



## TECHNIQUE TALK

# Reving the cardiovascular engine

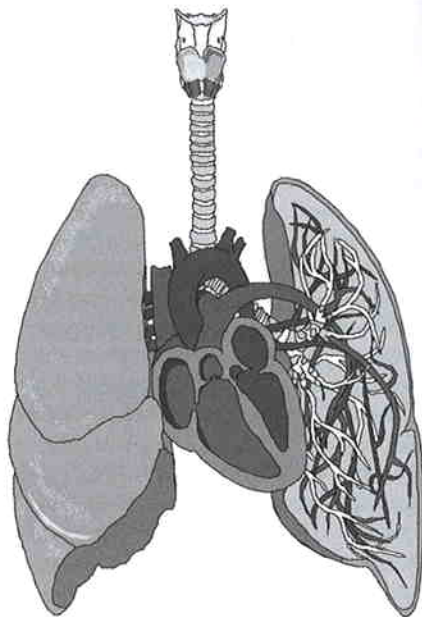
John Kellogg, leaving no stone unturned, describes precisely what's needed for long-term cardiovascular - and competitive - development

The late Kiyoshi Nakamura, coach of 2:08 marathoner and former Fukuoka and Boston champion Toshihiko Seko, was fond of comparing a distance runner's development to a steady fall of raindrops slowly forging a hole in a huge rock over a period of many years. On some days the rain falls hard, on other days it falls gently, and on some days it does not fall at all. But in the final analysis, the process cannot be rushed, and we must wait patiently for the natural order of events to run its course before we can admire the finished product.

Too many runners are in search of "magic" workouts, when in fact the real secret to ultimate success is the patient, prolonged cardiovascular development alluded to in the rain analogy. Other runners and coaches pay mere lip service to concepts such as *base training* and *long-term improvement* without realizing how much running is actually required to fulfill a runner's ultimate career potential. Of course, you must love running or know that you can come to love it to sustain the kind of dedication embodied in Nakamura's analogy. By taking a proper long-term approach, progress will often be slower, but it will be more complete.

When deciding on a long-term path for your running, it is important to consider *universal* principles (those that work for everyone) before examining experiment-of-one success stories or principles that might apply only to certain types of athletes. Several principles apply across the spectrum of body types. These include the following:

- Gradually work toward base mileage levels that are as high as can be safely tolerated (obviously, this figure



varies from athlete to athlete and depends on factors such as experience and age).

- Learn to stay comfortable on easy runs to ensure proper recovery.
- Spend an optimal amount of time at a high-end aerobic pace (at or near the lactate threshold).
- Include regular speed maintenance (in the form of short, alactic strides—that is, bursts of speed too brief to incur lactic acid buildup—drills, and hills).
- Build toward a seasonal peak with limited injections of oxygen-uptake training and harder, faster anaerobic-tolerance training.

This article focuses on how to implement all of these concepts into your training over not just a single season but over a period of years; I discuss how each relates to aerobic development, which for our purposes equates to cardiovascular strength.



## BUILD BASE MILES GRADUALLY

For any distance runner, there is a distinct correlation between acquired lifetime training mileage—particularly during base-training periods—and subsequent race performances. This raises a question: Is talent for fast performances in the distances also accompanied by the ability to handle high training mileage? Possibly, but *most* runners can safely increase their mileage over time by running more slowly for much of it and by applying other principles to their training to increase their speed. Some of these principles involve common sense. Getting adequate rest, nutrients, and fluids; wearing appropriate shoes; and varying the running terrain are obviously important. Also crucial is making smooth, safe, and gradual transitions when running on new terrain, when wearing new shoes, or when training at speeds you have not touched on for some time.

It is always best to establish the highest base mileage that continues to provide a favorable cost-to-benefit ratio—that is, figuring out the highest mileage you can

attain without injury or without detriment to your other training. You will find your own personal mileage sweet spot only by trial and error and by patiently building your fitness through the years. Then and only then will the training “secrets” widely sought by distance runners everywhere begin to reveal themselves to you.

In the 1970s, it was common for many American high school distance runners to average more than 100 miles per week during their preseason base-building period. This was not considered outrageous at all; it was merely the kind of thing serious runners did if they had big dreams. It was no coincidence that high school marks in the distance events were at an all-time high during this period, followed by a banner crop of American road runners and long track—event specialists in the ensuing years. This higher mileage fell out of favor among high schoolers in the 1980s and the first half of the 1990s, apparently as a result of media influences. Subsequently, both top-end performances and the depth of these performances seemed to



Recovery miles need to be done slowly



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significantly decline during this period. Since the late 1990s, there has been a return to higher mileage and more aerobically based training, and performances as of 2004 have returned to pre-1980 levels.

Upon closer inspection of the careers of the 1970s and 1980s elites, it becomes apparent that the runners who used high-mileage training, *year-round* in high school tended to outperform all others during their high school years, but were often surpassed later in life by athletes who had been somewhat slower in their youth. What is common among the elite adults of that era is the fact that most were exposed to high mileage in restricted amounts during their teenage years (which likely enabled them to safely make the jump to marathon-type training later in life), yet they saved their bodies for more year-round high mileage in adulthood. The implication here is that a gradual progression toward higher mileage, with brief forays into high-mileage territory during the teen years, sets a runner up for a long and maximally efficacious competitive career.

Regardless of training volume, frequent use of intense anaerobic interval training and racing in youth is a surefire way to thwart a runner's future development. So if you're a younger runner or a youth coach concerned about burnout, be far more wary of extravagant training intensity than extravagant training mileage.

The lesson here for younger runners is: Be patient! It takes years to create a sufficient mileage foundation for truly effective training and for reaching your ultimate potential. For example, Kyle Heffner had personal bests of 4:27 for the mile and 9:42 for the two-mile in high school—well above average performances, but nowhere near the national level. Kyle was only able to handle an average training load of 50 to 55 miles per week in high school and was not structurally comfortable running 100 miles in a single week until his senior year of college, when he was barely able to run six miles at 5:00 per mile. Yet he dedicated himself to full-time training after college and patiently continued to build his mileage until he could run up to 145 miles per week, much of it at 8,000 feet of elevation and on difficult terrain. The increased training load enabled him to make huge improvements in all his personal bests from 5,000 meters up to the marathon. He went on to earn a berth on the 1980 Olympic

marathon team with a 2:10:55 (4:59 per mile) and was ranked 17th in the world at the marathon distance. By gradually increasing his base mileage as he matured physically into his mid-20s, Heffner extracted the most out of himself as a distance runner.

During each new preseason, experiment with slightly higher mileage than you have previously run; for example, you may try an additional 50 miles or so spread out over a one-month period if you've got a few years of experience under your belt. Start by bumping up the volume for a few days at a time. This doesn't have to be done in seven-day blocks; two to four days at a time of higher mileage—say, 10 to 20 percent above your daily norm over the past several months—is sufficient at first. Recover from that injection of volume with a lower block of mileage for two to four days or as long as it takes to feel some "snap," then increase again for several days. An example for a runner accustomed to 40 to 45 miles a week might include a pattern of days with mileage like this: 6, 5, 6, 10, 7, 10, 8, 5, 6, 5.

Run extremely relaxed when you are increasing your mileage to previously unattained levels. Do not increase the mileage and the intensity (speed) of your base-building runs simultaneously until you have completed several seasons while incorporating each separately. You can and should run some short (15- to 30-second) buildups or strides every second or third day to provide variety, but avoid intense anaerobic work and races during these introductory high-mileage stages.

With each passing year, you should be able to increase the mileage itself and the length of the high-mileage blocks, so that you are eventually capable of several weeks in a row of very high volume without the need to reduce your mileage and without incurring stress-related problems because of the volume. With each season, your average pace may also become faster than it once was, but don't force this. Just allow the faster running to come to you over time as your body becomes ready for it. During base training, most of your effort should come from the mileage and the monotony of it all, not from a series of hard workouts. Through an increased number of muscle capillaries, a higher density of oxygen-processing muscle mitochondria, more red blood cells, and other changes directly and indirectly related to the cardiovascular



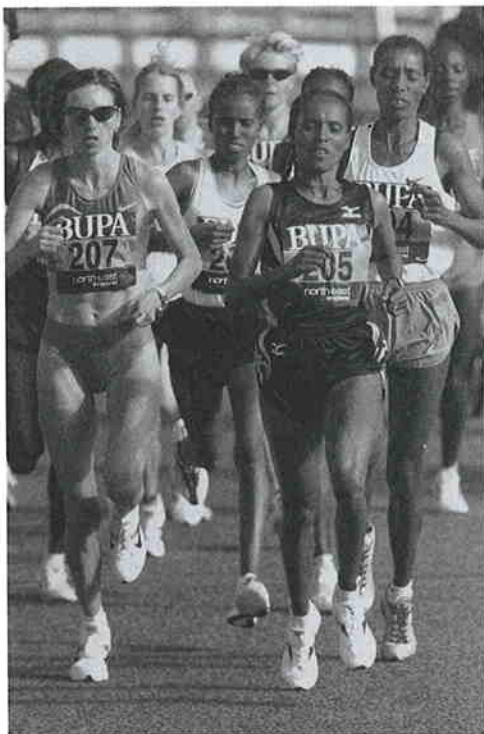
and circulatory systems, you will lay the groundwork for strength that will ultimately sustain you not for a season, but for the duration of your running career!

Begin introducing the higher mileage in short doses, particularly if you are still growing or in your first two or three years of running, allowing your body to absorb the training by dropping back in volume for a while between high-mileage segments. This plan follows the stress – recovery or stimulation – adaptation principle. Expand your boundaries with higher mileage and with longer installments of high mileage from year to year as you mature. In short, keep Kiyoshi Nakamura's raindrops analogy in mind and do not try to rush things too quickly. Start at the bottom rung of the fitness ladder and gradually work your way up.

Some sessions (and how they fit together to form an overall training program) actually facilitate future mileage increases by reducing injury risk and by enhancing the effectiveness of the high-mileage training itself. Particularly important are alactic strides and other speed maintenance workouts which provide variety in footstrike characteristics, rhythm, and muscle fiber recruitment. These sessions also help increase lower-leg integrity and allow you to segue seamlessly to faster-paced running as the competitive season approaches. Spending certain time periods at the high end of aerobic effort (near the lactate threshold) is also very cost-effective; I describe this in more detail later in this article.

### MAXIMIZE RECOVERY ON EASY DAYS

Runners often reach a point in their training when everything goes smoothly and a fairly quick pace seems surprisingly easy. During these times, improvements may be rapid; however inserting slower easy days can yield better results over a period of several years, although short-term gains may not come as quickly. In practical terms, if you are nearing your prime racing years—around 28 to 32 for men, perhaps a bit older for women—you may benefit from running a little quicker average pace on your daily runs. If you are in your teen years, however, you will likely be better served in the long term by incorporating more *slow* running, especially if you are in the process of increasing your mileage. In so doing, you may sacrifice a modicum



of high school glory, but will likely achieve more in adulthood; this holds true whether your event of primary focus is the mile or the marathon.

Much of your running during the preseason or base-building periods should not only be perceptually easy; it should actually be slower pacewise than you may think is beneficial. Running "slowly"—even two minutes a mile slower than marathon pace—confers cardiovascular benefits while still allowing recovery; blasting along at close to marathon pace will not introduce significant additional cardiovascular benefits but will almost certainly interfere with recovery if sustained over days or weeks. Of course, short strides (for speed maintenance) and some faster tempo runs during this base-building phase of training are necessary on occasion, but going too fast too often—even if it feels good at the time—can backfire by the time the peak of the competitive season arrives, as you likely won't be well-rested often enough to perform the quality sessions necessary for maximal competitive



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success. It is certainly possible to be fit enough from an aerobic standpoint to override your structural integrity and create overuse injuries without feeling as though the pace is fast. That is, a fairly quick pace on daily runs may seem easy to you if everything has been “clicking” on recent outings, but the impact stress, cellular overload, and muscle contractile force required usually cannot be sustained for months on end; staying close to 60 to 65 percent of max heart rate is more advisable.

Peaking for your most important competitions later in the season does not require you to be in better racing shape during a preseason than you were at the same point in previous preseasons. If you do things intelligently, you will often run better at the end of a competitive season after being slightly slower at the beginning of that season. Keeping the pace extremely relaxed and slow on many recovery days acts as a kind of insurance policy toward this goal. Most people run too fast on their easy days and never get adequate recovery; thus, they accumulate and experience chronic fatigue, often without realizing that they could be feeling much fresher. Most of your easy runs should give you the sensation of storing up energy for your next faster effort.



In 2003, Weldon Johnson ran 28:06 for 10,000 meters and placed fourth in the U.S. track championships in 2001 and 2003. He often does easy runs at 7:00 to 8:00 per mile, a pace that even many 35:00 10K runners might consider too slow to be of benefit. Yet this pace is functionally comfortable for him. Because of his overall high mileage (between 100 and 150 miles per week) and because of his accumulated lifetime volume (and buildup to this volume), even this slower pace is sufficient for maintaining capillarization of his muscles and some fitness as long as other crucial training bases are covered regularly. This last point is important. Weldon does not *always* run slowly; otherwise he would risk being a plodder and would never maximize his potential. He performs his share of challenging workouts leading up to competitions (even performing intense anaerobic ones during his base phase), but he always makes sure he is reinvigorated for his faster sessions when they are scheduled, even taking an extra (unplanned) easy day from time to time. Meanwhile, many midpack runners run at medium speeds on easy days and are rarely relaxed and rested when it is time to run hard. As the Japanese standouts of both sexes have long demonstrated, extremely slow miles—even if done at a pace most would consider jogging—really do have a beneficial effect as long as they're supported by the requisite sharpening work, particularly, but not only, for marathoners. It's all grist for your mill.

### SPEND TIME AT YOUR LACTATE THRESHOLD

To understand the cardiovascular benefits of training, you need to understand what occurs in your body—in particular your heart and bloodstream—when you run at specific intensities for specific periods of time. Properly allocating the amount of work you do among various well-defined intensity levels is vitally important in terms of your long-term development as a competitive athlete.

When examining specific training speeds, familiarity with a few terms promotes better understanding and facilitates discussion of the involved physiology; among these terms are lactic acid, blood lactate, and lactate threshold.



Lactic acid is the end product of anaerobic glucose metabolism (glycolysis). During intense efforts ranging from 200-meter track sprints to hour-long road races, glucose is converted to pyruvic acid, which is in turn reduced to lactic acid. Lactic acid dissociates quickly into lactate (its negative ion) and free protons, and it is usually referred to as lactate. It was long thought that the protons were responsible for interfering with muscular contractions, causing the "tying up" experienced during all-out efforts lasting longer than about 40 seconds (e.g., 400 meters and 800 meters or a long sprint at the end of a 5,000-meter race). More recent research (Robergs 2001) shows that this may not be the case. However, excessive lactic acid production during exercise goes hand in hand with the experience of tying up, and thus it is prudent to limit the amount of time at the effort level that results in this production; otherwise, chronic soreness, staleness, and possible injury may result.

Crucial to limiting the amount of time you spend with excessive lactic acid production is knowing your lactate threshold (LT). Your lactate threshold is the point during increasing exercise intensity at which a rapid accumulation of lactate entering the bloodstream (blood lactate) follows an "inflection point," or a change in the normal level of blood lactate. When lactate is produced faster than it can be cleared and begins to accumulate in the blood, a state of oxygen debt sets in and exercise intensity must drop; if it doesn't, biochemical obligation will cause activity to grind to a halt. Thus learning to stay just on the "safe side" of lactate production is absolutely invaluable (see the discussion of lactate threshold velocity).

Lactate threshold velocity (LT pace) is the speed (expressed in meters per second or kilometers per hour) or, more commonly, the pace (expressed in minutes and seconds per mile or kilometer) required to bring a runner to his or her LT or just below the point of rapid lactate accumulation. Most well-trained runners can maintain their LT pace (what could loosely be called high-end aerobic pace) for about 20 minutes before surpassing this point. A near-LT pace may be maintained for an hour or more, but once the threshold is reached, the accumulation of lactate is inevitable, so the effort will likely alternate between high levels of aerobic metabolism, and

anaerobic metabolism, and the pace will eventually have to slow. At such times, the runner will reach the respiratory compensation point, resulting in extreme hyperventilation. Experiencing this point in training may help the athlete learn to monitor the pace just below the LT in a tempo run during training. From the runner's point of view, the effort level just below the LT could accurately be called "maximum steady state," because all systems usually remain perceptually in equilibrium until the LT is reached. The ability to recognize the pace corresponding to LT—and by extension, the physical signs of reaching LT—is critical; the benefits of training as frequently as possible at this pace are substantial, while training at faster than LT pace can only be done in relatively short bursts because of lactate accumulation and its deleterious effects on working muscle.

So how can you determine your own lactate threshold? You can use data from a heart rate monitor to estimate where your LT occurs, but it is usually best to rely on sensory feedback (running by feel) to find that high end of aerobic effort. Many runners try to rush the process and begin doing hard tempo runs without first becoming attuned to the finer sensory signals that indicate that they are reaching their threshold. With enough background training at speeds somewhat slower than your maximum steady state (which you achieved with proper base building), you can turn your own *body* into an exquisitely tuned "lactate analyzer." This is something you must do to get the most out of your threshold workouts, especially when you begin to phase in sessions that might cause you to slightly *exceed* your threshold.

One of the first noticeable changes occurring at the lactate threshold is in the breathing pattern. Depending on the ability of the fibers of the working muscles to take in and use oxygen and to store fuel (also depending on the intensity of the work itself), you begin to breathe either harder or faster or both once you reach your LT. This is due to the fact that extra carbon dioxide is produced from the buffering of lactate by bicarbonates in your blood, from increased burning of carbohydrates to produce energy, and from lactate affecting chemoreceptors in the brain. Once you begin breathing harder and faster (hyperventilating), you've reached your respiratory compensation point



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and have *already surpassed* your LT. You also begin getting the first hint of tightness, perhaps in the legs, but possibly in the arms or abdomen, when you've operated above (faster than) your LT for several minutes.

At some point, you will want to find the fastest pace that keeps you feeling relaxed and in a good groove, the pace that trains you yet doesn't strain you. This strong, purposeful running is often referred to as a "high-end aerobic pace." This effort level is not a *hard* pace if sustained for only 20 minutes or so, but it certainly isn't *jogging*, either. The most effective training speed is at (or slightly slower than) that which you can maintain for about an hour in an all-out, evenly paced race. Beginners will not be able to run at a strong pace for a full hour or more, yet they have a high-end pace, too. They just cannot maintain it very long and may have to run in short *segments* with walking or jogging breaks when training at this effort level. Lengthening the amount of time you can maintain your high-end pace is part of what cardiovascular development is all about.

Some experienced runners can spend time training at their LT, or high-end, pace nearly every day, but most people are better served by including a greater number of very *easy* days in between their high-end outings, with perhaps one and one-half to two easy days for every high-end day. Again, cardiovascular development may take somewhat longer with these very easy days included, but it is usually more thorough after several years. Also the baseline fitness you establish with slower runs will contribute to a more ideal running weight; this will allow you the most productive high-end tempo runs.

A good high-end run should feel like one of those outings that begins as a planned easy day but then spontaneously progresses into a memorably awesome, fast run because you begin to get a floating, weightless feeling. As you become more fit, the pace should feel as though it is establishing itself, and you are just along for the ride. One of the keys to achieving this enjoyable and effective state is to start *extremely slowly* and to remain at this slow pace *longer* than you think is necessary. Your transition from slow shuffling to faster running should be so gradual that there is no definable point of effort increase. Conscious relaxation

assists in achieving a near-effortless maximum steady state. As you gain fitness, you may find that you can reach the high end of aerobic effort sooner during your runs without a conscious attempt to do so. You may also find that you can summon the magic at will and summon it more frequently.

On most high-end runs, you should have the discipline to pull the ripcord, i.e., bring the fast portion of the run to an end, *before* you experience undue struggling or tying up. The amount of time you accumulate *before* struggling actually contributes *more* to your aerobic development than does the time spent fighting on after beginning to suffer. You can *occasionally* go ahead and release the hounds with a very fast finish to a continuous tempo run if you really feel awesome and want to fly, but try to avoid doing this too often or the effect will be similar to overracing. Of course, if you are extremely tired and cannot find the groove you want, you should stay at an easy pace throughout the entire run.

You can and should perform lactate threshold training for different lengths of time and at various speeds. On continuous threshold efforts, you may skirt right on the brink of struggling and run for a moderately short time (20 minutes or so) or you might hold back slightly from that pace and stay even *more* controlled for up to an hour. Performing runs of various lengths in this fashion provides a slightly different stimulus for improvement from workout to workout and relieves the possible monotony of grinding out the same pace on every high-end run. Most coaches and physiologists agree that 20 minutes seems to be the "ideal" duration of a true lactate-threshold run, although marathoners often go twice this long. Track athletes typically de-emphasize threshold runs in favor of faster interval work during the competitive season, whereas road racers—especially marathoners—keep them as a staple throughout.

Do not hammer these sessions in an attempt to hit a predetermined pace; just allow perceived effort (sensory feedback) to dictate the speed. By all means, avoid racing your high-end runs, either against your training partners or against your times from previous outings. Your aim is to lock into the pace that will train you, yet force a slower runner to strain, i.e., relax a runner, kill a jogger. This pace may vary from day to day,



so focus instead on your effort level.

One final note, it is a good policy to wear *racing flats* for most high-end workouts. Doing so ensures a more natural footstrike and fosters better foot, ankle, and lower-leg strength and flexibility, which will ideally reduce injury risk. Wearing racing flats also affords you the opportunity to achieve the fastest pace for any given effort level. Finally, regardless of your distance of choice, include year-round, regular speed maintenance in the form of short alactic strides and drills.

## **BUILD TO A PEAK OF HIGHER-INTENSITY TRAINING**

When you first experience a nonlinear increase in lactate as a result of increased running intensity, bicarbonates in the blood buffer the lactate entering the bloodstream, which precipitates an increase in CO<sub>2</sub> production. This stage of exercise is known as the *isocapnic buffering period*. At some point, as the intensity increases (or as moderate intensity is prolonged), lactate production exceeds the buffering capacity of the system, resulting in an additional drive to breathe, which marks your respiratory compensation point. In practice, this means you begin hyperventilating and start to have a tight, straining feeling, a sign that you've crossed your lactate threshold.

### **Isocapnic Buffering Zone**

The isocapnic buffering zone is a highly effective training zone that is also fairly safe for many hard workouts at *slightly* faster than your maximum steady state (at or slightly above your threshold). This involves a very thin window of effort intensity, i.e., even the slightest misjudgment in pace or in duration of effort can send you sailing into distress. The state you want to achieve is a pleasantly challenging or barely uncomfortable feeling that is just short of the onset of hyperventilation. You should be pushing, but should not quite be in trouble. Particularly competitive runners tend to make these workouts harder than they need to be for maximum effectiveness. As with continuous high-end, or LT-pace, running, you might need to experiment to get the effort intensity just right. Consequently, you need to spend some months improving and learning to recognize your

maximum steady state before focusing on training in this nebulous area between comfortable and uncomfortable.

You can train most effectively in the isocapnic buffering region by using repeats that feature short rest periods relative to the run periods. An example of such a workout is 10 to 15 X 3 minutes at about 8 to 12 seconds faster than the pace you could run for one hour in an all-out, evenly paced race, with 30 to 60 seconds recovery between each 3-minute bout; less experienced runners should gravitate at first toward the longer recovery interval. Just take enough rest that you are ready to go again and achieve that same *nearly* uncomfortable feeling by the end of each bout, but pace yourself so that you need only 30 seconds or so between reps. If you feel you are going over the intensity after 8 reps, you can end the session when you finish the 10th rep. If you feel great through 10, you could do 12 or even 15 reps. Remember—do not be a slave to numbers written on a workout schedule. Other sample sessions that achieve this training include 5 X 7 minutes at slightly faster than one-hour race pace (LT pace) with about 2 minutes of walking or jogging recovery or 3 X 15 minutes with 3 minutes recovery of mostly jogging. Regardless of the parameters you choose, remember to monitor your physical signs to determine what “zone” you're in and whether you're pushing too hard for the workout.

Breaking up a workout into segments in this fashion allows you to spend more time in the isocapnic buffering zone than would be prudent in a continuous run (although continuous high-end runs are important in their own right and should never be neglected). For example, if you ran longer than, say, 25 minutes at your LT pace, you might drift from being under control to a state of hyperventilation and suffering. However, you could amass more than 30 minutes at a marginally *faster* pace with *less* distress (and with less continuous pounding) by running those medium-length segments with short rests as outlined previously. Trial and error shows that spending a total of 30 to 45 minutes at your LT pace or slightly faster with these short rests between the work bouts is most effective. Of course, you must first have enough background running to be *capable* of running at a fairly strong pace for about an hour!



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**VO<sub>2</sub>max Zone**

To produce energy aerobically, your working muscles must *consume* oxygen. Oxygen uptake (also known as VO<sub>2</sub>) is a measure of how much oxygen your body is consuming at any given time. It is usually expressed in milliliters (or sometimes in liters), of oxygen consumed per minute of exercise. The V in VO<sub>2</sub> stands for ventilation. The dot over the V represents "per minute" oxygen uptake.

There is an upper limit to how much oxygen your body can consume. This figure varies according to hereditary factors, with training (including childhood activity), and sometimes with living conditions such as high altitude. This maximal oxygen uptake is customarily referred to as VO<sub>2</sub>max and can be expressed in either absolute terms (usually milliliters of oxygen consumed per minute) or in relative terms (milliliters of oxygen consumed per minute per kilogram of body mass) to compare values between individuals. **Running performance at VO<sub>2</sub>max is strongly assisted by anaerobic energy production,** which means that lactate levels can be very high after several minutes of running at maximal oxygen uptake.

Exercise physiologists normally take measurements of an individual's VO<sub>2</sub>max using a maximum effort running test on a treadmill. When following most testing protocols, in which the subject begins at slow speeds and then increases the intensity at regular intervals, there is a *speed* associated with working at VO<sub>2</sub>max, that is commonly referred to as velocity at VO<sub>2</sub>max (or VO<sub>2</sub>max pace). Of course, this value varies from runner to runner, but it is normally the pace that a runner could sustain for roughly nine minutes in an all-out, evenly paced effort.

When training at your VO<sub>2</sub>max, you want to minimize the negative effects of lactic acid accumulation so that your movements remain efficient, muscle groups are recruited in harmonious concert, and aerobic energy production dominates your efforts as long as possible. Therefore, prudent use of training in this zone involves shorter repeats of 2 to 4 minutes each at this pace, with nearly equal rest-to-run ratios and with about 15 to 20 minutes **total time spent at the pace.** Examples of VO<sub>2</sub>max workouts would be 8 to 10 X 2 minutes on, 2 minutes off (jogging some or all of the rest period)

or 5 x 4 minutes on, 3:30 off. This format works the respiratory muscles, improves the ability of the left ventricle to deliver more blood per stroke, induces maximal oxygen uptake, and provides a small (but not excessive) degree of anaerobic tolerance training. As with easy runs and high-end continuous runs, you can perform these "VO<sub>2</sub>max repeats" on a cross country course or on a track. These workouts are quite challenging after accumulating 15 to 20 minutes at this pace, but with adequate recovery periods your lactic acid levels should stay somewhat under control, so that you will not tie up and resort to flailing, struggling movements, or even slow down while increasing your effort. For maximum effectiveness, you should pace yourself so that you can run the last few reps in a VO<sub>2</sub>max session *faster* than you ran the early reps.

It is normally best to keep the run distances or durations constant within the workout, i.e., use all 800s or use all four-minute runs rather than using ladder (also called pyramid) sets or step-down sets. This trains you to monitor effort better and to mount rising fatigue with additional effort in a more linear fashion. It is also desirable to vary the distances from session to session. This provides variety in duration of effort and prevents you from obsessively comparing times from previous workouts, which leads to forcing too fast a pace too early in the session.

If you are feeling pleasantly "itchy" and want to run a little faster than your usual VO<sub>2</sub>max pace, an effective session consists of running repeats of 30 to 60 seconds each at the speed you could maintain for about six minutes in a race, with equal rest periods in which you jog exactly *twice* as slow as the speed you are using on the work bouts. For example, a high school runner with recent bests of 4:35 for 1,600 meters and 10:00 for 3,200 meters might choose to run repeats of 200 meters in 36 seconds each (about midway between 1,600 race pace and 3,200 race pace), with a jog of 100 meters in 36 seconds between each 200. He continues until it becomes difficult to maintain the pace of the faster segments without tying up. High schoolers are invited to do such workouts; they just shouldn't form the cornerstone of a younger runner's training program, as too often happens.



As with most timed sessions, oxygen uptake workouts should be those in which you let a strong, challenging rhythm come to you, not sessions in which you write down times and hit them at all costs. Most people make enormous improvements in their race times or places once they add a few weeks of these (and faster) workouts, then they incorrectly conclude that hard interval running is the most important type of training. Do not adopt the attitude that killer workouts automatically create fast races; this is not entirely correct. Superior aerobic fitness plus a few judiciously spaced fast workouts (including a killer one here and there) create fast races. Once you have built an adequate base, you can do fast workouts as often as once per week, and "killer" ones perhaps once every three weeks.

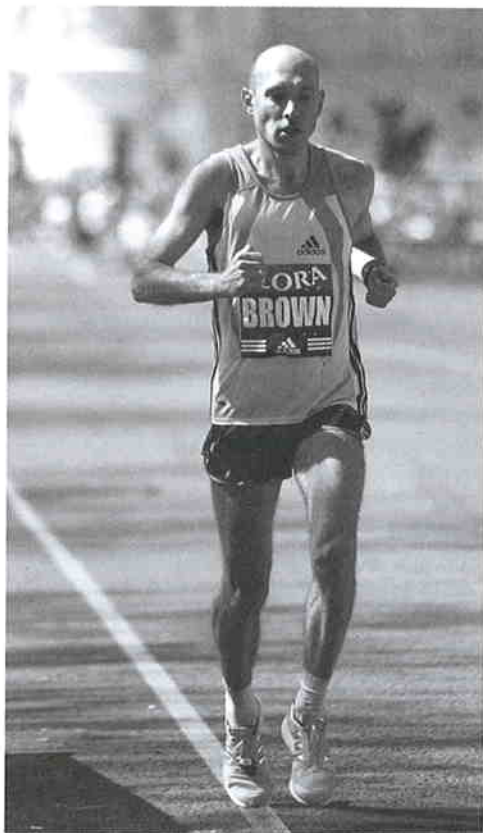
### OPTIMIZE YOUR RUNNING TIME

The reason you should work at certain percentages of parameters such as LT pace and  $\text{VO}_2\text{max}$  pace is to optimize your time spent running. Over a few months, the person who spends a fair amount of time training within the most favorable guidelines—at speeds that are proven to provide the best return for the investment—gains an advantage over an equally talented fellow runner who strays outside of these boundaries and trains haphazardly too often. This advantage may be minimal during the course of one or two seasons, but if you follow the correct guidelines, the differences become more pronounced after several years of persistent and methodical training.

Having offered that advice, it is crucial that perceived effort almost always trump rigid numbers. Your LT pace and your  $\text{VO}_2\text{max}$  pace will not be exactly the same every time you attempt to run at some percentage of either of those parameters. Weather conditions, recent diet and hydration, recently run sessions, and so forth all add up to produce workout-to-workout fluctuations in your rate of lactate production or rate of oxygen consumption. It is also all too common for runners to use all-time personal bests or atypical performances when determining their training paces from charts, rather than relying on recent races or on performances they normally produce.

When given the option, runners with big goals are usually headstrong about hitting specific times rather than applying principles to their workouts, but it is more important to get the desired effect than it is to satisfy the stopwatch. Times should be guidelines only. Making a daily practice of hitting fixed times at all costs is often a prescription for reckless overtraining and subsequent burnout.

In the same vein, regimented, canned "systems" that lay out, months in advance, an unmodifiable list of specific daily workouts are about as effective in running as a similarly inflexible scheme is in monetary investment. You may profit a few times by visiting a casino and applying an algorithmic system, but the odds are not in your favor over a longer time frame. You are much better served by diversifying your portfolio while following proven long-term





## TECHNIQUE TALK

investment principles. Using this approach, you may have seasonal ups and downs, but you will come out ahead in the long haul if you keep your cool. Once you have enough in the bank, you can then use some of your resources to take those really big risks on occasion.

With that in mind, be wary of strictly paced cookie-cutter training systems offered in books or magazines. Instead, be somewhat flexible and think of critical training speeds (and percentages of them) as a kind of road map, a way of pointing you to the neighborhood the pace should be in on certain workouts. The more often you can hit the exact level of effort that yields the desired result for each session, as opposed to merely adhering to precise pace-per-mile constraints, the more cumulative benefits you will reap over the course of several seasons.

No aspect of fitness stands alone. All physiological systems must be optimized. This is where rigorous, controlled laboratory studies often muddle the training picture by examining only a few factors at once, therefore being of limited scope, particularly if the test subjects are rats, whose "running careers" last only a few months. What is best is to experiment with these restricted findings to see if they blend in favorably with the greater context of long-term training. It is myopic, for example, to believe that raising maximal oxygen uptake is the Holy Grail of training and that 40 miles per week is sufficient total mileage for a serious distance runner. Drawing that conclusion is analogous to quaffing a soft drink, getting a quick energy burst, and reasoning that simple sugars and caffeine are the nutrients that matter most in meeting day-to-day energy requirements. Yes, this will provide a quick fix, but it is not optimal over an extended period. In order for you to reach fruition as a runner, you must incorporate the full spectrum of training, with each energy system worked at its proper time and in satisfactory balance with the training of other systems. To quote Kiyoshi Nakamura, "When you break down a car, it is nothing more than pieces of iron, rubber, plastic, and glass. But when they are all put together in a correct way, it becomes a car. What would happen if even one of many screws is deformed?"

Each workout should have a purpose. A well-placed easy, shake-out run is just as important a training tool as a seven-mile run at a strong pace, and (depending on the time of year) it's likely more important than 10 stomach-knotting 400s as far as long-term development is concerned. Do not merely train harder than your competitors; train smarter! Follow the proven principles that have elevated great runners to the pinnacle of the sport. Above all, you must be a runner, not just a person who runs, to achieve your full potential. That is, if you love training and racing enough to persevere through the difficult times, you will likewise relish those magic moments of effortless soaring.

● *John Kellogg is a full-time professional running coach based in the USA.*

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## Seminar Announcement

**Title:** "The New Horizon of Youth Conditioning"

**Speaker:** Brian Grasso, Athletic Development Specialist.

**Venue:** Dublin City University, Dublin, Ireland.

**Date:** Saturday May 27th 2006

**Time:** 10am - 6pm

**Cost:** €97.00 (Lunch Provided)

### Topics to be discussed:

- (1) Acceleration and Deceleration Techniques
- (2) Strength Training Skill Sets
- (3) Coordination and Movement Aptitude
- (4) Program Design and Considerations

For more information or to register:  
[www.AthleticBodyConditioning.com](http://www.AthleticBodyConditioning.com) or contact:  
Ian Graham on (M) +353- (0)860652387