Explanation of Terms as They Particularly Relate to the Concept of Power in Cycling
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The following explains the terms Speed, Cadence, Torque, Power, Power to Weight Ratio, Heart Rate, Work, Normalized Power, Functional Threshold, Intensity Factor, Training Stress Score, Acute Training Load, Chronic Training Load, and Training Stress Balance as they relate to the sport of cycling.

Speed = a measure of the velocity of the bike, measured in mph or kph. Speed is not a good measure of exertion or intensity while cycling because it is greatly affected by opposing forces such as wind, grade, road surface, drafting, gravity (body & bike weight), aerodynamic profile and friction (drivetrain efficiency) as well as power. It is important to remember though, that races are won by the fastest rider, not the rider with the most power. Speed = Power - Opposing Forces (aerodynamic, gravity, rolling resistance) so in the end a rider must optimize this equation by increasing power and decreasing opposing forces as much as possible to produce maximum speed.

Cadence = a measure of the velocity of the cranks, measured in rpm. Under constant conditions, if rpm increases, power increases. "Normal" rpm for most riders on a flat road is 85-100 rpm. Lower rpms (less than 85 rpm) will place more of the stress on muscular strength, and thereby cause more muscular fatigue and higher rpms (greater than 100) will place more of the stress on aerobic capacity (and cause less muscular fatigue) but the rider will be less efficient since the "dead spot" in the pedal stroke will occur more often. Depending on the efficiency of the rider, higher rpms may cause higher oxygen utilization, heart rate and glycogen usage. Every rider will have their own optimal rpm where they can produce the most power for a given period of time. It should be noted, though that this ideal rpm for the rider will change based on the type and length of event.

Torque = a measure of the angular force applied to the pedals, measured in inch pounds or foot pounds. Under constant conditions, if torque increases (the rider uses a harder gear), power increases. Riders with better muscular strength should be able to produce and sustain more torque with less muscular fatigue.

Power = a measure of the work over time done by the rider to push the bike forward, measured in watts. Power = Torque x RPM. Power will increase (under constant conditions) if torque or rpm is increased.

Power/Weight Ratio = a measure of power over a given period of time relative to the body weight of the athlete. Power to weight ratio at functional threshold (see below for definition) or Lactate threshold is most commonly used. It is speculated that to win the Tour de France a rider must have an FT power to weight ratio of around 7.0 watts/kg (in the case of Lance Armstrong, this came out to approximately 500 watts at threshold at a weight of 160 pounds!). Power to weight ratio is important because it requires more power for a heavier rider to travel the same velocity than for a lighter rider. However, it is important to remember that gravitational resistance is just one of many opposing forces while riding and only a small percentage of the opposing force on a flat road.

Heart Rate (HR) = A measure of the frequency of an athlete's heart beats, measured in beats per minute (bpm). As exertion increases, heart rate will increase. However, there is a delay in the response of heart rate (as exertion increases, heart rate will take some time to raise and as exertion decreases heart rate will take some time to drop). Therefore, heart rate is not a good measure of exertion in shorter efforts. Additionally, heart rate is greatly affected by heat, hydration and fatigue. There is also a great difference in heart rate values from athlete to athlete, even with the same level of relative exertion.

Work = average power x time, measured in kJ. Work done will increase if power increases or if time increases, so work is a measure of intensity and duration. A given route (under constant conditions) should require a given amount of work that will remain constant regardless of speed. In other words, if the speed is low the power will be lower and the duration will be higher. If the speed is high the power will be higher and the duration will be lower. Either way, the work done will remain the same. Work should not to be confused with energy burned by the rider, measured in kCal, which depends on rider efficiency and is better estimated using heart rate and/or oxygen consumption.

Normalized Power (NP) = calculated power over a given duration that better takes into account non-steady state efforts. Average power will decrease if there are significant recovery periods during warmup, cooldown or in between efforts but the stress of the ride does not necessarily decrease (think of driving a car¦ you can average under the speed limit but it doesn’t mean you won't get a ticket). Therefore, average power is not a good measure of exertion for non steady state efforts such as races, hilly rides and many group rides. Normalized power should reflect the actual intensity of the effort. It is calculated by taking a 30 second rolling average of the power values, taking these values to the 4th power, averaging these values and taking the 4th route of this number. Therefore, when the power spikes are very high, these spikes will be given exponential weighting. For example, a criterium may produce an average power of only 160 watts (due to the regular periods of coasting) but the same race might yield a normalized power of 280 watts (due to the many accelerations). Though normalized power is a very good measure of true exertion, because NP works on a 30 second rolling average, rides with power spikes of less than 30 seconds may not be weighted as highly as expected and likewise other rides that contain maximal efforts of 30-60 seconds may be weighted more highly than expected.

Functional Threshold (FT) = the maximum power a rider can produce for a period of 60 minutes. This can be estimated by completing a 60 minute time trial, a 60 minute "race-type effort" with a high normalized power (commonly a difficult criterium or fast group ride), by taking 95% of the power produced in a 20 minute time trial, 90% of the power produced in an 8 minute time trial or by completing a lactate threshold test in the lab.

Intensity Factor (IF) = the normalized power for a ride with respect to the functional threshold of the rider = NP/FT. Therefore an effort at 100% of threshold should equal an IF of 1.0. If the rider has an IF of over 1.05 for over an hour, their functional threshold may have increased since the last test (or their power meter needs to be calibrated)

Training Stress Score (TSS) = a measure of the intensity and duration of the ride. Intensity is measured in IF and duration is measured in minutes. If the ride is harder the IF will be higher and therefore the TSS will be higher. If the duration of the ride is increased, the TSS will increase as well. As a rule of thumb, most people should be able to recover from a workout with a TSS of 150 or less in 1 day 150-300 in 2 days, 300-450 in 3 days and a workout with a TSS of over 450 should require more than 3 days recovery. However, actual recovery rates will be affected greatly by fitness level and fatigue as well as recovery habits (nutrition, sleep, massage, etc.). It is also important to remember that if a rider's FT changes it will affect the IF for the ride, which will in turn affect the TSS for the ride. For example, if a rider increases his FT, the same workout done at the same wattage will produce a lower IF and a lower TSS.

Acute Training Load (ATL) = a measure of short term exercise fatigue level using TSS values from workouts. This is usually calculated using a 5 or 7 day time constant. A rider's ATL will increase incrementally if the TSS value for the day is greater than their ATL and decrease incrementally if the TSS value for the day is less than their current ATL. The greater difference between the rider's TSS and their ATL, the more the ATL will change.

Chronic Training Load (CTL) = a measure of overall fitness level using TSS values from workouts. This is usually calculated using a 30 or 42 day time constant. A rider's CTL will increase incrementally if the TSS value for the day is greater than their current CTL and decrease incrementally if the TSS value for the day is less than their current CTL. The greater difference between the rider's TSS and their CTL, the more the CTL will change. This implies that the higher the level of fitness, the more it takes to keep raising the fitness.

Training Stress Balance (TSB) = CTL - ATL. When an athlete peaks for an event, they should have a high TSB (a high level of fitness and a low level of fatigue). If an athlete takes a break at the end of the season and then resumes training after a break, their fitness (CTL) will most likely be low but their fatigue (ATL) should be low. When the athlete first resumes training, their ATL will go up quickly, and their CTL will remain low at first (meaning that their fatigue is high and fitness is low). After a long and intense training period, CTL will most likely be high, but ATL will be high as well so the athlete will be unable to fully utilize his high level of fitness until he takes a rest period and allows the ATL to decrease. In general, athletes should avoid TSBs of less than -40 for risk of injury, illness and/or overtraining. TSB should be at least above 0 for B races and over 20 for A races. If CTL is high, a period of high ATL will not produce as low of a TSB than if the CTL were lower. This implies that if fitness is high the same amount of training may not cause as much fatigue.

** Normalized Power, Intensity Factor, Training Stress Score, Acute Training Load, Chronic Training Load and Training Stress Balance are terms created by Andy Coggan and Hunter Allen as ways to objectively model the stress of training and the body's short and long term responses to this stress. To read more about these terms, you should read their book, "Training and Racing with a Power Meter". Though these models hold up very well when compared to other objective and subjective models, it is important to remember that the human body also operates with a certain degree of unpredictability. In other words, we are not robots.*