



A critical confusion

The critical power concept was first proposed by Monod and Sherrer in prehistorical times of performance analysis. Critical power CP was defined as the power limit between easy (non-fatigable) and hard (fatigable) exercise. The second parameter of the model, W' is the total amount of work that can be achieved in a continued effort at power levels in excess of CP. As per definition an effort below or at CP can be sustained without duration limit.

In order to measure these parameters CP and W' a multiple exhaustion (MEx) protocol was developed in the mid 80's. The testing subjects were instructed to ride at constant power levels between 85 % to 105 % of their individual VO_{2max} power. The corresponding exhausting duration ranges between 2 and 12 minutes. A $(1/T, P)$ plot of power versus the inverse of duration yields a straight line from which CP and W' are extracted. More recently an alternative 3-minute all-out test is used. The subject is instructed to start sprinting and to sustain highest possible effort during 3 minutes. Power level during the last 30 seconds is considered to be CP.

CP as determined by any of these protocols is unable to explain or predict performances that elucidate sustainable durations longer than 20 minutes, i.e. long TT or climbing stages in the Grand Tours

Therefore many authors have erroneously re-defined CP as being the power limit between "hard" and "extreme" exercise and accept sustainability durations of less than 20 minutes. This unfortunate duality leads to confusion, misunderstanding and to inability to predict performances in the climbing stages of grand tours TDF, Giro, Vuelta.

Proper analysis of power-duration field data i.e. Mean Maximal Power, or Power Profile are preferable.

Examples of long sustainability in climbing stages are shown for various top-10 riders of the 2013-2014 TDF. The absolute top class achieves CP-values of ~ 5.4 W/kg and $W' \sim 0.9 - 1.5$ kJ/kg

The short-long duality is illustrated by simple $(1/T, P)$ plots of the 1 year MMP data of World Tour cyclists. In all cases two straight line segments are identified. We conclude to introduce a (CP_s, W'_s) as critical power and anaerobic work for short efforts (from $\sim 2'$ to $\sim 15'$), together with (CP, W') as critical power and anaerobic power for intermediate and long efforts (from $\sim 15'$ to 120' or more). The intersection of both linear segments occur at supercritical power SCP which is the real treshhold between exercises at hard and extremely hard intensity..

Because exhaustion occurs at or near depletion of either W' or W'_s it is also interesting to monitor the depletion-recovery state of a cyclist after a ride, or live during the ride. The near future may even bring us on-bike power meters with exhaustion indicators.