

## The Heartbeat of Power

The use of heart rate monitors to gauge training intensity is not new to the cyclist. Since there is a linear correlation to an increased/decreased heart rate with an increase/decrease in effort, many cyclists use the rate at which their heart is beating as a measurement of their workload. That would mean that an individual with the highest heart rate is doing the most work, right? That would mean that the pace of your heart determines how much power you can produce, right? That means that when heart rate increases, the bike moves faster, right? *WRONG, WRONG & WRONG.* Let's get a better understanding of heart rate and how to incorporate your beating heart into power training sessions.

It's important to understand the difference in a heart rate monitor and power meter. The synonym of monitor is check, watch, observe, and keep an eye on. The meaning of meter is to weigh, gauge, indicate, measuring device. Last, the definition of measure is calculate, determine, quantify and compute. By definition alone, it is clear to see that a heart rate monitor is correctly used as a device that allows you to check, watch, observe and keep an eye on how fast your heart is beating. The CycleOps PowerTap power meter is a measuring device that calculates, quantifies and determines power.

Yes, there is a linear correlation. As you produce more work, your heart rate increases. However, there are so many variables that determine how fast the heart pumps blood; whereas power is not vague. Your power output (work) is what drives the various physiological responses, like heart rate, ventilation, core temperature and perceived exertion. The PowerTap accurately measures the work that your muscles generate to drive the bike and heart rate "monitors" how fast the heart is pumping blood to do the work. Since power represents a direct and immediate measurement of every pedal stroke, using the PowerTap is the most accurate and effective way to train. To achieve the most effective training, measure your work and monitor how your body responds to the work. Converting the specified power levels to corresponding heartbeats and ranges is somewhat tricky, due to the likely variability of heart rate. On the other hand, monitoring how your body is responding at various power outputs will be of assistance in steering your training.

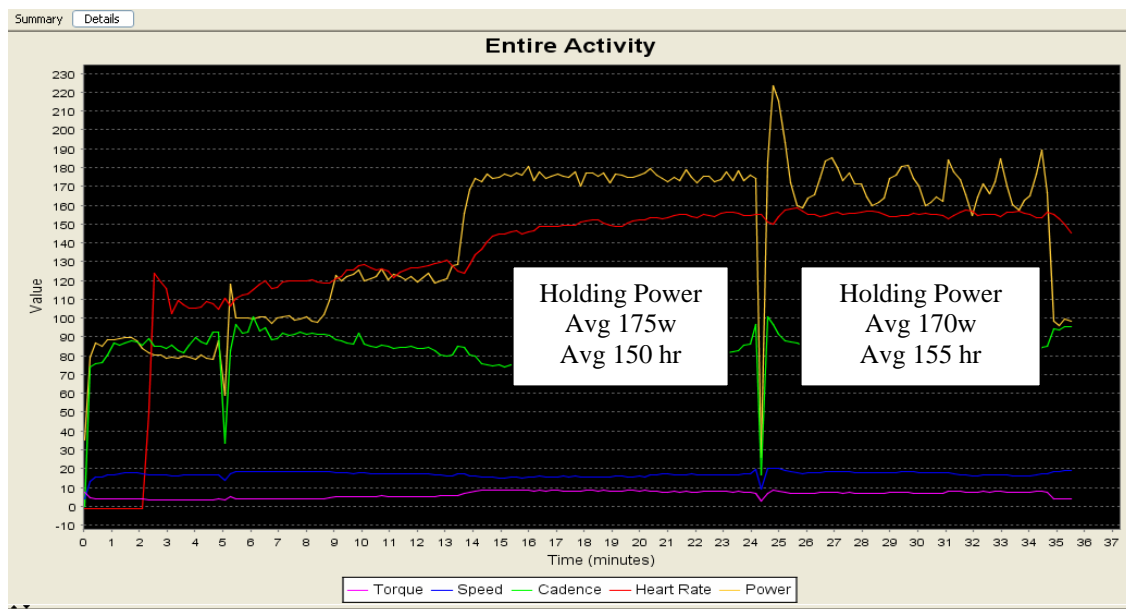
First, it is critical to understand why there is so much variability in heart rate. The heart's rate of pumping blood is based on the demand. The amount of blood pumped increases to meet that demand. In cycling, there is an increased demand on the muscles used to pedal the bike. As the muscles turn the pedals they rely on the heart to pump blood through the arteries, which are responsible for sending oxygen and nutrients to the dynamic muscles to generate energy. The blood subsequently picks up the waste and the heart pumps it thru the veins, carrying the build up of toxic lactic acid and carbon dioxide, to be expelled. Think of your muscles as a factory full of workers. As long as you keep paying them, they will produce work for you. As soon as you decrease their salary or stop paying them, they have no desire to perform. Once payment begins, the workers are activated and production increases again.

The brain is always sending signals to the heart to adjust the rate of blood flow. Other than pedaling the bike, here are just a few factors that may influence that rate:

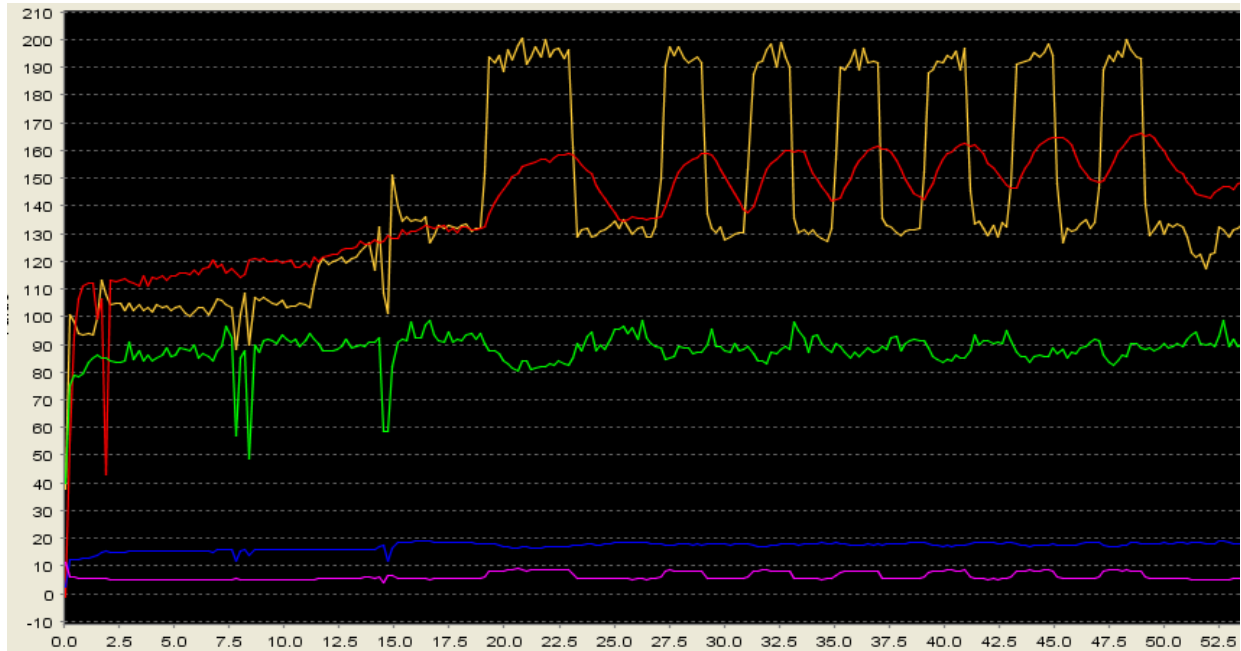
- Heart rate can rise by simply thinking about effort, which is referred to as anticipatory response. Your body reacts to emotions by going into a state of readiness, called Fight or Flight. The body prepares for activity by increasing heart rate and releasing glucose from the liver for energy.
- Tense muscles and death gripping the bars or using muscles not involved in cycling, will signal the brain to send blood to these areas as well. Therefore, relaxation and efficient use of muscles will assist in managing the rate of blood flow and ensure the blood flows to the muscles truly needed to move the bike.

- Medications can affect heart rate. Antihistamines and anti-depressant drugs typically increase blood flow, while beta-blockers and blood pressure medications tend to slow down blood flow. It is critical to discover these effects, prior to training while taking medications.
- In hot temperatures, heart rate increases to increase the ability to release the heat and cool the body. However, in cooler temperatures, heart rate is typically lower as the brain is diverting the blood throughout the entire body to keep it warm.
- At the same workload, woman typically have higher heart rates than men, due to the fact woman have lower stroke volume (in general).
- Altitude generally demonstrates higher heart rate, as the heart needs to work overtime to pump blood for re-oxygenated and boost the removal of lactate from the blood and muscles.
- Fitness elicits a decrease in heart rate due to its ability to work harder with less effort.
- Fatigue, cramping and dehydration can cause an increase in heart rate, due to the body attempting to transport additional nutrients and remove more toxins.
- Being in a state of over overtraining or needing more recovery may lower heart rate during exercise, as the brain signals blood flow for recovery, in lieu of sending blood flow to dynamic muscles.

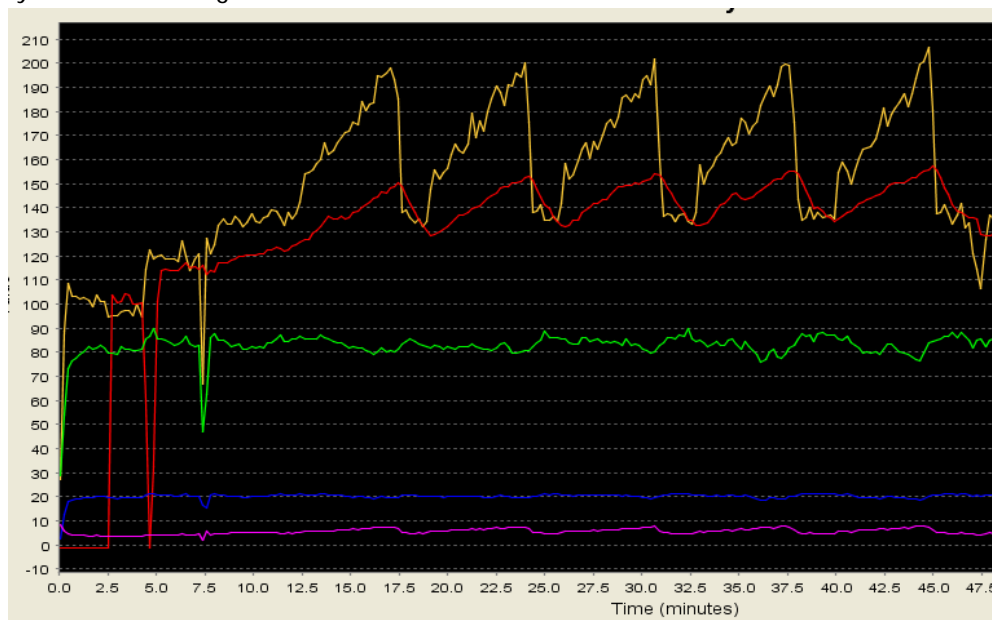
Using a heart rate monitor is a way to judge how the intensity of your training is affecting your body. However, since heart rate does not determine the work, it is critical to measure the intensity. Without a doubt, the most effective training is based on measuring your work. Below is data from PowerAgent software. This rider performed two intervals. The first interval focused on sustaining a workload of 175 watts. The second interval focused on sustaining heart rate response of 155 bpm. Note that when sustaining load, heart rate progressively increases over time. However, when sustaining response, workload is unmanageable and dwindles. Which is more beneficial? Sustain an average 175 watts @ an average 150 bpm OR sustain an average 170 watts @ an average 155 bpm? Interval #1 sustains more work, more efficiently. Measuring intensity is critical to ensure you are doing the work. Use the heart rate monitor to determine how efficient the ticker is. Remember, if you train by sustaining response, the amount of work you do will likely decrease. Who wants to train their body to do less work over time? No one!



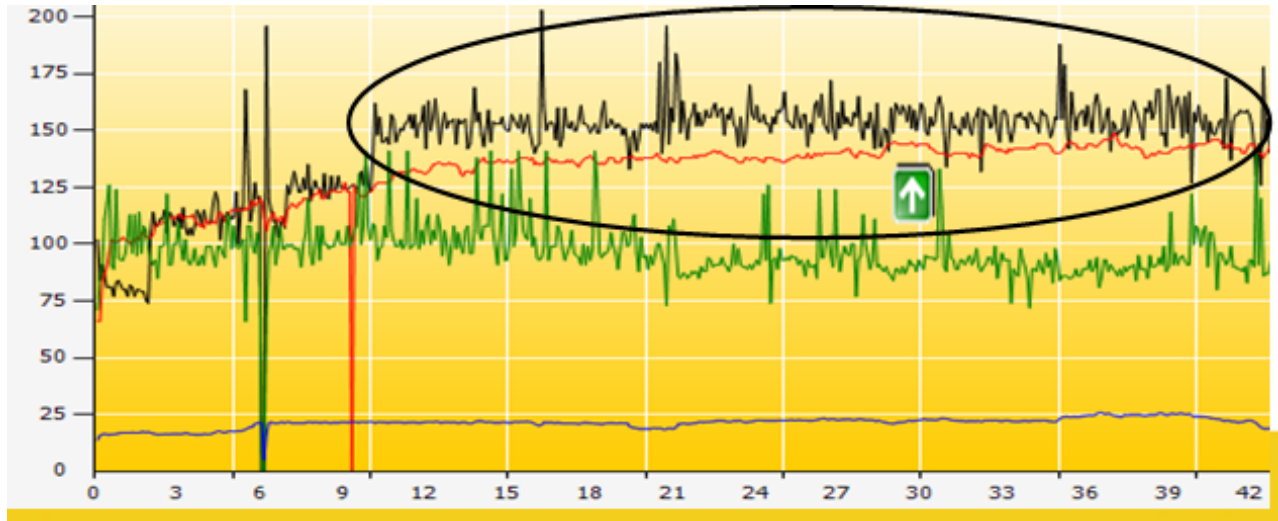
Below is data from PowerAgent software, demonstrating a great training workout used to determine progressive strength in the cardiovascular system. After a long warm up, sustain 90% of Threshold Power (determined during a PowerTest) for 5:00. After a 5:00 recovery, perform several intervals of 2:00 at 90% Threshold Power. Note your heart rate at the end of 2:00 and recover 20 heartbeats. Once you have recovered 20 heartbeats, repeat. You will continue this process until fatigue sets in or due to time limitations. Note that there is a rise in heart rate during effort, over time. Therefore, the recovery heart rate is higher as well.



Below is a similar training session. After warm up, take 5:00 to gradually progress from 70% of Threshold Power to 100% of Threshold Power. Check your heart rate at the end of 5:00. Return to 70% of Threshold Power until you have dropped 20 heart beats. Once you have recovered 20 heartbeats, repeat. You will continue this process until fatigue sets in or due to time limitations. Note that there is a rise in heart rate during effort, over time. Therefore, the recovery heart rate is higher as well.



Below is a training session used to determine when the load is becoming stressful for the rider. The rider's goal was to see how long they could sustain their aerobic base, before their body begins to respond to the load. By sustaining the work and monitoring the response, the rider pays attention to the point where the response (heart rate) begins to rise. Their future training sessions would include increasing the duration of time they can sustain the load, before signs of fatigue set in.



The idea of training is not to raise your heart rate, but to raise the amount of work you can do with well-trained cardiovascular, pulmonary & muscular systems. Therefore use power to ensure you are doing the work. Use heart rate to keep an eye on how your body is responding.