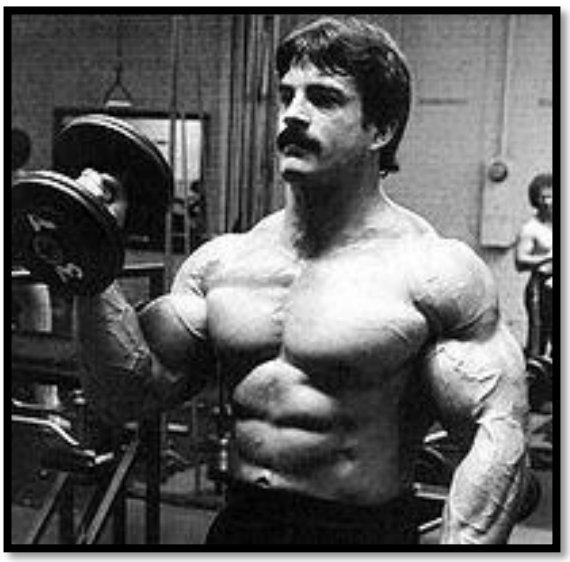
The Science of Health, Nutrition and Fitness

Single Versus Multiple Work Sets for Strength and Mass **Author: Carl Conroy**

A question that is often questioned or debated within the strength and bodybuilding community is whether short highly intense workouts are more effective than multiple set, longer duration workouts. Many proponents may be found for each training type but what is the science behind these workout styles and is there evidence to suggest that one is better than the other? These questions are the remit behind this article.



Mike Mentzer Was a Major Proponent for HIT Training

For our discussion we shall first take a slightly more than cursory glance at the theory that 'short high intensity workouts' are a good way to train if strength and muscular growth are the primary goal. This method of training; espoused by such bodybuilding dignitaries as Arthur Jones, Mike Mentzer and the multi Olympian winning Dorian Yates; involves minimal work sets, training to failure and the application of several other intensification techniques such as negatives, forced repetitions and drop sets. So what is the scientific premise behind this training style? This is the first aspect we will address.

The first physiological aspect to be scrutinized will be the sphere o f energy provision. In that respect we must understand the energy systems that are used by the body to provide the impetus for muscular contractions to take place.

There are three main energy systems; those being the Adenosine Phosphocreatine System (ATP-PCr); the Anaerobic Glycolytic System (Lactic Acid System) and the Oxidative System (Aerobic System). These three systems work continuously throughout life in a coordinated manner to provide all of the human organism's energy requirements. However, they all have distinct pathways and utilise different substrates in order to provide the chemical form of energy known as Adenosinetriphosphate (ATP). They also have differing abilities to supply short or long term supplies of energy. From that statement we can derive our first physiological implication.

Schoenfeld B.J., Ratamess N.A. Effects of Different Volume-Equated Resistance Training (2014)

'This study showed that both bodybuilding- and powerlifting-type training promote similar increases in muscular size, but powerlifting-type training is superior for enhancing maximal strength'.

The system most utilised in terms of strength and power production is the ATP-PCr system. Simplistically, and not detailing the interactional abilities of the three energy systems; this 'short burst mechanism' provides the energy for most heavy weight training movements within the 4 – 6

repetition range. The range that is most associated with size and strength gains. It is generally considered that the ATP-PCr system has a 'life' of around 6 - 8 seconds, after which the second anaerobic system has to become more significantly engaged to provide ATP. An all out set of 90% maximal deadlifts would therefore significantly utilise the ATP-PCr system. This system relies on Phosphocreatine (PCr) as its main fuel source, which is used to re-synthesise ATP. There are limited stores of PCr, which are found predominantly in muscle fibres; specifically, most PCr is found in the Type II muscle fibres; which are associated with strength and power.

So in summary of the above with respect to the ATP-PCr system; we have established that there are limited stores of PCR. Its main characteristic is the provision of short term powerful energy bursts as would be seen in high intensity training. It is commonly associated with FT fibre types which are the muscle fibres used in intense anaerobic activity. Consequently, longer less intense workouts which use multiple sets of higher repetitions would not significantly stimulate this energy system. Therefore, short intense workouts using 80 – 90% of maximal poundage would certainly benefit this system. With other factors also being considered, this could result in gains in both strength and power. If one of the mechanisms of strength increase is increased muscle fibre cross sectional area; then hypertrophy will probably also occur.

Wolfgang k. Kemmler, Dirk Lauber.
Effects Of Single - Vs. Multiple-Set Resistance Training On Maximum Strength And Body Composition (2004)

'Body mass and body composition did not change during the study. The results show that, in pretrained subjects, multiple-set protocols are superior to single-set protocols in increasing maximum strength'.

Another physiological factor of significance is muscle fibre type. There are three predominant muscle fibre types. Simplistically the slow twitch (ST) fibre type; which is aerobic in nature and the fast twitch type a (FTa) and (FTb) fibres, which are predominately anaerobic. It is generally considered that it is mainly the FTb fibre types (fast twitch glycolytic) that are responsible for force production in relation to strength and power. Such fibres are characterised by events such as the shot putt, javelin and boxing punches and are certainly best stimulated by the power moves in the gym such as heavy bench presses, deadlifts, snatches and squats. In this type of muscle fibre there is an ability to split ATP quickly which results in 'power bursts' but there is also a limited resistance to fatigue. Therefore it can be surmised that they are best stimulated by high intensity work of low time duration. In addition to that factor type IIb fibres have greater volume and have greater motor neuron size. All of this adds up to greater potential for hypertrophy and strength increases. Type IIb muscle fibres are stimulated by high intensity work. If lower weights and higher volumes were utilised it is more likely the FTa or ST fibres would be stimulated. This is another argument for the short intense workout theory in relation to muscle mass and strength increase requirements.

Wolfe, B.L., L.M. LeMura, and P.J. Cole.
Quantitative Analysis Of Single- Vs. Multiple-Set Programs In Resistance Training. (2004)

'The results of this quantitative review should offer additional perspective on the debate regarding the role of single- vs. multiple-set training programs with trained and untrained individuals, respectively. These data support the use of multiple-set programs for trained individuals and single-set programs for untrained individuals during the initial short training period.'

The last factor we shall consider in the 'pro-high intensity camp' is that of recovery. For an organism to adapt it must be 'pushed' beyond its normal physiological boundaries. Also, once stimulated it must be given adequate time to recover and undergo the adaptive process. It is the consensus that fast twitch fibres require a longer duration of recovery than slow twitch fibres. There are many physiological implications for this including the fact that ST fibres have a greater blood supply, thus allowing greater delivery of nutrients for recovery and eradication of exercise by-products; and also

slow twitch fibres undergo less intense stimulation. While not scientifically based it is a rudimentary fact that the harder you push something the greater will be the requirement for recovery. Under this supposition short intense workouts that allow for an increased recovery time might have beneficial effects on recovery ability and thus the adaptive process.

Many famous bodybuilders have used high intensity type training; such individuals include, Franco Columbo, Mike Mentzer, Sergio Oliva, Bertil Fox and the Immortal Dorian Yates. In terms of the power athletes all of the world's strongest men use high intensity training. There would be no specific event based advantage to using any other type of training.

However, other bodybuilders have gained massive success in terms of muscular development through the use of higher volume, higher repetition type training. Individuals that fall under this category are, Arnold Schwarzenegger, Serge Nubret, Jay Cutler and the inimitable Frank Zane. These and many individuals with superb physiques would use around 5 work sets typically involving 8 – 12 repetitions per exercise. Sometimes more!

The premise behind such training strategies is that more sets to failure have a greater adaptive potential than one set taken to muscular failure. Both methods of training are certainly heavily intensive if applied correctly. Some proponents would say that multiple sets allow a significant increase in that intensity and therefore more adaptive influence. This method of training also takes on more credence if an effective split routine is applied to allow better recuperative ability. The higher reps have the potential to stimulate the FTa fibres and also the ST fibres. With a greater amount of fibre involvement there is an increased potential for not only significant positive adaptations in muscle hypertrophy but also strength. There is also greater stress on all of the energy systems.

As the science shows, and also the visual observations of champion bodybuilders attest to; both methods of training can produce significant increases in body mass through hypertrophy. Although some studies argue with this consensus, it is the case that lower repetition, higher weight sets can increase strength more than lower weight higher repetition sets. This is probably due to the increased ATP-PCr and FTb muscle fibre involvement. In summary a trainee must establish their goals and determine which method is best for them. Of course there are many other considerations in this equation such as genetics, nutrition and ergogenic utilisation. But that is a whole other story!

Research and References

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