The Mathematical Nature of Strength Training

by

Mark Rippetoe

Starting Strength

Few things could be simpler: use a few exercises that work as much of the body at one time as possible, find out how strong you are now on these exercises, and next time you train, lift a little heavier weight. Just a little. It’s the same process you used to learn to read, to play the guitar, to get a suntan, and to finish your master’s thesis. It’s the same process used to build an airplane or to evolve a more complex organism. It’s the accumulation of adaptation – the enemy of entropy – and it can be done by quite literally everybody.

The ability to adapt to stress is a trait common to all living things. A physical stress is a change in the physical conditions under which an organism, like you, lives. If the conditions stay the same, you stay the same. If the conditions change, you have two choices: adapt, so that the new conditions aren’t a stress anymore, or fail to adapt, and perhaps die.

It is also important to understand that adaptation is specific to the stress that causes it. The calluses on your hands from the shovel grow on the palms, where the shovel handle rubs, not on your face. You don’t learn to play the piano by practicing the clarinet.

At its most elemental reduction, this is the situation. The ability to adapt to physical stress is built into our DNA, and it’s kept us alive for a long time. Training is the systematic and intentional application of progressively increasing specific stress – enough to produce the desired adaptation, not enough to kill you. It’s just simple arithmetic.

So what’s the problem? If this process is so simple, both logistically and philosophically, then why in the hell is there so much pointless confusion about what, how, and why?

I’ll tell you: because it suits the purposes of lots of people to make you think it’s complicated. Ever heard the term “muscle confusion”? It was popularized decades ago by the Weider organization, publishers of Muscle Builder magazine, as one of the famous “Weider Principles” of bodybuilding. Along with several other fabulously screwed-up ideas, such as the “Retro-Gravity Principle,” the “Partial Reps Principle,” and the “Triple Split Principle,” the idea that things have to be complicated to be effective was planted in millions of young minds. The Trainee Confusion Principle.

We grew up, some of us got into the business ourselves, and many of us clung to the idea that effectiveness requires complexity. Sometimes it does, usually it doesn’t. If you are playing the piano at the level of Glenn Gould, and you want to get even a little better, the process will be complex. It
will involve a high level of tortuosity, relying on constantly-varying tempo, difficulty, precision, and musical style.

Most of you reading this are not Glenn Gould – none of you, actually. You have more in common with me, who can barely play the trumpet. When I started at the age of 40, with a pawn shop cornet, a lesson once a week, and a Clarke studies book, the process was simple: learn the fingerings of the notes at the bottom of the staff and the way you move your lips to produce them. As I got better, I moved up the staff, playing higher notes until I developed a usable range. Since I didn’t learn the instrument when I was a kid – when learning things like languages and music are much easier than when you’re an adult, dammit – the process of learning to convert the notes on the page into sounds played in the right order and in the right tempo was much more difficult.

I’m still not very good, but the process that I used was very straightforward: I accumulated skill through practice. After six months I was better than when I started, so I could play at a higher level, and thus practice at a higher level, continually driving up my range and reading ability. I’m still not very good, but my little brass group plays a couple of times a week, so I maintain my level successfully.

But if I was actively seeking to improve, I’d have to do more than just play. I’d have to “train” by using a metronome to drive my ability to play faster while reading the music. I’d have to sight-read a bunch of music, again under the pressure of time. And if I wanted to extend my range upward, I’d have to take a progressive approach to that too. Even now, it’s a very simple, straightforward process, because I’m not good enough that it needs to be complicated.

The bad news is that simple doesn’t mean easy. Progressive improvement like this is hard. It’s a lot of work, so it has to be worth it to you. But a very large cohort of the fitness industry has spent a lot of money reinforcing the idea that complex not only works better, but that it’s the only thing that works at all.

The Pros – the strength and conditioning people that deal with professional and D1 College teams – have largely adopted a physical therapy model of exercise. Their version of unnecessary complexity takes the form of lots of different exercises done with relatively light weights, the hard part being balancing on something. This is fine for rehabbing an injury, but when rehab replaces training, the athletes suffer the consequences. D1 and pro athletes already know how to balance on things; that’s why you hired them. They get strong just like everybody else, if you let them, 5-10 pounds at a time, and stronger athletes are better athletes. Nothing confusing about that.

The popular-culture aspect of the industry you see advertised in 30-minute infomercials has finally convinced you that easy doesn’t work. Duh. But they have also convinced you that your muscles need to be confused or they won’t get strong. P90X, CrossFit, and other extreme conditioning programs are popular because they employ random exercise assignments that are not boring for those of you with a short attention span.

But is “muscle confusion,” constant variation, and randomness necessary, or even desirable? Back to adaptation for a second: Stress results from a change in the conditions to which you are currently adapted, so a 5-pound increase on the squat is a stress. You can do the 5 more pounds (because it’s only 5 more pounds – more weight, but not much more), so after you squat and recover, you have adapted to that change in the environment. But if you try to do a 50-pound increase, it will be too heavy to either squat for 5 reps or to recover from. Likewise for 20 sets of 5, which represents such a huge increase in work volume that it cannot be recovered from in time to squat again anytime soon. And if you go swimming, it won’t make your squat go up, amazingly enough.

Adaptation likes a manageable amount of stress on a regular basis. And since adaptation is obviously specific – you can’t learn to play the trumpet by playing the saxophone – you have to design
The Mathematical Nature of Strength Training

the stress to cause the adaptation you want. If you want to get stronger, you have to lift weights. But
neither you nor your muscles should be confused about what you're doing today, what you're doing
next time, or even what you're doing next month.

The mathematics of strength training is quite simple. The addition of small incremental
increases over a sufficient amount of time increases strength. The process is linear at first, and then later
the slope of the improvement curve flattens out and approaches a limit. The process is accumulative,
its most important aspect. But never is the process random, nor can it be made random. After a while,
when you get as strong as Glenn Gould was virtuosic, it will be complicated. Chances are you'll never
need that level of specialization in your strength training. For now, just keep it simple and get stronger,
by the numbers.

A version of this article appeared on PJ Media 2/25/2015.