

Watts per Kilogram

Using the iBike Power Meter
to Improve Your Performance

Richard Wharton
USA CYCLING ELITE COACH
Dallas, TX



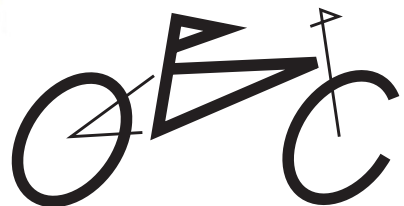
**BREAK THE
POWER
BARRIER**

iBike Pro

Precision and innovation at a fraction of the cost of its competition.

► Features
► Description

Peak	24.16
Avg. Max	24.3
Sp	128



onlinebikecoach.com

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Library of Congress data pending.

Printed in Dallas, TX USA

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INTRODUCTION

Welcome to the world of iBike! By purchasing your iBike, you have taken a huge step toward improving your performance and enhancing your physiology on a bike, as well as your feelings of self-respect and confidence. If you use your iBike wisely, the investment will reward you with more stamina, more speed, more strength in the hills, and more power in the sprints. I am convinced that the iBike is the most cost-effective device for training and analyzing the results of every ride.

As a new iBike owner, you may already have a high level of experience in training with power, you may be a total neophyte, or you may be a jaded ex-user. Whatever your experience level, the iBike will be easy to set up, easy to use, and easy to interpret.

The summaries presented here represent the latest information available in the fields of exercise physiology, kinesiology, biochemistry, and biomechanics. You will find that over time your workouts will be of higher quality, will take less time, and will be safer and more effective than those you may have tried before. By combining the information provided here with your regular rides, cross-training, and races, you will be able to improve upon all four parameters of performance in bicycle competition: speed, strength, stamina, and skill.

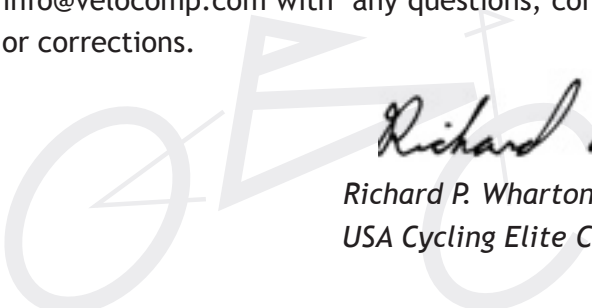
There is more to using the iBike than just throwing a leg over

your bike and pedaling. The iBike is an integral part of any training program, and you need to be comfortable with the concepts of progression, periodization, and physiological adaptation in order for your performance envelope to grow. This booklet is not designed to give specific coaching advice. Instead, it is designed to give you, the cyclist or coach, the knowledge to determine what you are currently capable of and how to improve your performance.

Technology and equipment continue to improve our understanding of training and its effects. However, decisions regarding frequency, intensity, and time will always be too personal for ANY non-specific coaching template. Therefore, I try to remain general with all the concepts since you will have to use your own judgment and make decisions based on the data you get from the baseline tests described in this book.

I'm really excited about the number of features included in the iBike. You can use your PC or Mac to analyze your ride with the iBike software included with your purchase, or you can use software like CyclingPeaks® to compile and analyze the wealth of data your iBike records during your rides.

Finally, please don't hesitate to call, write, or e-mail me at info@velocomp.com with any questions, comments, suggestions, or corrections.



Richard P. Wharton

*Richard P. Wharton | Online Bike Coach
USA Cycling Elite Coach, Dallas, TX USA*

STANDARD WARNING PRIOR TO STARTING ANY EXERCISE PROGRAM

You already know that cycling in itself, while not inherently dangerous, is extremely unforgiving for those who fail to take health and safety seriously. That said, I urge you to see a doctor and get a physical prior to engaging in any sport or exercise. The doctor may not tell you anything you don't already know, but it's always better to be safe than sorry. If you are new to the sport, are not used to long or hard aerobic activity, have a family history of Coronary Artery Disease (CAD), experience pain in the chest, shoulder, neck, or arms during exercise, get dizzy, nauseous, or faint during or after exercise, have been diagnosed with high blood pressure, or have been told by a doctor that you have any type of heart condition, you should talk to a doctor prior to beginning or engaging in cycling workouts, or any type of workout, for that matter.



TRAINING WITH POWER

Bicycling is a largely aerobic endurance sport that mixes in bouts of anaerobic intensity and moments of sheer stress, where all you can think of is survival in terms of seconds, rather than minutes or hours. But the key purpose of training with power is this:

WHARTON'S DICTUM

It is your goal to increase your watts per kilogram of body weight as much as possible over different and specific periods of time so that you can be better prepared to meet the unique and highly varying physiological demands of cycling.

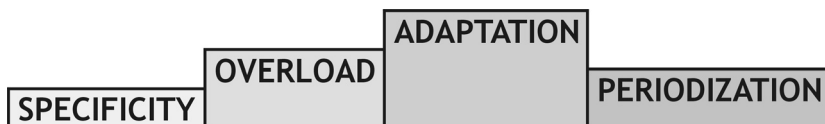
Remember this every time you throw your leg over your bike!

But how do you go about doing this? Well, we need to re-think the foundations of performance.

When you were a child, you based your cycling performance on two things: distance and time. How far was it to your friend's house? How long did it take to get to school? As an adult, when you train with power, the parameters change. You want to monitor how many watts you can generate on average over the course of an hour? Two hours? How about 10 minutes? What you'll find is that absolute average power, divided by body and bike weight, measured over different periods of time, will become your new benchmarks.

THE UNDERLYING PRINCIPLES OF TRAINING

You probably purchased your iBike to analyze your rides and become a better cyclist. To improve, however, you need to train, and all training programs need to include these four themes: specificity, progressive overload, constant adaptation, and periodization.



Specificity

Specificity is the practice of focusing one's efforts on the demands of the sport, or events within the sport. Take mountain bikers. Recent evidence has shown that mountain bikers have stochastic (highly variable) power outputs over the course of a race, and that most of those outputs are on a second-by-second basis. So, in order to train for this and improve performance, a mountain biker would focus on short, intense bursts of power, followed by brief pauses, much like she would while pedaling and then coasting through tight and twisty single track. Roadies, on the other hand, need more aerobic efficiency, combined with efforts that may be 2-10 minutes long above anaerobic threshold wattage, as they climb hills, make breaks, or bridge to breakaways. There are lots of variations in power output that occur in cycling.

Specificity is relative, however, to the foundation of the sport as being aerobic- or endurance-oriented. Think about some of the challenges you face on your regular rides. Are you riding solo into headwinds on flat terrain? Do you have multiple short hills that challenge you with 30-second bursts of anaerobic power? Are you climbing over mountain passes on a regular basis? Do your races almost always end in a sprint? Think about the specific demands your body faces when you ride, and isolate your training to certain aspects of those demands.

Progressive Overload

Progressive overload is the concept of “Whatever you did last time, you can either do it harder this time, or do more of it.” As we stress different systems in our bodies, those systems have both immediate and long-term responses. If we continue to do only as much as we’ve done in the past, our bodies will no longer respond to the stress and will simply maintain the status quo. In order to improve, we have to increase the frequency, intensity, or time of our workouts (or of the intervals within those workouts). By overloading systems through increased power output, our bodies become capable of higher levels of overall performance.

Constant Adaptation

Adaptation is both the immediate and long-term result of specificity and progressive overload. As we add stresses to our body through different workouts and on different energy systems, our bodies respond by altering those systems, so that the muscles

work more efficiently, contract with more force, or grow stronger afterward. The next time a load of that demand is placed on the body, it will have the capacity to respond with less overall stress. Our bodies are incredibly efficient machines, but through adaptation – the result of specific workouts designed to overload the body’s current capabilities – our capacity to do more with less greatly improves.

Periodization

Periodization is a term with many definitions, but basically it boils down to this. Proper periodization means coordinating your training correctly over weeks, months, seasons, and years so you can incorporate the first three underlying principles:

- **Specify** goals based on your watts per kilogram over different periods of time;
- **Overload** the system you’re training so that it responds positively after proper recovery; and
- Force your body into **adaptation** by regularly changing modes of training, durations of average power output, work, and rest intervals.

Periodization, when done well, can lead to huge gains in fitness and prepare you for anything from a weekend ride with friends to major competitions.

The old model of periodization – three steps up, one step down

– was a single static mode of programming progressive overload and adaptation. Thanks to new software like CyclingPeaks®, I see the emergence of a new, more dynamic model. The combination of iBike and CyclingPeaks® makes it possible to micro-manage your efforts and detect trends in your performance, allowing you to develop your own periodization program – one that is specific to your own capabilities, goals, and life limitations, such as work, school, or family.

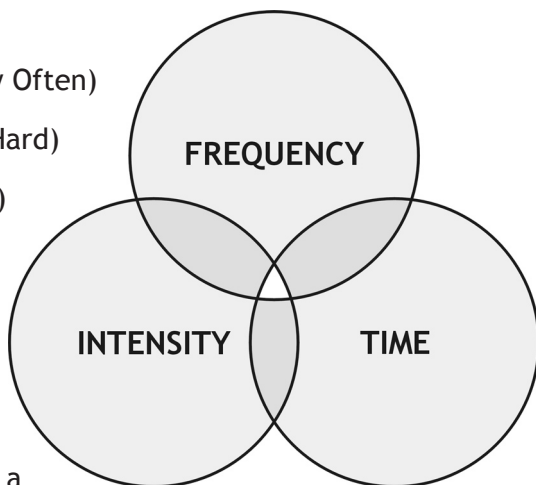


THE VARIABLES OF TRAINING

Whenever we start a training program, it's important to remember that there are three things we can immediately manipulate:

- **Frequency** (How Often)
- **Intensity** (How Hard)
- **Time** (How Long)

When we talk about the frequency of a workout, we mean either how often you work out or how often you perform a specific workout. Intensity is a measure of how hard you work out, and time refers to the length of your workout.



The iBike's real strength is its ability to measure all three variables in great detail. Frequency can be quantified in terms of intervals per session or sessions per week with iBike's "Interval" function or the "Fast Find" function in CyclingPeaks®. Intensity as instant and average wattage can be found on the top screen of the iBike; time is found on the iBike's lower screen.

Why be concerned with frequency, intensity, and time? Well, as a cyclist, remember the previous workout mantra. You're trying to increase your performance envelope as much as possible, given the other restrictions and limiters in your life. Recording the results of a ride will give you the ability to compare that ride to previous and future efforts.

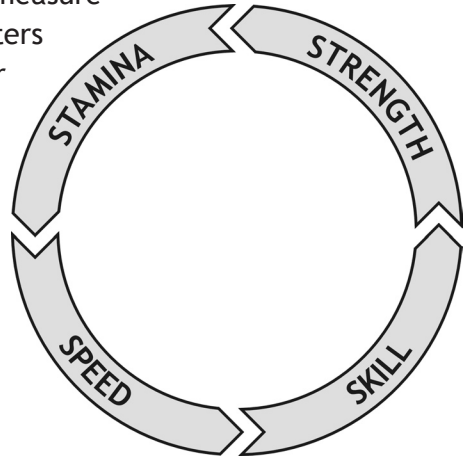
By measuring the frequency of your intervals, the intensity of the ride, and how long the intervals or the ride took, you will start to understand exactly what is happening in terms of your performance. Once you understand what's currently going on, you can begin to plan your training around the manipulation of frequency, intensity, and time. You can focus on your specific strengths and weaknesses, progressively overload the appropriate energy systems, and back off periodically so your body can recover and adapt.



THE PARAMETERS OF PERFORMANCE

The iBike allows us to measure and focus on the four parameters of performance that together make us better cyclists:

- Stamina
- Strength
- Speed
- Skill



Stamina

Cycling is an inherently endurance-oriented sport. Even track sprinters and BMXers can benefit from some optimization of stamina. Stamina is defined as “enduring strength and energy,” and it is improved through rides that focus on moderate intensity and progressive overload over extended periods of time. Cyclists develop stamina through manipulation of the aforementioned four underlying principles of training and three variables of training. If you’re riding 15 miles in the span of an hour, twice a week, and that’s all you do, well, you’ve probably got the stamina to do that and not much more. But if you extend your rides to 25 miles and drop the speed or wattage accordingly, then you’re working on

improving your stamina. Stamina is all about ever-longer distances and the steady progression of endurance. It's not about riding fast; it's about riding longer at moderate speeds.

Strength

Strength is the ability to take a mass (like a body plus a bike) and move it with ever-increasing force over distance and time. Strength on a bike is what allows you to climb a hill at a faster velocity, or accelerate away from other riders. Strength comes from both indoor and outdoor workouts, and through cross-training activities, like resistance training. Strength is what will improve your watts per kilogram over different periods of time more than any of the other parameters of performance. Strength is one of the biggest benefits you will get from training on an iBike.

A great way to increase your strength with an iBike is to program “grinders” – intervals of 4-8 minutes each set at high wattage and low cadence. Once you drop below the 70 rpm threshold, go ahead and practice either pedaling at a super-low frequency while seated, or go find a hill and climb standing, using your weight for leverage. Doing these types of workouts will increase your strength, especially in your legs and back.

Speed

Speed is a direct result of both stamina and strength, but it also has a lot to do with coefficients of drag. When your body works more efficiently at lower levels of intensity, and allows you

to ride with more strength at the higher levels of intensity, an increase in speed is the only logical conclusion.

Think about a ride you may have been on, where you were able to hang with the pack or climb a trail with the group for a while, but at some point, you found yourself all alone, unable to keep up with the pack, which is rapidly disappearing into the horizon. You didn't fail, you just didn't have the stamina, strength, and speed necessary to stay with your friends.

While speed is largely the result of hard work on your stamina and strength, it can be affected by many physical issues, such as aerodynamics and rolling resistance. Here again is an area where the iBike can help, through its accurate measurement of coefficients of drag and its calculation of where most of your drag is occurring – on the road, in the hubs, or how your body is positioned on the bike. The iBike can help you determine the right mix of components, position, and even tire pressure to get the most watts per kilogram when cycling. While the iBike's measurements are not as precise as those you'd get at a wind tunnel facility, many facilities' hourly rental rates are more expensive than the iBike's purchase price.

Skill

The iBike can help you develop some of the many different types of skills cyclists need to master. You definitely need to go out in the real world to learn how to bunny-hop, avoid cracks in the road, stay upright when bumped, or read the nuances of a Peloton. But with your iBike you can learn skills such as effective

use of drafts and how to measure your rate of acceleration in a sprint. You can learn the best way to climb over a course, descend more smoothly, and ride in headwinds and crosswinds. Overall, a mix of iBike and real world riding will make you stronger, faster, more efficient, and more skilled as a cyclist.

Summary

In order to optimize watts per kilogram of power output over different periods of time, you need to work on building your stamina, strength, speed, and skill. To do that, tweak and manipulate the frequency, intensity, and time of your workouts, and the intervals within those workouts. The workouts should be specific to your goals and must be progressively harder over time so that your body will adapt to the stress and become more efficient and strong.



ESTABLISHING BASELINES

In order to become a better cyclist, you need to think about how powerful you were in the past, how powerful you are now, and how powerful you want to become. This is what baselines are all about.

After you familiarize yourself with calibrating the iBike and using its features, you should take a couple of weeks to get comfortable with downloading and assessing ride data. It's important to do this before setting up baseline testing, because it's easy to get confused about button sequences and such when learning to use a new device. Once you feel comfortable with the iBike, start setting baselines so you can figure out how to increase your watts per kilogram.

NOTE: It's probably best not to do more than one baseline test on any given day. You should start each one fresh, and completely recover afterward.

Wattage at Lactate Threshold (wLT)

Look for a piece of road or trail – preferably flat or slightly uphill – that will take you 20 minutes to complete. If that's not possible in your area, find a loop you can ride repeatedly with few interruptions. Make sure it's a course you can repeat at a future date. Get warmed up, then switch the iBike to Sub-Trip mode

(simultaneously press the left and right arrow keys, then release immediately), and go for it! Ride as hard as possible for the entire 20-minute period. Once you've completed the interval, leave Sub-Trip mode (simultaneously press the left and right arrow keys, then release immediately) and recover.

At home, download the file and record the distance traveled, coefficient of drag, weight, and average wattage. This last value is your wLT. There's a chart at the end of this booklet (Appendix A: Performance Baselines) that you can use in addition to the software to keep track of your test results. Congratulations, you've set your first baseline!

Wattage at Maximal Volume of Oxygen Uptake (wVo2max)

Look for a piece of road or trail that you can ride without interference for six minutes. Like the last test, this should also be a fangs-bared, all-out effort, and should leave you dizzy and exhausted when you're done. This test should yield a very close approximation of how much oxygen you can absorb when working at maximal aerobic capacity. It's a great marker of fitness.

Make sure you're warmed up and well hydrated before you head out. Set the iBike to Sub-Trip mode, and go! When you're finished, leave Sub-Trip mode and get a complete cool-down.

At home, download the file and record the distance traveled, coefficient of drag, weight, and average wattage. This last value is your wVo2max.

Wattage at Anaerobic Capacity (wAC)

This test only takes one minute, but it will seem like the longest minute of your life! You will need a combination of sheer anaerobic strength, mental fortitude, and determination as you overload every system, generate a ton of lactic acid and carbon dioxide in your muscles, and watch your instant power output sag dejectedly until you reach that crucial 60-second mark. Don't try this test twice; it will only frustrate you. Nevertheless, it's a great way to measure how much average power you can generate and how much that power drops over the course of a minute.

First, get warmed up, perform a few 15-second sprints to prepare your legs, set the iBike to Sub-Trip mode, and take off! Push yourself to your absolute limit; don't let up on your maximum output for even one second. At the one-minute mark, leave Sub-Trip mode and get a thorough cool-down. Of all the baseline tests described here, this is the one that might make you sick.

At home, download the file and record the distance traveled, coefficient of drag, weight, and average wattage. This last value is your wAC. Notice how all of a sudden you have this weird desire to work on your short-term anaerobic capacity (... or not!).

Sprint Wattage (wS)

Sprint wattage is usually defined as the maximum average power you can sustain up to 15 seconds. However, it also has a lot to do with acceleration, so make sure you're always in the right gear. Good indicators of your sprint wattage are your peak 5- and 10-

second average power outputs, measured by iBike and identified by CyclingPeaks®. I find the high measurement sensitivity of this equipment/software combo extremely useful.

This is a value that is usually best measured during the course of a group ride or race, because you always try harder and have more adrenaline in a competitive context. It is possible to train for sprints alone, especially in a velodrome or on a mountain bike, but there's something about sprinting for a street sign or edging out a comrade at the finish line that brings out one's best. A better use of your solo training time may be working on firing your muscles in a lower gear in rapid succession, thus enhancing acceleration and your ability to sprint away from people.

Coast-Down

There's one final baseline test, unique to the iBike, which involves determining your coefficient of drag (Cd) through a coast-down. It's important to understand how your power is being spent. Take a day to do nothing but coast-down tests, all on the same piece of road.

NOTE: To read out the frictional and aerodynamic drag coefficients between coast-downs you'll need to have your iBike USB connector device and a laptop with you.

First, measure the weight of your body plus your bike with gear, and enter that information into your iBike setup. Do your first coast-down with your tires at regular pressure, your bottles full and in their cages, and your saddle bag on, then download and

record your coefficient of drag. Continue doing tests, changing only one thing (body position, bits of equipment, etc.) at a time. After each test, download and record the values from your iBike.

You'll find that tiny changes can make huge differences in frontal surface area (FSA), rolling resistance (RR), and overall Cd. Use the data from the iBike to find the best overall position and equipment setup for you. You'll also be able to determine just how much more efficient one position or piece of equipment is over another, information you can use to your advantage.

It's often said that the difference between good and great is less than 4%. See if you can get that 4% difference in efficiency by doing a day of coast-down tests every 12 weeks or so and adjusting your equipment and position accordingly. I've provided a chart at the end of this booklet (Appendix B: Position/Equipment Coefficients of Drag) for you to use to track your results.

Using Your Test Results

Your baseline values for wLT, wVo2max, wAC, and wS should give you a good idea of how many watts per kilogram you can generate using different energy systems. Remember, this section is about finding out and recording what you're currently capable of doing so you can look back at a later date and check for improvement in your watts per kilogram in each of the four areas.

NOTE: "Watts per kilogram" is ratio of power to weight, but believe me, it's all about the power, not the weight. Don't fool yourself into thinking that equipment makes all the difference.

People often focus more on the weight of their bike than on their body weight or level of fitness, as if they could “buy” their way to higher performance. I’ll be the first to tell you how many times I’ve finished BEHIND a cyclist with a bike that was heavier and half as expensive as mine! So do pay attention to weight, but focus much more on fitness, training, and aerodynamics. A lighter wallet won’t compensate for lack of preparation when you get into a challenging situation on the bike.



SAMPLE INTERVALS

Practicing different types of intervals during workouts is one of the best ways to improve your performance. In the previous section I outlined how to establish several baseline measurements of intensity across time. In this section I will describe four sample interval workouts that you can program into your iBike for training purposes. Of course, you should consider building a personalized set of intervals based on your own needs.

2 by 20 at wLT

There is growing evidence that two 20-minute intervals at wLT separated by five minutes of recovery results in higher efficiency and power below wLT (it will help you ride harder, longer).

Connect the iBike to your computer, launch the software, and with the interval programming feature, set up the intervals as described above. Start with a goal wattage of 95% of your baseline wLT value so you don't kill yourself. Put your iBike on your bicycle and after a thorough warmup, perform the intervals. The iBike will indicate whether you are above or below your goal wattage.

You may want to do these about twice a week for 8-10 weeks, especially when starting out training with power. Once you've achieved your initial goal wattage, raise your goal value by about 2% per week. At the point in your progression when you can't

complete two intervals at your current goal wattage, re-program the iBike to lower the goal wattage on the second interval only. Once you can complete both intervals, slowly step up the goal wattage on the second interval until it is once more equal with the first interval. After a week's rest (to allow for adaptation), do another wLT baseline test and look for improvement in the data.

The Hour of Power

This is another workout that won't necessarily raise your wLT, but it will help you increase your speed at tempo wattage (wattage you can sustain for 90-120 minutes). It will help you maintain stronger pulls and ride at a faster clip than before.

Program your iBike for a single 60-minute interval at a goal wattage of 90% of your current wLT, and see if you can achieve that goal. If so, increase the wattage by 2% per week. Once you miss the goal on an interval, either lengthen the duration and change the wattage to 98% of your highest wattage so far, or shorten the duration and up the wattage to 102% of your highest wattage so far. This is a great way to play with both intensity and time, and the result is your very own customized periodization schedule.

8 by 4 at wVo2max

Program your iBike for eight 4-minute intervals at your current wVo2max value, each separated by three minutes of recovery. Perform these intervals until you can get through all eight. On each subsequent workout, raise the goal wattage of the intervals

by 2%. These do wonders for your $wVo2max$ as well as your wLT , and they'll help your body develop tolerance to high intensity effort and process lactic acid better during recovery. Only do these once a week for about 6-8 weeks, and not at the same time as the 2 by 20s, or the excessive intensity will cause your performance to plateau. Make sure you're well rested when you start, warm up fully, and have plenty of sports drink on board.

N by 1 at wAC

Program the iBike for 10-12 1-minute intervals at 85% of your current wAC value, each separated by two minutes of recovery. After a 10-minute interlude, attempt another set of 5-7 intervals at the same wattage. Each week either increase the number of intervals per set and keep the same wattage, or keep the same number of intervals and increase the wattage, slowly edging up towards your true wAC.

This workout will improve your ability to jump away hard, stay away, and then recover, often making this a simulation of repeat attacks. N by 1s are difficult, so only do them once a week for 4-6 weeks. Otherwise, your performance will plateau early, possibly leading to more trauma than gain.

Once you've accomplished a set of intervals for an extended period of time, it's always a good idea to spend a day or two re-evaluating your baseline power output. You may detect a trend that you want to continue, or you may expose another weakness. Talk with a coach about some of the finer points of progression, overload, and adaptation so you can maximize your gains.

CONCLUSION

The iBike has lowered the cost of entry into the world of accurate and consistent power measurement. As you incorporate it into your training, you will become more excited about your potential as a cyclist, whether you are a recreational rider or a competitor. The iBike will allow you to track subtle growth in performance more accurately than ever. It will help you identify weaknesses and how to improve them. You will shatter your previous personal records and enter each season stronger, faster, and more prepared than ever before.

Before a race I always say to my clients, “good luck, but since you’ve been training well, you probably don’t need it!” As you learn how to train with power, preparation will overtake luck in importance, and you’ll meet the challenge of each ride with more confidence and ability than ever.



ABOUT THE AUTHOR

Coach Richard P. Wharton is the owner and operator of Online Bike Coach (www.onlinebikecoach.com), an online and on-site coaching, training, and testing business based in Dallas, Texas. He has been coaching since 1993, and is currently a Category 3 road cyclist.

Richard began cycling in the late 1980s. He lived in Montana and Idaho in the 1990s, during which time he he operated a junior development program and was an Expert-level mountain biker.

He returned to Dallas in 1999 to work on the Dallas 2012 Olympic Bid, and in 2000 became Director of Development at the Superdome in Frisco. In 2002 he interned at Tailwind Sports, which at the time owned and operated the US Postal Service Pro Cycling Team.

Richard is accompanied in life by his wife, Amy, and their Boston terrier, Shadow. His custom vanity “Lance Armstrong” license plate reads, simply: “POWER”.

