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Name of Article: Using Intervals to Target VO2max Adaptations
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Last month I discussed the notion that the most common use of interval training is likely to mimic the specific demands of a given event/competition. And, yes, this is a logical approach to training, but, alternatively, intervals can be used, in a more broad sense, to specifically elicit physiological adaptations that will contribute to the overall development of the athlete. This is particularly pertinent to cycling due to the dynamic and diverse nature of most cycling disciplines. For example, in running, if one is a middle distance runner, it is relatively easy to specifically address the demands of the event (e.g. the 1500 m) because the distance and pace is well defined. On the other hand, most cyclists participate in very diverse events, and in the course of a single stage race may compete in a 20 km time trial, 40 km criterium and 100 km hilly road race. Each of these events will be different in duration, and the nature of the efforts can be quite different (e.g. constant for the TT and variable for the criterium). Therefore, it is more difficult to precisely target specific efforts, and it may be best for the athlete to train physiological systems or attributes rather than competition specific efforts.

In general, there are two physiological attributes, VO2max and the lactate threshold (LT), which are arguably of greatest importance in cycling. Sure, it's nice to have a fast sprint, but riding in a break, climbing with the leaders, and performing well in a TT are dependent upon VO2max and the LT. And let's face it, a fast sprint isn't much good if you don't make it to the finish with the leading group. We will discuss LT training in later installments; but specifically with regard to training VO2max, intervals of the appropriate duration and intensity are likely the most effective approach, as opposed to group training rides, or races.

Before I go any further, I will make one recommendation. If you don't have a power meter, get one. I know, I know, they're the latest fad and boy, are they expensive. Jaques, Eddy, and the Badger didn't have them, so why do I, local Joe crit racer, need one. Training principles for cycling have come a long way in the past 20 years, and more importantly, training approaches in cycling have made huge gains in just the last 5 years with the wide availability of on board power meters. They're not a fad, they're here to stay. Moreover, VO2max training is one of the most effective uses of a power meter. Neither heart rate nor perceived exertion are sensitive enough to appropriately gauge such efforts.

Remember from last month's newsletter, I suggested that one should know exactly what they are trying to accomplish with interval training. So, let's ask ourselves, "What are we trying to accomplish with VO2max intervals?" Well, since VO2max, by definition, is the maximal amount of oxygen an individual can utilize to do work in a given period of time (usually a minute), we are trying to stress the body to utilize as much oxygen as possible, and induce an adaptation resulting in improved VO2max. So, if we want to utilize as much oxygen as possible, we should do long, slow rides that are totally aerobic, right? It's true that we do utilize a lot of oxygen over the

course of a long endurance ride, but the **rate** of oxygen utilization is too low. Therefore, we want the intervals to be aerobic in nature, but hard enough to elicit maximal rate of oxygen consumption. One of the basic misconceptions in cycling training is long slow rides are the best way improve VO2max. It's true that almost any type of training will improve VO2max to some extent in an untrained individual, but for trained cyclists, traditional "base" training will do little, if anything, to improve VO2max.

In general, there are a couple rules of thumb when performing VO2max specific intervals. The first rule is that you should perform these intervals at an effort between 90% and 105% of your VO2max power (pVO2max). The second rule is that the intervals should last between 3 minute and 10 minute in duration. Rule one and two are interrelated in that, if performing an interval at 105% of VO2max power, one will likely only be able to sustain the effort for approximately 3 minutes. Conversely, if performing the interval for 10 minutes, the intensity will necessarily be lower, in the vicinity of 90% of pVO2max. If we adhere to the training principle of specificity, the intervals should be performed at 100 % of pVO2max. In this case, the duration should be 3 to 5 minutes. Highly trained, or elite athletes have been shown to sustain intervals at the effort associated with VO2max for up to 7 or 8 minutes, but this is a gut busting effort, which likely isn't necessary to elicit the training effect. Further, in order to introduce the training principle of overload, one could perform multiple short intervals, and theoretically apply a greater overload than a single longer interval.

You might ask, "why not perform intervals harder than 105% pVO2max?" Again, because at intensities of 110% pVO2max the duration of the interval will necessarily be short; likely shorter than 3 minutes. One thing to take into consideration is that at the start of an interval, increased oxygen consumption takes anywhere from 60-180 seconds to reach the point of VO2max, therefore, a two minute interval at 120% pVO2max may not elicit VO2max, and certainly won't stimulate adaptations that would optimally improve VO2max (this lag in the response of VO2 is also why monitoring heart rate is of little value when attempting to gauge the intensity of these intervals). Performing an effort at a greater intensity than 100% of pVO2max, does not stimulate greater oxygen consumption; our VO2max is just that, the maximal rate of oxygen utilization, and any effort above that needs to be fueled by anaerobic metabolism. So, if one were to perform an interval for 4 minutes at pVO2max, they might achieve actual VO2max after 90 seconds and spend the remaining 2.5 minutes stressing that system. Figure 1 presents a conceptual representation of the relationship between the length of the interval, given the intensity, and the resulting time that one spends at VO2max. As can be seen from the diagram, intervals performed above 100% pVO2max result in little, if any, time actually at VO2max. Similarly, although intervals performed at 95% pVO2max, that last a total of 8 minutes, might result in 5 minutes of time spent actually at VO2max, if we decrease the intensity only a couple percent, and extend the duration past 10 minutes, the individual never actually attains VO2max, and hence spends no time at VO2max for a tough interval; high cost, little gain. This diagram is conceptual in nature, and individual differences will exist regarding time spent at VO2max given duration and intensity, but the premise generally holds true.

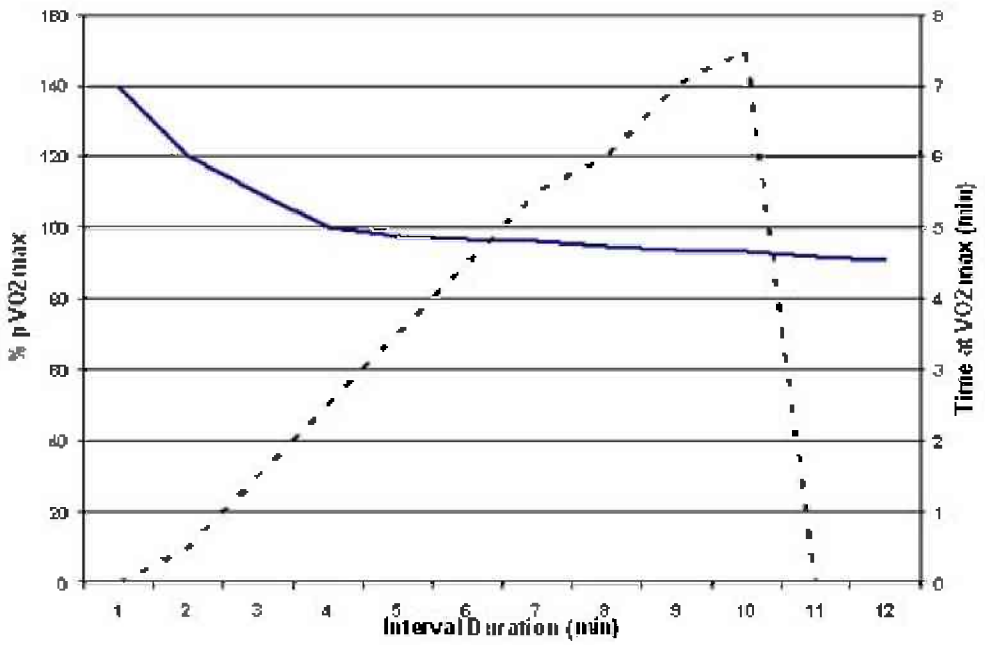

Figure 1. Intensity versus time spent at VO2max. -------- Intensity (% pVO2max) - - - - - Time spent at VO2max.

Other considerations when performing intervals are the number of repetitions to perform, and the rest period between intervals. With regard to number of repetitions, the accumulated interval time should be between 12 and 25 minute total, and the rest duration is typically equal to the work duration.

In short, what are the points to consider when attempting VO2max intervals?

1) Interval duration should be minimally 3 minutes and maximally 10 minutes in length.
2) Intensity of the interval should be minimally 90 % pVO2max and maximally 105% pVO2max.
3) Total interval work time should be minimally 12 minutes and maximally 25 minutes.
4) The rest between interval is generally equal to the work interval itself.

By using these guidelines, you should be able to devise an interval training approach that will target adaptations to VO2max, and that will result in improved overall performance in diverse cycling events.

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