



Helping cyclists train intelligently

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The Third Dimension to Training ***A Very Brief Introduction to Training with Power***

Affordable heart rate monitors became widely available in the 1980's and we dinosaurs who rode back then rushed out to buy them. While it was interesting to know what your heart rate was, it wasn't very informative in the early days. It wasn't until the late 80's or early 90's that we learned how to turn heart rate data into *useful information* for training purposes. The heart rate monitor became an important tool in the cyclists training kit. And its use has revolutionized the way we train, from professionals down to weekend warriors. Today, we're on the brink of another revolution in training: training with power.

Power at lactate threshold has been shown to be a more reliable predictor of performance in 40K time trials than VO2 max. Until recently, power was only measurable using an ergometer in a laboratory. However, there are now reasonably affordable and accurate power meters available to every cyclist, most notably by SRM and PowerTap. Polar recently introduced an add-on option that attempts to measure power via chain tension but its reliability and accuracy remain in question.

What is Power?

So what is power anyway? Power, measured in watts, is an instantaneous and objective measure of the rate of work produced by the cyclist and can be expressed as:

$$(A) \text{ Power} = \text{Work} / \text{Time or}$$

$$(B) \text{ Power} = \text{Pedal Force} \times \text{Cadence}$$

Formula A stipulates that if I cover the same distance in half the time, I must be averaging twice as many watts (assuming identical conditions). The second formula simply indicates that we can increase power by exerting more force on the pedals at the same cadence, by increasing cadence while exerting the same pedal force, or by increasing both force and cadence.



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Why is Power Useful?

There are only three variables to control in a training system: duration, intensity and frequency. Duration and frequency are easy to measure objectively. We usually measure duration in hours or miles and frequency in sessions per week. Intensity, on the other hand, is difficult to measure. Many of us have been using RPE (rating of perceived exertion) and/or heart rate.

Heart rate is a pretty reliable way to execute your training plan during lower intensity (i.e. aerobic) training. But as we move into more race specific (i.e. shorter but more intense) training, heart rate becomes a less effective proxy for intensity. Besides being subject to certain variables (e.g. humidity, temperature, etc.), heart rate lags effort. That is, heart rate will be lower than your RPE during the early part of an effort and will be higher than your RPE after the effort.

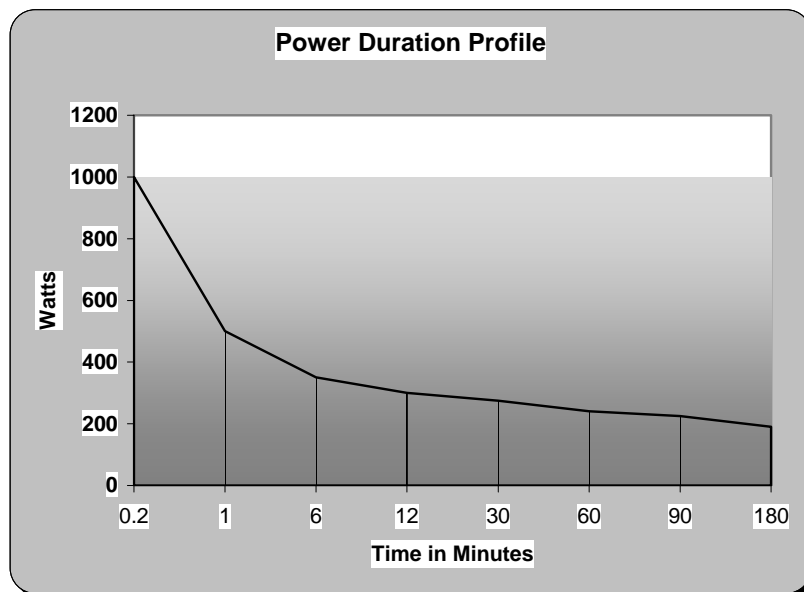
Power is an especially useful training device because it is both instantaneous and completely objective in measuring intensity: 300 watts is 300 watts, no matter how you feel, how hot it is outside or what your heart rate is.

As you can imagine, the average power you sustain for one minute is dramatically different from what you can average for thirty minutes. There is a non-linear relationship between power and duration (Figure 1), but the slope of the line becomes fairly constant as we increase duration beyond 12 minutes.



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Joe Friel, who is my mentor, refers to the power duration relationship as critical power points.¹ The average power you can sustain for six minutes thus becomes your CP6. Certain segments along this line become your training zones when training with power. Which of these points to monitor will depend in part upon your event focus and where you are in your training program. Average power for 30-minutes is a reasonably good proxy for lactate threshold power, which is a key performance metric and is highly predictive of success in endurance cycling events. The higher this number, the less often you are dipping into precious reserves, which means you'll have more left to go with the winning move. Whether you race or ride for general fitness, CP30 is an important metric.

The beautiful thing about using an entirely objective measure is the ability to periodically test yourself to determine whether or not your training is paying dividends. Once you establish your initial power curve, then you periodically test only those portions of the

¹ This is different from the concept of critical power presented by Monod and others in the scientific literature. In their definition, critical power is a level that can be sustained for "a very long time." While some scientists are disturbed that we use CPxx to describe our power duration levels, think of it simply as average power for any given duration.





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curve which will be most affected by your training. For example, every four weeks during “base” training, you test your average power for 30 minutes, as this is where you would expect to see the most benefit. As you move into race-specific training (i.e. “build” phases), you will focus on training and testing your race-specific limiters. For example, as a criterium specialist, I am focused on CP0.2, CP1, and CP6. I know what numbers I need to achieve to be truly competitive in the Pro/1/2 crits and now I have the tools to judge whether or not my training is effectively preparing me.

So now you’re wondering, “If I start training with power, do I sell my heart rate monitor on E*Bay and ignore RPE?” Absolutely not. I’ll draw an analogy from the media. The introduction of the radio did not render newspapers useless, nor did television result in the demise of radio. Each medium has its inherent strengths and weaknesses and most of us draw on all three to gather information. It is the same with RPE, heart rate and power. Each has its place. Use them together to get a three-dimensional view of your training. And maybe beat a few youngsters to the finish line in the process.

