in the muscle itself and that stops you exercising. That really can't explain very much because you can't explain why you choose the pace when you're exercising and you can't explain why you speed up at the finish.

Because if the muscles really were exhausted, you'd never be able to speed up but the characteristic of competition, is that athletes speed up near the end. The greatest athletes are the ones who speed up the most in the last kilometer or lap of the race. If your muscles were the reason why you couldn't run any faster earlier in the race, then why can you suddenly speed up at the end?

The answer is because it's your brain that's regulating the system. The peripheral model doesn't work. The peripheral model is that you either run out of glycogen, so you've run out of carbohydrates and you have to stop, or you've got too much lactic acid in the muscle and you have to stop, or you've got too much phosphate. All this time, another failure, and that doesn't really explain the models.

The other one is that it's a brain model where the brain suddenly runs out of something or gets too hot, or the chemicals change. That also doesn't work because that's also a catastrophe model and the brain doesn't work like that. The whole function of the brain is to protect you. For example, if you were to starve yourself, the one organ that is not affected is your brain.

Your brain weight will always be the same at death if you were starving.

The brain has developed all these methods of looking after itself. It would do everything to shutdown the peripheral and make you slow down in order to protect itself. In a sense, that's the Governor model, that the brain will respond to all the information that it's receiving and will then choose what is appropriate for you.

**Co-host:** Could you take us through exactly what occurs in the Central Governor model? Let's say, running a marathon, could you take us through the different stages of how this Central Governor theory would influence his performance?

**Dr. Noakes:** First off, once you're on a marathon, you have to think about it for a couple of months. It's a lovely statement. If I said, "Let's go and race 10K's tomorrow, you'd be there." If I said, "Let's go and race 15K's," obviously someone has given you the distances in American terms. If you were going to run 6 miles, you'd say, "Sure, no problem. I'll meet you tomorrow and we can race tomorrow morning." Even with 10 miles, you'd say the same.

If I said 20 miles, you'd say, "If only I could prepare myself immediately overnight." If I said it's a marathon, you'd say, "No, no, no. I can't go out

and race for tomorrow. I've got to keep two months to prepare for it." Much of that preparation is mental.

The race I used to love was the 56-Mile Comrades Marathon. It would take me two years to prepare for that. I could only ever do it every second year. It would take me a year to get over my previous efforts and then it would take me a couple of months to think, "Okay, I can start training properly for it." Then I would try and fight out for six months and run it. That would be my mental preparation. Of course, we thought it was physical preparation, but I don't think it is.

For the last two months, you're preparing mentally for this race and you start to visualize it. That's your brain getting ready to push you and accept the discomfort that you're going to go through. For the last three days, you're going to sleep more and race more because your brain needs a chance to store something, I don't know what it is, so that when you get really tired near the end of the race, you're going to be better.

The only marathon I never finished was when I was doing my internship in medicine and we're working 100 hours a week, and I just had a Saturday morning off. Here, we're working probably with sleeping every second or third night. We weren't sleeping every night. I reached 20 miles in the race and I just said, "That's it. I can't do more of it. Anyways, the only time I ever quit in a race. I have no question there. It was because my mental preparation just wasn't there and I was just so exhausted from working so hard in the hospital that I couldn't do it.

That's the effect. Then, you start the race and you've got your mind right there as prepared. Then how important is the race for you? Is it going to be a training race or is it a race that I'm trying to do as hard as I can or is it the Olympic marathon? Depending on that, your motivation will be different.

What then happens is that in my view, the brain has already worked out how fast you're going to run for the whole race. It starts your symptoms of discomfort, which we rate as ratings of perceived exertion. As you go through the race, there's a linear increase in these ratings. The exercise originally feels moderate or moderately hard, then it becomes hard and

then it becomes harder. Then near the end, it becomes very, very hard and it becomes extremely hard, which would be a rating of 19 on the Borg Scale for Rating of Perceived Exertion. That's the characteristic that happens.

What's interesting is that this is a linear function of the distance, but I doubt that everything in your body is changing as a linear function of how far you've run. What inputs to set that Rating of Perceived Exertion is I really don't know. In our view, it's set before you start by some sort of expectation that the body has set for the race.

It would be easy to say as you get hotter, that explains why your Rating of Perceived Exertion rises. It would be easy to say, as you become dehydrated, that that causes your Rating of Perceived Exertion to rise; or as you run another blockage, that causes the Rating of Perceived Exertion to rise. The only problem is that the rate of which RPE rises is set right from the start of a race, where none of these things has changed very much. It can't those variable. It's mystical as to what is determining the symptoms that you develop during the race.

My conclusion is that it's got something to do with your expectation that you develop over the years. The brain uses that to set the rate of which the sensations of discomfort will rise during the exercise.

Co-host: I've read a book called Run by Matt Fitzgerald. He talked a lot about performing workouts that increase your confidence versus workouts that necessarily increase your muscles' ability to perform workload and that kind of thing. That basically sounds what you're talking about, basically training your body to respond differently to forms of stress. Is that what you're saying?

Dr. Noakes: Yeah. I think he definitely advanced the theory because we never said that. He interpreted it quite correctly, I think, that what you're trying to do when you're trying to run faster, that's the key. You're not trying to change your VO2 max or whatever, whatever, or your anaerobic threshold. That's not what it's about. It's about running faster.

He said that you have to try in yourself to run fast and become confident at it. Have we not read that, I realized that's exactly what we do do and I remember, because the first of what I did was rowing, or called crew in the United States. That's exactly what we did. We just told ourself to row faster.

We used to race 2,000 meters but if we told ourselves to race faster every 500 meters and you would just get your brain around the concept that actually, you could row faster. Eventually, you put that into 1,000 meters and then into 2,000 meters. We were in training so our Vo2 max has gone up. We were always racing the clock. I think that's the reality that you want to run faster so you must train and get your body to realize what it feels like to run at a faster pace. Eventually, you will have the confidence that you can run faster.

A lot of the running that we do is at low pace and endurance running, which really doesn't do that. Certainly, one of the findings I've learned in both research and experiences that when you get near the race, you really have to start doing interval training and very quickly, with using few intervals, your performance can go up dramatically. That's what's surprising. Eight hard sessions, of interval sessions, will improve your performance dramatically.

In my view, that's got nothing to do with physiology, but it's got everything to do with adapting your brain to accept that actually, you can run faster without damaging it.

Co-host: Cool. The Rating of Perceived Exertion that most people think is affirmative and that kind of thing and I think a lot of coaches are moving towards heart rate training and power training and those metrics. Do you think Perceived Exertion is still a fairly good representation of how hard you're working?

Dr. Noakes: No, it's not because it's a measure of how close you are to the finish. That's they key. The Rating of Perceived Exertion was started a measure of your intensity. The heart rate is a much better measure of intensity, and it's very reproducible. If you try and regulate the same heart rate, you'll be doing roughly the same intensity.

If you want to know your intensity, the heart rate is really a very good measure. Whereas Rating of Perceived Exertion doesn't tell you your intensity because it rises the longer you go on. If you run at the same intensity, your Rating of Perceived Exertion will rise. Therefore, it's not related to the intensity. It's related to how long you can keep going at that pace.

That's what the information you get from the Rating of Perceived Exertion is, how long can I go at this pace.

Co-host: How can people improve their resistance to fatigue? You mentioned mental training and mentally preparing yourself before races, we talked about intervals. Is there anything else people can do?

Dr. Noakes: Develop self-belief, have a coach who tells you you can do things that you don't believe you can do. I think that's the key. How do you know how good you are that the coach tells you? All the great coaches, why is it in the United States or in any country, that there are a few iconic coaches in whatever sport it is, be it American football or baseball or track and field? That there are only a few iconic coaches who can get the best out of their athletes.

The best access in part is because the athlete believes the coach cares for them, but let's put that aside. If some other coach understands how good this athlete is and pictures the challenge to show what's appropriate for that athlete, I always think of Jim Ryun who is one of my great heroes, who was the first runner to run a sub-4-minute mile.

He tells a story that he started running at 13. At the age of 15, the coach calls him in and says, "Jim, what can you think you can run in in two years time?" He says, "I have no idea. Maybe 4:10. His coach says, "No, Jim. You can sub-4-minute mile." He says, "You're crazy, coach. There's no way I can do it." Two years later, he runs a sub-4-minute mile.

If the coach hadn't said it, it wouldn't have happened. The point of course is that the coach can't go and tell everyone in the club everyone in the club, "You can all run a sub-4-minute mile." He had to know that Jim Ryun was one athlete in a billion who could do it, that he spotted the

brilliance in the young man and could then set the targets that was appropriate.

If he hadn't set the target, Jim Ryun would have thought he was a 4:10 miler and not a 3:39 miler.

The coach is crucially important in setting the standard and showing the athlete that if you believe strongly enough, you'll be able to do it.

Co-host: Positive reinforcement is one of the big parts of this, it seems, and getting positive feedback from your coach. Could the opposite also be true, trying to avoid negative influences on your psyche and avoid people that tear you down? When you're talking about, "Yeah, I really like to run, you know, a 4:30 mile at this race." Then one of your friends were like, "Oh, you'll never do that. Is it good to avoid people like that at least before a race?"

Dr. Noakes: You have to absolutely avoid those people, or else you ... I was looking for a quote on that very topic recently. I was reading a rowing book in which the guys at Cambridge Boat Race, which is the same as the Harvard Yale Boat Race. They race the same distance, about 4 miles, which is amazing because most races are over 1.5 miles or 2,000 meters.

You have to keep the same intensity for 4 miles that you normally keep for a 1.5 mile. The one guy said, "You are supposed to believe that you can do it before you start," and then he said, "You have to overcome all the negative impressions that you've had from your coach and everyone else, implying that you actually can't do it."

I found that interesting because you shouldn't be in an environment which is negative. That's not going to help you. You have to believe and the only way you're going to learn to believe is if people will support you and then you start to achieve. I guess there are some people who negative motivation does help. They say, "I'm just going to prove you wrong." For many people, that doesn't work. You got to have the support of the coach and to believe the coach.

Co-host: How's your [inaudible 00:28:08] on the Central Governor Theory evolved over time. I'm sure when you first started learning about this, you were probably still following the already preconceived notions about fatigue. How did your involvement in this developed over time?

Dr. Noakes: I think it really started in 1981 when we started our research. What happened was, we started doing VO<sub>2</sub> Max testing in athletes and we were told that you would always find a plateau. In other words, the oxygen consumption will rise as you exercise harder and harder and harder. Then suddenly, there would be no further rise. The athlete will continue for a minute or two on the trail, but his or her oxygen consumption will not rise 1 millimeter higher.

As a consequence, you show this plateau and what that means is that the heart is no longer able to provide more oxygen to the muscles. The muscles become anaerobic. The anaerobiosis then causes lactic acid production. The lactic acid shuts down the muscles.

Our problem was, we couldn't find this in the majority of athletes. At that time, in 1981, if you wanted to publish a study of the VO<sub>2</sub> max in athletes, you have to write, "In 100% of athletes, we saw the plateau phenomenon." We had the choice; you either lie because we didn't see it in 100% of athletes or we found out what's gong on.

I said, "Okay, in those athletes who don't get a plateau, my view is that they don't show off some efficiency." Then we started testing athletes and found that the VO<sub>2</sub> max was a dreadfully poor predictor of performance. I could get two athletes where the VO<sub>2</sub> of 70 and 1 would be running a 3-hour marathon and one would be running a 2 hour 20 marathon. I said, "If oxygen consumption is so important, why can't this person with a VO<sub>2</sub> max of 70 or so and he's running a 3-hour marathon, why can't he run a 2 hours 20 marathon?"

Then we saw that looking some of the best athletes that we had in South Africa that time, and their VO<sub>2</sub> maxes were 73, 74. It went fantastic. As I've indicated, we measured values of 74 and other runners were doing 2.5 hours. Then we noticed that the key predictor of their performance on our testing was how fast they run on the thread mill during our test.

For example, the test protocol was that we would start the thread mill at, say, 12 kilometers per hour. Let's say it's about 8 miles an hour. Then we would speed it up 1 kilometer an hour every minute. What we noticed was the really elite athletes were able to reach 25 kilometers per hour. In other words, they're running sub-4-minute mile pace. They would sustain that for 2 minutes at least on the thread mill, having already run for 10 minutes at progressively increasing speeds.

We noticed that that was the predictor of their performance. The speed they reached on the thread mill was the predictor of their performance, and it was very, very good predictor. If you couldn't reach 25 kilometers per hour on that thread mill under those test conditions, you've never run a 4-minute mile and you've never run a 2-hour marathon. Those were the data.

Then I said, "Well, there's something in the muscle that's determining this and maybe these athletes have super powerful muscles and it's got nothing to do with oxygen." That was the hypothesis at the time. Then only later did I realize that in fact, they have to have super powerful muscles.

You never thought that, but Haile Gebrselassie, I can tell you, his muscles must be as powerful as the most strongest weight lifter in the world because when his foot is on the ground, to run faster, his foot must be on the ground for a short time. To run faster, his foot must be on the ground for an even shorter time. He's got a few milliseconds to generate enough force to bounce him 4 or 3 meters through the air. He's got no time to do that. You can only do that if you've got very strong muscles.

More to the point, what I realized is that the amount of muscle that you recruit must be very important because when you're running, you don't recruit 100% of all your multi units in your muscles. You only recruit a proportion of the muscle mass.

For example, near the end of the marathon, you're probably recruiting only 40% of your muscle. I began to realize that if you wanted to be a great runner, just by recruiting 43, 44, 45% of the muscle and also

making the muscle very powerful would make you a better runner. Those things are related to the brain, not to the oxygen delivery to the muscle.

Then I suddenly realized, the major characteristic of humans is that they can exercise without killing themselves under extreme conditions of heat or altitude. Then I realized the brain must be there to regulate and make sure you don't run into trouble. That was the final realization that's finally brought the whole model together.

Co-host: You talked about making the muscles more powerful. Would things like Plyometrics and weight training help with that?

Dr. Noakes: Absolutely. We don't do [inaudible 00:33:44] of it. I mean, there are older runners in this country who will tell you that by just lifting weights and particular doing eccentric loading of the calf muscles, you can get by with much less training in ultramarathons.

I also know that Bruce Fordyce, who is the great South African ultramarathoner, who won the comrades Marathon nine times, he really became good as a downhill runner when he started to do a lot of eccentric loading of his quadriceps muscles. Yes, you have to do weight training for your muscles of your lower leg if you want to be a really good runner.

Co-host: Something else I've noticed since I started to do more weight training is that it also boosts your confidence. It seems like it's coming at this from two sides; both strength in the muscles, which allows you to produce more force and then as the same time, you just feel more confident because you've been doing weight training. Do you think that could be part of why it helps?

Dr. Noakes: Exactly. What you're referring to now is the potential placebo effect. In other words, if you believe something, it will make you go better. That's the reality. There's a massive placebo effect in everything we do. Franz Stampfl, who coached Roger Bannister to become the first sub-4-minute miler, said exactly that.

He said, "Training is an act of faith. You have to believe." I couldn't understand that for 50 years, because we were teaching. The reason why you run fast is because your VO2 max goes high or your heart gets stronger. How could it be changing your belief systems?

I absolutely believe the placebo effect is that if you believe your training is going to make you better, it will. Then conversely, if you don't believe it's going to help, you don't do it because it's not going to help. That training, if you believe that the weight training is helping, it is going to help and it could have a substantial effect.

Co-host: Could that be true for other activities as well, such as shaving your legs before a race or wearing a certain clothing and that kind of thing? Could that also provide a placebo effect?

Dr. Noakes: Exactly. Anything that you believe will help, will help. We showed that years ago interestingly with carbohydrate ingestion; where we did studies where we gave placebos to people and told them that they were taking carbohydrate and then sometimes we would give them carbohydrate and we would mark the test and we'd say, "No, actually, you're not getting an active carbohydrate."

They always did best when they were given carbohydrate and they believed it was carbohydrate. When they were given water so that it tasted like carbohydrate, and they were told that it was carbohydrate, they performed almost as well when they got carbohydrate and believed it was carbohydrate. The placebo effect is enormous.

Co-host: Wow, yeah. Are there any other good examples that you can think of the Central Governor Theory in action? Any major studies that really stand out to you?

Dr. Noakes: I've written an article in review the whole basis for ... There are about 50 studies at least which you can only explain on the base of the Central Governor. The Central Governor model then, the first thing is that you could influence the brain directly and influence performance without changing anything in the periphery. There are about 30 studies that show that.

Just off the top of my head, one of them is that if you ingest carbohydrate acutely, within seconds, your performance goes up. If we're measuring your force output of your muscles and we give you glucose about enough, within seconds, your performance, you can pick up a heavier weight.

That can't be because the glucose has been absorbed. It's because the glucose is acting on your tongue in the back of your mouth and the brain is then picking up information that this is beneficial to you and your performance goes up. You can't explain that any other way.

Another interesting one is if you give people who are getting cramps salt, you give them pickle juice for example. The cramps are much more likely to go away if they drink pick juice. The only problem is the cramps disappear long before the pick juice gets in the circulation. Again, it's a central effect through the brain. These people of course get confused as they approve that salt efficiency was cramping. Not at all, because the salt didn't even get into the blood stream before the cramps were broken. Those are a couple of examples.

The other one is the amphetamine effect. That would be the most effective drug that aids performance are amphetamines. They're unavailable today in the forms that they were available in the 1950s. The athletes in the 1950s who took these amphetamines were at great risk of getting heat stroke because if they exercise in the heat, they would block out the feedback from the body telling the brain that it's too hot.

There are many famous cases. Simpson, the British cyclist who died in the Tour de France, a month or two, he was taking amphetamines on that day and he drove himself to death or cycled himself to death. He raced many, many times on a hot conditions and it never happened. Amphetamines are acting in the central governor and blocking out the central governor effect. They're very dangerous drugs because then you override the governor and develop heat stroke.

Along those lines, if you remember Paula Radcliffe in 2004 in the Athens Marathon. She stopped running at 36 kilometers. She was paralyzed

because she said, "I couldn't put one put in front of the other." She didn't say I was tired and I would walk to the finish. The reality is she was going to be paid a million pounds if she finish the race, and she didn't finish it. All she had to do was just walk to the finish and she couldn't, because she was paralyzed.

In my view, what happened was her body temperature got to 42 degrees centigrade, and the brain said, "That's it. If we don't stop you now, you're going to get heat stroke. So, we're going to stop you and you have to sit on the side of the road and wait until your temperature has gone down." That was a classic example of the central governor stopping her running in order to make sure she didn't develop heat stroke.

This, of course, was in the greatest race, on the most important race, which as I've indicated, not only could she win a gold medal, but she could also win a million pounds. She had every incentive to finish the race but she couldn't because her brain stopped her.

Just to make the point, the reason why it stopped her was because she had accumulated heat too rapidly because she was too big. She weighted 52 kilograms and she couldn't run at her chosen pace under those conditions and lose all the heat. Whereas the Japanese lady who beat her weight 40 kilograms. Only at 40 kilograms can you run that fast and not accumulate so much heat that it would eventually stops you.

Co-host: Could you the pressure of the race also influenced her performance? As you said, she was getting paid a million pounds, it was Athens, the birth of the marathon and it was on the Olympics and it was the gold medal race. Could all of that have really played on her mind in the days preceding the race and maybe she started contemplating what would happen if she didn't win and that could have negatively influenced her performance?

Dr. Noakes: No, I don't think so. I mean, I think she's one of the greatest athletes of all time. I think she was well prepared for the race, although she hadn't done enough heat training. Besides that, literally, if the temperature

would have been 2 degrees cooler, she would have won the race and she wouldn't have developed her condition.

Let's get back, if you read what she describes, she says, "I felt terrible from the start." Now, it interprets that to mean that she wasn't really properly prepared for the race. According to the central governor, the explanation is simple, that she was overriding what her body was telling her. Her body was saying, "Slow down, slow down, slow down. You can't finish if you keep running at this pace."

She overrode it because she couldn't understand why she couldn't run next to these other athlete who she perceives to be a less good athlete, and that's a reality. The Japanese lady was 3 or 4 minutes slower under cool conditions. Paula had every reason to believe that she should have been running ahead easily, but she didn't understand the biological problem.

The point was, her body was telling her, "Slow down, slow down, slow down," and she was overriding it. When you override it, then you get these symptoms, and it just feels terrible. That's what happened. It wasn't necessary. It was because she wanted to win so badly that she forced herself to run. She couldn't run slower or she wouldn't have won, and she knew that.

Co-host: Now, let's talk about exercise. I'd like to talk a little bit about how the Central Governor Theory might be used in regular, everyday life. Specifically, let's say, with sleep deprivation. If somebody, let's say, slept for only 5 hours a night and then woke up the next day and wanted to do ...

I think the Tour de France would be a good example. These riders at times have to sleep for a very small amounts of time and then get up and ride over 100 miles the next day at incredibly high speeds. Do you think a large part of their ability to do that is just the fact that they have convinced themselves that it's possible?

Dr. Noakes: Exactly, and they don't use it as a negative. To be a good athlete, you have to obliterate the negatives and not use them as an excuse, as the

rest of us would. The rest of us would say, "Oh gee, I didn't sleep enough last night so clearly, I'm not going to perform well." Then that sets what the performance is.

I believe very strongly that outcome is what you believe it will be. You then use these symptoms as an excuse or as an explanation. "Gee, I didn't feel good during this race. No wonder I ran so poorly." The reality is that you generated those symptoms yourself and they are therefore used to condone what you did or to justify what you did.

I have this really interesting explanation for why an athlete comes second, and particularly if it's a close race. In my view, the athlete who comes second justifies the performance by producing symptoms which are more severe than they really need to be. "Oh gee, this symptom, I really tried my hardest but I was exhausted." In fact, that's a justification.

If you understand that those symptoms are generated by yourself, you realize how you could influence the outcome by believing you want to be more tired than you really are.

Co-host: I just have it myself. I know at times, I used to believe, "Oh, if I didn't sleep like 8 hours, my performance will drop." At other times, when you block that out, it works. Could that work with other people, in everyday settings? I know a lot of people will say things like, "Oh, if I don't eat for another 4 hours, I'm going to lose all my focus and I won't be able to concentrate," and that kind of thing?

Do you think a lot of that is again, they just entrained that belief that if, let's say they don't have a snack or something, they're going to feel like they're tired? Do you think overcoming that in their own lines could also be beneficial and an example of the Central Governor Theory?

Dr. Noakes: You're talking about negative placebos now. That's the opposite to a placebo. They are setting themselves up for failure. I can explain that what you believe is what the outcome will be. That's how the brain functions. If you believe something enough, that's what the outcome will be.

How can you possibly, when you go out and run, when you've got all of these thoughts, "Actually, I'm not going to perform well today," how can you perform well under those conditions? You absolutely can't. Of course, the old argument where the muscles are determining it, but that's not the reality. It's your motivation that's driving you through the central governor.

If your motivation is low when you start and you're explaining why you're not going to perform well, the only thing the brain is going to do is it's going to do exactly as you wanted to do, and you're going to under-perform. The great athletes are the ones who never, never ever think like that or if they do think like that, they switch it off immediately and correct their thinking.

I'm sure you've dealt with some astonishing athletes in your time, but I've met ... The very, very best are different. Mark Allen was one of the guys, the great triathlete, who to me was one of the great athletes I've ever met. Paula Newby-Fraser was another one because I helped her, she was a South African before she immigrated to United States.

They didn't conceive that defeat was possible. That's it. When they went to the start, and Mark Allen had to learn because he lost The Ironman six times before he won it. Once he won it, he didn't go to the race believing he could lose. Paula was the same. She didn't believe she could lose. That's the difference eventually. They have such strong self-belief that when they're running, the thoughts of failure just don't come into their heads.

Co-host: I'd like to talk a little bit about some weird and a little wacky examples of the central governor. One of the things I read about that you discovered something called Anticipatory Thermogenesis. Could you explain what that is?

Dr. Noakes: That was with my good friend, Lewis Pugh, who swam at the North Pole, swam 1 kilometer at the North Pole in his Speedos and with a cap on and goggles. He was completely naked apart from the Speedo. What we noticed with him was that before all the swims that we did, whether we did that in Cape Town, in an ice bath or at the North Pole, that in the last

half hour or so before the swim, he would start to eat up and start to sweat.

When I was dressing him at the North Pole in ice cold conditions, he was actually sweating. That was because his temperature had risen from the normal of 37 degrees centigrade or 98 degrees Fahrenheit and it had written by about 2 degrees Fahrenheit. In fact, it was more. It was more like 3 degrees Fahrenheit. It went up to 38.4 degrees centigrade. That's made a huge difference to him because that extra degree allowed him to swim for about 10 minutes longer in these very cold water.

Now, are there examples of this happening? Yes, there are. There are certain bird species in Cape Town and elsewhere, and the one is the penguin, which is a very big, fat bird. When it goes out and swims in cold water, it doesn't heat up before. There's another diving bird called the cormorant, which is very, very thin.

You can tell when the cormorant is about to go out and start fishing and diving for fish because its body temperature rises. When it's gone about 2 degrees higher than normal, then the bird will leave the nest and fly out and fly out and go and start fishing. That's the Anticipatory Thermogenesis.

It has a role in that it allows the birds to dive for more fish before they get cold and have to stop. The same with Lewis Pugh that allowed him to swim for an extra 10 minutes at the North Pole. That 10 minutes allowed him to finish the 1 kilometer. There are other very famous examples.

Tibetan monks, who use this, and they taught themselves how to do it. You can put a wet, ice-cold towel on the back of a Tibetan monk overnight and they will generate enough heat to dry that blanket or that towel overnight. That's a well-described phenomenon.

Probably many people can do the Anticipatory Thermogenesis, but if you want to be a long distance swimmer, it's certainly would be helpful if you can do it.

**Co-host:** One of the people we've talked about or that I've read about is Tim Ferriss. I don't know if you know him but he's this biohacker entrepreneur guy. He's a very interesting guy. One of his recommendations for weight loss and fat loss is to put ice packs in your shoulders to increase your body's thermogenesis and fat burn. Do you think that could be an effective method and do you think it might be explained by the Central Governor Theory?

**Dr. Noakes:** I know Tim quite well. He actually came to South Africa and we did some tests on him and helped him with some things. The reality of weight loss and weight control is that if you do use those mechanisms, the body will compensate. You will either eat more or you'll do less exercise. The body, satisfies its body weight goals. That is also a central governor mechanism or a governor mechanism, but it's related to activity and food consumption.

Where all of the advice on nutrition fails, it's because it doesn't include the brain in the models. You have to put the brain and the brain acts through appetite. If you want to lose weight, you have to get the diets that will associate you and allow you to eat for your calories. For many of us, the only diet that allows that to happen is the high protein/high fat diet. In contrast, the high carbohydrate diet stimulates appetite and stimulates overeating.

Tim would be better advised to tell people to look to their nutritional and the macro nutrient composition of the diet. If you want to lose weight and if you're a runner, eating a high carbohydrate diet will prevent the weight loss. All that happens if you're eating a high carbohydrate diet, you can run all day and all night and you simply eat more, and you'll never lose weight.

If you want to lose weight and run, you got to change your diet and reduce the carbohydrate content. Then the brain becomes a better controller and it allows you to do more exercise without stimulating your appetite to eat more. You'll eventually reach a steady state, depending on how much carbohydrate is in your diet.

If you want to then reduce further, you have to reduce the carbohydrate content of the diet further. That's the real information you need if you're an athlete. The brain is absolutely involved in the regulation of your body weight. You can't fool it, but human biology is that what does fool it and disturbs it and makes it unable to regulate your weight. It's forcing it to eat more carbohydrate than your body can tolerate.

That's because we evolved as hunters and our gut is designed to process protein and fat. The liver and the rest of the body is not designed to process glucose rushing into it from high carbohydrate meals, particularly refined carbohydrates. That's what the body can't cope up with.

The fact that there are athletes like the Kenyans, who can survive on a 75% carbohydrate diet, doesn't change the reality. They are genetically different and the runners are a small population. You can't cope with a high carbohydrate diet.

For many of the athletes I deal with, whose body mass index is a little bit over 25, it's like 27, 28 and they all these training and they can't get their weights down and they wonder why. They say, "Well, I must run more." They've got to change their carbohydrate composition of their diet. As soon as they reduce their carbohydrate content, their weight will come sliding off.

**Co-host:** Speaking of the brain when it comes to weight loss and using the Central Governor Theory for that kind of thing, my friend, Dave Asprey, who does the show with me. He eats about 4,500 calories a day or between 4,000 and 4,500. He hasn't done exercise for like two years and he's still pretty lean. He eat the modified Paleo diet that's very high in fat and protein and very low in carbohydrate. Do you think part of the reason he's able to do that is his body is adapted to a larger caloric intake?

**Dr. Noakes:** That's a very high caloric intake. It's twice what I eat and I'm 84 kilograms. I don't know what his weight is, but that's a huge intake. The prediction would be that he has to be doing three or four hours exercise a day to balance that up.

If he's not doing three or four hours and he's balancing his nutrition on that, then it's really interesting. If you're not eating carbohydrate, the theory is you could afford to eat as much as you like on protein and fat. I don't know if he's changed his diet, I predict that if he was eating 4,500 calories, of which 50% was carbohydrate, he wouldn't be able to maintain his body weight on that.

I mean, the whole theory of the high protein/high fat diet is in fact, you don't have to restrict. You can eat as much as you like, and you don't put on weight, that it's the carbohydrate content that drives your weight up.

Co-host: One of the other interesting theories I think relates a lot to this ... I know we're getting close to the end but I just thought you'll find this really interesting, is the Theory of Food Reward. It's one that's becoming more popular. It's basically been put together mostly by a guy named Stephane Guenette. He writes out a blog called [wholehealthsource.blogspot.com](http://wholehealthsource.blogspot.com).

What they found in past studies is that there some studies in the 1950s where they had these people eating diets that had no stimuli or whatsoever. They are drinking out of these liquid tube things that had no flavor, no texture, no smell, no color and they put obese people on the system. After I think about four weeks or four months ... Either way, the people were eating 200 to 300 calories a day and they said they felt completely satiated and their way continued to drop and everything.

Their metabolism wasn't slowing down and the idea is that the stimuli in a diet, like super satiating foods and these refined foods raise the level which the body likes to maintain body fat. By removing those, it tricks the brain into trying to lower its own body fat. Have you heard of those?

Dr. Noakes: No, I haven't heard of that theory. I mean, if what's that they found but again, I would guess that they were low carbohydrate diets. The easiest explanation for obesity is that it's a function of how sensitive your fat cells are to insulin and how sensitive to glucose and insulin your muscles are.

If your muscles are highly glucose-sensitive and insulin-sensitive, when you take lots of carbohydrate, you will distribute that into the carbohydrate reserves without acquiring much insulin, so you won't grow fat. The problem arises is if you have resistance of the muscles to take up the glucose and the insulin, so you over secrete insulin. On top of that, you have fat cells which are highly sensitive to insulin.

Because in the phase of glucose and insulin, the fat cells, if they are sensitive, will simply just grow and become huge. There's something about repeatedly stimulating these fat cells with glucose and insulin that makes them get bigger and bigger and bigger. That makes you hungry and want to eat more and also to become physically inactive.

In my view, the simplest understanding of obesity of how sensitive your fat cells are to glucose and insulin. If you have very sensitive fat cells, you will become obese if you eat a high carbohydrate diet. If you have fat cells that don't respond to glucose and insulin, you can eat all the carbohydrates you like and it will not have any detrimental effects on your fat stores and then because of that, on your health.

I think the individuality of the response to diet can be explained almost ... Again, let's not say almost entirely, but a large portion of it can be explained by how sensitive your fat cells are to glucose and insulin.

Co-host: Cool. Thank you for talking about this Tim. I know we went a little over our time but I just love talking to you, man. You're awesome. If people wanted to learn a little more about you, are there any books or anything that you would recommend they check out or any websites?

Dr. Noakes: Thank you for asking but obviously, Lore of Running tells you a little bit. My Scientific [inaudible 01:00:13] that's a history of all the ideas that we've developed and tested and the reasons behind them. The book is called Challenging Beliefs. That will give people an idea of who I am and why I think as I do.

Then I've got a book called Waterlogged. That is a history of the changing advice, after it's been given, about drinking during exercise and the role of dehydration and so on in performance.

Finally, you could check the website of the Sports Science Institute of South Africa. That's where I work. We have a website there which will indicate what work we do and what our research is about.

Co-host: Tim, thank you so much. I'll make sure there's a link to everything that we talked about in the show. I'd love to get you back to talk about hydration in sports as well.

Dr. Noakes: It will be a great pleasure. I think that we have a lot to talk about that as well. I really enjoyed this and thank you for having me on your show.

Co-host: Thank you, Tim. Have a nice day.

Dr. Noakes: Thank you so much. Bye-bye.

Co-host: You can find links to everything we've talked about in the show notes at [bulletproofexec.com](http://bulletproofexec.com). That's like Bullet Proof Executive, but short for Executive. If you enjoy this, you can help by leaving a positive ranking for us on iTunes.

If you'd like to learn more about biohacking, follow us on Twitter on [@bulletproofexec](https://twitter.com/bulletproofexec) and check the blog. If this was really useful to you, you can also consider ordering yourself upgrades from our small business sister site at [upgradedself.com](http://upgradedself.com).

## What We Cover

1. Why your ability to go faster and handle pain is controlled by the brain.
2. The Central Governor Theory and how it relates to sports and regular life.
3. Why bonking is all in your head.
4. How super athletes recover between races like the Tour de France.
5. Why you should focus on building confidence instead of training your muscles.
6. How your brain is keeping you from reaching your full athletic potential.
7. How to train your mind and body to resist pain.
8. The workouts and advice you need to build an unstoppable mindset.

9. Why you'll never reach your fastest times without high intensity training.
10. Real world examples and research behind the Central Governor Theory.
11. Anticipatory thermogenesis and weight loss.
12. The secret to Dave's ability to eat 4500 calories a day and not get fat.
13. Tim Ferriss's recommendation to put ice packs on your shoulders to aid fat loss.
14. Dr. Noakes' new book Challenging Beliefs.
15. How you can train your brain to overcome fatigue in all walks of life.

## Links From The Show

[Dr. Noakes' Wikipedia Page](#)

[Exercise Science and Sports Medicine Research Unit At The University of Cape Town, South Africa](#) (Where Dr. Noakes works)

## Books by Dr. Noakes

[Challenging Beliefs \(kindle edition\)](#)

[The Lore of Running](#)

[Brain Training For Runners](#)

[East African Running](#)

[Running Injuries](#)

## Books mentioned in the Q & A

[The Vegetarian Myth](#) by *Lierre Keith*

## Supplements & Food

[Upgraded™ Whey Protein](#)



[Upgraded™ Collagen](#)

[Vitamin D](#)

[Upgraded™ Glutathione](#)

[KerryGold Grass-Fed Butter](#)

[Medium Chain Triglyceride \(MCT\) Oil](#)

[Coconut Oil \(Organic/Raw\)](#)

[Lugol's Iodine](#)

[Vitamin C](#)

[Alderspring Ranch Grass-Fed Meats](#)

## Listener Q & A

1. Which is better, Paleo Pemmican or Hydrolyzed Collagen?
2. What supplements does Dave take?
3. Does a high fat diet cause insulin resistance (revisited)
4. Do fats have nutrients, and why doesn't eating fat make you fat?
5. Can you eat grass-fed butter if you're allergic to dairy?
6. Can raw vegetarians eat a Bulletproof Diet?

## Biohacker Report (latest studies & research)

[“Why We Crave Creativity but Reject Creative Ideas”](#)

[“Bacteria in Gut Influence Brains of Mice, Soothed by Probiotic Broth”](#)

## Updates

1. [Bulletproof Coaching](#)



We're now offering a full [Bulletproof Coaching Program](#). Check it out if you need to lose fat, gain muscle, or upgrade your brain.

## 2. Grass-Fed Meat: An Epic Series

We started a massive series that will tell you everything you ever wanted to know about grass-fed meat. Sign up for our newsletter to have every article delivered straight to your email.

## 3. Bonuses

Don't forget to tweet a link to this episode and enter to win a free copy of Dr. Noakes' new book: [Challenging Beliefs](#).

## Questions for the podcast?

**Leave your questions and responses in comments section below.**

You can also ask your questions via...

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## Listener Questions

### Michael

Is it more cost effective to go for the Paleo Pemmican or the Collagen Powder? As with the Paleo Pemmican you get the whole shebang with the collagen. The Collagen Powder only has pure collagen.

What gave you the most benefit and is it overkill to take both?

### Rachel

It seems like you take a ton of different supplements. I was wondering if you could outline exactly which ones you take and why?

### Kent



What is your take on animal research that shows being on a high fat diet is strongly linked to decreased insulin sensitivity?

**Dave**

If the goal is 50-60% of calories from healthy fats, that implies fats have nutrients. Could you expand on this? Also, what keeps fats down the gullet from becoming fat around the waistline?

**Ronn**

1) I've had dairy allergies since childhood. could I substitute extra virgin coconut oil for grass-fed butter in Bulletproof Coffee? If not, do you have any other suggestions on replacements for dairy?

2) I'm 95-99 percent raw food vegetarian (a vegetarian for 35 years, raw foodie for 4 years). I eat eggs occasionally, and can tolerate small amounts of raw goat milk cheese (is raw goat milk cheese evil?). Is there a place for me in the Bulletproof Diet plan?

\*

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