The Law of Repeated Efforts

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Abstract

There's an old adage frequented by school teachers across the globe. It simply states: " repetition, repetition, repetition. " Which is to say: the more you study a concept, and repeat it to yourself, the quicker it will sink into your mind. Consequently, this is proving to be a universal truth. One that must be not only understood, but also applied to the daunting task of hypertrophy training.

The Law Of Repeated Efforts Defined

This law, in its simplest of forms, states that one must repeat an activity(in this case, weight training), a certain amount of times before a learning or adaptive effect can take place. In other words, one can only learn to properly squat, through repeatedly squatting. But this definition, as we will see can lead to some extremely broad, and in many ways philosophical areas in the world of bodybuilding(I covered many of these philosophical areas in the article, the greatest training method of all time).

Basis From Which This Article Stands

I want to make it clear, that several great minds have manipulated this principle. It is my intension to present to you, these different interpretations. What must be understood, is that many of them seem extremely unorthodox, but they all come back to this basis. I will hold back any prejudices(though I will add analysis and suggested applications), and present the ideas.

Law Applied to The Nervous System

When this article began, we used the mental analogy of learning material for a certain school subject. What needs to be understood, is that the same principle can be applied to the training. Your brain after all, is part of your CNS, you not only " learn " and store facts, but the CNS also learns and stores motor information, and actually improves its ability to perform a certain action.

How does it accomplish this? There are actually several adaptations to training that take place. They can be broken down into two categories.

1. Enhanced Neural Drive – To improve nervous system function
2. Hypertrophy / Hyperplasia – To increase the overall size of a muscle group (this is known as a peripheral factor rather than a central factor).

Lets analyze these to get a better idea of the concepts:

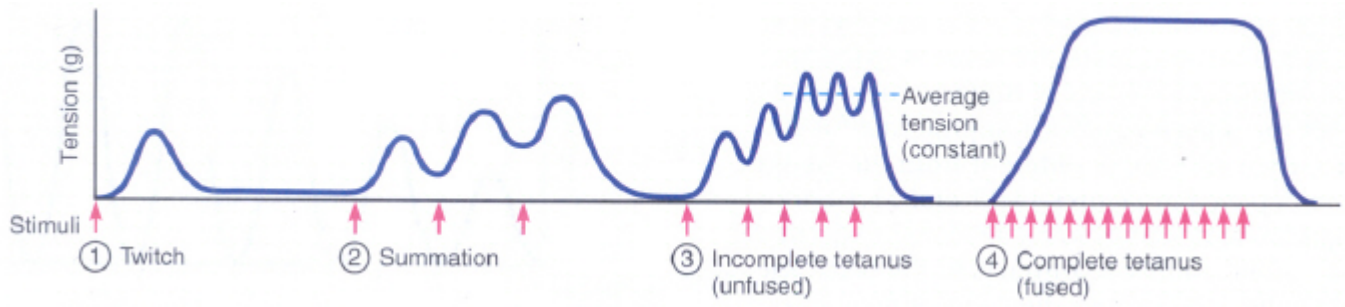
Enhanced Neural Drive – This can actually be further broken down into several categories. My goal today, is to introduce these concepts to you. Wet the palate if you will. In future Issues, I will go into insane detail on each of them, as I do for each muscle group in the anatomy section. The goal, is to get a firmer grasp on the adaptations that take place in your body, in response to certain stimuli.

A. In review, we know what a motor unit is. It is a neuron that innervates a muscle. Better defined, a neuron is a cell, that begins in the central nervous system via its head or cell body. In other words, the cell body lies in the spinal cord. Its axon, which looks like a long extension cord or tail, then travels to the muscle that it controls. This cell, is a specialist at conducting electrical signals, just as the cord connected to your lamp is. Think of the head of the neuron as the plug, which inserts into the wall(in this case though it is your spinal cord), and the axon, as the extension which lights the lamp, via an electrical impulse. Only in this case, the electrical impulse, sent out from your nervous system causes the muscle to contract.

One more thing that is vital is that one motor neuron, innervates from between 2 and 2, 000 muscle fibers. Whenever an electrical impulse is conducted, the muscle fibers being innervated contract. However, what must be understood is the concept of tetany. Wilson(2003, Cliff Hanger Part 1) explained Tetany as follows:

Tetany – Lets Fuse it!

There is a concept in the Physiological Sciences that we call Tetany. When viewed in graphical form, it appears like so:



The graph to which you have just been exposed is comprised of several stages. The first is an individual muscular contraction which appears on a desert isle, alone and unaided. That is-unlike those to follow, it is devoid of support. In the second and third aspect you are viewing what is called incomplete or Temporal Tetanus. This is defined as two or more muscular contractions spaced close enough in time so that part of their effects are combined to elicit a stronger force. Complete Tetanus is the ultimate form of contractile summation. This simply put, occurs when the contractions of a muscle fiber, or group of muscle fibers are so close in time that you can no longer distinguish between one contraction and another. The result? A peak in force so explosive that you would feel as if you could punch through a wall!

Tetany is caused as more and more calcium floods into a muscle cell. Calcium is the key to musculature contraction (See Wilson 2002, Is the All or None Principle Applicable to an Entire Muscle?) and a greater rate of neuronal firing causes a piggy backing effect of calciums entry into the cell.

This my friends is rate coding! The rate, at which each motor unit fires(a motor unit, is a neuron and the muscle fibers it innervates). Therefore, one nervous system adaptation is to increase this rate. Your nervous system " learns " how to increase its firing rate. The opposite can also take place. You can slow down the rate, via, slow training(i.e. endurance athletes).

B. Motor Unit Recruitment – This is a very easy concept. As I mentioned, a motor unit is a neuron, and the muscle fibers it innervates(stimulates). Which can range from 2 to 2, 000. Most muscle groups have a few hundred thousand muscle fibers, and therefore, many motor units. The second way to increase force output, is obviously to increase number of motor units are recruited.
In other words, you can call more muscle fibers into play for a given task. A sprinter will obviously be more efficient in this category, then a marathon runner.

C. Intermuscular Coordination – Ever wonder why you shake, or have problems balancing your body, when performing a new exercise? This is one of the main reasons. Intermuscular coordination is exercise specific and or activity specific. This is defined as the capability for muscle groups to work together, during a given task. Take the deadlift for example. Your spinal erectors are working, your traps are working, your calves, your forearms, your glutes, quads, hamstrings etc.. The ability to coordinate all of these muscle groups together in unison is intermuscular coordination.

D. Skill – Discussed in further on in the article, in a very unique way, including a discussion, on a very unique study.

E. Synchronization – I received back to the future for a Christmas present. And The doc and Marty always had their watches synchronized. The same principle holds true here. Two motor units are synchronized when they are firing at the same time. The best example to use here, would be when you are moving a friends couch. Before you lift it, both of you count to three and lift at the same time, so that the weight of the couch is distributed evenly. If one person is off, then it screws up the whole process. The nervous system can increase synchronization, in reply to stimuli that call for it.

The above information, is what is involved when your body " learns " an activity. There are other mechanisms, which I will cover at a latter date, but those introduce you several important concepts. I feel it is vital to understand what and how our body adapts, because it can seriously influence our training. For example, if I want to increase rate coding, I am not going to perform super slow motion exercises, with light weight. It depends on what your current focus actually is. Additionally, I will refer back to these concepts, throughout the duration of the article.

Muscular Hypertrophy

In the very near future, I am going to write, an extremely extensive article on muscular hypertrophy, and the theories, and mechanisms responsible for it. Briefly however, there are several ways to stimulate the process.

A. Increase in Muscle Fiber Size
B. Increase in Muscle Fiber Number (gaining more and more prestige as a method for gaining mass, as science progresses)
C. Capillary Density(number of capillaries)
D. Increase in Organelle concentration (i.e. mitochondria(synthesizes atp) ribosomes(site of protein synthesis! A huge topic in the future!)
E. Connective Tissue Hypertrophy – Most people don't realize the role connective tissue has in gaining size.

All of the above adaptations, and how to bring them about, are discussed extensively in the following articles(Wilson, 2001):

Muscle Fibers Part II
Muscle Fibers Part III

Overall, the following principles apply to gaining strength, or hypertrophy. Again, though, muscle fibers differ in composition, and if you want the distinctive differences in each, the above articles are vital to your comprehension. What I have done below however, is discuss a range of percentages, which is a nice addition to the repetition continuum. Note that it is more complex than this. However, a basis for overall
gains is displayed.

Enhanced Neural Drive - Top Priority on Strength Gains (1 Rep Max)

A. One Repetition at 100 percent of maximum

B. Two Repetitions at 94 percent of maximum

C. Three repetitions at 90 percent of your maximum

D. Four Repetitions at 88 percent of your maximum

E. Five repetitions at 85 percent of your maximum

Middle Ground – Between Strength and Hypertrophy

A. Six Repetitions at 83 percent of your maximum

B. Seven Repetitions at 80 percent of your maximum

C. Eight Repetitions at 78 percent of your maximum

Optimal Hypertrophy Gains

A. Nine Repetitions at 76 percent of your maximum

B. Ten Repetitions at 74 percent of your maximum

C. Eleven Repetitions at 72 percent of your maximum

D. Twelve Repetitions at 70 percent of your maximum

Mitochondrial Density, Capillarization and Hypertrophy in Slow Twitch Muscle Fibers

A. Thirteen Repetitions at 68 percent of your maximum

B Fourteen Repetitions at 67 percent of your maximum

C. Fifteen Repetitions at 66 percent of your maximum

D. Sixteen Repetitions at 65 percent of your maximum

E. Seventeen Repetitions at 64 percent of your maximum

F. Eighteen Repetitions at 62 percent of your maximum

G Nineteen Repetitions at 61 percent of maximum

H. Twenty Repetitions at 60 percent of your maximum

Strength Gains Will Be seen, *within* this particular range.

The main reason why I discussed percentages is that they can be an important tool when reaching new levels. Many veterans of bodybuilding will know exactly what range to work in. For example, I stated that twelve repetitions performed properly at 70 percent of your maximum, was optimal for that range. However, if you are choosing a weight, that causes you to fail in that range or come near to it, then you are probably naturally at that range already. If you are a powerlifter, I would meticulously monitor your maximum strength, a bodybuilder however is not as reliant on this, and can go a bit more instinctive.

Hardwiring Technique Applied

hard·wired

Pronunciation: 'härd-"wIrd
Function: *adjective*
Date: 1968
: implemented in the form of permanent electronic circuits; *also* : having permanent electrical connections <*hardwired* phone>

The following technique, is very much nervous system based. The goal is to literally hardwire your nervous system's efficiency, into enhancing its ability to train with

weights. It can have another connotation though. Lets get a closer, more simplified look at this word, as applied to athletics:

Technique Explained – The method, known as hardwiring, is a vital concept. In essence, it means to repeatedly perform an exercise, intensity level, workout, *style of training*, shocking method, principle, or repetition bracket(i.e. heavy lifting as opposed to light training) for an elongated(more than usual) amount of time, so as to cause the body to maximally adapt to the desired stimulus.

Hardwiring Applied to Specific Goal

The key is to first clearly establish your current goal, and base it on your overall goal. This is a bodybuilding site, therefore lets use hypertrophy as an example. One very specific way to increase muscular hypertrophy is to increase the amount of work done in a workout. Have you ever heard top athletes make the statement: I am going extremely heavy this workout in the 8-12 repetition range. That doesn't make sense does it? What you need to do, however, is analyze it from a bodybuilding perspective. Without an efficient nervous system, you will not reach your full potential in that range. In other words, by improving nervous system function, you will enhance your body's ability to recruit motor units, and all the other aspects vital to stimulating as many muscle fibers as possible. Furthermore, there is a distinct training style that can be applied immediately to make that claim come to pass.

In regards to my first statement, I believe that certain aspects of the year should be dedicated to specific activities that will increase our ability to hypertrophy a muscle group. In other words, if we only train, in the 9 -12 repetition range all year long, you will accommodate and staleness will incur. This, is one of the ways, that hardwiring can be invaluable. As it gives your body, ample time to adapt to a stimulus. This is not necessarily optimal for mass gains, but it is to improving nervous system function, which will allow you to increase loads, in the optimal hypertrophy training range. I will now list a few of the techniques which can assist you in neural enhancement.

A. Monitor The Specified Range – Lets go back to the analogy of studying for a test. What is easier, studying for a test, while simultaneously writing 3 papers, or preparing for it, without any other distractions? Obviously the latter. The same principle applies here. In other words, you will stay within a specified range, and allow your nervous system to map it out, without any other distractions!

Lets take the bench press for example. If you are working in the 4-8 repetition range, your goal is increased neural drive, hypertrophy and a high enough repetition stimulus, to make an easy transition to the optimal range for hypertrophy. Using an extremely strict method, your goal, for each set, will be to stay within 10 percent of your starting max. In other words, you might begin with 85 percent of your max, but you would not allow yourself to fall, below 75 percent of your maximum. This is a small enough percentile range, so that your body can maximally adapt to the stimulus.

You can take the hardwire principle to a high level, and use the exact same system for weeks to come, or you can change it slightly to further the adaptation. A looser variation, but, none the less, I believe a more effective one. Because you will stay heavy, and in a range familiar enough to adapt to, but challenging enough on the

system to cause further adaptations.

2 Sample Workouts on The Bench Press(note this is not a full workout, but one section of it)

Plan A For Week One

10 repetitions at 75 percent of your max

7 repetitions at 80 percent of your maximum

5 repetitions at 85 percent of your maximum

5 repetitions at 85 percent of your maximum

5 repetitions at 85 percent of your maximum

8-10 repetitions at 75 percent of your maximum

Plan B For Week Two

10 repetitions at 75 percent of your max

8 Repetitions at 79 percent of your maximum

5 repetitions at 84 percent of your maximum

5 repetitions at 84 percent of your maximum

7 repetitions at 81 percent of your maximum

8 repetitions at 85 percent of your maximum

That is a sample of a slight change, that still allows the body to be hardwired. The point is, if you want to increase your strength, one method of doing so, is to allow the body to over adapt to the activity. This will definitely improve synchronization, motor unit recruitment, and rate coding.

I would like to clarify something. Many bodybuilders, change their routines often. Hardwiring, in the less strict sense, calls for you to maintain a certain routine longer then you are used to doing. Therefore, if you change up, once a week, then maintain the same workout, or something similar for 2-4 weeks. Yes, that is extreme, but it is the nature of the method. This is why, as a bodybuilder, I use an assortment of methods, as there are specific goals in mind when using them. The goal here is enhanced neural drive.

B. How To Hardwire an Exercise – Lets say, your goal is to become more proficient at intermuscular coordination. You would then coordinate yourself to a specific compound exercise, as it is the most demanding in this respect. In fact, from this view point, you can see why compound movements are so vital to athletes in sports which call for great intermuscular coordination, such as Football(exploding off the line), and hockey which is one continuous explosion.

Therefore, one very basic way to force the body to adapt in such a way, would be to overexpose it to a particular exercise. For example, performing the bench press for 6weeks straight, first in your routine. This is an extreme approach, but it is definitely a method that can work at improving neural drive.

Tips

1. This method seems quite still. However, it can be quite dynamic if you think about it. It will force you to come up with more creative methods of training. For example. If you change the placing of your hands, even an inch from the previous week on the bench press, you will force the body to adapt to a new stimulus, but still have the same basic pattern, to which it can hardwire itself to.
This slight movement may be a vital process, as it heightens adaptation, and avoids staleness.

2. If you are a bodybuilder, and still want creativity, you might change the rest of your workout, while leaving the first aspect the same. For example, lets say you perform 4 exercises, the last three can vary, where as the first is changeable.

3. Reps can be varied, depending on the main goal. If the goal is motor unit recruitment, you might vary it, as was discussed in the above section, under *monitoring the specified range.*

I need to point out a very significant point however, and that is the next section of this article.

C. *When Hardwiring Do It Right!* – One vital aspect of improving neural drive is to perform the exercise correctly. This is why reps must be applied accordingly, to the exercise at hand. Movements that take less coordination such as leg extensions, obviously take less coordination then say the deadlift. Many exercises should be performed at very low reps such as the:

Power clean – Look at it this way, once you perform more then 5-6 repetitions, several muscles, such as the infraspinatous, the teres minor, and the rhomboids fatigue before your larger muscles. What does this do? It compromises the most vital aspect of the exercise: form and posture. Once you get into 7-12 reps, you would be performing the exercise improperly, which would lead to your nervous system structuring the exercise improperly, and have a much more difficult time remembering the positive aspects which occurred when you were fresh. This leads to progressively weaker form in workouts to come, a heightened occurrence of injury, and lessened neural enhancements. All of which defeat the purpose.

Therefore if your lifts, or posture, or explosiveness are not improving, you might try, repeated efforts, and no more then six reps on exercises such as the deadlift, front squat, etc. This is just one method used. Perhaps all you need to use it for, is to correct your form. Bodybuilders typically use higher reps, and for good reason. Therefore, if mechanics need to be improved, this may be the way to improve them. Furthermore, powerlifters, or football players, trying to enhance explosion, will find this very useful, in certain phases of their yearly schedule.

The bottom line: If the goal is nervous system enhancements, then provide the

body, an optimal environment for adaptation. By exposing it to negative elements, you are essentially asking for negative feedback.

The Law Of Repeated Efforts Applied To The Overall Goal

The above examples were based on strict and precise hardwiring. However, this law can also apply to a desired theme. That is, you can lift in an overall manner, be it heavy, or medium or light lifting. The key is of course to target your goal. For example, if you want to enhance sarcoplasmic hypertrophy and capillarization, then you will train a bit lighter, and use more of a constant tension motion, regardless of your selection of exercises. If we analyze one aspect of Mr. Knowlden's eight week pectoral workout, we can see that he wanted to keep the reps heavy and in a range very much conducive to hypertrophy. As discussed above, there are several factors involved within the equation listed above. He took each of them into consideration. For example, Adam used ample rest periods to allow the body to overcompensate. This is a profoundly effective technique.

For example, lets say that a person lifts the following amount of weight, each to his maximum capabilities

200 for 10 reps
1 minute rest
200 for 7 reps
1 minute rest
200 for 5 reps

Total Weight = 4, 400 pounds

If you change the rest periods it may have looked like this

200 for 10 reps
3 minutes rest
200 for 10 reps
3 minutes rest
200 for 8 reps

Total Weight = 5, 600 pounds

With method two you exposed the body to a higher capacity of work. That is a very simple look at the process. There are advantages to both low rest periods, and higher ones. The key, for every athlete is to use them in various training stages, throughout the year.

Application To Volume

This is again, the entire key to the law of repeated efforts. If the body adapts to three sets, try exposing it to 5 or six sets of a certain exercise! You see, your nervous system, through the enhanced exposure, provided by volume will increase its ability to learn(also known as synaptic facilitation). This is why high volume is a

substantiated method of building muscle. By adjusting it to your needs, it can be a powerful ally.

How To Perform Endless Repeated Efforts Without Overtraining

Tom Platz actually believed that he could add an inch to his biceps, with his mind alone. Today, many modern, new age bodybuilders have abandoned such talk as being, dare I say, ‘ outdated. ‘ In fact, there is an unfortunate trend today, to abandon what the greats have demonstrated as effective.

The question is: Was Tom Platz correct? Can the mind have a profound effect on training, outside of the weight room?

To be quite honest, the answer is an unequivocal yes. This entire article, or the majority of it, has been based on neural adaptations. Last time I checked, the Central Nervous System is composed of the brain, and the spinal cord. There is no doubt, you can improve your strength levels by just visualizing a workout! I believe, that you can literally teach your body to recruit more motor units, and thus, have a larger selection of muscle fibers to inflict damage to!

Dr. Yu, and Dr. Cole conducted a fascinated experiment. They used the movement of leg abduction as the concentrated movement in the study. They had their subjects divided into two groups. One group, trained, using this movement against resistance isometricly. The other group, sat down, placed their hand on a table, and imagined performing isometric contractions. This experiment lasted 5 weeks. Following completion, Yu and Cole found that the group that had trained, increased their strength by 33 percent. What amazed me however, was that the group that imagined training actually increased their strength by a whopping 22 percent!

Dr. Meyers, a researcher in sports psychology, also supports this study. In his study, Meyers discussed the use of imagery with performance improvement. He compared several groups, training in a variety of sports, from weight training to improving ones vertical leap, to groups performing the same activities physically, and mentally(i.e. visualization) in combo! As you may have guessed, the groups who used both, consistently outperformed the opposition!

The overwhelming point, is that the bench press, squat, deadlift, or any exercise can be performed for endless sets in your mind’s eye! An improved nervous system will directly enhance your ability to add muscle.

Note: for more information on developing the mind’s eye, click here

Final Thoughts

As Lou Ferrigno said in pumping iron: " I just wanna eat my cake. "

Yours In Sport

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