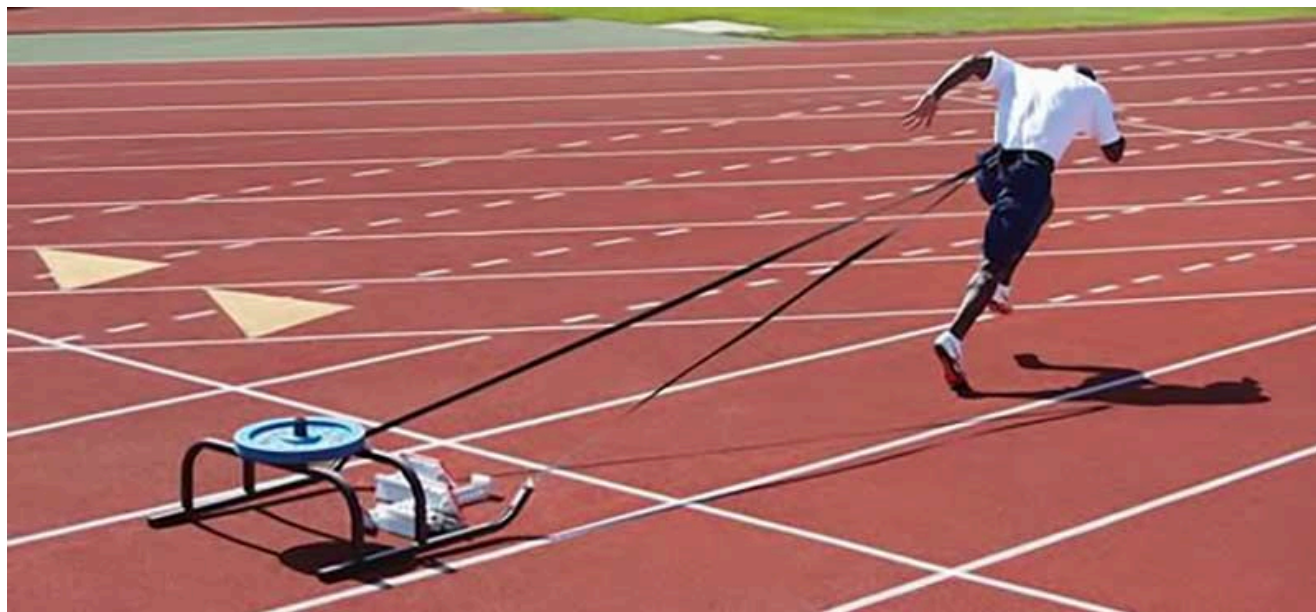


Resisted Training for Speed Development

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Resisted Training

I wrote this article a long time ago - but upon review, it is still a relevant article for today's speed training environment.

Any athlete wishing to increase running velocity must overcome the inertia of the body through the acceleration phase. In this phase, it is the strong extensors of the hip (gluteals and hamstrings), knee (quadriceps), and ankle (Gastrocnemius and Soleus) that are actively involved in this process.

The hip extensors have been shown to produce the greatest muscle moments when analysing hip, knee and ankle joint moments in the sprinting movement. (A muscle moment indicates the resultant muscle activity and details which muscle groups dominate a given activity.) Therefore to maximise horizontal velocity in both the acceleration and top running velocity phases, it is the hip extensor muscle groups that resistance training must target – with a view to increasing force output.

A second component of sprinting performance that can be targeted with resistance training is minimising the drop of Centre of Gravity with each ground contact. The Centre of Gravity should not sink too low through the ground contact phase. The stronger the extensor muscle groups in the lower limb, the less drop in Centre of Gravity during the ground contact phase.

The less flexion of these joints, the greater the stretch reflex that will be activated resulting in greater concentric contraction during the driving phase of each stride.

Weighted Vest Running

A sprint study looked at the effect of increasing body weight (7-8%) on sprint athletes over a three week period, training 3-5 sessions per week. The added resistance through weighted vests was worn from morning to evening and the athletes were tested for jumping, and running on a treadmill, pre and post experiment. The jump tests included squat jumps (SJ), counter-movement jump (CMJ), drop jump (DJ) and 15 second continuous jumps on a resistive platform. Over a three week period, the SJ improved from 42.9cm to 47.4cm. As the correlation between maximal running velocity and SJ has been measured at 0.68, the increased loading would have a positive effect upon force production and running speed.

Another positive effect of weight vest running is the added mass would increase the vertical force at each ground contact. This would increase the stress placed on the stretch-shortening cycle (reactive strength) function of the muscle and would improve muscle stiffness at ground contact. This would improve the muscle's capacity to tolerate greater stretch loads, store more elastic energy and improve power output, which may be seen in an increase in stride length.

Whilst this study suggested the wearing of a weighted vest all day, it was only a three week project, and over a longer period it could be assumed that loading only during training sessions would have a similar effect.

Uphill Running

A biomechanical study was completed on maximal running up a 3% incline. Results showed the velocity to be slower than that of level ground running (8.35m/s to 8.85m/s) and biomechanically the subjects performed the runs with shorter stride lengths and longer ground contact times. It was thought that uphill running will increase the stress placed on the hip extensor muscle groups as the athlete will attempt to maximise stride length therefore increasing this component on the flat surface.

This training method should develop a shorter ground contact time if the athlete emphasises fast push off to conquer the effects of the positive grade. An incline of greater than 3% would still be beneficial in developing the forceful hip extensor movements required but will be less specific in the simulation of the specific technical movements of the sprint action.

Sand and Water Running

Whilst both environments are ideal to increase the resistance placed upon a running athlete, they both have limited application to increasing stride length (utilisation of hip extensors). The resistance in running in these two conditions leads to a greater activation of the hip flexors rather than the hip extensors. In shallow water running (20-30cm), the main emphasis is to get the leg out of the water. When running in soft sand, the ability to apply great extension force is diminished, and the increase in speed is through an increase in stride rate through a shorter stride and faster hip flexion activity.

Towing (Resisted)

Towing either a sled, tyre, speed chute or other weighted device, over set distances are frequently used methods to develop running speed. The basis behind these methods is to increase the movement resistance requiring the athlete to increase force output (especially in the hip, knee and ankle extensors) to continue to run at speed. Studies suggest that the improvement of a particular action (eg. sprinting speed) is directly related to the similarity of movement in the training regime and the velocity specificity of the movement.

Two towing methods used are that of tyre or sled towing and the use of a speed chute. The benefits of using a tyre or sled are that it is quite easy to change the size of the tyre/sled from small to large (thereby increasing the resistance), or using a tyre/sled with weights added to increase resistance.

It is important to have a long attachment to the towed device (10m), as shorter attachments can lead to the device not sliding flat on the ground, leading to bouncing of the tyre or sled as the athlete increases speed.

The second method, that of Speed Chute towing requires the use of a combination of small parachutes depending on the amount of resistance needed. Advantages of this device is that they are easily transported, the chute size can be changes very quickly, and the chutes can be easily released mid flight allowing the athlete to finish a repetition with no increased resistance, giving the athlete the sensation of increased speed.

A major disadvantage of using chutes is that they do not stay directly behind the athlete during the repetition. They move about from side to side (even more so in windy conditions), and can make it very difficult for the athlete to run at any great speed as he/she is trying to keep balance throughout each repetition. This may be of some use to team sport athletes who are attempting to sprint whilst having to dodge and weave between opposing players, but for the purpose of purely increasing running speed, they have limited application.

Speed-Strength Jump Training. (Plyometrics)

There is substantial research showing that high velocity, light resistance training led to a speed specific enhancement of the neuromuscular system. This enhancement increased the subjects' abilities to move small resistances with speed (such as own body weight) as shown by performance levels in the high velocity portion of a force-velocity curve (Fig. 1).

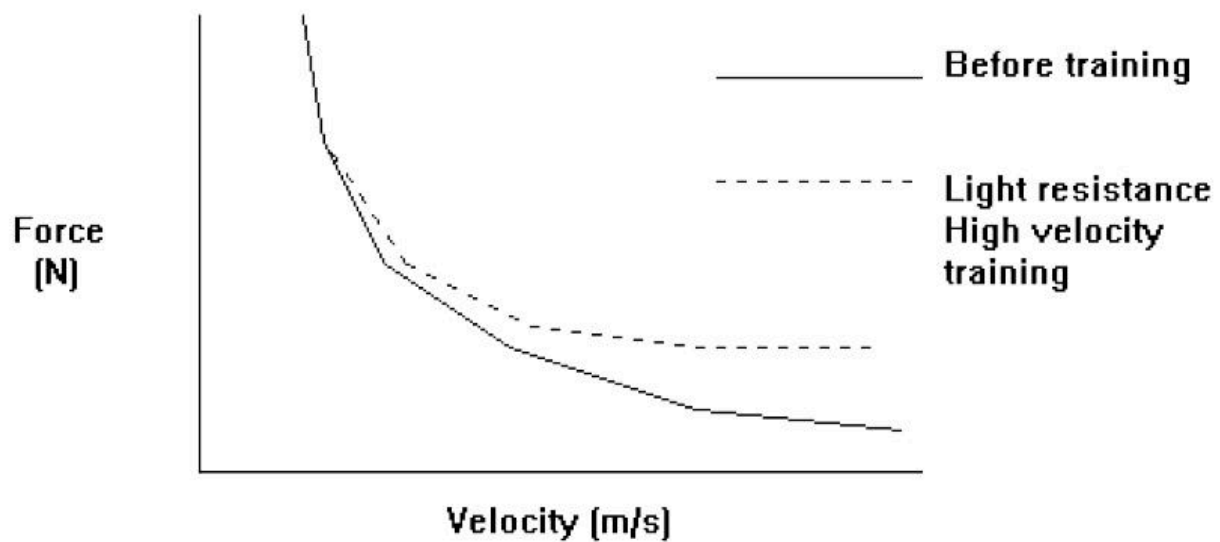


Fig. 1 Change in force-velocity curve for subjects performing high velocity, light resistance training.

This study measured Squat jumps, Counter-movement jumps, standing long jump, and isometric rate of force production (Fig. 2) with results indicating that adaptation was different to that achieved from heavy resistance training. For speed development, the athlete will have minimal time to apply force to the ground, therefore requiring an increase in the early portion of the force production curve (increased rate of force production).

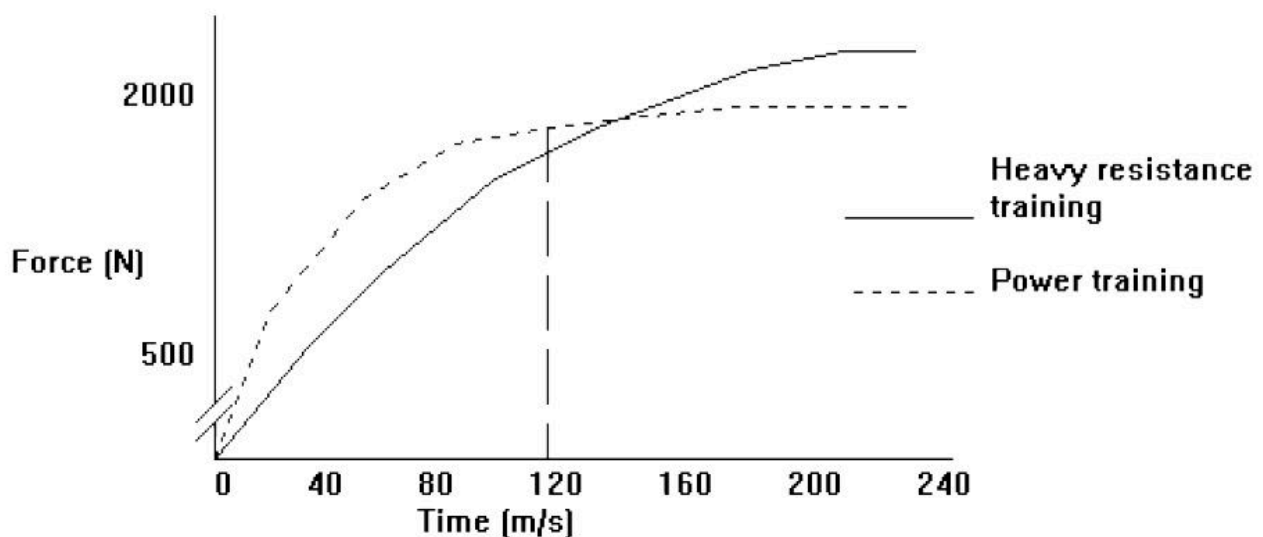


Fig. 2 Change in isometric force-time curves for subjects performing high velocity, light resistance training versus heavy resistance training. The vertical intersect line at 120ms represents the maximal time an athlete has to apply force during any ground contact near maximal running velocity.

This training modality can include long alternate leg bounds, double and single leg hops, hurdle jumps, and sandpit jumps. The movements can be dynamic in nature depending on the phase of training (Preparation phase - less intensity, Competition phase - more intensity, less volume), and on the training level of the athletes involved.

Coaching Implications

If specificity of athletic performance is to be achieved, the added resistance must be minimal for speed-strength jumps (own body weight is usually sufficient for all but the most powerful of athletes) and 10-25kg for sled or tyre towing.

A regular speed-resisted training program will lead to adaptive changes in the neuromuscular system that are specific to speed of movement.

The combination of the above resisted exercises with maximal strength training will increase the transfer of strength to speed movements, thereby increasing the athlete's explosiveness throughout the training year.

A power/strength study demonstrated that subjects combining squat and plyometric training made significant improvements in power production (measured by vertical jump) over groups performing just squat or plyometric training.

It is more appropriate to develop speed strength characteristics during the full training year, rather than develop these attributes after strength or endurance phases of training.

Next week I will review several [Assisted Methods for speed development](#).

For an indepth view of these techniques, check out this link [Resisted and Assisted Training for Sprint Speed - A brief Review](#).

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