

Nautilus
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Articles

Negative Work as a Factor in Exercise

When an exerciser lifts a weight, his muscles are performing positive work... or in a language of physiologists, concentric contraction is occurring. Muscles are producing movement by reducing their length. A common example of positive work is provided by the lifting portion of a bench press.

Negative work, or eccentric contraction, is produced when an exerciser lowers a weight... when the downward movement of a weight is limited by the action of muscles.

In either case, the exerciser's muscles are working... during positive work, the muscles are working to lift a weight against the force of gravity... and during the negative work the muscles are still working against the force of gravity by preventing the normal acceleration that would result if the weight was simply dropped.

Most forms of exercise involve both positive and negative work... only recently has it become possible to perform a style of exercise that involves only positive work, a type of exercise that totally removes the negative part of the work. Since the introduction of such positive-only forms of exercise, a great deal of controversy has arisen concerning the relative merits of positive and negative work. The primary result is great confusion on the part of many coaches and athletes.

Nearly 40 years ago when I visited the Texas Centennial in 1936, I first became aware of one of the results of negative work... a result that surprised me at the time, and a result that I then did not understand. My brother and I rode the elevator to the top floor of the tallest building in Dallas (30-odd stories) and walked back down to street level... the following day I was so sore I could barely walk.

Walking down stairs involves almost pure negative work, and it was the negative work that made me sore... if instead I had climbed the stairs and then returned to street level on the elevator, I would have experienced little or nothing in the way of muscular soreness; because, in this case, the work would have been almost pure negative work... and the positive part of work produces very little or no muscular soreness.

Why? In what way is negative work different from positive work to the extent that one produces considerable muscular soreness while the other produces almost no soreness? I cannot answer that question. But I am clearly aware that such a difference exists. And there are other differences... some of which are obvious... but most of which are not so obvious. But most of these other differences are easily understood once they have been pointed out in simple language, which is the purpose of this article.

One obvious difference is the effect upon cardiopulmonary activity; climbing stairs, performing positive work, will quickly elevate both the rate of breathing and heart rate... while going down stairs, performing negative work, will have a much lower effect in these areas. So it is immediately apparent that negative work is not of much value for the purpose of increasing cardiovascular (or cardiopulmonary) condition.

So far it might appear that negative work is thus left with the short end of the stick... since it causes a great deal of muscular soreness and is of little value for cardiovascular conditioning purposes; but a clear look at the whole picture gives an opposite impression... and when all of the facts are considered, it then becomes obvious that negative work is certainly the most important part of exercises performed for a wide variety of purposes.

For example... pre-stretching, the neurological stimulation required for a high intensity of muscular contraction, is a result of negative work; so a truly high intensity of muscular work is impossible without negative work... and exercises performed for the purpose of building strength are of very little value without a high intensity of work.

Third... full range exercise designed to work the entire length of a muscular structure also requires negative work; to provide the back pressure of force that is required in a finishing position of full contraction.

Fourth... negative work makes it possible to exercise a muscle that is too weak to move against the slightest resistance. Thus negative work is a very valuable tool for the purpose of working muscles that have become weak as a result of injury.

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So the facts are plain; there is a place for both positive and negative work... the relative value of one or the other type is being determined by the purpose for which exercises are being performed. If flexibility, strength or full-range exercise is an exerciser's goal, then he must provide negative work as part of his exercise... if he is interested only in cardiovascular conditioning, then negative work is not required.

Approximately three years ago we conducted a large number of lengthy tests that involved pure negative work... negative-only exercise; the positive part of the work was entirely removed. We wanted to see just what would happen to subjects exposed to such a form of exercise. But it should be clearly understood that these tests were not conducted because we felt that positive work was somehow bad... rather, it was necessary to eliminate the positive work only in order to be sure that the results produced were in fact a product of negative work. If both positive and negative work were mixed, it would then have been impossible to say which result produced by which type of work.

I also want to point out that such a style of training is certainly not a practical style of exercise because it requires a large number of willing helpers; assistants are needed to lift the weight so that the test subject can perform only the negative part of the work by lowering a weight that was first lifted by his helpers.

As test subjects, we used several professional football players, a number of athletes in other sports, a few non-athletes, and, after gaining a few months of experience with these trainees, I tried a negative-only workout program myself. The results in every single case can only be described as outstanding; growth was rapid in all subjects, and strength increases came much more rapidly than we expected.

Only three workouts were conducted each week, and in several cases we used approximately 10 exercises during each workout, some subjects performed only 8 or 9 exercises during each training period and a few subjects performed as many as a dozen different exercises.

Seven to 10 repetitions were performed; thus, an entire workout might consist of as few as 56 repetitions... 7 repetitions of each of 8 exercises. And a maximum length workout would be not more than 120 repetitions... 10 repetitions of each of 12 exercises.

Performed in the style that we did them during these test programs, a set of an exercise requires approximately two minutes... and we used very little or no rest between exercises... thus an entire workout usually required approximately 18 to 20 minutes, and never much if any more than 30 minutes. Barbells, exercise machines and Nautilus machines were used as equipment during these test programs... and we restricted our attention to basic exercises involving large muscular structures; pullover exercises performed in a Nautilus machine, hip and back exercises in a Nautilus machine, biceps and triceps exercises both performed in a Nautilus machine, chinning and dipping exercises performed on a conventional machine, and seated presses, bench presses, and shoulder shrugs all performed with a barbell. A few other exercises were performed at times by some subjects, but the exercises listed were the prime movements involved.

In addition to the weight exercises listed, the athletes also ran for 12 minutes on the same day that they trained with weights, running immediately after the weight workout. Thus their entire training required a total of approximately two hours.

As mentioned previously, such programs prove to be impractical for the use of a large number of subjects simply and only because a large number of helpers were required to lift the weights, and it became increasingly difficult to recruit willing helpers in great enough numbers. Secondly, some of our subjects became so strong that it was literally impossible to lift as much weight as they could properly lower; with the tools we had at our disposal, it was not possible to get enough people into a proper position to lift a really heavy weight... for example, one subject reached a point where he was using 1,400 pounds on a Nautilus Hip and Back machine, and we could not get helpers around the machine to lift that amount of weight.

That particular problem was eventually solved by using a 500-pound weight stack on the machine, and by adding the weight of a 200-pound man standing on the weight stack after it had been lifted by the helpers... and then by having the test subject use the machine one leg at a time.

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Another problem was caused by the fact that helpers would not always release the weight simultaneously... the result being that the weight would be released unevenly, causing too much weight to be placed on one arm (or leg) while no weight was on the other limb. So great caution must be used during the hand-off of the weight; if not, the subject might drop the weight and an injury could result. We had no injuries with any of our subjects, but we quickly learned to be very careful with the hand-off of the weights.

Since it is possible to use far more than a normal amount of weight when performing negative-only exercises, this also presented a problem... it was impossible, for example, to load enough weight onto a barbell for some of the exercises. And, during the shoulder shrugs, it was impossible for the test subjects to retain a grip on the bar with their hands if the weight was as heavy as really required; in that case, the problem was solved by strapping the hands to the bar.

In all cases, we used as much weight as possible... determining the correct amount of weight by simple trial and error; selecting an amount of weight that the subjects could handle properly for at least 7 (but not more than 10) repetitions.

Speed of movement was quite slow; the subjects permitted the weight to move slowly to the bottom position, resisting this movement and not permitting the weight to drop suddenly... a normal repetition required approximately 10 to 15 seconds for the lower portion of the exercises. During the first 2 or 4 repetitions, it would have been possible for the subjects to stop the downward movement of the weight... but no attempt to stop the movement was made; instead, the weight was permitted to move constantly, but very slowly.

After a few repetitions, if the weight was selected correctly, it was then impossible to stop the downward movement... and from that point until the end of the exercise, the subject tried as hard as possible to stop the movement. An exercise was finished only when the subject was trying as hard as possible to stop the downward movement, but couldn't... and the entire movement was completed in 2 or 3 seconds in spite of the subject's best efforts to stop the movement.

So a properly performed set of an exercise consisted of a few repetitions during which the subject could have stopped the movement, but did not try... followed by a few more repetitions during which he was trying as hard as possible to stop the movement, but failing.

The weight should be impossible to lift, but possible to *hold* motionless in any position during the movement.

Altogether, we performed several man years of such training over a period of approximately six months; the results were outstanding in all cases, and we learned a great deal about the actual value of the negative part of exercise. Since these first experiments, we have continued to test various combinations of training methods and styles. In the meantime, we have solved most of the original problems that we encountered during these first tests of negative-only training.

Probably the most important thing we learned is the fact that people (ourselves included) have been neglecting the negative part of exercise for years, and that their results have suffered as a consequence. So pay careful attention to both the positive and the negative parts of exercises; lift the weight steadily, smoothly, and fairly slowly. Doing exercises in this fashion will cause an exerciser to reduce the number of repetitions or the amount of weight, or both... but it will greatly increase his results, and that is what he is after. And, as a side benefit, such a style of training will almost totally eliminate the chance of injury.