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The Think Muscle Newsletter publishes the latest news and research on exercise physiology, dietary supplements, performance enhancement, lifestyle management, health & nutrition, and bodybuilding & fitness. The newsletter is dedicated to providing accurate and unbiased scientifically based information.

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Message from the Editor-in-Chief: Do Passion and Science Really Make Strange Bedfellows?

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Why is it that passion cannot be the driving force behind scientific inquiry? In Hollywood, the combination of passion and science has lead to marvelous feats of accomplishment. Stories such as The Fly, The Island of Dr. Moreau, and Mary Shelly's Frankenstein are all stories of science driven by passion. Take for example Dr. Frankenstein's ~~monster,~~ er…huh, "project". I can still remember the first time I saw the monster come to life on the small screen. In a castle-like setting with the scientist, eyes wide with fervor, running around flipping switches and checking instruments. His tone was most enthusiastic as he barked commands to his loyal lab tech, Igor. With flashes of lightning cracking through the open ceiling and startling booms of thunder adding to the moment, Dr. Frankenstein realized his passion and brought his creation to life. "It's alive! It's alive!" he shouted, trembling with the exhilaration of accomplishing a dream. Of course in the real world, much like the movie, his peers frowned upon such passion. They failed to understand the source of his commitment. They felt his zeal clouded his judgment and introduced inexcusable bias (and yes, evil) into his research. Why? Because they had never experienced such a powerful driving force them selves. Then again, it could have been because he created a freak of nature that went on to terrorize all but innocent children and those blind to his appearance.

Scientific inquiry is traditionally wrought with conservatism. This is rightfully so. Without a conservative approach to science we run the risk of acting hastily on false assumptions. Because not all people can be trusted, including scientists, you also run the risk of being duped by con artists. History tells us that a snake in a white lab coat is often difficult to spot. Partial truths and misrepresentation of data are the tools of dishonest researchers with ulterior motives. With such a need for conservatism in science, is their room for passion?

Passion *can* fuel scientific inquiry as long as the passion is for discovery not money. It was just the other day I was asked about the claim that honey was better than maltodextrin in a post workout protein drink. I guess people were on the news groups and bulletin boards arguing about it. Those who were saying honey was a better carb source cited a recent article in a respected scientific journal that demonstrated honey to be the best carb source for a post-workout protein drink. What they weren't sharing was the fact that this study was the second of a series of studies funded by the National Honey Board at the University of Memphis Exercise and Sport Nutrition Laboratory. Located in Longmont, Colorado, the National Honey Board is a non-profit organization that develops research and consumer information programs to increase the demand for honey. So, the research was designed from the outset to increase the demand for honey. This is passion in science. Unfortunately it is a passion for money that is fueling the science, not a passion for understanding.

Anytime there is money riding on the outcome of some line of scientific inquiry, the results must be thoroughly evaluated for bias. This is true for research done by powerful drug companies all the way down to fly-by-night supplement companies. At the same time, there are those people, all over the world, whose lives revolve around their research. Many of who spend every waking hour pondering obscure questions and ways to find the

answers. These are they who lie awake at night, trying to think of new ways to test and measure. Not because they think they are going to get rich, but because the already feel rich having been given the opportunity to do what they love to do in life. We at Think Muscle share their passion for science, and your passion for health, fitness, and muscle. We feel it our privilege to bring much of this research to you with the goal to help sift through the bias, anywhere it may exist, to arrive at the truth.

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Viagra: His or Hers?

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It seems that everyone is talking, or giggling, about Viagra. You see it advertised directly to consumers on television. I get several junk e-mails per week asking if I want to buy some. Among teenagers it has reached illicit drug status, with teenage boys hording single pills and showing them off to their friends at school. Grown men and women can often be heard giggling about it over the office drinking fountain. Viagra is now the most profitable prescription drug ever produced. Viagra is seemingly bringing us into a brave new world.

Don't get me wrong. I don't have a problem with what has become a recreational drug becoming socially acceptable. I do, however, have a problem with misinformation. The problem I have with Viagra as well as many other "lifestyle drugs" is that the companies who make it push it on consumers without explaining to people what it does. Nor have doctors put as much emphasis on educating as they have on prescribing Viagra. This has lead to wild and unrealistic expectations about what it can do for people.

Here at Think Muscle we are dedicated to fighting misinformation. Why? Because it leads to consumers being taken advantage of. Yes, even prescription drug hype is used to take advantage of uneducated consumers. The company that makes Viagra could easily put out information that would better educate potential consumers. Of course this would significantly reduce the demand for the drug simply because people would know what it does and doesn't do. As it stands, many people who use Viagra will not get any benefit whatsoever out of it simply because it will no effect on their particular problem or disorder.

Now, with men representing only half of what this drug company sees as a potential market, it is now being recommended to women. Not directly mind you. That approach would not work because women have generally been led to believe it is for men. Instead, someone in the industry has begun spreading rumors of research involving Viagra and women. That way they can use the social credibility of university researchers to inadvertently hype up the drug even more, thereby increasing demand, and profits.

Despite my ranting, the question remains, is Viagra for men, women, or both? In order to answer that question for yourself you need to know the science behind this little blue love potion. I'm going to use some scientific terms that you may not be familiar with. This doesn't mean you should skip this part however. Read through the science and then we will discuss it in less scientific terms.

Science Box: Viagra 101

Viagra is the brand name for *sildenafil*. Sildenafil is a selective inhibitor of cyclic guanosine monophosphate (cGMP)-specific phosphodiesterase type 5 (PDE5). A phosphodiesterase is a phosphatase that acts on diesters to hydrolyze only one of the two ester groups. In target cells such as those in the penis, phosphodiesterase acts to hydrolyze cGMP and cAMP into inactive fragments. A phosphodiesterase-inhibitor is a molecule that inhibits the action of phosphodiesterase. Probably the most common phosphodiesterase inhibitor that you all have used at one time or another is caffeine. Keep in mind however that even though caffeine and Viagra are the same class of drug, they have considerably different effects.

Now Viagra can't work without another common substance, this time a gas known as nitric oxide, or NO. In blood vessels, NO activates the enzyme guanylate cyclase, which results in increased levels of cGMP, producing smooth muscle relaxation of blood vessel walls. This causes vasodilation. Sildenafil has no direct relaxant effect on smooth muscle alone, but enhances the effect of nitric oxide by inhibiting PDE5, which is responsible for degradation of cGMP. For example, when tactile or visual stimuli cause local release of NO, inhibition of PDE5 by sildenafil causes increased levels of cGMP in the blood vessels, resulting in penile vasodilation and subsequent erection. IF you are impotent because you have a problem somewhere along this physical chain of events, Viagra should help. IF on the other hand, your impotence is caused by vascular or neurological damage as a result of diabetes, Viagra will not help. Likewise, if your impotence has psychological roots, Viagra will only help if you really believe it will.

Viagra will help men get an erection if they suffer a lack of penile vasodilation in response to visual or tactile stimuli. Unlike testosterone, it will not increase sexual desire.

So where does this leave women? Viagra was developed to treat erectile dysfunction, and this, for obvious reasons leaves the benefits for women a bit dubious. It is not a drug that effects sex drive so what exactly does the company want women to think they will get from it? They want you to think it will improve your sex life.

Here is where I will concede somewhat and say that a woman might feel "something" with Viagra. When sexual differentiation occurs in the womb, the genitalia for men and women are basically identical when the physical changes begin. In an adult woman the clitoris is the remnant of what would have become the penis if she had become a male. The clitoris maintains some of the characteristics of the penis such as becoming engorged

with blood during sexual arousal. If anything, Viagra may increase blood accumulation in the clitoris. If this is what is keeping you from having a fulfilling sex life, go for it. If not, save your money for a nice dinner and a romantic movie.

I guess the bottom line is that Viagra acts only as an aphrodisiac because people expect it too, not because it actually affects anything but blood flow. If blood flow is what you are lacking, Viagra may be just the ticket.

Just a note before putting this topic to bed, there are no current over-the-counter alternatives to Viagra. There are no supplements available at this time that can mimic the mechanism of Viagra. Therefore, any advertising you here claiming that a product is as good as Viagra, or is a natural alternative to Viagra, or is just as effective as Viagra, are false. We at Think Muscle just thought you should know.

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Would You Like to Die Old and Still Leave a Good Looking Corpse? Science Now Makes it Possible!

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Title: Viral mediated expression of insulin-like growth factor I blocks the aging-related loss of skeletal muscle function

Researchers: Elisabeth R. Barton-Davis*, Daria I. Shoturma*, Antonio Musaro, Nadia Rosenthal, and H. Lee Sweeney*
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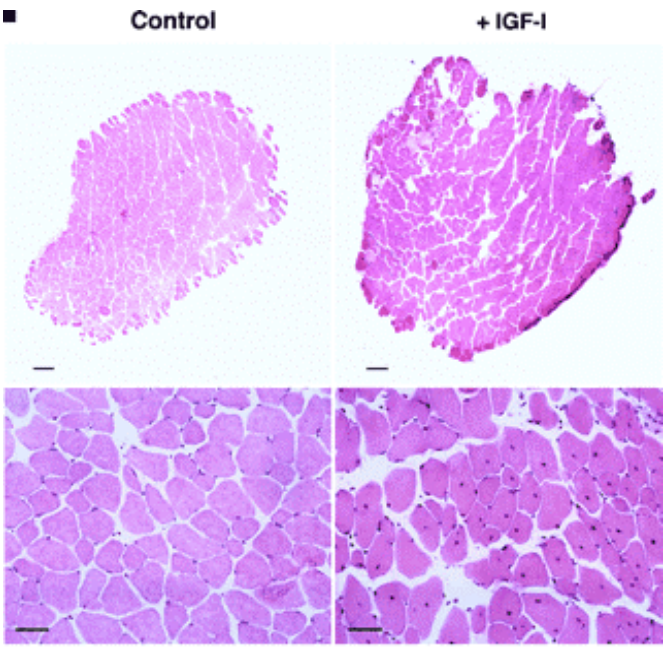
Source: Proc Natl Acad Sci U S A 1998 Dec 22;95(26):15603-7

Summary: Although the mechanisms underlying age associated muscle loss are not entirely understood, researchers attempted to moderate the loss by increasing the regenerative capacity

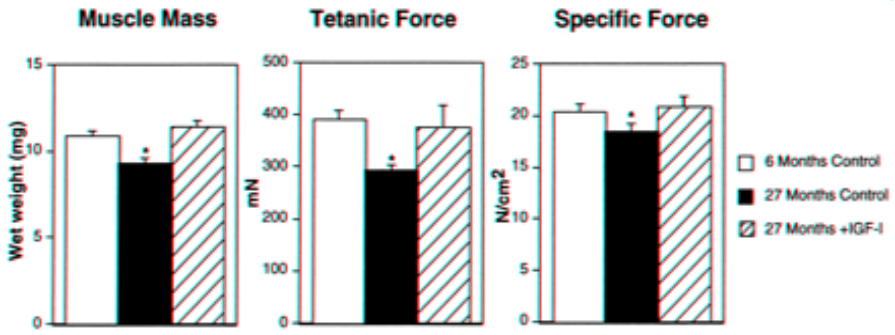


of muscle. This involved the injection of a recombinant adeno-associated virus directing over expression of insulin-like growth factor I (IGF-I) in differentiated muscle fibers. They demonstrated that the IGF-I expression promotes an average increase of 15% in muscle mass and a 14% increase in strength in young adult mice (Figure 1), and remarkably, prevents aging-related muscle changes in old adult mice, resulting in a 27% increase in strength as compared with uninjected old muscles (Figure 2). Muscle mass and fiber type distributions were maintained at levels similar to those in young adults. These results suggest that gene transfer of IGF-I into muscle could form the basis of a human gene therapy for preventing the loss of muscle function associated with aging and may be of benefit in diseases where the rate of damage to skeletal muscle is accelerated.

Discussion:

I'm not sure where to begin. This study has the potential to completely change the way we age. In this experiment, a recombinant adeno-associated virus, directing over expression of insulin-like growth factor I (IGF-I) in mature muscle fibers, was injected into the muscles of mice. The DNA that was originally in the virus was removed along with markers that stimulate immune response. DNA coding for IGF-1 was then put into the virus along with a promoter gene to ensure high rates of transcription. The results, as you can see by figures 1 & 2, were dramatic.

IGF-1 plays a crucial role in muscle regeneration. IGF-1 stimulates both proliferation and differentiation of stem cells in an autocrine-paracrine manner, although it induces differentiation to a much greater degree. *IGF-1, when injected locally, increases satellite cell activity, muscle DNA, muscle protein content, muscle weight and muscle cross sectional area.* The importance of IGF-1 lies in the fact that all of its apparent functions act to induce muscle growth with or without overload although it really shines as a growth promoter when combined with physical loading of the muscle.



IGF-1 also acts as an endocrine growth factor having an anabolic effect on distant tissues once released into the blood stream by the liver. IGF-1 possesses the insulin-like property of inhibiting degradation, but in addition can stimulate protein synthesis. The insulin-like effects are probably due to the similarity of the signaling pathways between insulin and IGF-1 following ligand binding at the receptors.

The ability of IGF-I to stimulate protein synthesis resembles the action of GH, which was shown in separate studies on volunteers to stimulate protein synthesis without affecting protein degradation. Although it is often believed that the effects of GH are mediated through IGF-1, this cannot be the case entirely. First, the effects of the two hormones are different, in that GH does not change protein degradation. Second, the effect of GH is observed with little or no change in systemic IGF-1 concentrations. Age related muscle loss has been prevented with GH injections, however it is believed that this is accomplished through IGF-1.

The results of this study are similar to other studies where IGF-1 was injected directly into muscle tissue, resulting in increases in size and strength of experimental animals. Using a virus as a genetic vehicle has an advantage over simply injecting the growth factor. The effects of a single viral treatment last significantly longer (months if not years) because the muscle cell itself is constantly overproducing its own IGF-1 from injected DNA.

The fact that the IGF-1 produced by the muscle of these mice did not reach the blood stream is interesting. Systemic injections of IGF-1 have not been successful in inducing this kind of anabolic effect in humans. In addition, IGF-1 produced by the liver is genetically different than that produced by muscle tissue. It could be that providing additional DNA for the muscle to produce its own IGF-1 is the key to achieving anabolic and rejuvenative effects specifically in skeletal muscle.

In this study there was a preferential preservation of type IIb muscle fibers in aging mice. These are the fibers most sensitive to muscle hypertrophy from training and they are also the first fibers to disappear with aging. In the mice receiving the engineered virus, there was also a preservation of the motor neuron, leading to an increase in functional capacity. It is speculated that age related muscle loss is secondary to the loss of neuronal activation of type-II fibers. By preventing the degeneration of typ-II motor units, functional capacity could be maintained into old age. This technique may also serve useful in the prevention of osteoporosis. Further study is necessary to determine whether IGF-1 is having an effect only on muscle fibers or on nervous tissues as well.

Finally, it was also exciting to see muscle growth in the *young* mice that received the injection (15% increase in muscle mass). This means that the injection provided levels of IGF-1 far and above what the muscle normally has access to and not simply a preservation of normal levels. Remember that this was not combined with exercise. The growth of the injected muscles happened even without an extreme mechanical stimulus. The mice were simply allowed to run around as they usually do. Because of these dramatic results, the authors expressed concern about the use of this technique to enhance performance or cosmetic appearance. Research Update is not my personal soapbox so I won't go off on the gender centered hypocrisy of cosmetic enhancement in our society. All we can hope for is that this technique will be used to treat more important diseases such as muscular dystrophy and thereby become somewhat available for other uses as well.

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Creating Peak Performance on Demand (From the HST Series)

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Peak performance is often referred to as the "zone" or the "grove", or even finding one's "rhythm". It can happen at any time and nearly always results in breaking personal records. People often get in their own way trying to make it happen, thinking that if they just try hard enough it *will* happen. Frustration and poor performance are almost always the result. I'm now going to share with you something that very few people know. It is a method of greatly increasing the odds of peak performance every time you lift. It requires practice and commitment. In return you will find strength you never new you had.

Within the arena of strength sports, Olympic lifting, powerlifting and bodybuilding are certainly the most recognized. You see the Olympic-style events during the summer Olympics. You see the Worlds Strongest Man competitions on ESPN. If you were at the last Mr. Olympia competition you saw many of the worlds top bodybuilders gathered together all vying for the famed Sandow. Yet have you ever stopped to ponder what psychological exercises are involved in the act of building the bodies strength and size through heavy resistance exercise? Hereafter, I would like to share with you some insight into a principle of the Hypertrophy-Specific Training method I have not shared before. It's a method of increasing strength and generating peak performance. It consists of Centering, Charging, Grounding, and Discharging (CCGD). It is the mental act of controlled, high intensity, physical exertion.

Centering is the first step in the process of CCGD. Centering is a state in which you draw within yourself mentally. Your attention is turned and focused on your own mind, in a very calm or relaxed way.

Breathing and concentration techniques are often used to center ones self. The breathing method most effective is what is called diaphragmatic breathing or abdominal breathing. It involves allowing the inhaled air to displace the contents of the lower abdominal area instead of the thoracic region. Inhalation during diaphragmatic breathing does not expand the chest. Instead, it pushes your belly out. This is the type of breathing that you will experience automatically when you are already in a deeply relaxed state. In order to purposely center yourself you will intentionally do some of this "abdominal breathing" for a period of time sufficient to relax you and allow you to become centered.

Centering should not be confused with simple relaxation. Although it is to the advantage of the athlete to be centered, too deep of a relaxed state can lead to feelings of lethargy. Instead of lethargy, becoming centered is about concentration. Concentration means to direct ones attention on a single point. Concentration should be focused internally while working towards centeredness. It is important to reach a state of concentration that

eliminates all unnecessary external distracters. This is why focusing on ones breathing, for example, is so effective at achieving both relaxation and a sense of centeredness.

It is important to maintain your concentration in such a way that you are only selectively aware of your surroundings. Selective in such a way that you can perform optimally either during a competition, when you need to be aware of the starting guns, judges or the scheduled lifting order, or in a gym where you should be aware of your coach or training partner. It is important that while being centered you are able to interact normally with others when necessary. This may sound like an unnecessary precaution, yet many times you can see someone that looks as if he is on some kind of rampage and is totally oblivious to his social responsibilities (other people) training in a public gym.

Charging is the second step in CCGD. Charging is the process of increasing physiological activation (i.e. arousal) while remaining centered. Charging is obviously an integral part of CCGD. Without charging the athlete would be left trying to achieve high intensity exertion while still in a state of relative calm and relaxation. The Yerkes-Dodson law tells us that without sufficient charging, you would not be in an optimal state for performing, competing or training.

As with centering, breathing plays an important role in charging. Thoracic or costal breathing is the type of breathing that will allow the athlete to charge effectively. In thoracic breathing, the external intercostals muscles and several synergistic muscles actually force an expansion of the rib cage while the belly is sucked in. In thoracic breathing, the chest works like a bellows, sucking air in and forcing it out.

Thoracic breathing is natural during periods of high physical exertion or stress. This being the case, thoracic breathing can act as a signal to the rest of the body to prepare for exertion and/or stress. Usually three or four rapid thoracic breaths are all that is necessary to charge. Too many of these breaths performed in rapid succession can lead to hyperventilation so don't overdo it. The point is simply to trigger the fight-or-flight response.

To facilitate the charging phase of CCGD, many athletes have successfully used a technique known as "anchoring". A classic example of anchoring is Pavlov and his dog. Pavlov, an early psychological researcher, borrowed his neighbor's dog. Every time he got ready to feed the dog, Pavlov would show him food and then ring a bell. The dog would salivate and then Pavlov would give him the food. He did this same procedure over and over until the dog linked the sound of the bell to being fed. So eventually, all Pavlov had to do was ring the bell and the dog would salivate. He even went so far as to put a tube through the dog's cheek to measure the amount of saliva that the dog produced before and after the conditioning period. He found that there was no difference in the amount of saliva the doge produced either in response to actually seeing and smelling the food in front of him, or later, in response to hearing the bell alone. The dog had anchored the sound of the bell to being fed.

To develop an anchor, you first have to achieve the desired state. In Pavlov's case this was a salivating dog. This desired state should be one that was or is experienced during peak performance. To do this you must either visualize a period of peak performance that you have recently experienced, or you have to go out and make one happen. Once you have done this, continue visualize and "re-live" that peak state several times a day. Stand exactly how you were standing, breath exactly how you were breathing, and try to see and feel exactly what you felt during that specific peak experience. This may take some practice. Over time the visualization will become more vivid and physiologically effective, meaning you will feel your body begin to respond to the visualization.

Before you attempt to gain this charged state through anchoring, you should pre-plan a unique and specific anchor. An example might be a certain motion like rubbing your hands together in a unique way, or moving the arms in a stretching motion as if to loosen them up, or even something as simple as stomping your foot on the floor. It should just be a simple and unique movement that you would not normally do. Some people, rather than relying solely on a certain act or motion, rely on other stimuli like music. Generally this is some sort of aggressive music like "real" heavy metal, or even something from today's rap/hip-hop/metal blends. Whatever does the trick is fine.

Now, while experiencing or visualizing your peak performance, perform your unique movement. It is important to perform your movement right when you are at your peak state or feeling. Over time you will begin to connect the peak state with your movement. The more intense the experience, the faster the anchor will be established.

Developing an anchor takes practice and some experience with peak performance. Ideally you should perform your anchor just prior to peak performances. You can continue to make your anchor stronger and more effective as time passes, by reinforcing the anchor during all future peak performances. This is done by repeating your movement when you achieve a new 1RM, or when you do well in a competition, or even when you just feel at your biggest and strongest during a particular workout.

In summary there are four keys to developing an anchor:

1) You must be able to put yourself in the peak state for the experience you wish to anchor.
2) Anchors require repeated conditioning.
3) The movement (or song) you choose as your anchoring stimulus must not be one that you perform commonly. Or in the case of music, it shouldn't be a song you listen to during other activities.
4) You must be able to replicate the peak state by firing the anchor.

The next phase of CCGD is called Grounding. Grounding is fairly self-explanatory. It simply means to establish a foundation through contact with the physical ground. Do not be misled by the simplicity of the precept. Without proper grounding, the final phase of CCGD known as Discharging, cannot occur optimally.

In the standing position, grounding is through the legs and feet. In other positions it is through whatever body part that is acting as your foundation, for example your feet, upper back and buttocks while bench pressing.

In addition to the primary grounding that involves the contact boundary and the physical ground, there can be secondary grounding through the eyes. Looking intently at a stationary object anchors one in and to their environment. An example of this is when a ballet dancer will visually ground him or herself while performing a pirouette. This adds additional stability in an intentionally unstable position.

The final phase of CCGD is Discharging. Once the athlete is Centered, Charged, and Grounded, what remains is to discharge the energy. The discharge is controlled by virtue of the lifter's centeredness and grounding. Its force is a reflection of the lifter's muscular strength and level of charge.

Being centered at the time of discharging means being at one with the task. No distractions. No ambivalence. No hesitation. No holding back. The discharge is the explosion of one's commitment to the task. So, upon discharge, one puts every bit of available energy into the lift with a precise and narrow focus on energy.

In summary, the process of CCGD is as follows:

1) Centering through slow abdominal breathing, relaxing the muscles, and the use of imagery to focus the attention on the inner self. All mental chatter and negative messages must be removed from the mind.
2) Charging through fast thoracic breathing and the use of anchors.
3) Grounding through a heightened awareness of the body's contact with the physical ground. A visual anchor may also be beneficial.
4) Discharging by focusing the rapid release of all charged energy towards accomplishment of the lift.

The lifter is a living energy system that requires control not only of the muscle but also of the mind. I hope this brief look into this HST principle gave you some new insight, information and tools to break new ground and achieve your goals.

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From the Think Muscle Vault: Quality Strength for Human Athletic Performance: A Guide to Speed Strength Training

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Although most athletic skills and events depend upon a variety of physical qualities, speed strength (also called power) certainly rates among the most important. Whenever you need to accelerate yourself (as in running, cycling, swimming, skating, or skiing), an external object (such as a ball, a barbell, a javelin, or another person), or both (such as pushing a bobsled or driving through an opposing lineman in football), your ability to generate force with speed will be a primary determinant of your success.

As the duration of the event or skill becomes reduced, the need for speed strength (I'll abbreviate it as "SS" from this point on) increases. However, even triathletes rely heavily upon explosive strength as they sprint to the finish line. It's not a matter of whether or not you need to develop SS, but to what degree you need to prioritize it in your training.

SS is also a vital quality during emergency situations, such as when it becomes necessary to quickly dodge a car when walking across the street, or duck to avoid being hit by a stray ball. In fact, SS is the body's preferred method of force generation— the last time you had to lift a heavy object from the floor to a high shelf, did you accelerate the load to make the task easier, or did you make a concerted effort to lift the object with a constant speed?!

For bodybuilders, SS training methods are immensely valuable for their ability to improve intramuscular coordination (the ability to recruit high threshold motor units), which has significant payoffs during later training phases utilizing lower intensity loads. In other words, a two week training phase emphasizing accelerative training techniques will potentiate the ability to lift greater loads during a subsequent phase utilizing more "traditional" bodybuilding lifting technique (i.e., constant tension, avoiding joint lock-outs, etc).

Strength: the Multi-faceted Motor Quality

Of course, SS is simply one expression of force output, and strength as a bio-motor ability has many expressions. The following list briefly describes the types of strength available to athletes:

Absolute Strength (maximal strength)
Absolute strength is defined as the amount of musculoskeletal force you can generate for one all-out effort, irrespective of time or bodyweight.

This form of strength can be demonstrated or tested in the weight room during the performance of a maximal, single repetition lift. While only powerlifters need to maximize and demonstrate this type of strength in competition, all athletes need to develop absolute strength as a foundation for other bio-motor abilities such as SS, strength endurance, agility, and others.[1] For this reason, absolute strength is brought to high levels in the preparatory period, and then "converted" to more event-specific forms of strength later in the macrocycle. Absolute strength can be displayed through three types of muscular actions:

1) Concentric Strength: the ability to overcome a resistance through muscular contraction, i.e., the muscle shortens as it develops tension.

2) Eccentric Strength: displayed when a muscle lengthens as it yields to a resistance. Eccentric strength is normally 30-50% greater than concentric strength, meaning that you can lower significantly more weight in good control than you can actually lift. This may be the result of increased intra-muscular friction (a concept not yet validated by science) during the eccentric portion of a lift. In eccentric muscular encounters with external resistances, there are two possible scenarios which can occur:[2]

> a) The resistance encountered is less than one's maximal isometric strength. In weight training applications, this applies to any load less than 1RM.
>
> b) The resistance encountered is more than one's maximal isometric strength. In weight training applications, this applies to any load more than 1RM (commonly called "eccentric training").

3) Static Strength: muscular contraction which does not cause external movement of the resistance, either because the athlete has chosen to produce exactly enough force to prevent the resistance from lowering, but not enough to lift it; or because the external resistance is immovable. Static strength is also observed during the momentary pause between the eccentric and concentric portions of a movement.

Absolute Strength Forms the Basis for Speed Strength

Despite the current preoccupation with plyometrics, specialized shoes, and the like, improving absolute strength remains the most efficient way to improve SS.[3]

In fact, Romanian strength & periodization specialist Tudor Bompa suggests that "No visible increments of power are possible without clear gains in maximal (absolute) strength."[4]

To appreciate the importance of absolute strength on SS, imagine a rocket weighing 1000 pounds, with an engine capable of 1200 pounds of thrust.

This rocket has only 200 pounds of reserve force to propel itself. The same rocket, when equipped with an engine rated at 3000 pounds of thrust, will have 2000 pounds of reserve thrust that can be used for propulsion.

Now back to the gym: a 200 pound man capable of squatting 250 pounds for a single rep will have a mere 50 pounds of reserve strength available to propel his body upward during a vertical jump. Contrast this with a 200 pound elite-class powerlifter capable of squatting 600 pounds. Now we've got 400 pounds of strength reserve available, and all things being equal, will have a vastly superior vertical jump compared to the novice squatter.

Relative Strength

Whereas absolute strength refers to strength irrespective of bodyweight, relative strength is a term used to denote an athlete's strength per unit of bodyweight (his or her "pound for pound strength"). It can be used as a modifier for other categories of strength, such as speed strength or strength endurance. So, if two athletes of different bodyweights can power clean (a display of SS) 275 pounds, they have equal speed strength for that lift, but the lighter athlete has greater relative speed strength.

Athletes who compete in weight-class events depend heavily on relative strength, as do athletes who must overcome their bodyweight to accomplish a motor task (i.e., long jump, sprinting, etc.). Further, sports which have aesthetic requirements (figure skating, gymnastics, etc.) demand the development of strength without a commensurate gain in bodyweight.

As a side note, in the World of sport, lighter athletes have better relative strength than heavier athletes, whereas the heavier athletes get the nod for absolute strength. In Olympic weightlifting for example, elite-level athletes in light weight classes have lifted triple-bodyweight from the floor to an overhead position. World-class competitors in the superheavyweight division are unable to lift even double-bodyweight; however, the absolute poundages they lift are far greater than that of their lighter peers.

Since strength training targets the neuro-muscular system, strength can be developed through two very different means— by applying stress either to the muscular or to the neural aspect of the system. The former method is usually accomplished through the application of "bodybuilding" methods (repetitions between 6-12 to exhaustion, using continuous tension techniques), and results in strength gains through an increase in muscle cross-section. The latter method employs higher intensity training (repetitions between 1 and 5 using accelerative technique and full recoveries between sets), and increases in strength are the result of the body's improved ability to recruit more of its existing motor unit pool.

Contrary to conventional wisdom, athletes who depend upon relative strength or SS should not completely avoid bodybuilding methods, which, when used judiciously, can be used to facilitate recovery between periods of intensive nervous system training. And, as you might expect, I strongly recommend that bodybuilders keep an open mind with regards to SS methods as well.

Speed Strength

Now to the topic du jour: SS is defined as work divided by time, where work is defined as force x distance. Therefore, SS is defined as force x distance, divided by time. SS is characterized by three distinct components:

- Starting strength: Defined as the ability to recruit as many motor units (MU's) as possible instantaneously at the start of a movement.[4] Common examples include the lunge in fencing, coming off the line in football, and the start in short sprints.
- Explosive strength: This quality refers to acceleration or rate of force development. In other words, once you've recruited a maximal number of MU's, how long can you keep them recruited? In his seminars, Dr Fred Hatfield, co-founder of the International Sports Sciences Association and the first man to officially squat 1000 pounds, compares starting strength to the flash bulb of a camera, and explosive strength as a flash that stays on and becomes brighter and brighter the longer it stays on.

With regards to above distinctions, different sporting skills and events can be classified as either starting or explosive strength events, depending on the relative proportion of speed and strength required. The javelin event in track and field would be classified as a starting strength event because the implement is very light, which permits the athlete to impart a great degree of speed during the throw. Conversely, the shot is relatively heavy, which means that less speed can be achieved. This makes the shot put an explosive strength event. Thus, it logically follows that starting strength athletes emphasize relatively lighter weightloads in strength training than do explosive strength athletes.

- Stretch Shortening Cycle (Reactive Strength): Although traditionally classified as a component of SS, reactive strength is more accurately thought of as an independent motor quality.[5] It involves the storage of potential kinetic energy during the eccentric portion of a movement, which is then converted to actual kinetic energy during the subsequent concentric phase— much like stretching and releasing an elastic band.

During many skills (jumping rope, for example), the working muscles attempt to maintain static contraction, with force output being provided by the storing and release of elastic energy through the tendons. Since static muscular activity requires less energy than dynamic muscular activity, reactive strength is an extremely energy-efficient way of moving— you can do more work with less calories. This is why novice exercisers can always be seen doing exercises in the easiest possible manner, using quick, choppy movements, whether it's on the bench press or the stair climber. Reactive strength is also the method of choice when someone who is tired and/or weak gets up out of a chair: instead of simply standing up, they will actually lean back first, and then quickly reverse this action, springing out of the chair. If you ask someone to rise out of a chair using pure concentric movement, it looks very unusual. To appreciate the effect of reactive strength on force production, perform a vertical jump in a normal manner, where you first crouch, and then rapidly switch and jump upwards as explosively as possible. Next, crouch, but

pause for five seconds (this pause will dissipate most if not all of the stored potential kinetic energy), and then jump upward. You'll find that the jump where the crouch (or eccentric phase) was IMMEDIATELY followed by the jump results in a more successful attempt. The key to preserving as much potential kinetic energy as possible is to switch from eccentric to concentric as rapidly as possible.

How Muscles Produce Force

1) MU recruitment (intramuscular coordination): All muscle fibers are one component of what physiologists call "motor units." A MU is defined as a motor neuron (or nerve cell) and all the muscle fibers it innervates or "recruits." Without going into excruciating detail, there are several essential bits of information that athletes and coaches should understand about the functioning of MU's:

- All the fibers of a MU tend to have the same characteristics.[5] When all the fibers are type II, the motor unit is said to be a high threshold or "fast" MU. If the fibers are Type I, it is a low threshold or "slow" MU. See Table 1 for an in-depth description of fiber types.
- The all or none principle: When an action potential is sent from the cell body to the muscle fibers, one of two events will occur. If the action potential is strong enough, all the fibers of that motor unit will contract maximally. If the action potential is not strong enough, nothing will happen. In a nutshell, muscle fibers either contract all the way, or not at all. When the body needs to apply more force, it simply recruits more MU's. Generally, untrained people have limited ability to recruit high threshold MU's because they are unfamiliar with high-tension efforts.
- The size principle: MU's are recruited in order of size— small to large. This explains why we can use the muscle to pick up something light (a pencil) or heavy (a dumbbell). As resistance increases, the body recruits more MU's.

2) Intermuscular coordination: the ability of different muscles to cooperate during the performance of a motor task. Muscles can function in several different ways depending on the task at hand. The most fundamental roles that muscles assume are listed below:

- Prime Mover: The primary muscle responsible for a movement around a joint at any given point in time. For example, during the bench press exercise, the pectoralis major is the biggest and strongest muscle involved, and as such it provides the most force during most of the exercise.
- Synergist: A synergist is a muscle which dynamically assists the prime mover. Going back to the bench press example, the front deltoid muscle and triceps would be considered synergists in this exercise.
- Stabilizer: Stabilizers are muscles which anchor or stabilize one part of the body (through static activity), allowing another part to move. In other words, they assist the prime mover and synergists through static or "isometric" muscular

contraction. The stabilizer role of muscles can be trained with exercises conducted in an unstable environment, which might involve dumbbells, Swiss balls, wobble boards, or other devices designed for this purpose.

For clarification, be aware that prime movers, synergists, and stabilizers are not different types of muscles— they are ways in which muscles perform. A single muscle might be a prime mover in one situation, and a stabilizer in another situation.

- Agonist/antagonist relationship: (Not to be confused with the roles described above). For every muscle in the body, there is another muscle capable of resisting its force. If this were not the case, controlled human movement would not be possible. When you throw a punch for example, your tricep is one of the primary agonists (you can distinguish between these two terms by remembering that "the agonist is the one inagony"), as it is the muscle which extends the elbow. The primary antagonist during punching is the biceps, which acts eccentrically to control the extension force created by the triceps so that you don't hyper-extend your elbow at the end of the movement.

3) Rate Coding: The nervous system can vary the strength of muscular contraction not only by varying the number of MU's recruited, but also by varying the firing rate of each MU, called rate coding. The tension that a MU develops in response to a single action potential from the nervous system is called a "twitch." As the stimulus from the nervous system becomes stronger and stronger, the twitches per millisecond become more and more frequent until they begin to overlap, causing greater amounts of tension to be generated by the muscle fiber. The mechanism behind rate coding is very similar to the way in which increased vibrational frequency of a sound increases it's pitch.

As an example, a muscle comprised of 100 MU's would have 100 graded increments available to it. In addition, each MU can vary it's force output over about a 10-fold range by varying its firing rate (e.g., from 10 to 50 impulses per second). For any set of conditions, the force of contraction is maximal when all MU's have been recruited and all are firing at the optimal rate for force production.

The size of a given muscle may in part determines the relative role of rate coding to total muscular force development.[6]
In small muscles, most MU's are recruited at a level of force less than 50% of maximal force capacity. Forces requiring greater tensions are generated primarily through rate coding. In large proximal muscles (such as the pectoralis and lats), the recruitment of additional MUs appears to be the main mechanism for increasing force development up to 80% of absolute strength and even higher. In the force range between 80% and 100% of absolute strength, force is increased almost exclusively by intensification of the MU firing rate.

Training Methods for Speed Strength

Since SS is comprised of speed and strength, it becomes important to consider what can be done to improve these two qualities independently, since an improvement in either aspect will improve the whole.

"Traditional" Strength Training

Since speed is primarily a genetically-inherited characteristic of the nervous system, it responds poorly to training, as compared to strength, which is perhaps the easiest motor quality to improve. For this reason, and because safer methods should be considered before more risky ones, the starting point for all athletes who wish to promote SS is traditional strength training. (I use the term "traditional" to refer to common weight room exercises performed in a traditional bodybuilding manner using a variety of intensities).

Compensatory Acceleration Training (CAT)

CAT training is a distinct form of accelerative lifting coined by Dr. Fred Hatfield. It refers to compensatorily speeding up your movement in such a way that improved leverages are compensated for. For example, when ascending out of a deep squat position, mechanical leverage begins to improve once you pass the "sticking point." This improving leverage reduces the tension on the working muscles, and in turn, the training stimulus is compromised. Deliberately accelerating through this movement path serves to increase muscular tensions. CAT technique takes time to master, because the acceleration must continue past the sticking point, yet end before the antagonist muscles are triggered into decelerating the movement in an effort to prevent joint hyperextension or loss of control. This "braking" action would be detrimental to normal coordination patterns involved with common athletic skills such as hitting, throwing, jumping, and kicking.

Ballistic Training

William Kraemer, perhaps this country's most respected and prolific strength researcher, uses the term "ballistic training" to describe movements that are "accelerative, of high velocity, and with projection into free space."[7] Ballistic training involves plyometrics, modified Olympic lifting, jumping, throwing, and striking movements (such as punching or kicking a heavy bag).

Kraemer argues that, in traditional barbell training, a significant portion of the movement path (specifically, the end of the concentric phase) is spent decelerating the bar— a protective measure assumed by the antagonists to maintain joint integrity (in upper body movements such as bench pressing), or to prevent the athlete from leaving the ground in exercises such as the squat. If Kraemer's contention is correct, one would choose to gradually reduce the volume of traditional barbell drills as the training cycle progresses, in favor of ballistic exercises which lack this deceleration phase, making them easier to learn and much more coordination-specific for most athletes.

The modified Olympic lifts

The sport of Olympic weightlifting (sometimes called "weightlifting") contests two separate lifts: the snatch, where the barbell is grasped with a wide grip, and explosively pulled to an overhead position in a single movement; and the clean and jerk, where the barbell is grasped with a narrower grip, "cleaned" to the shoulders, and finally "jerked" to an overhead position.

Competitive lifters reach very deep squat positions as they struggle to get under ponderous weights prior to achieving the overhead position. But when slightly lighter weights are used, the lifter can manage to get under the weight without going below parallel, meaning that the top of the thighs never goes past the point of being parallel to the floor. When a lifter can accomplish this, the lift is called a power clean (or power snatch). The term "power" indicates that the load was not maximal, since the lifter didn't have to squat to rock bottom to get under it. Thus, a power clean has less of a force component and more of a speed component than a competitive "squat clean."

Arthur Dreshler, MSS, author of The Weightlifting Encyclopedia, eloquently describes the benefits of Olympic lifting and its derivatives for athletes:[8]

1) Olympic lifts teach an athlete how to explode (to activate a maximum number of motor units rapidly and simultaneously).
2) Olympic lifts teach the ability to apply force with his or her muscle groups in the proper sequence (i.e., from the center of the body to the extremities). This is a valuable technical lesson for any athlete who needs to impart force to another person or object.
3) Olympic lifts teach how to accelerate objects (including other people) under varying degrees of resistance.
4) Olympic lifts teach how to effectively receive forces from another moving body.
5) The actual movements performed while executing the Olympic lifts are among the most common and fundamental in sport.
6) The Olympic lifts are commonly used to measure an athlete's force output capabilities.

If you are unfamiliar with the Olympic lifts and their derivatives. I strongly suggest that you find either an ISSA-Certified Specialist in Sports Conditioning, or a USA Weightlifting Certified Coach in your area who can assist you with these exercises. These lifts, though not beyond the capabilities of most athletes, are more complex than the majority of strength training exercises.

Plyometric Training
Although "plyos" are overused by many athletes in their quest for the "magic pill" solution to their training problems, plyometric drills performed with bodyweight, weighted jackets, light resistances such as medicine balls, logs, sand sacks and gymnastic equipment can be a valuable component of a SS development program.

Plyometric training programs must be designed with sufficient recovery periods to ensure that fatigue does not take the "elasticity" out of the athlete's movements, since it is this repeated elastic neuromuscular control of impact which provides the training effect.

Testing Your Speed Strength: The Max Jones Quadrathlon.[9]

Few athletes are aware of this unique and very useful testing implement created by the English track & field coach of the same name. The MJQ can be used to regularly monitor your level of speed strength, and can also used as a fun competition several times a year. This test is very easy to administer (you'll need to do this at your local high school or college track) and involves only a tape measure and a stop-watch. One note of caution,

however: The four test drills, although relatively simple, will take a toll on your body (particularly your hip flexors) if you have never done them before, or if it's been years since you've done them. If you fall into this category, I strongly suggest you practice these drills for before going at them "full bore." Start with very low volume (just a few repetitions of each drill) and progress gradually over a series of 4-6 sessions.

The test drills are as follows:

Three Jumps: Feet together, hop three times and land in a long jump pit. Measure from your starting position to the closest disturbance of the sand where you landed.

Standing Long Jump: Standing at the edge of a long jump pit, with toes slightly over the edge of the board, perform a standing long jump into the pit. Measure from the lip of the board to the closest disturbance of the sand where you landed.
Thirty Meter Sprint: Using starting blocks (you may also have a partner place his or her foot behind your lead foot to simulate a block), start on the command of a timer at the finish line. The timer starts the watch when your back foot makes contact with the ground on the first step, and stops it when you break the finish line.

16lb Overhead Shot: Standing on top of a shot put stopboard (your back to the pit), dip down (much like the preparatory crouch for a vertical jump), swing the shot between the legs, and then extend and throw the shot overhead backwards. It is not necessary to remain on the stopboard. Measure from the lip of the stopboard to the first point of impact.

Please see Table 2 for the quadrathlon scoring tables. Simply convert your scores into the numerical scores provided, and total for your MJQ rating.

A Periodized Training Program for SS Development: The Rule of Thirds

Since fatigue is specific to the motor quality being trained, when microcycles with different objectives and varying demands follow each other, it promotes enhanced recovery, allows for maintenance of maximal strength and body composition during periods devoted to SS (and vice versa), and protects against "overuse" types of injury. The "rule of thirds" is a planning concept which partitions each mesocycle into thirds—the first two thirds are spent training the targeted motor ability; the final third is spent training a complementary motor ability to provide recovery and balance to the program. In this program, maximal strength is the targeted motor ability for the first six weeks, while SS is the focus of the final six weeks.

Note: Before initiating this training program, complete the MJQ and record your score. At the completion of the program, re-take the quadrathlon to assess the effects of the training.

Citius, Altius, Fortius!

A Periodized Training Cycle for SS Development

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From the Think Muscle Vault: Practical Application of Speed Training Techniques in Advanced Bodybuilding Training

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Charles Staley's comprehensive article on speed strength training laid the theoretical background for understanding the various sport uses of speed strength training as well as the various methods suitable for each and the mechanics of the working muscles. That article, however, did not specifically address the application of speed strength training techniques in bodybuilding, which is the aim of this article. The goals of speed-strength training for specific sports are quite different to those of bodybuilding; while the former strives to develop maximal speed-strength (power) or plain velocity (speed) of movement, the latter uses speed training as an alternative way of increasing training intensity for the purpose of inducing muscle hypertrophy, with no special concern for maximal velocity goals.

Regular Training First

If you are a beginning trainer, it would be a mistake to incorporate speed training in your training. The ability to employ speed training techniques in an effective and safe way relies upon a foundation of muscle strength, biomechanical integrity, and neural pathways which are developed during the beginning stages of bodybuilding. If you rush your way to use speed training, you will face the risk of various injuries, including muscle strains or even tears, and tendon and ligament damage. You would do well to stick to conventional training, in which the weight is lifted in a slow, constant speed and the muscles are under a more-or-less constant tension throughout their range of motion. (Notice I did not use the adjective "controlled" to describe the movement, as "controlled" is sometimes used to qualify the movements in traditional training as opposed to other,

more advanced, methods; I maintain, however, that control is an essential quality to observe in *any* type of training, including speed training, as I will show later).

Physics for Physiques

Some very basic laws of physics first. *Weight* is a product of mass (m) x gravity coefficient (g) = (mg). When you lift an object vertically (like a weight, say...), you are generating a *force* equal to its weight plus the product of its mass (m) x acceleration (a) =(mg + ma). If there is no acceleration, like when moving the object upright at a constant speed, a = 0 so the force you are generating is equal to the object's weight. *Work* is the product of force x distance. Therefore, if you push a dumbbell 20 inches above head level you will have performed a work double that of pushing it only 10 inches. *Power* is defined as work divided by time, so the less time it takes you to do the work, the more power you generate. For instance, moving that dumbbell the same distance in 2 seconds requires generating 2 times the power as moving it in 4 seconds. For our intent, this last rule is the most important issue, because it shows why training at a higher speed entails higher intensity.

Why Speed Train?

Speed training provides an alternative path to the progressive resistance principle, which states that in order to induce muscle hypertrophy, one has to constantly keep increasing the weight used. Once past the beginning/intermediate stage, many bodybuilders reach a plateau or a "rut" where they cannot increase the weight they are using anymore. In order to continue to induce hypertrophy, you have to keep increasing the intensity, but if you cannot up the amount of weight, you have to use alternative ways to increase the intensity. Moving the weight at a higher speed implies expanding more power, as explained above, and more power translates directly to a higher intensity. Also, consider that like any other systematic change in the way you train, you are actually periodizing your training, which is a good thing by itself, whatever the change. Finally, speed training may develop motor unit recruitment patterns different to those developed using the same exercises with regular training, thus potentiating better gains with subsequent regular training cycles.

Speed training would best be applied in the form of a cycle. It should not be used on a constant, ongoing basis as an alternative to conventional training based on the progressive resistance principle.

Machines vs. Free Weights

Machines lend themselves well to speed training, provided they are not of the iso-kinetic type (mechanically damped to enforce constant movement speed), are of high quality (robustly constructed with heavy-duty bearings having relatively small friction) and are well maintained. (This needs to be carefully observed, because as the speed increases, the chances of the machine jamming in the course of execution increases sharply. See below). The execution of speed training with free weights, on the other hand, places extra demands on stabilizer muscles, mostly because the body is not accustomed to the

relatively large momentum resulting from the fast movements. The stabilizer muscles (which are not specific muscles in the body, as Charles Staley explained, but rather the ones that contract statically to anchor or stabilize the body in each exercise) have to adjust to the forces generated by fast movements in speed training. It would be wise, then, to begin speed training with machines (pulley stations qualify as "machines" for this purpose). This will allow the use of relatively heavy weights while observing proper form. "Proper form" in speed training does not relate only to keeping proper posture and not using other muscles to "cheat", but also to accurately carrying out the acceleration, speed and deceleration goals of the specific speed training method and exercise.

Because of the increased possibility of machines jamming when using speed training, carefully check the following points:

- Inspect the bearings of the moving part. Make sure that they don't have any free play, they are not wobbly, and they don't have any tendency to stick. Ascertain that bearings are properly lubricated. If you are not sure, ask the facility manager. Explain that you intend to use high speed on the machine and that you need his or her approval of the integrity of the machine.
- In machines using a single stack of weights or a single loading bar for plates, and which present a wide span between two arm handles (fork-like designs), you can inspect the integrity and quality of the bearings by *carefully* attempting to apply force to one side of the machine. Using a relatively light weight and applying force at a high speed, observe whether there is any noticeable friction, wobble or tendency to stick. This method is also applicable to inspecting the movement of the bar in a Smith machine, the movement of the padded bar of the leg curl machine (leg extensions are not suitable for speed training - see below), and the movement of the platform in the leg press machine.

This is not to say that speed training should not be executed with free weights. On the contrary, speed training with free weights affords some advantages over machines, specifically the complete lack of friction, the extended range of motion in some exercises, the recruitment of synergist muscles, and a kinesthetic feedback (sense of movement at the joints) more closely resembling that obtained in everyday movements. However, the initial weight used should be lower than those used with machines, to allow the body to learn to compensate correctly for the forces generated by the movement. I suggest you heed this carefully - you could end up with an injury otherwise. After some training with relatively small weights, you could then build on the improvement of the stabilizer muscles in coping with fast movements and gradually use heavier weights.

Bodyweight Exercises

Bodyweight exercises are also very suitable for speed training. The reasons again have to do with stabilization during the movement. As it happens, we know how to handle relatively fast movements of the body - and how to stabilize it during such movements - from our everyday activities.

The two exercises that come to mind here are dips and chins. If you can't perform these satisfactorily using speed training - and many can't - a good idea would be to perform these on an assisted machine, where the foot platform is counter-balanced (loaded) by a varying weight. Selecting a proper amount of counter-balance weight will allow you to perform a satisfactory number of reps using speed training.

Velocity Patterns through a Movement

The positive (concentric) part of most exercises, no matter whether performed traditionally or by employing speed training, can be divided into three phases:

> *Acceleration Phase:* The initial part of the movement, in which the weight is brought from a standing still to the target speed;
>
> *Constant Speed Phase:* The part of the movement in which the weight is moved in a more or less constant speed (note that some speed training techniques omit this phase);
>
> *Deceleration Phase:* The final part of the movement in which the weight is decelerated in order bring the weight to a stop at the required position while avoiding hyper-extension, -flexion or -rotation, depending on the case.

The best-known exercise deviating from this pattern is the deep squat (going below 90°), in which the pattern is acceleration - deceleration (reaching the sticking point) - acceleration - deceleration. But many other exercises can be performed using differing acceleration and deceleration patterns throughout the movement, depending on both the varying force curve through the movement and, with advanced trainers, trainer's explicit control.

Joint Lock-Out

While in conventional training it is advisable to avoid joint lock-out at the end of a movement, especially where the elbow and knee joints are concerned, this is not practical in speed training. However, because of the lower weights used in speed training, the risk of joint hyper-extension is somewhat reduced.

Observing the Speed Limit

While the target of sports-specific training may be to achieve very high speeds, our goals in bodybuilding are quite different and so is the desired speed. In bodybuilding our aim is to induce maximal muscle hypertrophy and so we want to use *the combination of resistance (weight) and speed* that will accomplish this. This implies using heavier weights and slower speeds than those used in many types of sports-specific training. Another consideration is that the use of heavy weights promotes the risk of hyper-extension, -flexion or -rotation at the end of a movement. The higher the weight, the more

inertia it has and the bigger the momentum it generates, and consequently bringing it to a stop requires the antagonist muscles (the muscles working in an opposite direction to the "working" muscles) to generate more force and do this in a shorter order. Since there is a practical limit to the capabilities of the antagonist muscles, the speed employed should be such that it will not risk arriving at such danger situations.

The target speed for the concentric part of the movement for bodybuilding training should be between 0.75 and 1.5 seconds. This, however, is a generalized figure and should be determined individually for each exercise. The determining factor here is the length of the movement, which is, of course, directly related to the time it takes to execute it. For instance, the length of movement in a machine shoulder press is larger than that in a dip and, consequently, you should aim to complete a dip in about 1 second while for the machine shoulder press you should aim closer to 1.5 seconds.

Selecting the Weight

There are no hard and fast rules in selecting the weight to use in speed training for bodybuilding. The most important guideline is to select a weight which will force you to use just about the right speed of movement. This should be light enough to allow you to use the faster movement speeds implied by speed training yet heavy enough to *naturally* limit the speed when applying maximal effort. By *naturally* I mean the weight will dictate a maximal speed commensurate with our speed goals for bodybuilding. As a rule of thumb, if you can complete the concentric part in less than 0.75 seconds, the weight is too low. I actually find that the best way to determine the amount of weight is to work my way down until I can move the weight at the right speed. A good starting point is to employ about 60 to 70 percent of your usual poundage (*not* your 1RM). For instance, if you are usually using a weight of 140 lbs. on a narrow-grip lat pulldown machine, use no more than 100 lbs. for speed training.

What should happen after a few sessions of speed training however is that, for each exercise, you will develop a "feel" for both the amount of weight to use and the speed at which to move it such that the resulting intensity and gains will be optimal.

Proper Technique

The most important issue to observe with speed training is that of constant tension through the range of motion. Even though you will speed the weight through the motion, which means you will generate a momentum that may decrease the load on the working muscles at some points in the movement, you still want to keep the muscles under constant tension. This implies adhering to two principals:

> **Using Super-Strict Form.** You do not want any of the acceleration imparted to the load to originate from jerking or "cheating" movements. If you jerk, the initial part of the movement may be devoid of any tension on the working muscle - something you'll dearly want to avoid.

Using Progressive Acceleration. Because the momentum that is generated when a mass is accelerated tends to reduce the load once acceleration stops, you should attempt to continue to accelerate the load throughout the movement. As long as the load is accelerated, more power is generated and the muscles are kept under tension. If you rely on the momentum generated during the initial part of the movement to "carry" you through the end of the movement, you are not placing the muscle under the constant tension necessary for best results. This also means that you should try not to apply maximal force right at the beginning of the movement, but rather increase it gradually over the course of the first third to one-half portion of the movement.

Speed Training Techniques for Bodybuilding

Since the purpose of using speed training in bodybuilding is not to develop maximal speed (velocity), but rather to achieve higher intensity training, I will discuss only those speed training methods that provide increased training stimulus for muscle hypertrophy:

Constant Speed Training

In constant speed training, you perform the rep at a relatively high speed, but without acceleration throughout the movement. This is a misnomer because as you begin your movement, you *will* accelerate the weight until it reaches a certain speed; in this respect, any type of weight training involves acceleration of the weight from its dead-stop starting position to a certain speed, only in conventional training this speed is relatively low and the acceleration required is proportionally small.

In constant speed training, you should attempt to accelerate the weight to a relatively high speed during the first one-third to one-half portion of the movement, and then attempt to maintain a constant, but high, speed through the end of the movement. Near the end of the movement, deceleration is achieved through both the reduction of power of the agonist muscles and the braking action of the antagonist muscles.

Explosive (Ballistic) Training

Perhaps the best known of all speed training techniques, "explosive" refers to the rapid recruitment of a large number of muscle fibers, and is expressed kinetically as a continuous acceleration of the weight throughout the movement. While what might happen in reality is that acceleration will occur in only part(s) of the movement, interspersed with constant speed/deceleration parts, the aim of the trainer is to keep accelerating the weight during the entire course of the concentric phase. Varying leverage points as well as the force curve of the muscle through the movement will translate to various speed patterns in reality, however the feeling of the trainer may be that of continuous acceleration.

The effectiveness of this technique lies in two factors: 1. The constant tension on the muscle that is maintained throughout the movement, as the continuous acceleration ensures that the momentum generated by the weight does not decrease the tension on the muscle as would happen with constant speed training; and 2. The motor unit recruitment patterns, which would seem to favor more high-threshold units as power is developed explosively through the movement.

Compensatory Acceleration Training (CAT)

In various exercises such as the squat, mechanical leverages change through the movement so the tension on the working muscles changes in various points in the movement. In CAT, the trainer deliberately accelerates during the points where the leverage improves in order to keep the tension high. For instance, in a squat, the leverage improves once past the "sticking point" on the ascend, so a CAT trainer will attempt to apply more power at this stage. In classical CAT training for sports, a very deliberate attempt has to be made to prevent a forceful braking action near the end of the movement, which might hamper sports-specific faculties; however for bodybuilding this is not necessary and no special attempt at deceleration should be made beyond what is necessary to prevent injury.

Reactive Strength Training

Reactive strength consists of two elements: The stretch reflex (also known as the Stretch Shortening Cycle) and elastic kinetic energy. The mechanism behind SSC is as follows: As the agonist muscles stretch at the end of the eccentric (negative) part, a reflex mechanism kicks into action which causes the contraction of these muscles, thus preventing them from over-stretching. (This, by the way, is one of the reasons you have to stretch slowly and gently). When properly utilized, this reflex can add to the power of the subsequent contraction. Also, near the end of the eccentric, kinetic energy is stored in the elastic connective tissues, including muscle sheath, tendons, ligaments and the muscle itself. This energy is released at the beginning of the concentric phase, contributing to the power generated at that phase.

For reactive strength training, you should use a weight even lower that that used for the other techniques. A good starting point is to use about 50% of your usual poundage. The sudden reversal from the negative to the positive portions places extreme demands on muscles, tendons and joints. To utilize reactive strength in speed training, you should use a specific form as follows: Perform the eccentric part (e.g. lower the weight) in a moderate pace. Just as you reach near the bottom of the movement, brake (decelerate), almost coming to a full stop, but not quite; then slightly relax again, allowing the weight to "tension" your working muscles while mentally preparing to forcefully reverse directions. Then apply a strong, ballistic reverse force to begin the concentric part. If you do this right you

should feel as if your muscles have a "springy" quality near the end of the eccentric and the beginning of the concentric. It is interesting to note that experienced trainers use this technique instinctively, even if they are not aware of it.

Be careful with this technique where balance of the body needs to be securely established before beginning the positive portion, such as in the squat, the bench press, etc.

The Pre-Stretch

The pre-stretch is used in regular training, but it has a synergy with speed training. The difference between the pre-stretch and reactive strength forms is that for the pre-stretch you decelerate and brake at the bottom of the movement, then slowly relax the working muscles somewhat so that they are slightly stretched beyond their normal starting position, then *pause* and *hold* this position for a moment and start the concentric position. There are specific exercises where the pre-stretch is most effective, such as low-pulley rowing, narrow-grip lat pulldowns, chins and dips.

Alternating Reps/Sets

I find it very effective to alternate speed reps with regular reps as well as speed sets with regular sets. Within a set, the basic idea is to perform a regular rep, then a speed rep, then a regular again, but variations on this theme are possible, like 2 speeds/1 regulars, etc. For sets, I find that a 1/1 alternation works best. Presumably, fiber recruitment patterns vary somewhat between regular and speed reps and this allows for a (short) partial recovery of fibers between the alternating reps, allowing for a fuller exhaustion of the entire muscle. On a larger scope this may be true for entire sets as well.

Selecting Exercises

Let me now discuss specific exercises. I'll start with exercises suitable for speed training and then list some that are not.

Suitable

Exercise	**Optimal Execution Time of Concentric Part (in Seconds)**	**Notes**
Machine Shoulder Press	1.0-1.5	Make sure not to lock your elbows out too forcefully at the end of the movement. (As explained above, joint lockout is unavoidable in speed training. The point is not to lock the joint out with excessive force).

Assisted Dips	0.75-1.0	As above.
Assisted Chins	~ 1.5 or less for partials (see note).	1. With chins there's no concern of elbow hyper-extension, so you can accelerate right through the end of the movement. 2. If you do partial reps - e.g., going down to parallel (upper arms at 90° to the ground) - cut the speed down to 1 sec. or less.
Narrow-Grip Lat Pulldown	1.0-1.5	Use a pre-stretch or reactive training form for maximal effect.
Low Pulley Rowing	1.0-1.5	As above.
Pec Dec Flies	~ 1.5	As above.
Smith Machine Bench Press	~ 1.5	Avoid using too heavy weights.
French Triceps Extension	1.0-1.5	As above.
Triceps Pushdown	1.0-1.5	As above.
Hack Squat	~ 1.5	As above.
Leg Press	~ 1.5	As above.
Seated Leg Curl	~ 1.5	Do not perform on a lying curl machine. See below.

Unsuitable

Exercise	**Reason**
Leg Extension	High risk of knee hyper-extension, in a position preventing other joints from absorbing some of the lock-out impact.
Lying Leg Curl	High risk of lower back injury.
Shoulder Lateral Raises	Because of the long movement at the palms, this exercise is performed at quite a high speed normally, generating a rather large momentum; using speed training will result in a *decrease* of tension through a large portion of the movement.
Deadlift	High risk of lower back injury.

Designing a Program

While various speed training regimens call for relatively low volumes (sets x reps), they are usually targeted at certain sports-specific goals such as maximal velocity or strength speed (power) and not muscular hypertrophy. Your training volume as a bodybuilder should be about the same as for a regular routine. Within your routine, you can mix regular and speed training exercises. I do suggest, however, that for the first few times you use speed training techniques, you will stick with them for at least two weeks, because it takes some time to master the skills for correct execution of speed training exercises. As you progress, you will develop the "feel" for which exercises and which techniques work best for you, and the mastery of the best way to accelerate the weight for achieving best muscle growth goals.

It is best to utilize speed training in a cycle lasting no more than 2 weeks, during which you should attempt to work each bodypart from 2 to 4 times. After the cycle, take some time off from training - 3 to 6 days would be appropriate - before switching to your next cycle. You may notice an improved performance in the subsequent cycle resulting from the neuromuscular adaptations that occurred in the speed training cycle.

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Best regards,

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