

the **CrossFit** JOURNAL ARTICLES

What Do We Know?

Tony Leyland

When Coach Glassman asked me to write for the *CrossFit Journal* on the science behind CrossFit methodology, I thought that the first thing I should do is discuss the term “science” and some important related concepts.

Science in the broadest sense refers to any system of knowledge attained by verifiable means. A central concept in science and the scientific method is that all evidence must be *empirical*—that is, it must be based on evidence that is observable by the senses. CrossFit trainers and athletes can certainly observe and measure the response to CrossFit training, but there are few other similarly intense training protocols that we can compare results with. Without this comparison it is difficult to scientifically validate CrossFit methodology. The Canadian military has done that, comparing CrossFit methods with conventional physical training methods (*CrossFit Journal* issue 41), but more such studies are needed.

The basis of the scientific method is that researchers propose specific hypotheses as explanations of natural phenomena and then design experimental studies to test these predictions for accuracy. But scientists cannot perform experimental studies on humans. In an experimental study all variables are kept constant except the variable of interest. You can do this in chemistry, for example, where everything in a number of solutions is identical except the one element under study. However, it is impossible to do in human populations.

The studies scientists perform on people are more correctly termed epidemiological, or non-experimental, studies. To do an experimental study on the effects of exercise you would have to randomly split your population into two groups that had identical lifestyles except their exercise habits. They would have to sleep the same amount, eat the same food, smoke and drink the same, etc. Strictly speaking they would have to have the same genetic make-up, as we do not all respond the same way to the same training stimulus. This is obviously impossible.

So, any single scientific study on humans must be viewed with caution. The confidence of epidemiological studies is judged on how many studies come to the same conclusions and how strong the effect they identify is. If the effect is both very strong and

evident in numerous studies, the studies’ results are considered reliable. We pretty much “know” that overloading the muscles makes them stronger because every study shows that much at least. We also “know,” because it is a very consistent research finding, that athletes reach plateaus and show reduced fitness gains if they stay on the same training regime for too long. Other than those two pieces of information, research has generated a lot of conflicting results.

The 2005 March/April issue of the *National Strength and Conditioning Association (NSCA) Bulletin* included a session review article titled “The End of the Single-Set Versus Multi-Set Discussion.” The article discussed a meta-analysis study (meta-analysis is a statistical analysis combining different research studies that have different methodologies) conducted by Dr. Matthew Rhea of Southern Utah University. His analysis looked at the results from more than 175 studies. Dr. Rhea found that the number of weight training sets that produced the greatest strength gains was four sets for untrained individuals; four to five sets for trained athletes, and eight sets for elite level athletes. While this study would be considered “science,” later that year at the annual NSCA national conference there were some discussions on the topic that I would, conservatively, call “very heated.”

I can understand this heated—and at times angry—debate. First, the ideal number of sets for strength gains has been an open question for a long time (more on that later). Second, and more important as far as I’m concerned, we should never say things like “the debate is over” with issues as complex as how human beings interact with their environment. The editors of the *Bulletin* should know better, and some NSCA members told them so. To claim that any one analysis “ends the debate” is sticking your neck out, to say the least. Moreover, the terms of the study appear to be too broadly defined to be useful, since the number of reps per set (and therefore the total volume of work) were not considered.

Epistemology is the branch of philosophy that studies the nature and scope of knowledge. Epistemology primarily addresses the following questions: “What is knowledge?” “How is knowledge acquired?” and “What do people know?” I never subscribed to the “one set to muscular failure is enough” concept, so Dr. Rhea’s

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What Do We Know? *(continued)*

study didn't really surprise me. But the question is: Can I truly say I *know* that three or four or five or any number of sets is always better? Not really, because well controlled studies on humans are non-experimental and very difficult to conduct—and are therefore neither conclusive nor plentiful in the literature.

CrossFit focuses on optimal ways to exercise. However, we must always be mindful of the question “How do we know this is optimal?” because, to be honest, we don't. CrossFit has arrived, in my view, at a training methodology that is incredibly effective at developing all-around fitness, as defined by the ten general physical skills that measure fitness (discussed in the free *CrossFit Journal* issue “[What is Fitness](#)”). Are there further iterations?

⇒ Quite possibly? Almost certainly? CrossFit's open-source model invites feedback, and, as more coaches and trainers get involved, additional components may well be added.

The pursuit of knowledge never wants, or expects, to stand still. It is my hope that some well constructed studies will highlight the benefits of CrossFit training compared to other methods, as well as provide information that can help CrossFit athletes fine-tune their workouts and performances. Imagine, for instance, the applications of a study that could offer some insight into the question, often asked on the website, of which work to rest ratios are most effective for certain kinds of WODs. There is already some good science out there that can help us answer these kinds of questions—and it is these types of studies that I would like to cover in later articles here in the journal.

Maybe, though, if things work and you are happy with how they work, you don't care about science or yet another study on exercise. You could argue that any coach has to focus primarily on outputs rather than the why of things; the bottom line is: Are my athletes getting faster? Are they getting stronger? Experience is real truth for the individual. Who needs scientific studies and fancy words like epistemology?

I can understand that point of view. But even if your athletes are improving, could they improve more? What about some of your family and friends? Are they all easy to convince of the effectiveness of CrossFit? What about the English sprint coach who once told me he has to “see the science” before changing his training methods? What about most of the strength and conditioning coaches at universities who look to the NSCA's published studies for guidance?

My point is that many people want to see “proof,” and I think it is important that we explain the “why” of our methodologies. Simply stating “Because it works” is OK, and that's certainly enough for some. But being able to say “This is why it works” is better. More people are going to be influenced when there are numerous studies supporting a methodology. Mark Rippetoe, in his excellent article on the squat “[Going Deep](#)” (*CrossFit Journal* issue 49) doesn't just tell you “Get down there!”; he actually explains the mechanics of the squat and the forces on the physiology of the knee joint to explain why you should and why it works. That is the kind of information that makes people rethink assumptions.

I said I'd talk about optimal number of sets in this article. So before I finish up I'll give you the answer. The answer is that, yes,

there is an optimal number of sets—but on a given day for a given individual. I can't tell you what it is and no coach or scientist can either. Moreover, because strength-training exercises can be used to develop cardiovascular endurance, tolerance of high lactate concentrations, skill, accuracy, etc., as well as strength, the optimum number of sets also depends on your goals. (Dr. Rhea's focus was specifically on strength gain.)

The literature in the field includes studies showing that one set is as effective as three for developing strength, others demonstrating that five sets is most effective, others proving that the correct number is eight, and on and on. I even found one study with results suggesting that three sets of 2RM, two sets of 6RM, and one set of 10RM reps all elicited similar strength gains. Go figure. You'd be laughed out of any gym for trying to argue that one! So how do we see such bizarre results? Just about any difference between individual trainees could affect the outcomes, and there is no way to control—or even know—all the relevant variables.

So what to do if you agree that knowing the exact optimum for any individual on any day is “unknowable”? The answer is simple, isn't it? Do CrossFit. Do one set (“Grace”); do three sets (“Fran”); do five sets (“Barbara”); do ten sets (“Linda”). And do your sets to work all three energy systems. Do sets of exercises that require balance and skill (overhead squats, Turkish get-ups, handstand push-ups); do sets of exercises that require speed and power (cleans, jerks, sprints), do heavy strength-based sets leading to multiple 1RM lifts with long recovery periods (deadlift 3-2-2-1-1-1). Mix it up

I believe CrossFit embraces the reality that we cannot conduct true scientific experiments on humans and that we may never really know the exact how or the exact optimum. What we do know is that CrossFit is extremely effective. If others out there can show exactly how and why it works—can give some insight into what happens in the black box of CrossFit inputs and outputs—all the better. If they can show a better way, we remain open to seeing their evidence.



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