Volume 22, Number 5, pages 22–23

Variation: An Important Component of Training

Bruce W. Craig, PhD
Human Performance Laboratory
Ball State University

Bruce W. Craig
Column Editor

TWO KEY INGREDIENTS IN ANY exercise program designed to increase muscle size and strength are hard work and time. However, to be successful you must use effective training techniques. Individual or team training protocols based on established rules of training can be very effective but may produce less than the desired results if they lack one important factor: variety. Variation is an important component of a successful training program, but it is often overlooked. By concentrating on workload, rest to work ratio, or muscle balance, it is easy to forget that although muscles are very adaptable, they are rather dumb. I do not intend to diminish the role that the muscle plays in movement, but it can only do what the nervous system tells it to do. In other words, the muscle is controlled by neural input.

Neural Adaptation

Exposing the central nervous system (CNS) to a new experience sets up a recruitment pattern that produces enough force to move the muscle. The developmental stage of this process is termed neural adaptation, and it represents the time it takes the CNS to establish an appropriate recruitment pattern. The basic decisions involve picking the appropriate motor units (motor neurons and the muscle fibers they activate) and determining how many motor units should be involved and at what rate of stimulation. Constant repetition of the stimulus eventually sets up a neuronal sequence that becomes a motor memory.

The strength gains you experience at the start of a resistance program can be attributed to neural adaptation. Basically, the CNS adapts to the stimulus. Its first efforts are rather crude, but as the CNS learns to adjust, the motor unit number and rate of stimulation activity becomes smoother. Progressive workloads will force the muscle to grow, and the resultant muscle hypertrophy will account for the strength gains of the latter stages of training.

Recruitment Patterns

An understanding of how the CNS controls muscle contraction is important if you want to maximize your training. Movement patterns are produced by a feedback system that involves the cerebral cortex, the basal ganglia, and the cerebellum, which enables you to form a motor memory. The memory represents the type of movement needed (eccentric versus concentric, isometric versus isotonic, etc.), the muscles required for the movement (agonists versus antagonists), and the amount of force necessary to overcome resistance. Except for force, all of these factors are preselected for most of your movements because they represent movement patterns you developed long ago (walking, running, lifting, etc.). Therefore, they may only need minor adjustments. Force adjustments, on the other hand, require more feedback and may recruit motor units you have not recruited before or have not used for a long time.

The peripheral feedback system the CNS depends on the most is located in the muscle and its joints. The belly of the muscle contains muscle spindles that give the CNS an indication of how many motor units have been activated, whereas the Golgi tendon organs in the tendons give an indication of how much tension was developed. Proprioreceptors in the skin and joints give an indication of speed, and, when combined with visual input, give you a sense of movement.

One method of improving feedback prior to lifting is testing. For instance, if you are asked to lift an unknown weight, you might test it before you lift it. Once the CNS has a feel for the weight—"Yes, I can lift that"—it can do a better job of determining how many motor units will be needed and at what rate they should fire. After the number and rate are decided, the weight is lifted and adjustments are made if too much or too little force was used. It might seem odd that the CNS depends on both the motor unit number and the rate of stimulation to control force, but the two work very well together to give you a smooth lifting performance. The basic rule is that small muscles are more dependent on the rate of stimulation, whereas large muscles use more motor units. However, even in large muscles the stimulation rate is important during the early activation of a muscle, and numbers are more important later in the lift.

Other factors that control the amount of force the muscle must generate during a lift are inertia (the force needed to start the weight moving) and joint type (force can vary though the range of motion). Considering all of the factors involved, it is not surprising that it takes the CNS a while to adapt to a new movement pattern.

■ Muscle Fiber Types and Fatigue

Current literature demonstrates that skeletal muscle consists of 3 specific fiber types and several hybrid isoforms, which are too complex to review here. Therefore, I will limit this discussion to the common forms: types I, IIa, and IIx. The size principle of recruitment states that small motor units (type I) are recruited before larger ones (types IIa and IIx). Although size (motor neuron to muscle fiber number) is important, contraction speed and fatigue also set the recruitment pattern. Type I fibers are slower and less likely to fatigue than either of the type II fibers, and therefore produce less force when contracted. During low-intensity exercise (below 60% of the 1 repetition maximum [1RM]), type I fibers are more active, but as the workload moves above 60%, type II fibers become more involved.

Lifting a weight may not represent a new experience, but lifting a weight that is heavier than you normally lift will recruit muscle fibers you do not normally use. For example, if you use a typical routine (3 sets of 8-10 repetitions) that involves a workload high enough to produce failure (unable to complete 8 repetitions by the third set), your CNS will begin using a greater number of type II fibers. Your inability to maintain force will be because of motor unit failure, which is brought on when your type II fibers start to fatigue. This makes the CNS recruit additional fibers, which may also fatigue. Given enough stimulation (repeated bouts) and time, the CNS adapts to the resistance (neural adaptation), and the muscle fibers grow (hypertrophy). At this point, strength gains stop unless the workload (weight) is increased.

■ Variation

Progressively pushing your muscle will make it enlarge, so why include variation? As I stated earlier, the muscle is not very intelligent, and training on 1 plane (such as a standard biceps curl) will only produce a standard recruitment pattern. By introducing different lifts for the same muscle (preacher or hammer curls), you make the CNS system lay down a more complex recruitment pattern that trains both heads of the biceps. New stimulation will also bring in muscle fibers you are not now recruiting and will help you involve the entire muscle in your training. Another variation you might include is a change in speed or workload.

If all of this sounds familiar, you might review periodization guidelines. Periodization is based on variation, and it has been proven to be an effective form of training. Why is it so effective? There are several reasons: (a) it keeps the CNS on its toes and constantly pushes it to maintain neural stimulation, (b) it relieves the boredom and helps the athlete maintain training intensity and focus, and (c) it works more of the muscle by changing the stimulation pattern.

■ Recommendation

Before you make any changes in your personal training routine or that of your team, evaluate your program to make sure it contains the basic components for effective training. If it does, look for ways to improve it by adding more variation. If you are following a periodization plan, add microcycles that vary exercise intensity or include different lifts for the same muscle groups. Lifting is not always fun and can be pure work if you make it too routine. Add a little zip to your workout by changing it occasionally. ▲