

The Art Of Speed Training

Applications for Aerobic Events with a focus on Cross-Country Skiing

By Steven Gaskill, Ph.D., University of Montana, Human Performance Laboratory

Editor's note: In addition to his current academic status, the author is also a well-recognized former U.S. National Team Coach, Coaches Education Director, and former club coach. AXCS greatly appreciates Steve taking the time to contribute this article to the AXCS News.

The purpose of this article is to convince you that learning to go faster takes patience, long-slow-distance training and about 10-20% of your training time doing intervals that are just a tiny bit faster than you can currently race (vs. as hard as you can go). If you want to get right to the meat of the information and skip the introduction jump right down to the section titled "practical interval training".

Introduction

The information provided below is from anecdotal evidence, some published research and lots of coaching years of accumulating data. The practical applications have come through trial and error during coaching at all levels from youth, young juniors, high school elite, U.S. Team and master skiers.

Much of the experimentation into training methods was inspired by Brian Sharkey and other scientists who formed a sports medicine advisory group to help me to understand that there might be a better way to coach than to duplicate how I had trained.

There are some major principles of training that always need to be met when discussing a training plan. These principles, when viewed together, will dictate whether potential plans make sense and will help an athlete move forward with their development. The six basic principles include:

- **Health** – The number one focus of all athletes is to maintain their health. Athletes who become sick or injured are not able to train.
- **Overload** – You have to do more than you are currently doing in order to stress your physiological systems to improve. Generally overload is adjusted by changing the intensity, the duration or the frequency of training. This

article will focus mainly on the intensity of training. "If you always do what you always did, you will always get what you always got."

- **Recovery** – There must be adequate recovery between overload periods for the athlete to recover and for the physiological changes to take place. Without adequate recovery improvements slows, may stop entirely and the athlete may begin to exhibit signs of over-training.
- **Specificity** – "What you do is what you get." Specificity refers to the idea that your training needs to mimic what it is you are trying to accomplish. I believe that specificity refers to mode (what you are doing), the intensity of the training, the speed of the training and the exact movements (technique) that you use during training. The idea that practice makes perfect is incorrect. "Practice makes permanent and only perfect (specific) practice makes perfect permanently".
- **Reversibility** – When you stop training your physiology will respond to the lack of stimuli and you will detrain or get out of shape. We seem to lose aerobic capacity, speed and power more quickly than strength.
- **Maintenance** – It takes less to maintain fitness than to become fit. However, the higher the level of fitness that one wishes to maintain, the more time one must spend to maintain that level.

continued on page 14

Stretching Is Still Beneficial (So Don't Stop!)

Even though a 2002 British Medical Journal review cast doubt on how much stretching helps in injury prevention and decreasing soreness, Dr. David Nieman (FACSM, RCEP) offers these reasons to keep stretching.

- * More graceful body movements.
- * Enhanced performance of sport skills.
- * Relaxation of mental stress and tension.
- * Muscular relaxation.
- * Better body fitness, posture, symmetry, and self-image.
- * Reduced risk of low-back pain & other spinal aches.
- * Rehabilitation/treatment of pain and injury.

ACSM Health & Fitness Journal, Mar/Apr 2003

Speed Training continued from page 13.

In the proceedings of the 1984 International Coaches Symposium, a paper was presented that supported the theories of Arthur Ledyard in suggesting that elite endurance athletes need to spend most of their time either training very slow (80-90% of the time) or training at or above their current race pace (10%). The data that were presented showed three large groups of 18-24 year old athlete's development over a period of 3 years using one of three training methods. One group focused on high intensity interval training and race simulation training 60-70% of time and moderate intensity work the remainder of the time. A second group focused on training near the lactate threshold for the balance of their training (50-60%), some high intensity intervals (20-25%) and easy training (20-25%). The third group spent about 80-90% of their time doing long slow distance at very easy intensity and about 10-20% of their time doing race simulations, racing or interval training.

If you look at the data you will notice that within the first 6-10 months the higher intensity groups were most successful at raising their VO₂max (Figure 1) and their Lactate threshold VO₂ (VO₂lt, Figure 2). When the data were evaluated over two and three years, the low intensity group were most improved in both VO₂max and VO₂lt as well as obtaining the best race result. At about this time

the famous swimming coach, Dr. Councilman, was also promoting the concept of high volumes and specific intervals.

Training requires maintaining health. At the same time we are expected to stress our bodies to stimulate the overload

Figure 3 - Stress and Overtraining

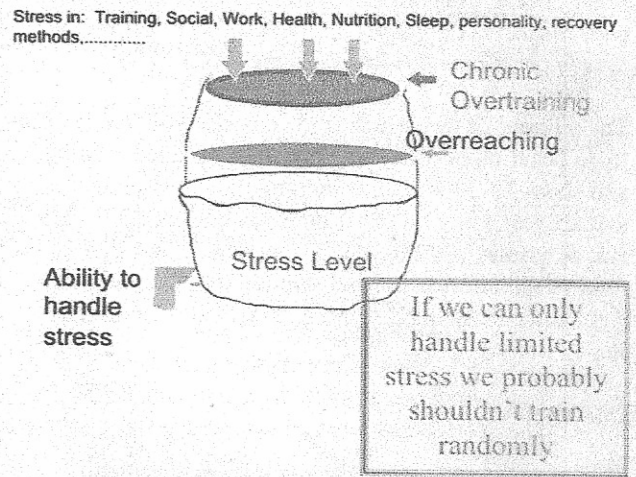


Figure 1 - Changes in VO₂max

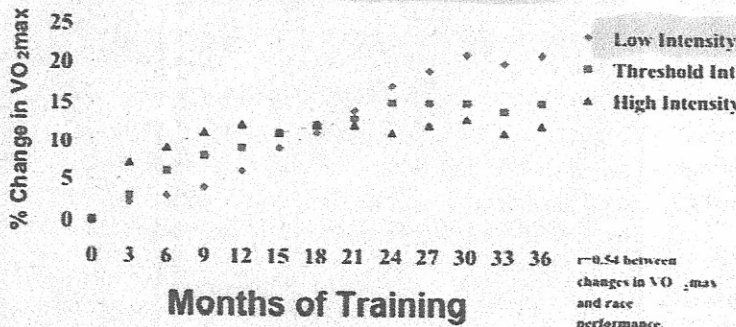
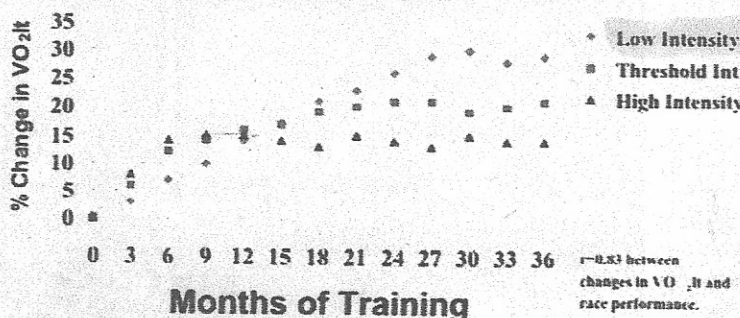


Figure 2 - Changes in VO₂lactate threshold



principle with the resultant improvements in physiology. Thus, we need to increase stress but avoid illness, injury or over-training. There has been good research to suggest that athletes need to over-reach (i.e. become tired and even have periods of declining performance, but not so tired that they don't rebound with a day or two of rest). Figure 3 conceptually shows that each person can handle stress. Some individuals have very large barrels and some have a lower ability to handle stress. The stress may be in many forms: physical, mental, social, work, school, nutritional, sleep deprivation...etc..

Good athletes learn to reduce unnecessary stress in their lives (and coaches learn that one of their main tasks is to help athletes reduce non-training stress). Additionally, good athletes learn how to manage their stress and reduce or eliminate the effects of stress (faucet on the barrel). Each individual can obviously handle different levels of physical stress added to the rest of their life. Thus monitoring is important (beyond the scope of this article). Important to the point of this article however is the concept that since we can

continued on the next page

handle only a limited amount of training stress, the stress that we do add must be beneficial, positive and fit within the principles of training outlined above.

Specificity of training is one of the 6 big principles. Specificity suggests that a portion of the stress that we add, especially during periods of hard training and race preparation, needs to very specifically overload the systems that we need to train. The overload also needs to be specific to technique, intensity, speed of motion, muscle recruitment patterns and resistance (and the list could go on). When you combine the ideas of stress and specificity one has to understand that training needs to be well planned (not random) and that there has to be a purpose to each stressful workout.

In watching athletes and coaches I came to believe that we do not really practice specificity. When I say this I am referring to my belief that we need to practice what we realistically believe we can sustain during competition (plus a slight overload). This lack of specificity is often true in terms of racing speed, neuromuscular specificity of timing and movement, physiological intensity (VO2, HR), psychological, emotional and technical intensity and speed of interval training. Though we don't always have to train in the same mode as we compete, I believe that when we are doing race preparation and speed training it should be done as specific as possible and in the same mode (i.e. XC skiing or roller skiing for cross country skiers).

Early on in my coaching I wanted to know what skiers were actually doing. Based on training logs US Nordic Combined Skiers in 1979 reported 15% of their summer training as intervals with 2% skiing, 18% roller skiing and 80% running. Within two years we had changed that to 90% roller skiing or skiing. When I was asked to be the head cross-country ski coach in the late 1980's I again collected past training data and expected that skiers would be more specific in their interval training. They were doing more intervals (7% of their training time) and they were a little more specific with 36% either on snow or roller skis. However, 64% of their intervals were still being done as running intervals.

I was further interested in the intensity of the intervals that the skiers were doing. In 1982 the average racing HR for the Nordic Combined National Team skiers was 164.5 beats/min. Their average interval HR's were 186.3 beats/min. Over the next year we worked to decrease the interval intensity (based on speed) and the resultant interval HR's decreased to 166.2 beats/min with a dramatic increase in racing velocity. In 1988 the national XC skiers, averaged intervals at 192.7 beats/min while that winter the

average HR during a few monitored races was only 166.5 beats/min showing that they were also doing intervals much harder (non-specific) to the intensity that they could maintain during racing.

In another study that I did with runners and skiers I evaluated high school runners and skiers and master skiers who did marathon skiing comparing their interval speeds to their actual race performance. Table 1 shows the results of that study. Note that the longer the event, the greater the disparity between race speed and interval speeds. Skiers, both high school and masters tended to do their intervals at 130 to 140% of race speed (vs. the 102-104% I would suggest). Additionally, athletes were typically only able to complete 4-8 intervals which is probably not enough to change their efficiency at the higher speed. These athletes were generally practicing speeds that had little or no relationship to what they could maintain for a race. The intervals were not specific to what they were trying to accomplish even though they came at a very high physiological cost.

Table 1: Is Speed of Interval Training Specific?

Distance	Race- sec/dist	Int. Length	Average Intervals	% race
400 Meter	56.2	100 M	53.6	104.9%
800 Meter	63.7	200 M	55.4	115.0%
1000 Meter	74.9	400 M	63.4	118.1%
2 Mile	197.4	0.5 mile	149.1	132.4%
3 Mile	209.3	0.5 mile	153.2	136.6%
Marathon	493.7	1 mile	349.8	141.1%
5km Ski	179.5	1 km	138.8	129.3%
15km Ski	187.6	1 km	142.1	132.0%
50 km Ski	203.2	1km	146.8	138.4%

Practical Interval Training

During the 1979-81 season the U.S. Team was well behind the international elite (9-12 minutes in most races), but by January of 1981 the U.S. Nordic Combined Team was winning most races. This improvement happened due to many factors, but the central controlling principle was specificity and learning to do interval training at speeds just slightly faster (overload) than they could currently race (specificity). When athletes struggled to improve their time trial or racing times, even with interval training we turned to technique, strength and power training along with equipment and waxing. By monitoring improvements in racing or time trials the athletes were well motivated to risk changes in technique, mental strategies, equipment, etc. when improvements in performance slowed down.

continued on the next page

Speed Training continued from page 15.

What you need to know and decide

In order to improve athletes need to have goals. The goals that I suggest starting with for this program are goals that you truly believe you have a change of achieving within one to two seasons. You need to take into account your available time, your motivation, equipment, and access to training possibilities.

For the purpose of this program it is important to quantify your goal in terms of speed. I use the speed units of seconds / kilometer as it is reasonably easy to calculate and easy to apply to intervals. In order to quantify your goals I suggest taking all of your race results for each technique (classic and skating) and determining your average race speed (your time in seconds / race distance in km). Now do the same thing for the winners or the group that you would like to be competitive with. I know that snow speeds change, courses are different, we ski faster on short courses than long coursed and many courses are not accurately measured. None-the-less, the averages will be close enough to get you moving forward.

Once you have these two speeds (your current or last-year's average) and where you would like to get to evaluate if it is reasonable to improve as much as you would like. Most master skiers, high school skiers and juniors can reasonably improve about 1 second per kilometer per week with some individuals improving faster

They Said It

A lot of people have the talent, but don't make it because of their work ethic. I try to work hard every day. Each practice has a different goal.

-- Shelly Ripple

Contrary to what many people believe, achievement does not result from wishing it to happen or by good luck, but from the daily application of industry, will and toil.

-- Byron Davis, world-record holder, 50 meter butterfly

My grandfather once told me that there were two kinds of people: those who do the work and those who take the credit. He told me to try to be in the first group; there was much less competition.

-- Indira Gandhi

You're stronger than you think, you're braver than you believe, and you're smarter than you think.

-- Winnie the Pooh

and others slower. Elite skiers should not plan on improving more than a second per kilometer per week. If your goal time requires that you improve more than that suggested above, possibly reevaluate or give yourself an extra season.

Using Race Velocity To Set Intensity

When I worked with the Nordic Combined Team the interval speeds that the Nordic Team did were always just a little faster than their current race speed. When planning the intervals I used that about a 3-4% increase in speed was specific enough to race speed that there was a hope of learning the new speed with enough practice and that it was a small enough increase to be sustainable during racing once enough intervals were completed to improve the neuromuscular coordination and technique at the new speed. Thus, to determine your current interval times you periodically need to do a time trial either on roller skis (summer) or snow (winter). If you know the exact length of the course then find your average speed. If you don't know the length of the course time yourself during the time trial over a couple of 3-6 minute sections with recognizable start and end locations. The net result is that you need to be able to quantify your speed during a race or time trial (or a portion of the race or time trial).

During the winter I measured nearly every course with a measuring wheel to establish race speeds. However, such effort is impractical for most skiers so I suggest timing yourself between km markers or just assuming that the race distance is reasonable accurate and calculating your race speed. When not racing I encourage skiers and endurance athletes to do a time-trial over a full length race course about once a month to reset your race speed. Time trials should be done as close to race conditions as possible.

Doing The Intervals

* *Length:* For most cross country skiers who are doing races from 5-50 km I recommend intervals that will last from 3 to 6 minutes. You can go slightly shorter or longer, but this length seems to work well.

* *Speed:* Once you know your race speed (or time for a section) you can set your intervals speeds.

-- If you timed yourself through a section convert the time to seconds and divide the seconds by 1.03 which will give you a time that is 3% faster than your current race velocity.

continued on the next page

This is your target time for that specific trail section.

-- If you are using the time from an entire time trial you will need to calculate your seconds / kilometer. Now you will have to measure a section of course to ski or roller ski. For skiing see if your local club has a measuring wheel. An alternative is to use a calibrated bike computer on a mountain bike and walk (or ride if allowed) the bike around the edge of the trail section you want to use. I suggest a section that has the same elevation start and end points. During roller skiing you can often use the mile markers on a road (1 mile = 1.62 km). In any event, you may have to be creative, but it really does not take a lot of effort to set up a couple of interval sections and determine your target velocity by calculating your expected race time over the distance (distance (km) X current race speed (seconds/km)). To calculate your interval speed, divide your race time for the section by 1.03. This is your target interval time in seconds.

* **Rest Period:** The idea behind these intervals is to practice a slightly faster race speed than you currently can maintain without undue stress. Thus it is very important that you rest adequately between intervals. Adequate rest (in a practical sense) means enough rest so that you can maintain your speed on the next interval. There is no magic HR or time. Generally, as you do more intervals you may find that you need more rest time (2-5 minutes) between the later intervals. As you get closer to the race season start taking shorter rests (1-3 minutes). Don't skimp on the rest!

* **How Many Intervals Do You Do:** This depends on the time and energy that you have. A basic training paradigm that I believe in goes as follows: "The athlete who practices a race speed more than another athlete will be most likely to maintain that race speed during competition as long as they remain healthy and get adequate rest". That said I think that you try to do as many intervals as many as possible with full rest. Remember, you are not doing these at a high intensity, but rather just as 1-2 km sections of a "race" with rest between each section. With the Nordic Combined Team we tried to do 15-25 intervals. Time becomes an issue if each interval is 3-6 minutes and you rest 2-5 minutes. These can become long workouts! Try them and you are the judge of how many. When you cannot maintain the speed it is time to quit.

* **How Often:** I believe that speed must be maintained all summer and so intervals at least once a week during the summer are appropriate increasing to twice a week during the early fall and 2-3 times a week during the pre-competi-

tion season. Of course your motivation, time constraints, goals and current skill levels will dictate what you do.

* **Mental Attitude:** Racing needs to be done at an intensity that you can maintain. The best athletes learn that you have to be relaxed to perform well. Thus I always view these intervals as technique workouts. Focus on how to go faster with less effort. The intensity is not critical, the speed is. Speed, not heart rate, wins races. Use the intervals to see how efficient and relaxed you can become. Experiment on getting up and over hills faster, but with less effort. As your target times increase, the effort will also go up a notch, but if you are patient and don't greatly exceed your current race speeds, you should find that these intervals are great workouts mentally, physically, tactically and for technique.

A hard part of training is how to put your entire program together. As I have said earlier we have a limited ability to handle stress so plan your training so that the stresses will be beneficial. Here are some summary points to consider.

1.) **Alternate Easy Days and Stressful Days:** Stress can come from either intensity or duration, thus pay attention to how tired you feel each morning. When tired do days with lower stress or even take a day off. It is often possible to 2-3 stressful days back-to-back but then be sure you take enough easier days to fully recover.

2.) **70-90% Easy:** I suggest that for most athletes 70-90% of training is very easy intensity such that you can talk in full sentences when training. If you have limited time you can increase the percentage of intervals and race-pace training but you will sacrifice your potential somewhat. (Life isn't all skiing to everyone).

3.) **Easy/Hard:** Alternate higher intensity days with lower intensity workouts.

4.) **Faster Than Race:** For intervals use a velocity about 2-4% faster than your current race pace for the race distance that you normally race.

5.) **All Year:** Intervals are done 1-3 times a week, year-round. Continue until you can no longer maintain pace.

6.) **Other Factors:** When improvements in speed become difficult try to determine what your limiting factors (technique, strength, endurance, arm power etc.) and work on those training areas during both intervals, easy training and other training such as strength, plyos or hill bounding that you are doing or might add to your program.

-- END --