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Should You Train to Muscular Fatigue?

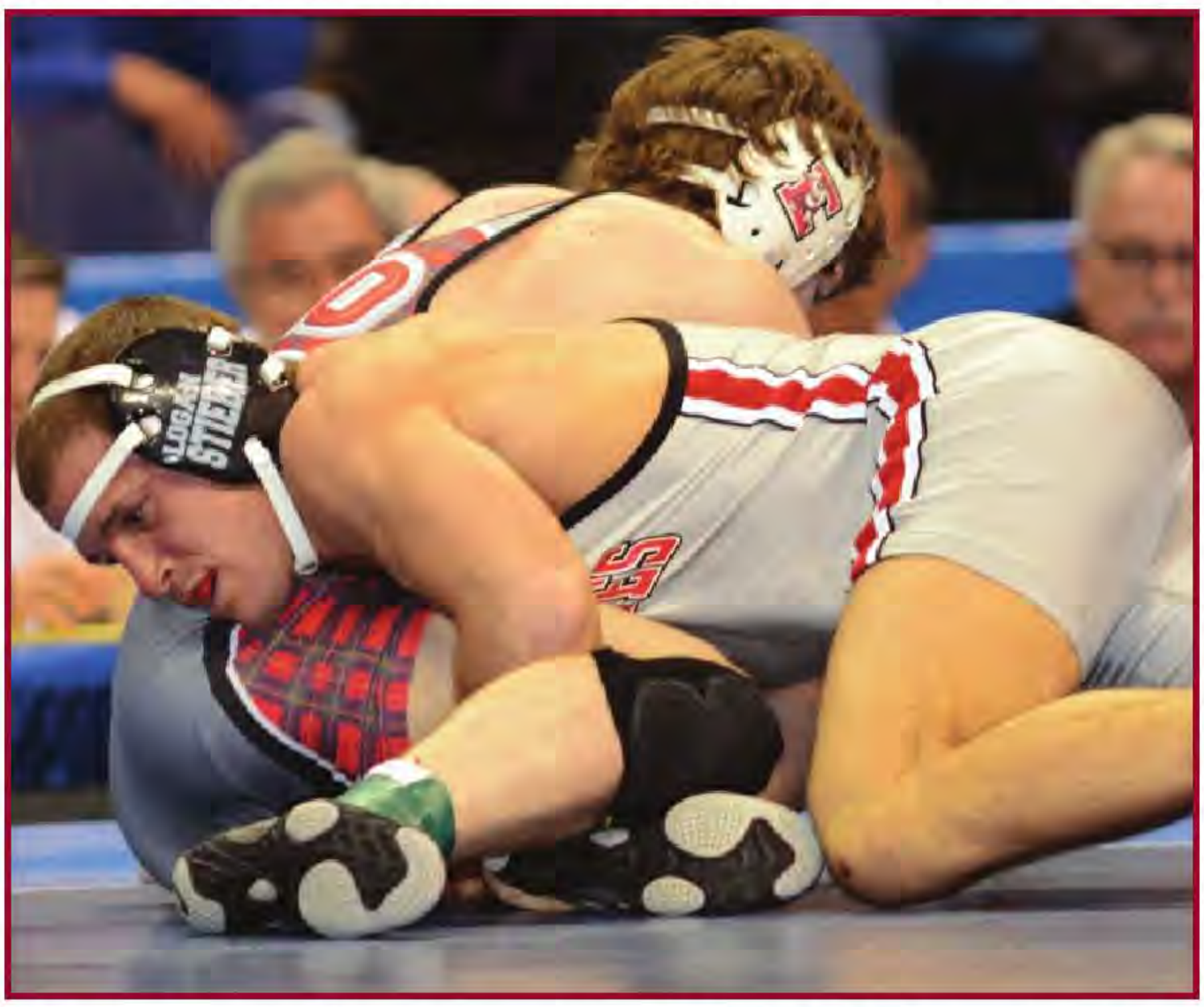
By Matt Brzycki

It was Sunday, January 7, 1996. I was one of six panelists who participated in a roundtable discussion during the National Strength and Conditioning Association (NSCA) Strength and Conditioning Conference for Football that was held in New Orleans. The NSCA had intentionally set up the roundtable as an "us versus them" debate with the six panelists falling into one of two camps, even going so far as to sit the two camps at separate tables. Essentially, one side favored the training methodologies that were promoted by the NSCA and one side opposed those methodologies.

Nowadays, many strength coaches administer hybrid programs which are a mix of more than one training methodology. This is really a smart move since being labeled as a card-carrying member of one camp or another often impacts employment opportunities and job security. But in the 1990s and earlier, the vast majority of strength coaches were purists; for the most part, they sided with either one camp or the other. Needless to say, this war of methodologies – which actually dated back to the mid-1970s – created a great deal of hostility within the strength-coaching community; most of the time, the two camps got along about as well as the Arabs and Israelis. And the tension was evident at the conference.

As a side note, the northeast was on the verge of getting clobbered by "The Blizzard of the Century" which eventually dumped more than 30 inches of snow on Philadelphia, shutting down a good chunk of Pennsylvania – which included the airport into which I was flying – and stranding me for two extra days in a place that consistently ranks among the annual leaders in murders per capita of any major city in the United States. But I digress.

Near the end of the roundtable discussion, one of the pro-NSCA panelists made this comment (or words to the effect): "Training your athletes to [muscular] failure is teaching them to fail." I must admit, this was a very clever use of words. But it was also one of the dumbest things that I've ever heard in my life. And I've heard some beauts.



2015 NCAA Division I Wrestling Championship Final - 141 lbs. Logan Stieber (Ohio State) finishing a takedown on Mitchell Port (Edinboro). Stieber won by decision 11-5 to become the fourth NCAA Division I wrestler to win four titles. Photo by Wyatt Schultz.

The verb "fail" has several definitions, including "to be unsuccessful." This would mean, then, that training athletes to muscular failure is teaching them to be unsuccessful. This would also mean that training athletes to stop short of muscular failure is teaching them to be successful. Both of those statements make absolutely no sense whatsoever.

To put it a bit differently, let's say that the most reps that you can do with a certain amount of weight is 12. So if you stop at 8 or 9 reps, for instance, you'll be more successful than if you did 12? C'mon.

WHAT IT IS

Basically, training to muscular failure means training with a high level of intensity. Understand that intensity shouldn't be confused with load or a percentage of maximum weight. Rather, intensity is another word for effort. Or, as defined by the World Health Organization, intensity is "how hard a person works to do the activity."

So if anything, training athletes to stop short of muscular failure is teaching them to avoid hard work. In fact, this would be like a coach telling his team: "Don't train too hard." And what coach would do that?

Another way to put this into perspective is to look at sprinting, an integral aspect of sport-specific conditioning for wrestling. Well, what's sprinting? It's a series of all-out efforts, right? Certainly, running as fast as possible is training with a high level of intensity. Does it make any sense, then, that having athletes do sprinting is teaching them to fail or be unsuccessful? Of course not.

Note: Years ago, the term "muscular failure" was used extensively by strength coaches from both camps. But Dan Riley, who spent 27 years as a strength coach in the National Football League, points out that "muscles only fail when you die." A much better term that has become more widely used is "muscular fatigue" or simply "fatigue." From this point on, then, the use of "muscular failure" will be abandoned in favor of "muscular fatigue."

THE OVERLOAD PRINCIPLE

The rationale for training to muscular fatigue comes from the way that a muscle responds to a demand (or stress). If a demand is of sufficient magnitude, compensatory adaptation occurs within the muscle. As the name of the process implies, a muscle compensates by adapting. The way that a muscle adapts is by getting stronger – and, to a lesser degree, bigger – within the scope of an individual's genetic profile (inherited characteristics). Look at compensatory adaptation like this: In response to what amounts to an assault, a muscle reinforces itself in preparation for another incursion. (This is just one of many types of compensatory adaptation that can take place at the cellular level.)

The Overload Principle was dubbed by Dr. Arthur Steinhaus way back in 1933. It is, perhaps, the most widely referenced principle in exercise science. According to Dr. Roger Anoka – a renowned biomechanist and author of Neuromechanical Basis of Kinesiology – the Overload Principle states, "To increase their size or functional ability, muscle fibers must be taxed toward their present capacity to respond." He adds: "This principle implies that there's a threshold point that must be exceeded before an adaptive response will occur."

The term "threshold" means that a minimum level of muscular fatigue must be produced in order to trigger compensatory adaptation. In other words, the intensity –

the effort – must be great enough to exceed this threshold so that a muscle is prompted to adapt.

THE INTENSITY CONTINUUM

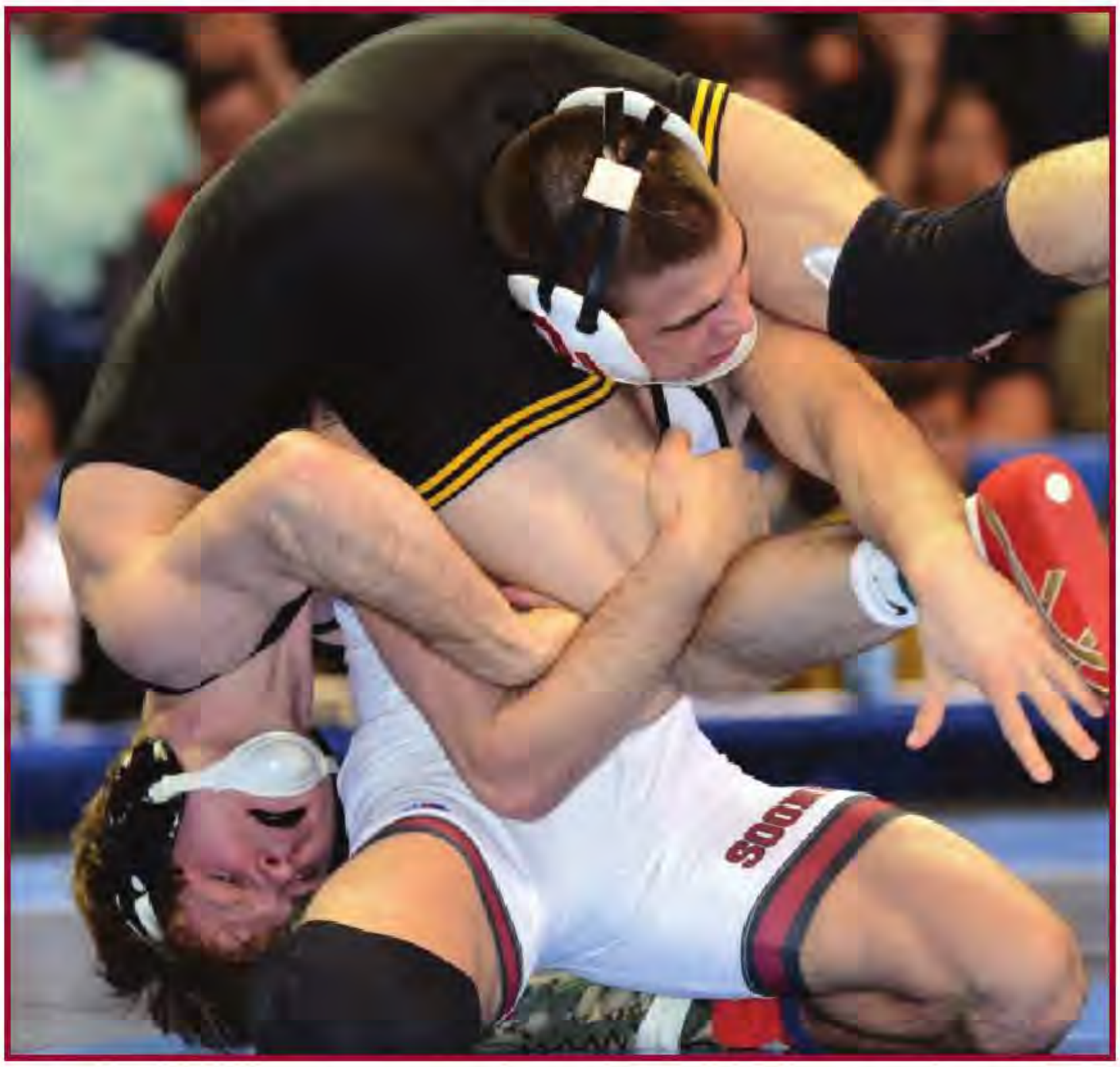
Falling short of the threshold – not creating enough muscular fatigue – will result in a response that's less than optimal; simply stated, a submaximal effort will yield a submaximal effect. Unfortunately, no one knows the minimum level of intensity that's needed to surpass the threshold in order to stimulate an adaptive response. No one. But even if the minimum level is unknown, the most productive level of effort can be determined by deductive reasoning. For the moment, let's suppose that 90% intensity is the threshold for achieving maximal results. If so, how do you pinpoint 90% intensity . . . or 95% intensity . . . or any other level of intensity for that matter? Answer: You can't.

Think of intensity as residing across a continuum that ranges from low to high. There are exactly two levels of intensity that can be determined easily and accurately. At one end of the continuum is 0% intensity or complete inactivity. Obviously, no intensity creates no fatigue and, therefore, produces no response. At the opposite end of the continuum is 100% intensity which is characterized by an all-out effort within the anaerobic domain (less than about three minutes). It's literally impossible to identify any other level of intensity. As a result, the only level of effort that's both meaningful and measurable is 100% intensity. This level is typified by training to muscular fatigue: when you've exhausted your muscles to the extent that you literally can't raise the weight for any more reps with good (strict) technique.

Do you have to train to muscular fatigue to achieve compensatory adaptation? Maybe not. But how else will you know whether or not you surpassed the threshold?

THE SIZE PRINCIPLE

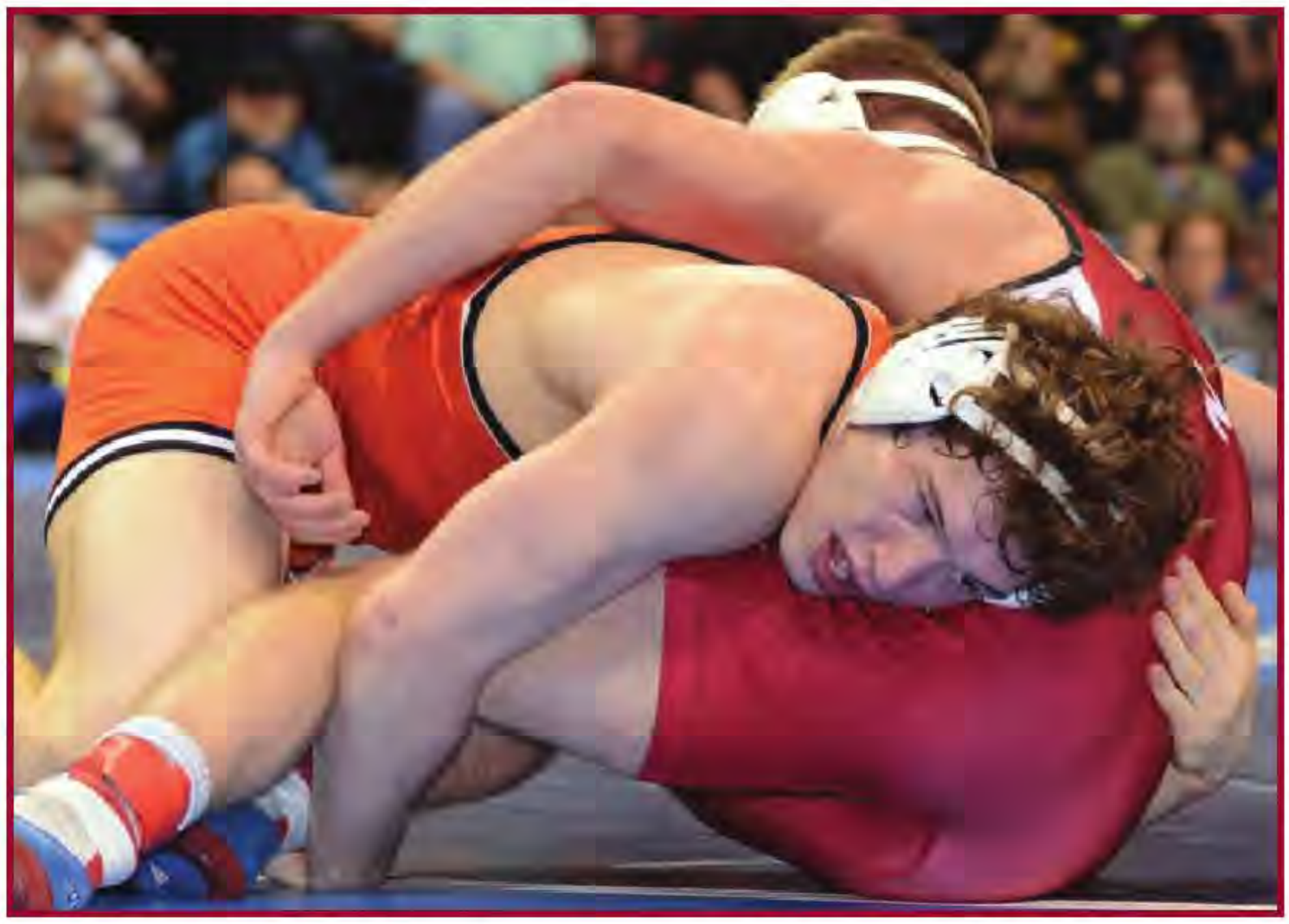
Further evidence that supports the idea of training to muscular fatigue is found in the way that muscle fibers are recruited. Muscle fibers can be broadly categorized as slow twitch (ST) and fast twitch (FT). From a functional standpoint, muscle fibers differ in several ways, including speed of contraction, magnitude of force and degree of fatigability. Relative to FT fibers, ST fibers contract slower, produce less force and have more endurance; relative to ST fibers, FT fibers contract faster, produce more force and have less endurance. And of no small importance is the fact that FT fibers display a much greater potential to increase in size than ST fibers. (Research also recognizes one or more intermediate or hybrid fibers that possess characteristics of both FT and ST fibers.)



2015 NCAA Division I Wrestling Championship Final - 133 lbs. Cody Brewer (Oklahoma) working to finish a shot on Cory Clark (Iowa). Brewer would win by decision 11-8. Photo by Wyatt Schultz.

Under normal circumstances, your nervous system innervates muscle fibers in an orderly fashion according to the intensity or force requirements of whatever it is you're doing. Demands of low intensity are met by ST fibers. Intermediate fibers are recruited when the ST fibers are no longer able to continue the task. FT fibers are recruited only when the other fibers are fatigued to the point that they can't meet the force requirements. All fibers are working when the FT fibers are being used.

This pattern is consistent with the size principle of recruitment that was proposed by Dr. Elwood Henneman in the 1950s. According to this principle, motoneurons are recruited based on increasing size: The motor unit with the smallest motoneuron is recruited first and the motor unit with the largest motoneuron is recruited last. (A motor unit consists of a motoneuron and all the muscle fibers that it innervates.) In general, the smallest motoneurons innervate ST fibers and the largest motoneurons innervate FT fibers. Therefore, ST fibers



2015 NCAA Division I Wrestling Championship Final - 165 lbs. Alex Dieringer (Oklahoma State) finishing a takedown as he works his way up on Taylor Walsh (Indiana). Dieringer won by decision 14-7 to win his second title in a row. Photo by Wyatt Schultz.

are recruited first and FT fibers are recruited last.

What's the moral of the story? In order to stimulate as many muscle fibers as possible – particularly FT fibers which are enormously advantageous in sports and activities that require strength, speed, power and explosiveness – you should train to muscular fatigue. Remember, muscle fibers that aren't stimulated have no need to adapt.

TIME AND INTENSITY

There are varied opinions as to how a high level of intensity can be achieved in the weight room. Many suggestions center on increasing some aspect of volume such as the number of sets, the number of exercises or the frequency of workouts. Although these ideas may seem valid, it's highly unlikely that increasing the volume of training will elevate the intensity of training to a desirable level. The reason for this is because there's an inverse relationship between the time (duration) of an activity and the intensity of an activity. As the time of an activity increases, the intensity of an activity decreases. Stated otherwise, you can't train with a high level of intensity for a long period of time.

As an example, suppose that you had to sprint as fast as you possibly could for as long as you could. I mean, you're running as if you were being chased by Darth Vader brandishing his lightsaber. If you're in reasonably good condition, you could probably run no more than about 400 meters (about one-quarter mile) at an absolute breakneck speed before you begin to smell the buildup of lactic acid in your bloodstream and have to stop due to total exhaustion. Your time would probably be in the neighborhood of 60 seconds. In this case, your level of intensity was high but your time of activity was low. On the other hand, imagine that you ran the same distance in three minutes. Relative to the first scenario, your time of activity was high but your level of intensity was low.

The fact is that you can train with a high level of intensity for a short period of time or a low level of intensity for a long period of time. However, you can't train with a high level of intensity for a long period of time. So by increasing the volume of training, you effectively increase the time of an activity thereby producing a concomitant decrease in the intensity of an activity. It's a lot like wrestling practice: You can have a practice that's harder or a practice that's longer but not harder and longer.

THE LAST REP

In my opinion, the main reason why most individuals fail to realize their strength (and size) potential is because they don't train with an adequate level of intensity. In some cases, they avoid hard work like the plague and don't want anything to do with muscular fatigue; in other cases, they simply don't know that hard work is an absolute requirement for optimizing improvements in strength and size.

The fact that your response from strength training is directly related to your level of effort shouldn't come as much of a surprise. It's like practically everything else in life: How hard you work in school, at practice and even in relationships will largely determine your success at those endeavors. This also applies to your strength training.

Something else to consider is that you compete like you practice. If you perform your strength training with a low level of intensity, will you be able to ratchet up your effort when you're in a tough match that requires you to dig deep and be aggressive?

Finally, think about this: As you perform a set, each rep produces an increasingly greater level of muscular fatigue. So of all the reps that you do, the most productive one is the last rep.

Matt Brzycki has authored, co-authored and edited 17 books on strength and fitness including four that are devoted to wrestling. His latest book is A Practical Approach to Strength Training (4th edition).