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CERTIFIED POWER BASED TRAINING COACH

Basics of Training with Power

Over the last 5 to 10 years training by power has been slowly taking over and displacing heart rate monitors as the training metric of choice by professional and amateur cyclists alike. It is not uncommon to see *SRMs, Powertaps,* or *Ergomos* on the bikes of professionals in the biggest races of the year and perhaps you have heard cyclists talking about watts and kilojoules. But what do these terms mean and can it really be that useful? Absolutely! With a little knowledge a power meter can revolutionize your training and help you achieve goals you never thought possible.

Terms

Let's start off by defining power and the common terms used with training by power. Power is simply the amount of work or mechanical energy you expend in a given period of time and is measured as a watt. Work or energy is represented in joules. One joule is equal to 1 watt per second.

Power = work/time = joule/second

In everyday life we often use kilocalories to represent energy thermically instead of using joules or kilojoules (1000 joules) to represent energy. In other words, we think of energy as the amount of food we eat in kilocalories. By measuring your power output and total kilo joule expenditure you can estimate the amount of kilocalories used. 1 kilocalorie is equal to roughly 4 kilojoules, so 1000 kilojoules is equal to roughly 250 kilocalories. However the human body is not 100% efficient. While riding a bicycle we are approximately 25% efficient with the remaining 75% of energy being lost to excess heat production. When the math is all done, 1 kilo joule is roughly equal to 1 kilocalorie.

How is power measured?

On a bicycle we measure power by the amount of force or torque generated at the pedals by the speed, or angular velocity, of the pedals or how hard and how fast you are pedaling. Power on a bicycle represents the speed you are traveling against all the resistant forces like aerodynamic forces, gravitational resistance, rolling resistance, and mechanical resistance (bearings, chain, etc). Given that two riders will have completely different resistant forces, it is possible for two riders going the same speed produce two different power outputs.

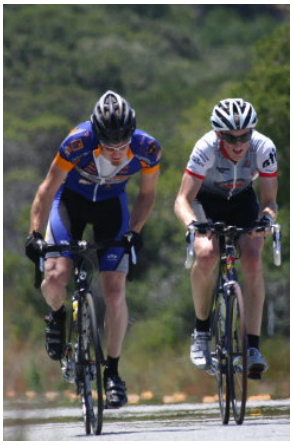
Power is measured by a variety of devices that measure torque and speed at either the bottom bracket (Ergomo), crank (SRM or Quarc), rear hub (Powertap), or chain (Polar). All of these devices have their pros and cons but I will leave that to another article.

So Why Measure Power?

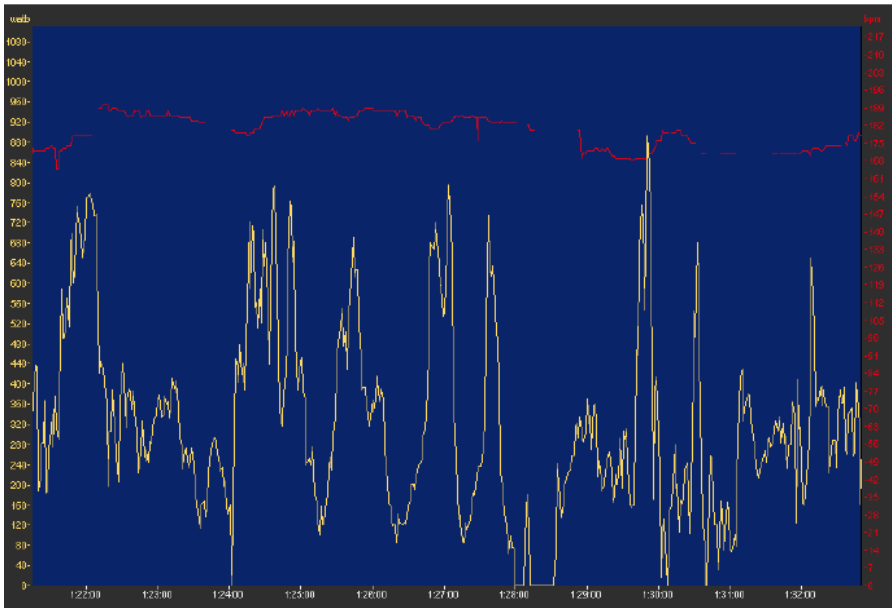
The "Stimulus-Response" Relationship

A German physiologist named Hans Selye was the first to conceive of the "Stimulus-Response" relationship as generalized as an inverted U relationship, where too little and too much stimulus or training load results in sub-optimal performances. Thus determining the optimal training stimulus will result in the greatest amount of performance gain. The difficulty has been in how to measure training stimulus. Speed and distance is too inconsistent due to the changing resistant forces in cycling like wind, terrain, and drafting. Heart rate represents a response to training stimulus and not the quantitative training stimulus itself (see below for more on heart rate). However, power output is an objective and absolute measure of the training stimulus or intensity, it is possible to accurately quantify an individual's training load during training and competition. By measuring power, a cyclist can now measure the actual training stimulus instead of relying on responses that may or may not represent the true training stimulus.

I have a heart rate monitor; doesn't that give me an accurate measure of training intensity?



With the advent of portable heart rate monitors several athletes have been proclaiming the benefits of measuring heart rate while exercising and have been extrapolating several fitness parameters from the data. While it is true that in a laboratory setting heart rate and power output increases in a predictable manner, this does not hold true outside the lab. There are several factors that impact heart rate outside the lab. For instance, dehydration, fatigue, heat stress, competition stress, caffeine, as well as several other factors can have a direct effect on heart rate. Furthermore, heart rate increases or decreases in response to work load and doesn't represent quick changes in power output. Heart rate responds to increases in workload in a 30-second half-life response. In other words, it takes heart rate approximately 30-seconds to respond to an increase in workload and the longer that workload is continued the closer heart rate will accurately represent the true workload. As a result, heart rate will underestimate training stimulus when a workout or competition has extremely variable power outputs.



This graph shows the variable power output (yellow) and how heart rate (red) does not respond as quickly.

This is not to say that heart rate is unimportant. It is a valuable physiological response to training but it should not be confused with the actual training stimulus. Measuring heart rate and power output can give us a better picture of an athlete's fitness. Not only can we see the actual training stimulus but also the physiological response to that stimulus.

Measuring and recording power output through out training and racing gives the athlete immediate and objective feedback to their performance. This valid and reliable feedback can establish the foundation of a good training program.

Training with Power

The basic principles of training have not changed but the ability to measure and fine tune one's training program has. A power meter allows you take previous theoretical training constructs into fully implemented training principles. You still have to ride the bike; you still have to do the work; and the training program still has to be constructed utilizing the proven, fundamental training principles.

Specificity

A fundamental training principle is that training should be as specific to the demands of competition as possible. By using a power meter in competition, an athlete can better understand the demands of the competition and alter their training accordingly.

Periodization

Another fundamental training principle is that training should be organized in a pattern of general to specific fitness, and alternating hard days, or overload, and easy days, or recovery. Through the use of a power meter we can now objectively measure

how hard the hard days are and how easy the easy days are, thus allowing us to better execute a training plan.

Individuality

One of the most important principles of a sound training program is one that accurately reflects the athlete's individual strengths and weaknesses, and their individual response to training stimulus. By using a power meter and some simple performance tests, it is possible to determine an athlete's strengths and weaknesses and design a training program that helps one improve their weaknesses. Furthermore, a power meter provides an athlete their own individual response to a training stimulus. This allows them to determine their specific response from a training program and make appropriate changes to make a general plan more specific to themselves.

A power meter, with a little knowledge, and hard work you can be an invaluable tool in training program.

To learn more about training with a power meter, coaching, or how to maximize your training program contact Chris Burnham at cburnham@burnhamcoaching.com.

Chris Burnham is a USA Cycling Certified Level I coach and one of six Level 1 Coaches who is also a Certified Power Based Training Coach. He has been a coach for over 7 years and has trained over 100 athletes. He continues to race at a Semi-Pro level on the mountain bike and regionally on the road, always using his power meter!