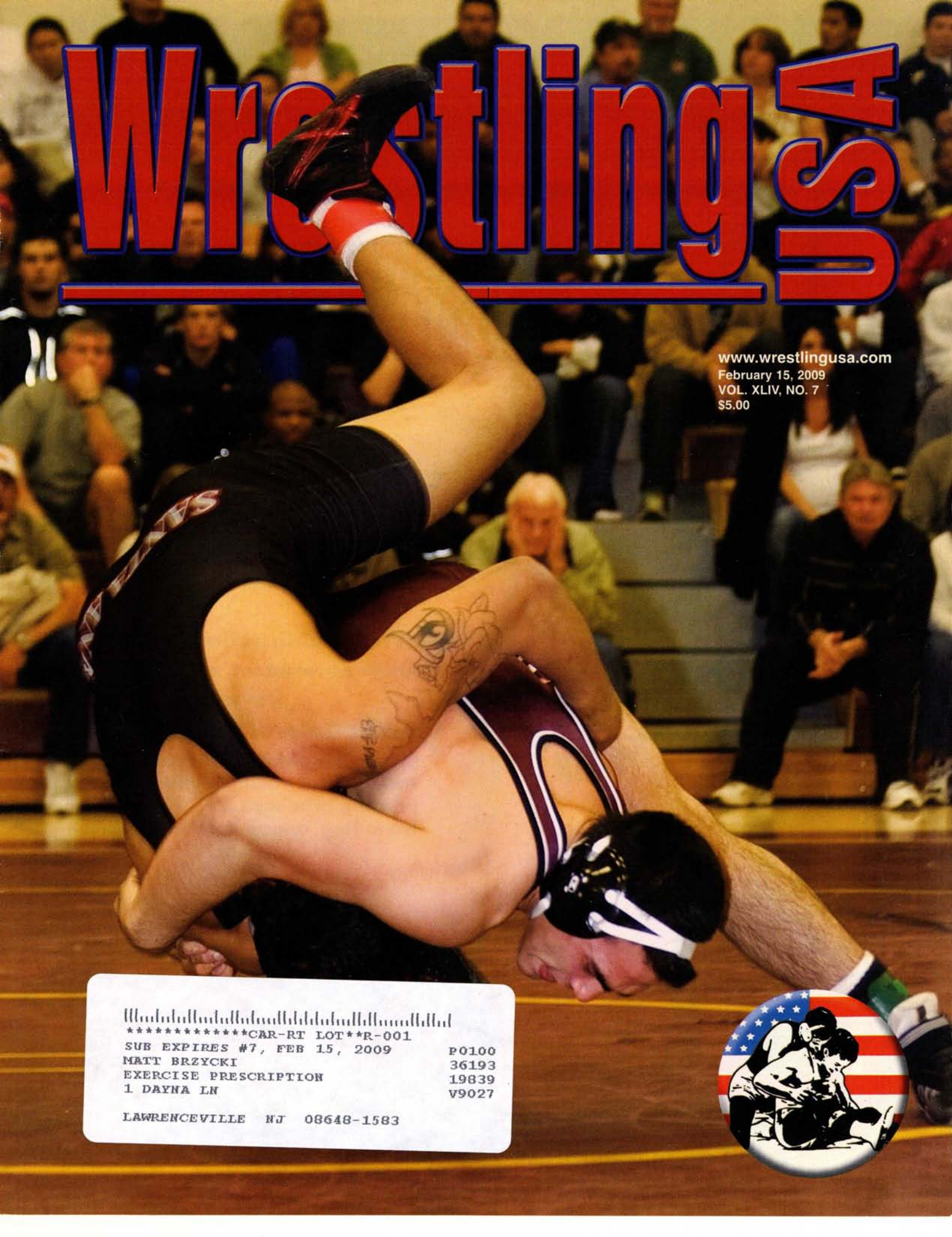
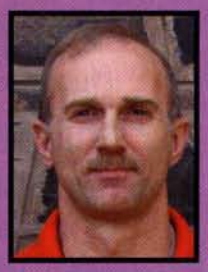
Wrestling USA

www.wrestlingusa.com
February 15, 2009
VOL. XLIV, NO. 7
$5.00



WHEN A NEGATIVE IS POSITIVE



By Matt Brzycki

For the most part, a negative is not a good thing. When you have a negative cash flow, for example, it means that your expenses are greater than your income. And when you have a negative attitude or negative outlook, it means that you are unenthusiastic and pessimistic.

But when you are lifting weights, a negative is a good thing. Let's see how.

MUSCULAR CONTRACTIONS

The term "contraction" implies that something is being shortened. But when referring to a muscle, "contraction" has a different meaning. In this case, a contraction is a process in which a muscle produces force.

There are three types of muscular contractions that can be used to lift a weight: concentric, eccentric and isometric.

A concentric contraction occurs when a muscle shortens against a load. Here, movement is away from the earth. If you stand up from a chair, your gluteals, quadriceps and hamstrings are doing a concentric contraction. Or if you raise a barbell from your upper legs to your chin in a curling motion, your biceps are doing a concentric contraction. Raising a weight involves positive work and is sometimes known as the "positive phase" of a repetition.

An eccentric contraction occurs when a muscle lengthens against a load. Here, movement is toward the earth. If you sit down in a chair, your gluteals, quadriceps and hamstrings are doing an eccentric contraction. Or if you lower a barbell from your chin to your upper legs in a curling motion, your biceps are doing an eccentric contraction. Lowering a weight involves negative work and is sometimes known as the "negative phase" of a repetition.

An isometric (or static) contraction occurs when a muscle shortens and its tendon lengthens by the same amount that the muscle shortens, thereby producing no change in the overall length of the muscle-tendon complex. If you hold your body in a half-squat position, your gluteals, quadriceps and hamstrings are doing an isometric contraction. Or if you hold a barbell in a bent-arm position, your biceps are doing an isometric contraction. From a scientific standpoint, work is defined as "force times distance." Since no external movement takes place during an isometric contraction – there is no "distance" over which the force is applied – the mechanical work is zero. (While there is no mechanical work, there is metabolic work.)

Note: Another type is an isokinetic contraction in which the angular velocity of a limb is constant. An isokinetic contraction requires highly specialized equipment and does not occur in sports – or in everyday life, for that matter. Therefore, this type of contraction will not be considered further.

STRENGTH LEVELS

Regardless of how a muscle contracts, it produces force. But the different types of muscular contractions produce different amounts of force. For the purposes of the ensuing discussion, you can think of "force" as "strength." A muscle has three levels of strength: positive (the ability to raise a weight), negative (the ability to lower a weight) and static (the ability to hold a weight motionless).

Your negative strength is always greater than your positive strength in the same exercise. Stated differently, you can always lower more weight than you can raise (again, in the same exercise). Or look at it this way: It takes less effort to lower a weight than it does to raise it. Indeed, walking down stairs (which involves negative work) is far easier than walking up stairs (which involves positive work). Clearly, going down stairs will not elevate the heart rate and respiratory rate as much as going up stairs. Along these lines, oxygen consumption and energy expenditure are significantly lower during negative work than positive work.

Another way to illustrate the fact that negative work requires less effort than positive work is to imagine doing a bicep curl with a 30-pound dumbbell. When you raise the dumbbell, you must produce more than 30 pounds of force. But when you lower the dumbbell, you must produce less than 30 pounds of force. Remember, if you produce more than 30 pounds of force, the dumbbell will move upward. (And if you produce exactly 30 pounds of force, the dumbbell will remain stationary.)

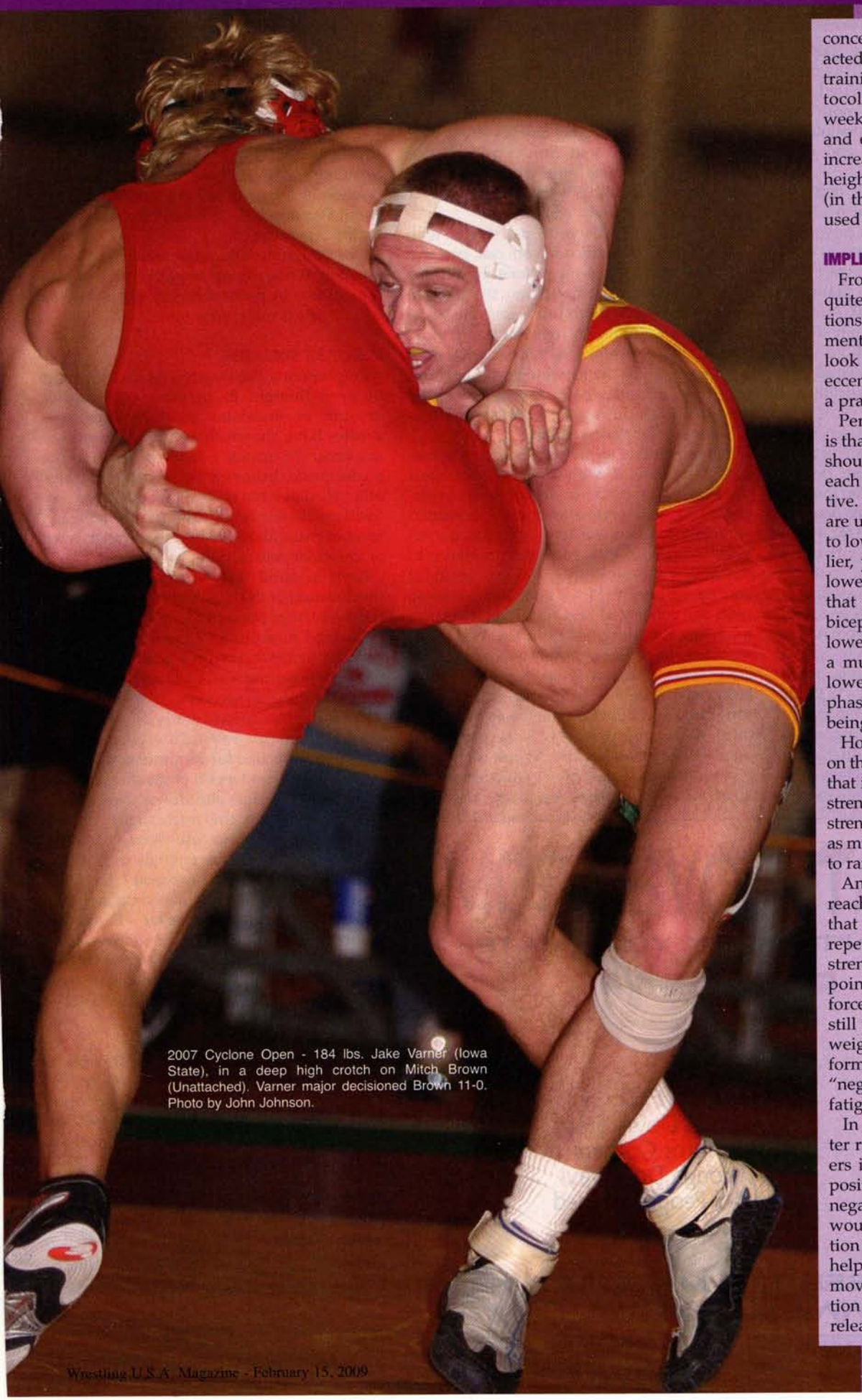
How much greater is negative strength compared to positive strength? Well, research has shown that negative strength is about 40% more than positive strength (at least in the case of a fresh, un-fatigued muscle). So if the most weight you can raise is 100 pounds, you can probably lower about 140 pounds. (Static strength is about 20% more than positive strength. So if the most weight you can raise is 100 pounds, you can probably hold about 120 pounds in one position.)

MORE NEGATIVE RESEARCH

A large number of studies have been conducted on eccentric contractions. Here are two that have relevance to strength training:

In one study, subjects were assigned to two training groups: One group did two sets of eight repetitions with 80% of their one-repetition maximum (1-RM) and the other group did two sets of eight repetitions with 40% of their 1-RM for the positive phase and 100% of their 1-RM for the negative phase. In other words, someone who had a 1-RM of 100 pounds used 40 pounds for the positive phase and 100 pounds for the negative phase. (The device used in the study allowed for independent selection of resistance for the positive and negative phases.) A third group acted as a control and did not do any training. After doing the assigned protocol two times per week for six weeks, the group that emphasized the negative phase with an enhanced workload increased their strength by 28.8% while the other group increased their strength by 19.0%.

In another study, subjects were assigned to two training groups: One group did five sets of 12 concentric contractions and the other group did five sets of six eccentric contractions and six



2007 Cyclone Open - 184 lbs. Jake Varner (Iowa State), in a deep high crotch on Mitch Brown (Unattached). Varner major decisioned Brown 11-0. Photo by John Johnson.

concentric contractions. A third group acted as a control and did not do any training. After doing the assigned protocol three times per week for 12 weeks, the group that used concentric and eccentric contractions had greater increases in peak torque, vertical jump height and three-repetition maximum (in the half-squat) than the group that used only concentric contractions.

IMPLICATIONS AND APPLICATIONS

From these and other studies, it is quite evident that eccentric contractions are an extremely important element of strength training. Let's take a look at how the information about eccentric contractions can be applied in a practical manner.

Perhaps the most obvious implication is that the negative phase of a repetition should be emphasized. By doing this, each repetition becomes more productive. Remember, the same muscles that are used to raise a weight are also used to lower it. In a bicep curl, as noted earlier, your biceps are used to raise and lower the weight. The only difference is that when the weight is raised, your biceps shorten and when the weight is lowered, your biceps lengthen. Because a muscle lengthens when a weight is lowered, emphasizing the negative phase also ensures that the muscle is being stretched properly and safely.

How much emphasis should be placed on the negative phase? It has been stated that in any given exercise, your negative strength is greater than your positive strength. Therefore, it should take at least as much time to lower a weight as it does to raise a weight.

Another implication is that when you reach muscular fatigue in an exercise – that is, when you cannot do any more repetitions – it is because your positive strength has been exhausted. At this point, you cannot produce enough force to raise the weight . . . but you can still produce enough force to lower the weight. This fact is the basis of performing negative-only repetitions (or "negatives") after you reach muscular fatigue.

In a negative-only repetition, a spotter raises the weight and the lifter lowers it. Essentially, the spotter does the positive work and the lifter does the negative work. As an example, you would perform a negative-only repetition on the leg curl as follows: With no help from you, your spotter brings the movement arm to the mid-range position (your legs bent). Then, the spotter releases the movement arm and you

slowly lower the resistance to the start/finish position (your legs straight). This procedure would be repeated for the desired number of repetitions (usually no more than about five). In effect, these "post-fatigue" repetitions are positive-assisted and negative-resisted.

To obtain the best results, each negative-only repetition should take about 6 - 8 seconds to complete. Performing a few negatives at the end of a set allows you to reach eccentric muscular fatigue – when your muscles have been exhausted to the point that you cannot even lower the weight. And that is why a set-to-fatigue followed immediately by several negative-only repetitions is so brutally effective: You have exhausted your muscles completely, both concentrically and eccentrically.

You can also do an entire set that consists of negative-only repetitions. Since your negative strength is always greater than your positive strength (in the same exercise), you can use more resistance for a set of repetitions done in a negative-only manner than you can for a set of repetitions done in a traditional manner. As a starting point, use about 10% more resistance than you are normally capable of handling. So if you can do a set with 150 pounds in a traditional manner, begin with about 165 pounds for a set of negative-only repetitions. In the case of eight-second negative-only repetitions, appropriate repetition ranges are about 11 - 15 for the hips, 8 - 11 for the legs and 5 - 9 for the torso.

The major drawback of negative-only repetitions is that at least one other individual is usually required to raise the weight. There are a handful of notable exceptions, mainly exercises that are done with the bodyweight such as push-ups, dips, pull-ups, chins and crunches/sit-ups. For instance, you can do a negative-only chin by stepping up to the mid-range position (your arms bent) and lowering your body slowly to the start/finish position (your arms straight). Stated otherwise, your lower body does the positive work and your upper body does the negative work.

If no one is available to assist you with negative-only repetitions, you can perform negative-accentuated repetitions. In doing a negative-accentuated repetition, the positive work is shared by both limbs and the negative work is done by one limb. In other words, the resistance is raised with both arms or legs and then lowered with one arm or leg. As a result, the resistance is literally twice as much during the negative phase as it is during the positive phase.

It is impossible to perform negative-accentuated repetitions with a barbell but most machines permit you to do so. As an example, you would perform negative-accentuated repetitions on the leg extension as follows: With both legs, raise the resistance to the mid-range position (your legs straight) and pause briefly. Move your left leg away from the roller pad and hold the resistance momentarily with your right leg. With your right leg, lower the resistance slowly to the start/finish position (your leg bent). With both legs, raise the resistance to the mid-range position but this time lower the resistance with your left leg. This procedure would be repeated for the desired number of repetitions. In the case of negative-accentuated exercise, appropriate repetition ranges are about 15 - 20 for the hips, 10 - 15 for the legs and 6 - 12 for the torso. (Note that these are the total repetitions for both limbs, not the total repetitions for each limb.)

As a starting point, use about 70% of the resistance that you are normally capable of handling. So if you can do a set with 100 pounds in a traditional manner, begin with about 70 pounds for a set of negative-accentuated repetitions.

One final note: You must maintain a stable position when doing negative-accentuated repetitions. In particular, you should avoid twisting or turning your torso.

MUSCULAR SORENESS

Emphasizing the negative phase of a repetition is thought to produce an excessive amount of muscular soreness. However, studies have shown that muscular soreness can occur if a muscle is loaded excessively in a concentric, isometric or eccentric manner; other studies have shown that eccentric contractions do not necessarily induce a greater level of muscular soreness than other types of muscular contractions.

Keep in mind that when lifting weights, the duration of the negative phase involves a relatively brief period of loading. If a weight is lowered in about 3 - 4 seconds per repetition, for instance, then the eccentric loading that occurs during a set of 15 repetitions only lasts about 45 - 60 seconds.

Compare this to one study in which rats were made to run downhill on a treadmill at a 16-degree decline for 90 minutes which, by the way, was the steepest angle that could be used before the rats slid down the tread. In fact, according to the researchers, "It was usually necessary to use some electrical shocks to stimulate the animals to run during the initial part of the exercise." Ya think?

The negative phase of a repetition – and eccentric activity, for that matter – is safe and productive as long as it is not performed to an extreme. As the muscles become more familiar with eccentric loading, the potential for muscular soreness will be reduced dramatically.

THE LAST REP

The lowering of a weight is at least as important as the raising of the weight. For this reason, the negative phase of each repetition should not be overlooked. This is one instance when you are encouraged to have negative thoughts!

Matt Brzycki has authored, co-authored or edited 17 books on strength and fitness including four that are devoted to wrestling. His latest book is Youth Fitness: An Action Plan for Shaping America's Kids.