The scientific basis of push-pull weight training programs

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Since the introduction of the overload principle, relatively little new has been developed that has significantly influenced the design of strength training regimens. Periodization is a successful strategy for attaining strength development, and is a variation of the overload principle.

Originally, strength training programs required the individual to overload the muscles three non-consecutive days a week. Using such a program, the athlete often trained the entire body Monday, Wednesday and Friday. More recently, however, a four-day split routine has been developed so that each muscle group can be trained only two days a week, but more intensely. A four-day split routine maintains a schedule that requires the athlete to lift on Monday, Tuesday, Thursday and Friday. The entire body is no longer exercised on a single day. Muscles are now grouped on a logical basis and each group is trained twice weekly, with a two-day recovery period between sessions. Resistance exercises that involve pushing are often scheduled for Monday and Thursday while resistance exercises that involve pulling are performed on Tuesday and Friday.

Using a four-day, push-pull split has a theoretical basis of support. In a paper presented at the National Strength Research Symposium held at Montclair State College in 1974, Dr. Walter Kroll put forth evidence supporting such a practice (1). Kroll theorized how strength could be affected by coordination. Such coordination involves the efficient use of agonist and antagonist muscle groups, such as the biceps curl. During the performance of a biceps curl, the biceps act to flex the forearm while the triceps can act to oppose the movement by contracting to stabilize the elbow joint. Therefore, the triceps can act as a drag to resist flexion of the forearm. As coordination improves, the triceps muscle group remains relatively inactive during biceps contraction, and the entire force of the biceps can be realized instead of wasted fighting triceps co-contraction. Keeping in mind the importance of neural input in early strength development, it is likely that the initial strength gains experienced by the novice weightlifter in the first several weeks of training are a result of improvements in agonist-antagonist coordination, after which hypertrophy as well as other neural mechanisms play a more important role.

Since a combination of neural and hypertrophic factors are important to strength development, the basic theories of motor control can be applied to the design of weightlifting programs to optimize strength gains through agonist-antagonist coordination. Kroll found that if isometric elbow flexion and extension fatigue regimens were administered on consecutive days, an increase in strength and endurance resulted upon re-test two weeks later (1). However, if the elbow flexors and extensors were fatigued separately but on the same day, strength gains were absent. This finding has been interpreted to suggest that resistance exercise of both agonist and antagonist muscle groups on the same day may impede the development of strength through coordination. In contrast, training the biceps on one day and the triceps on the other may have allowed for the development of some type of efficiency in flexor-extensor interaction. Kroll described this type of coordination as skill (1, 2). Any strength coach who has spent hours teaching the power clean will argue that skill is, indeed, an essential part of weightlifting. Therefore, practical application of the principles of motor control to
strength development would require the extensor and flexor muscles to be trained on separate days through a four-day, push-pull split. Table 1 is just an example of what a four-day, push-pull split routine would look like. Notice that on the push days, the order of exercise is always from larger to smaller muscle groups.

Speaking practically, it is difficult to gauge the isometric (single-joint) strength gains of any study with that of the isotonic (multi-joint) strength gains in the gym. However, the scientific results and theory behind Kroll’s study warrant consideration.

There are numerous training regimens being used today. This is just one alternative. Knowing that the key to continuous gains in strength is variation of training stimulus, this may be just what you’re looking for.

### Table 1. Sample Split Routine

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench</td>
<td>Power Clean</td>
<td>Incline</td>
<td>Clean Pull</td>
</tr>
<tr>
<td>Incline Dumbbell Press</td>
<td>Lat Pulldown</td>
<td>Bench Dumbbell Press</td>
<td>One Arm Dumbbell Row</td>
</tr>
<tr>
<td>Behind the Neck Press</td>
<td>Upright Row</td>
<td>Close Grip Bench</td>
<td>Lat Pulldown</td>
</tr>
<tr>
<td>Triceps</td>
<td>Straight Leg Deadlift</td>
<td>Dips</td>
<td>Hyperextension</td>
</tr>
<tr>
<td>Back Squat</td>
<td>Biceps Curl</td>
<td>Front Squat</td>
<td>Biceps Curl</td>
</tr>
<tr>
<td>Leg Press</td>
<td></td>
<td>Back Squat</td>
<td>Leg Curl</td>
</tr>
<tr>
<td>Leg Extension</td>
<td></td>
<td>Leg Extension</td>
<td></td>
</tr>
</tbody>
</table>

### References


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