CrossFit Journal Article Reprint. First Published in CrossFit Journal Issue 53 - January 2007

the CrossFit® JOURNAL ARTICLES

Removing Interference

Lon Kilgore

CrossFit makes my brain hurt. Coach Glassman has established a training model for developing fitness that works, and works well. However, the program and its results cannot be easily analyzed with a superficial examination. The system of training is innovative. Conventional exercise science thinking cannot explain why it works as it does. We have to dig deeper to solve this puzzle of human adaptation. The first piece of the CrossFit science puzzle for me was figuring out how VO_2 max gains were being driven by the interval-type training that is inherent in the system, since the conventionally wise could not fathom how these unconventional methods were developing exemplary endurance. But as in all good scientific inquiry, answering one question spawns new questions. So a second piece of the CrossFit puzzle, a real poser, emerged, and it concerns the coexistence of strength and endurance training in a single workout.

One of the observed benefits of CrossFit training is a simultaneous improvement in strength, endurance, and mobility. While improving these three components of fitness is achievable with other models of training, I have found it to be curious that strength and endurance are improving so effectively, and doing so in apparent tandem, with CrossFit. Conventional strength-training thought holds that training intended to improve aerobic fitness (endurance) must be separated from training intended to improve strength lest there be interference in achieving optimal fitness gains. The thought is that typical endurance training will reduce the amount of strength gain achieved if the two types of training are included in the same workout or are done sequentially. So why can CrossFit-trained people get strong and aerobically fit when they regularly do strength-enhancing and VO_2-max-enhancing work in the same workout? (Dramatic pause while I take a couple of naproxen.)

Conventional thought holds that training intended to improve aerobic fitness must be separated from training intended to improve strength lest there be interference in achieving optimal fitness gains.

The research on aerobic/strength interference is fairly well represented in a search of the National Library of Medicine and it is frequently discussed in exercise science textbooks. One of the most reliable and productive exercise scientists in the world, Keijo Hakkinen, has demonstrated that the inclusion of aerobic training with strength training does, in fact, reduce the amount of strength gain compared to that produced by strength training alone (*European Journal of Applied Physiology* 89[1]: 42-52, 2003). The mechanism of interference is not understood. In a pretty strong review of the relevant scientific literature, a well-respected group of exercise scientists from New Zealand noted that much of the research did demonstrate varying degrees of interference. However, there was a strong lack of continuity among the studies reviewed with respect to subjects used, training methods, volumes, intensities, and duration, making mechanistic conclusions impossible (Sports Medicine 28[6]: 413-27, 1999). Again, as I noted in my article in last month's *CrossFit Journal*, the lack of research funding support for performance research from any substantial source has produced a low-budget ragtag mishmash of experiments that produce occasionally interesting but frequently irrelevant data (and yes, I am indicting myself here as well; experience oft teaches hard lessons).

Two hypotheses regarding interference are currently suggested within the exercise science community. The first of the two, the "acute hypothesis," holds that fatigue produced from the endurance training segment reduces the ability to produce force during an ensuing strength training segment. Such a reduction in force production would tend to diminish the quality of the strength training segment and thus reduce potential strength gain. This hypothesis seems reasonable, but it does not explain the interference that occurs when strength training precedes endurance training and therefore cannot be accepted as a useful hypothesis for the practitioner.

The second hypothesis, the "chronic hypothesis," proposes that the working muscle cannot adapt simultaneously to the two competing training stresses. There are numerous experiments demonstrating that strength training and endurance training induce widely divergent adaptations. This should be readily evident and intuitive to all exercise scientists and practitioners. This theory holds more water than the "acute" one, as it does appear to address all possible temporal arrangements of endurance and strength exercise. So, in the absence of any real substantive data, let's take some time to consider this theory, frame it in what we do know, and see if it squares with what we observe in practice.The human body is amazing in its innate ability to respond to immediate physical demands and to adapt to long-term stresses according to a prioritized survival scheme developed over the eons of human existence. It is well known and fairly intuitive that during exercise the working muscle receives biological priority over other tissues. An example of this can be seen in the shunting of blood away from the gastrointestinal system in order to increase blood flow and metabolic traffic at the working muscle. Since exercise is mimicking a survival circumstance, the body "perceives" that supporting the demands of exercise is more immediately important for survival than digesting food. If we extend this concept of priority to metabolic and structural elements of the exercising human, we might arrive at the idea that when presented with two diverse challenges to our survival—represented, respectively, by long slow distance running and weight training—in the same period of time, the least permanent of the two will receive more physiologic attention. Hans Selye's general adaptation theory (which is essentially a scientific argument that "what doesn't kill you makes you stronger"— that events which stress but don't destroy the body cause adaptations that make it stronger) is relevant here. If aerobic training's depletion of metabolic substrates (carbohydrate and fat), which can occur in minutes to hours, is more of a threat to survival than the results of a lifting overload, the body may bias its adaptation to the simultaneous stress of the two toward the aerobic end. Further, we ought to consider the temporal nature of fitness loss. Aerobic fitness is very transient and can diminish within a week of becoming inactive. Strength, on the other hand, is much more stable, as the architecture of muscle will change very little over several weeks of inactivity. In our recent book on programming for weight training, Mark Rippetoe and I proposed an adaptation-persistence continuum of the stability of various fitness components over time (fig. 1). What I propose here is that the most

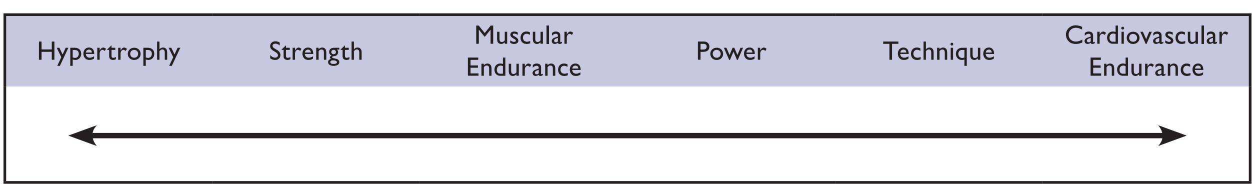

Figure 1. The continuum of adaptation persistence. Cardiovascular endurance is the least persistent; hypertrophy the most persistent. Significant loss of VO_2 max (cardiovascular endurance) can occur in a number of days whereas the significant decay of added muscle mass (hypertrophy) may take many weeks or months upon cessation of training (from Practical Programming for Strength Training).

labile of fitness components, aerobic endurance, will occupy a higher position on the biological priority ladder than a very persistent component, strength, and will therefore receive the most adaptive support following simultaneous stress of the two components.

Now with that out of the way we can specifically consider CrossFit and interference. CrossFit does not use carbohydrate- and fat-depleting long slow distance methods of training, so the vast majority of research into aerobic interference with strength gains does not apply. What CrossFit does use is short-duration glycolytic exercise (i.e., exercise that is fueled from glycogen and glucose stored in the body) to drive changes in endurance—which begs a new definition of "cardio" exercise—and short-duration phosphagenic exercise to drive changes in strength and power. These two types of metabolic support for exercise are next to each other on the metabolic continuum, do not significantly deplete nutritional stores of any energy substrate (carbohydrate, fat, or protein), and therefore are "perceived" by the body as more nearly equivalent stressors compared to aerobic vs. anaerobic exercise. Glycolytic adaptations will benefit and improve at a faster pace than strength, but strength will improve at a much faster pace than if it were coupled with aerobic exercise.

There will never be truly maximal gains when multiple external stressors are applied to the body in a single training session. If this were possible, we could have 2:08 marathoners with 700-pound raw deadlifts. This does not happen. Both these examples, the elite marathon time and the Herculean lift, represent specializations in fitness, a focus on one component of fitness at the necessary expense of the others. Specialization in a single fitness parameter is not the CrossFit philosophy and it is not the philosophy of most recreational exercisers. CrossFit represents an intended adaptation to a wide spectrum of physiologic stressors, adaptations relevant to the broad fitness required for demanding occupational effort and diverse recreational activity. While some interference does occur with this model of training, it is significantly less than with simultaneous or sequential aerobic and strength training. CrossFit training's organization and approach makes "specific" training for "general" fitness possible.

◇

Lon Kilgore, Ph.D., is professor of kinesiology at Midwestern State University, where he teaches exercise physiology and anatomy. He has extensive experience as a weightlifter himself, and he has worked as coach and sports science consultant with athletes from rank novices to collegiate athletes, professionals, and Olympians. In addition to publishing articles in numerous scholarly journals, he is co-author, with Mark Rippetoe, of the books *Starting Strength: Basic Barbell Training* and *Practical Programming for Strength Training*.