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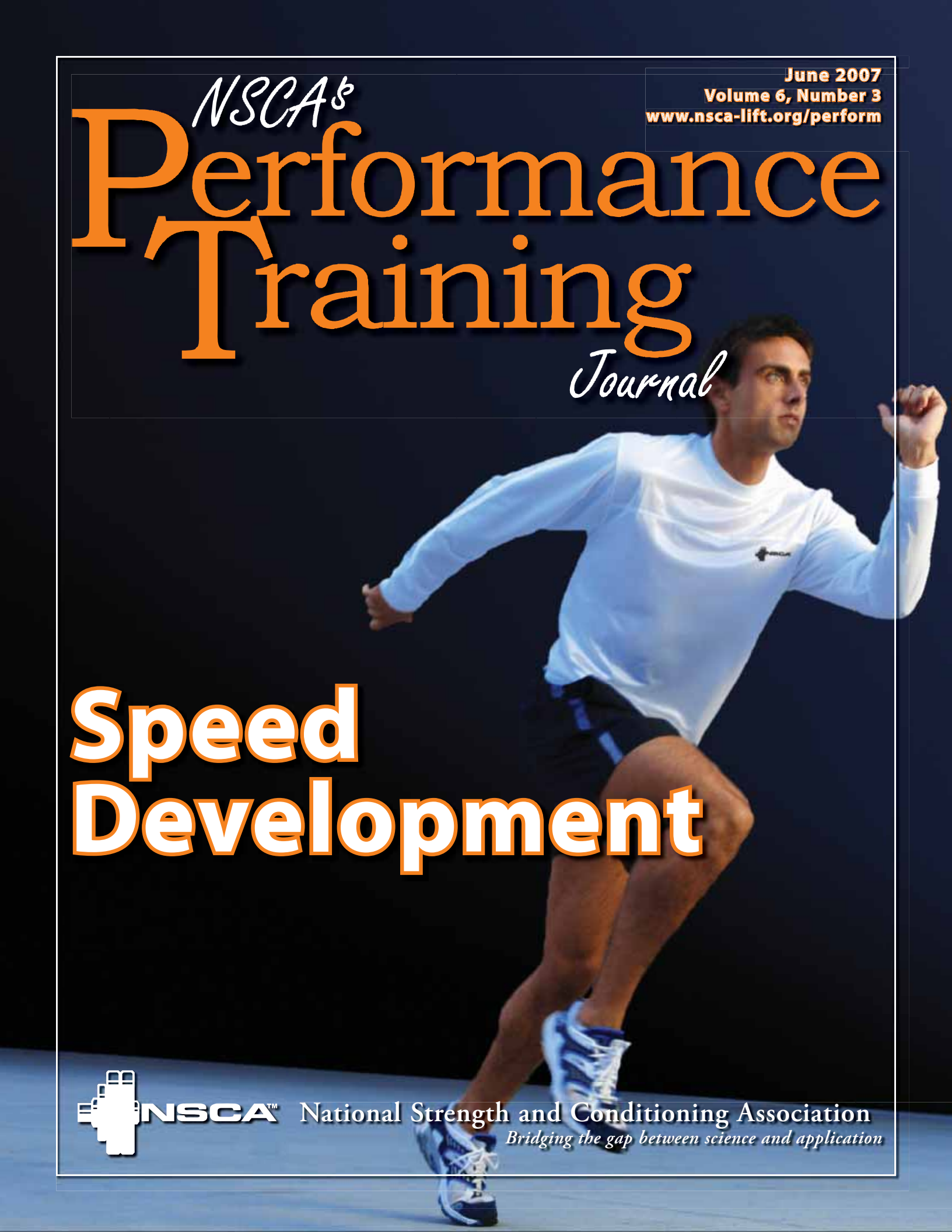

Speed Development

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NSCA's Performance Training Journal

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Do You Need Specialized Sprint and Agility Tests When Differentiating Athletes of Different Levels?

Recently, researchers in Australia developed two new performance tests designed to differentiate between high and low level Australian Rules football players. Twenty four high level and 14 low level football players were recruited as subjects for the present study. Subjects participated in a battery of tests which included: 1) 10-m straight line sprint, 2) 8-9 m change of direction speed test, and 3) a reactive agility test. The sprint test required the subjects to sprint all out for 10-m. The change of direction test required subjects to run 1.5 m in a straight line and then cut toward a specified target for a total of 8-9 m in distance. The reactive agility test required the subjects to run forward then react to a movement performed by the tester with the complete distance covered being 10-m. Subjects were tested with multiple trials in order to assess the reliability of the different tests employed.

The results of the study indicated that all three test were highly reliable (ICC=0.870). When comparing the low and high performance groups, the high performance group was significantly better at the reactive agility test. Interestingly, the change of direction and straight line sprint were not accurate tests for differentiating between different levels of players. The authors therefore suggest that traditional straight line sprinting or closed change of direction tests may not be the best methods for differentiation of players and that strength and conditioning professionals need to utilize test such as the reactive agility test. The reactive agility test, which was developed for this study was shown to be a reliable and valid tool for the differentiation of Australian Rule football players. Further research is warranted in order to determine if this new sprint and agility test is valid and accurate for the assessment of athletes in other sports.

Sheppard JM, Young WB, Doyle TLA, Shepard TA, Newton RU. (2006) An evaluation of a new test of reactive agility and its relationship to sprint speed and change of direction speed. *Journal of Science and Medicine in Sport*, 9(4): 342 – 349.

Sprint Training vs. Endurance Training

In a recent study, researchers from McMaster University in Ontario, Canada, compared the metabolic and performance adaptation of high intensity sprint interval training with that of traditional interval training. Sixteen active males were recruited and randomly assigned to either a high volume endurance training group or a low volume sprint interval training group. Both groups performed six training session over two weeks of training. The endurance training group exercised at 65% of maximal aerobic power (~175 w) for between 90-120 min for a total of 6500 kj of work. The sprint interval group performed four to six sets of 30 second sprint intervals with a four minute recovery between each set for a total of 630 kj of work. Performance tests were conducted before and after the two weeks of training.

There was no difference in the time to complete a 50 and 750 kj cycling time trial between the two groups. Both groups demonstrated significant improvements in muscle oxidative capacity, muscle buffering capacity, and glycogen content. Interestingly, there were no differences in the physiological adaptations between the two groups. The authors concluded that sprint interval training was a very time efficient method for improving endurance which has the potential to induce rapid performance and muscle adaptations which are comparable to endurance training. While the results of this study are extremely interesting and suggest that sprint training is a very useful tool, more research is needed to determine the long term effects of this type of training.

Gibala MJ, Little JP, van Essen M, Wilkin GP, Burgomaster KA, Safdar A, Raha S, Tarnopolsky M. (2006). Short-term sprint interval versus traditional endurance training: similar initial adaptations in human skeletal muscle and exercise performance. *Journal of Applied Physiology*, 3: 901 – 911.

Addition of a Light External Load Does Not Improve Sprint Performance in Middle Aged Men and Women

Researchers for Turku, Finland, recently examined the effects of a 16 week training intervention which divided 85 subjects into a light load and a no load training group. The light load group performed all exercise while wearing 1.1 kg ankle weights, while the no load
training group had no weights on their ankles.

The training program consisted of 3 blocks of training which lasted 60 minutes and required subjects to perform

a 15 minute warm up followed by 30 minutes of sprint, agility, and plyometric exercises. The sprint portion of the training program consisted of 3 – 5 m sprints. The agility drills were designed to increase coordination. The plyometric exercises consisted of countermovement vertical jumping drills, single leg hops, squat jumps, and rebound jumps. After completing the training program subjects performed a 15 minute cool down which was focused on improving flexibility. Subjects performed the training regime three times per week. A battery of tests was performed before and after the 16 weeks of training. The tests included assessments of 1) vertical jump displacement, 2) maximal anaerobic cycling capacity, 3) 20-m sprint time, and 4) maximal aerobic power.

The addition of a low load to the training program resulted in significantly greater increases in squat jump performance and maximal anaerobic cycling performance when compared to the no load training group. There were no other differences between the two treatment groups. The authors suggested that the addition of a light load (2.2 kg) to plyometric exercises can result in a novel stimulus which has the potential to improve some performance variables. However, caution should be taken when interpreting these results for application to your training program. Neither groups was participating in a structured resistance training regime nor were they athletes.

Surakka J, Alanen E, Aunola S, Karppi SL, Pekkarinen H. (2006). Effects of light loading in power-type strength training on muscle power of the lower extremities in middle aged subjects. *International Journal of Sports Medicine*, 27(6):448 – 455.

Do Periods of Overreaching Result in Improved Performance?

The effects of six weeks of overload training with limited recovery followed by a seven day taper were investigated in order to determine if systematic overreaching improves performance. Seven rugby players were recruited in Australia to participate as subjects in the study.

The training program involved two to three days a week of free weight exercises (squats, deadlifts, hang cleans) and plyometrics as well as rugby training. Subjects performed 23 – 30 sets of 5 – 8 repetitions performed at 78.5 – 86% of 1-RM. The taper consisted of five repetitions per set, with the average number of sets being performed per session being between 18 – 21, and an intensity of 55% of 1-RM.

Prior to and after the six weeks of overreaching and the seven day taper, maximal strength, endurance, sprinting speed, isokinteic strength, and vertical jump performance were assessed. After the overreaching period endurance, sprinting speed, 3-RM squat and bench press strength, and isokinetic strength and power all decreased. However, it is important to note that statistical significance was not always reached. After the taper there was a trend which suggested that performance variables tended to recover. However, only the 10 m sprint, 3-RM squat and bench, and isokinetic torque exhibited a trend toward improvements when compared to the pre-overreaching time point.

It is possible that the small sample of subjects masked the effects of the six week period on performance or that the seven day taper was not long enough to elicit statistically significant improvements. The important message presented in this study is that when training volume and intensity are high, performance will most likely be depressed as a result of increase fatigue. The greater the training stress, the longer the taper may need to be in order for increases in performance to be realized. The present study suggests that a seven day taper does offer some benefits for improving sprinting and strength power performance. Much research is still need in order to determine the optimal overreaching and taper protocols.

Coutts APReaburn P, Piva TJ, Murphy A. (2007). Changes in selected biochemical, muscular strength, power, and endurance measures during deliberate overreaching and tapering in rugby league players. *International Journal of Sports Medicine*, 28(2):116 – 124.

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Principles of Speed Training

Joseph M. Warpeha, MA, CSCS,*D, NSCA-CPT,*D

Speed development may not be at the top of the list for the average person who is concerned with general fitness components like strength, aerobic fitness, flexibility, and body composition. However, success in many sports is very much dependent on speed; therefore a discussion on some of the general ideas regarding speed development and how to train it is required.

Maximal speed and maximal power production go hand-in-hand and, as a result, training for maximal sprinting speed should be similar to that of training for maximal muscle power in the weightroom. Both rely heavily on a high rate of force production which speaks to the neuromuscular system and the body's ability to recruit a maximal number of motor units/muscle fibers for the given task.

One of the biggest mistakes made with speed training is the timing. For team sports like football, basketball, and soccer, the speed work is often done at the end of the practice. Perhaps the rationale is that if the speed work were to be performed before practice, the players would not be as fresh and this may be a correct assumption. However, when speed development is done at the end of the practice, the fatigue from the previous work/practice, however insignificant it may seem, will compromise the speed training. The neuromuscular system is highly fatigue-prone (particularly at high intensities) and it is unlikely that 100% effort will be possible following the regular practice session. Let us take the example of training overall power with explosive lifts. What strength coach would have his or her athletes train high-intensity weightlifting lifts immediately following some other significant physical stimulus like a team practice session? The answer is not many because they realize the quality of the lifts and ability to generate maximal power will be significantly compromised. The exception might be when time constraints demand this format.

Along those same lines, the above ideas must be weighed against the fact that time is at a premium and priorities must be determined which frequently necessitates that speed work be performed in less-than-optimal neurophysiological conditions. However, having athletes work on speed drills when they are less than 100% may actually be somewhat beneficial as it is sport specific owing to the fact that they are often required to perform maximally in fatigued states. One must keep in mind, however, that consistently training speed in a fatigued state is unlikely to yield optimal results in terms of absolute speed development. Timing can be a fine line for coaches to walk, particularly with student athletes, when there are only so many opportunities that the athletes can train during a given day and a limited amount of contact time for practice and supervised training. There may not be one right answer that satisfies the coach's desire for the athletes to give 100% during practice as well as during speed training. If contact time is limited, something has to give. However, just as traditional resistance training for power development does not require five or six days per week be devoted to one specific skill, sprint training can be performed two or three days per week with good results, provided the sessions are of very high quality and performed when the athletes are freshest. These sprint training days might be strategically placed on days when the practice focus is on watching film, doing walk-throughs, or learning new schemes/techniques so that neuromuscular fatigue does not become an issue when it comes time for speed training. The major problem with a format like this is that there is very little recovery time over the course of a week which can also cause problems. In the end, the specific training regimen needs to be tailored to the individual's or team's overall schedule with proper attention given to the aforementioned factors.

Not only is the timing of a speed training session often less than optimal, but the specific protocol frequently employs a volume that is too high. Instead of the desired result which is speed development, the actual outcome is more relat-

ed to conditioning. While there is nothing wrong with a football team doing ladders or ten 100-yard sprints at the end of practice for physical and mental conditioning, this is not ideal for speed development for many reasons. Number one, as mentioned previously, if the goal of the training is speed development and the training session involves individuals who are fatigued to some degree and therefore are not 100%, the results will not be optimal. Number two, if the desire of the speed training is to increase sprinting speed for the given sport, the distances that are commonly involved in the sport should be approximated and mirrored in the training. What football players on a regular basis must run 100 yards at maximal speed? Obviously the answer is none. Then why do so many teams incorporate sprint distances in their training that are not characteristic of the sport? Football is a nice model because of the wide range of positions. Sprinting speed for a lineman is indeed important, but performing 100-yard sprints or even 40-yard dashes are not very specific to the characteristic five yard or maybe 10-yard distances that are routinely encountered. For a lineman, it is the starting speed or how quickly they can get off of the line that translates to performance.

The final topic is the volume of speed training. Coaches often drive their players into the ground with volumes that are much too high. Again, while explosive lifts and sprinting are obviously very different forms of power development training, many of the basic training tenets are the same. The goal is to maximize power development and that is best accomplished with a relatively low volume of repetitions at a very high intensity and with high quality. Conditioning is about quantity whereas speed development should be about quality. Timing the individual sprint performances not only gives valuable feedback and provides motivation to the athlete but also serves as a useful guide to the coach in terms of the quality of the performance. When quality drops significantly (i.e. times go up) it is probably time to wrap up the high-intensity speed training for the day.

The purpose of this article is not to give specific speed training programs but to discuss general principles of program design that should be given consideration if the goal is to enhance sprinting speed. This discussion only dealt with straight line sprinting speed which is important but in most cases must be combined with agility training as most sports require the ability to accelerate, decelerate, and change directions quickly. Two very important ideas that the reader should take away from this article are: 1) if the goal of a speed development program is to maximize short distance/sprinting speed, the training sessions should be of low volume, high intensity, and high quality (longer rest periods aid in accomplishing this) and performed under conditions where fatigue is not a factor and 2) the specific distances that are trained should be specific to the typical requirements of the sport and/or position. Performing higher volumes and longer distances under conditions of greater fatigue are okay for general conditioning, energy system training, and mental toughness but will not result in optimal speed enhancement which is paramount for success in many sports.

About the Author

Joe Warpeha is an exercise physiologist and strength coach and is currently working on his PhD in exercise physiology at the University of Minnesota-Minneapolis. His areas of interest include muscular, cardiovascular, and thermoregulatory responses and adaptations to sport, exercise, and physical activity. Joe is an instructor in the School of Kinesiology and has taught several courses including "Measurement, Evaluation, and Research in Kinesiology", "Strength Training Program Design", and "Advanced Weight Training and Conditioning". In addition to having a Masters degree in exercise physiology, Joe is a Registered Clinical Exercise Physiologist through the American College of Sports Medicine, a Level 1 Coach with USA Weightlifting, and a certified referee with USA Powerlifting. Outside of the academic realm, Joe is a competitive powerlifter with over 15 years of training experience and has won several national and state bench press titles while competing in the 148, 165, and 181-pound weight classes.

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Eccentric Training to Reduce Hamstring Injuries in Sprinters

Jason Brumitt, MSPT, SCS, ATC, CSCS,*D

One of the worst things a sprinter can hear from an athletic trainer or a physical therapist is the words "you pulled a hammy". A "pulled hammy" is a strain injury to the hamstring muscle group. This injury can be extremely painful and have a slow recovery. The purpose of this article is to provide you with training suggestions in order to help reduce your risk of this injury.

Risk Factors for Hamstring Injuries

The hamstrings consist of three muscles: the Semitendinosus, the Semimembranous, and the Biceps Femoris. Hamstring injuries can occur during sprinting especially when decelerating. Many risk factors have been proposed including a previous history of a hamstring injury, hamstring weakness, and hamstring tightness (1, 2, 4). You may be able to reduce your risk of injury by performing some specific stretching and strengthening exercises (table 1).

Stretching

There are many ways to perform the static hamstring stretch. Figure 1 demonstrates a classic static hamstring stretch. When performing a static stretch for the hamstrings you should attempt to maintain a straight back throughout the movement. For optimal flexibility gains stretching should be performed on a daily basis.

Recent evidence suggests that an eccentric form of hamstring stretching may have a superior immediate effect on flexibility as compared with traditional static stretching (5). To perform the eccentric hamstring stretch, wrap a 3-foot strap or thick resistance band around the heel (figure 2). From this starting position, pull on the bands to bring the hip into full flexion. As you pull the leg into hip flexion, contract your hamstring muscles as if you were attempting to resist the hip flexion motion (5). You should perform each eccentric repetition for five seconds.

Static stretching appears to have limited to no effect on injury prevention and may even decrease an athlete's strength (6). Eccentric stretching exercises on the other hand may serve a protective role when incorporated into a pregame dynamic warm-up (5). You should consider performing static stretching at the end of your workout or event.

Tables 1 and 2. Hamstring Stretching and Strengthening Program

Hamstring Stretching: Perform Daily		
Static Stretching	3 sets x 30 second holds	Perform at the end of a workout or after an event. May be performed as part of a pre-event or pre-game workout.
Eccentric Stretching	6 sets x 5 second	

Strengthening Program: Perform 2 Times Per Week	
Leg Curl Machine	3 sets x 10 repetitions
Lunges	3 sets x 15 repetitions
Assisted Russian Hamstring Curl	1 – 2 sets x 15 – 25 repetitions
Good Morning Exercise	2 sets x 10 – 15 repetitions

Figure 1. Static Hamstring Stretch

Strengthening

The key to avoiding a hamstring injury may rest in your ability to increase the strength of the hamstrings. The following exercises (Table 2) should be considered and performed as part of a comprehensive training program.

Leg Curl Machine

Performing the traditional leg curl exercise can help athletes increase their overall concentric hamstring strength. Unfortunately, if one only performs this exercise, it probably will not serve a protective role.

Lunge *(figure 3)*

It has been speculated that core weakness can contribute to a hamstring strain (3). The walking lunge is a valuable exercise for sprinters in that it strengthens the core and the lower extremities in a functional position.

Assisted Russian Hamstring Curl *(figures 4 & 5)*

To perform this challenging exercise, hook your heels under a bench (or similar object). Assume the starting position with your knees bent to 90º and your back straight (figure 4). Perform the exercise by leaning forward, lowering your body as low as possible toward the floor. Once you are on the floor, contract your hamstrings to return your body to the upright starting position (figure 5). This exercise is usually extremely difficult at first, with many athletes lacking the strength to lower themselves all the way to the floor. If you are unable to lower yourself throughout the entire range of motion to the floor, use a bench or a stability ball to provide an alternate end point.

This exercise may also be performed with the assistance from a partner or your strength coach. Wrap a thick resistance band around your waist or torso. Choose a band that is pliable enough to allow you to lower yourself under control toward the floor, but strong enough to not break when loaded by your body weight. Return to the starting position by contracting your hamstrings. Pulling on the band, the coach or partner is able to assist your return to the starting position

Good Morning Exercise *(figure 6)*

Choose a training bar or a light weight-lifting bar (15lbs to 25lbs) and place it across your shoulders. The exercise is performed by bending at your waist while keeping your head up and your back and legs straight. Lower yourself toward a position where your torso is parallel to the floor. It is important to maintain proper form, especially avoiding rounding your low back.

Additional Training Tips

The exercises suggested here will provide you with an initial program to increase your hamstring flexibility and strength. These exercises should be performed as a part of your comprehensive training program.

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Figure 2. Eccentric Hamstring Stretch

Figure 3. Lunge

Figure 4. Russian Hamstring Curl Start Position

Figure 5. Russian Hamstring Curl Raising

Figure 6. Good Morning Exercise

Speed Development Through Resisted Sprinting

Brian Newman, MS, CSCS

Developing speed is tough. This is due to the fact that there are so many variables to consider such as: strength and power, running mechanics, flexibility/range of motion, and stride length. Any one of these variables can be targeted in a program to improve speed. This article discusses only one of those variables, strength and power, and how to develop it through resisted sprinting.

Resisted sprinting is a very common training method used to improve acceleration, for the simple fact that most sports require short bursts of speed. In theory resisted sprinting will improve drive or propulsion at the initial acceleration phase, assisting in improving an athlete's ability to reach maximum speed as fast as possible. For many sporting activities maximum velocity is not always attained, and repeated short sprints are more common (2). As such, the ability to develop velocity in as short a time as possible (acceleration) is of high importance to performance in many sporting activities.

Modalities

There are different modalities that can be used for resisted sprinting. These include: sleds, hills, parachutes, bungee cords, stairs, weighted vest, sand, water, etc. All are used to achieve an overload effect, recruiting and strengthening muscle fibers with the hope that the performance of these stronger muscles will carry over to competition.

Sleds

A sled is one of the better devices to use to provide sprint resistance. This is due to the fact that it keeps you in the acceleration position and you can adjust the weight to fit your strength and training experience. Since you can adjust the weight, this allows you to use the sled multiple times during a training week. You can begin the week with your heavier load (10% of body wt.) and taper the load as you get closer to competition.

Sand

Sand is a great resistive tool, but it has a tendency to throw the athlete off balance. From experience, I would prefer using wet or damp sand (2 – 3 inches deep), this way the athlete has a little more control but still gets a great resistive work out. One disadvantage of sand is having the space to build a sand pit long enough to sprint in.

Stairs

Stairs are good training tools for improving muscle endurance and cardiovascular endurance more than speed. One downside to training on stairs is the potential for shin-splints and other injuries due to the hard surface. Limit running stairs to once a week and fill the rest of the week with other forms of resisted running.

Bungee Cords

Bungee cords are a great training tool because of their limitless applications, portability, and low cost. But for resisted sprinting they are at a disadvantage because it requires two athletes and a great deal of communication to use them correctly and avoid injury.

Weighted Vests

From a coaching stand point, weighted vest seem to work better with improving the "maximum velocity" stage of sprinting, but not the "acceleration phase".

Weighted vest should be used during your interval sprint training.

Hills

When using hills you have to take into account the percent grade of the hill. You do not want it too steep, but you want it steep enough to elicit the effects you are trying to achieve. It tends to be a difficult task finding the perfect hill. Also, with hills you do not have the ability to change the hill to match your strength and experience.

Parachutes

The disadvantages of parachutes are due to factors like the wind. Wind will cause the parachute to pull you all over the track or field and the wind also causes the resistance of the parachutes to change while you are sprinting. Lastly, you must have a good distance separating you and other athletes using a parachute to avoid getting entwined.

Water

Water counteracts the force of gravity, taking away the impact that the body succumbs to when running on a hard surface. This way you can practice your running technique without the wear and tear on your body. Water also provides a fluid resistance to the sprinting form.

Load and Distance

Research has warranted multiple methodologies when utilizing resisted sprinting techniques. It is recommended that a 10% or greater change in external resistance may have detrimental effects on movement. Thus, conservative means of achieving overload should be used (1). Other research has suggested that a load less than 15% of the athlete's body mass will not affect the sprinter's technique (3). It is also believed, the load should be determined by the extent which performance is affected. If performance variables decrease by more than 10%, the load being used is considered too great and will have a detrimental effect of sprinting technique (6).

From experience, if the resistance is too heavy there are a couple of things that will take place. One, the upper body will rise up immediately and then drop back down to recover proper technique as momentum is gained. Secondly, the weight will cause you to waiver from side to side. Besides being a sign of too heavy of a load, it could also be a sign of weak core musculature (abdominals and lower back).

In regards to the optimal distance utilized for resisted sprinting, the research seems to have a gap in determining what distance constitutes the acceleration phase. It varies from 0 – 20 meter, 0 – 30 meters, 30 – 50 meters (1, 3, 5). To be on the safe side, use 30 meters as a safe acceleration distance. Of course this may vary from athlete to athlete due to experience, strength, and stride length. The novice sprinter will stay in the acceleration phase longer while the more experienced sprinter will reach maximum speed much faster.

In conclusion, while there are many different modalities for resisted sprinting, there is a need for more research in this area. There seems to be missing pieces to the puzzle in regards to determining how much resistance should be utilized and when participating in resisted sprints what distance is optimal for improving your acceleration. Remember, the load and the distance can always be adjusted to your individual level.

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Glycemic Index For Athletes

Debra Wein, MS, RD, LDN, NSCA-CPT,*D

Currently, the majority of our nation's health experts support a plant-based diet which is high in carbohydrate (45 – 65% of total calories), moderate in fat (20 – 35% of total calories) and adequate in protein (10 – 35% of total calories) (4).

The Glycemic Index

In addition to the quantity of carbohydrates in the diet, carbohydrates have been looked at based on their glycemic effect using properties such as texture, structure, and absorption rate rather than molecular weight. The glycemic effect of a food is how high and how fast the blood glucose level rises, and how quickly the body responds by returning the blood glucose to level normal (1).

Different foods have different affects on blood glucose depending on:

- The digestibility of the starch in the food.
- Interactions of the starch with the protein in the food.
- The amounts and kinds of fat, sugar, and fiber in the food.
- The presence of other constituents, such as molecules that bind starch.
- The form of the food (dry, paste, or liquid; coarsely or finely ground; how thoroughly cooked; and so forth).
- The combination of foods consumed at a given time.

Foods can be classified by their glycemic index (GI) as either low, medium, or high (See table 1). High GI foods are absorbed quickly by the gut and rapidly raise blood sugar levels, whereas low GI foods are absorbed slowly and have a moderate effect on raising blood sugar levels. Some of the low fat or nonfat, heavily processed foods (e.g. nonfat cookies and cakes) tend to have a high glycemic index due to the addition of simple sugars when the fat is taken out. Whereas minimally processed, high fiber foods, with a little fat (e.g. a slice of multigrain bread with peanut butter) tend to have a lower glycemic index.

How can the GI be used to help athletes?

Although some research indicates that the GI of the carbohydrate that is consumed immediate post exercise might not be as important as long as sufficient carbohydrate is consumed (3), others have shown that ingesting a low GI meal prior to exercise resulted in improved endurance capacity (5). Use the following guidelines to help you take advantage of the known benefits of glycemic index.

- Research suggests that endurance athletes may benefit from eating low-GI foods before exercise because these foods release glucose slowly into the bloodstream, which can help to sustain blood glucose levels (2,5).
- During prolonged exercise, consuming foods or fluids with a medium or high GI may promote carbohydrate usage and therefore help to maintain adequate blood glucose levels.
- After exercise, athletes should try to consume foods and / or fluids with a high GI in order to promote rapid glycogen repletion.

Training and eating properly can increase your glycogen stores and, ultimately, your performance. It is a good idea to understand the different types of carbohydrates and how your body metabolizes them.

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Table 1. High Carbohydrate foods and their Glycemic Index

	Carbohydrates (grams)	Total Calories	Glycemic Index
Cereals, Cold & Hot			**Med – High**
Grape nuts (1/2c)	46	200	
Shredded wheat (1 cup)	37	180	
Raisin Bran (1 cup)	42	180	
All Bran (1 cup)	27	180	
Oatmeal (1 oz.)	30	140	
Cream of wheat (1 oz.)	22	100	
Fruits			**Medium**
Apple or Orange	20	80	
Banana	26	105	
Raisins (1/2 cup)	60	240	
Grapes (1 cup)	16	58	
Apple sauce (1/2 cup)	26	97	
Dried apricots (8halves)	30	120	
Starchy Vegetables			**High**
Corn (1/2 cup)	18	80	
Winter squash (1/2 cup)	15	65	
Carrots (1, Medium)	10	60	
Peas (1/2 cup)	10	40	
Tomato sauce (1/2 cup)	10	18	
Legumes			**Low**
Baked beans (1 cup)	50	330	
Lentils (1 cup)	40	215	
Kidney beans (1 cup)	33	204	
Lima beans (1 cup) 28 140	28	140	
Garbanzo beans (1 cup)	27	28	
Split-Pea soup (11 oz)	35	220	
Bread Products			**Med – High**
Whole grain (2 slices)	25	150	
Sub roll (8 inches)	60	280	
Bagel	30	210	
English muffin (1)	25	130	
Bran muffin (large)	45	320	
Corn bread (large slice)	29	198	
Graham crackers (2 squares)	11	60	
Other			
Fruit yogurt (1 cup)	50	250	Low
Ice milk (1/2 cup)	22	120	Low
Spaghetti, macaroni, noodles (1 cup)	40	200	Medium
Rice (white / brown) (1 cup)	35	160	Medium
-parboiled			Low
Baked potato (1 lg.)	55	240	High
Stuffing (1 cup)	40	220	Medium
Pancakes (2)	30	140	Medium
Waffles , Eggs (2)	34	240	Medium

Lateral Speed Development

David Sandler, MS, CSCS,*D

Without a doubt, speed is instrumental in athletic success. And now, more then ever, speed work is being added into training programs for just about every athlete. All too often however, the emphasis is placed on the mechanics of straight line speed and we forget about the need to convert speed to on field performance.

While straight line speed mechanics are important, training should focus on turning basic speed into on-field or on-court speed. To do this effectively, training should focus on footwork transitions and shifting from linear movement to lateral movement and back again. But before laying out complex agility drills requiring rapid changes, the basic mechanics of lateral movement need to be perfected.

Previous articles in the *NSCA's Performance Training Journal* give excellent accounts on training movement mechanics and first-step speed. Building on that information, this article will focus primarily on lateral footwork and body mechanics in addition to some general speed and strength exercises. Linear drills refer to running forward and backward with movement mechanics focusing on the sagital plane. Lateral drills refer to side to side movement in the frontal plane, while diagonal drills are the combination of both.

Speed has many components. Besides the basic mechanical movement patterns that focus on starting position, stride mechanics, leg turnover, and arm action, there are other factors such as leg and hip strength and torso, hip, and ankle rotational speed. Each of these factors, when controlled and properly trained, will improve overall sport speed.

Body Position and Arm Mechanics

Without going into detail, it is important to remember that mechanics for all movements are virtually the same. The body should be in its sport-specific position, with weight on the balls of the feet and the head and chest should be up and looking forward. The arm action should originate from the shoulder with arms at about 90^{o} of flexion. During movement, the arms should pump back and forth rather then opening up as in a triceps extension. Even in lateral drills, the arms should move in the sagittal plane and not across the body.

Speed-Strength Exercises

Maintaining proper stride mechanics is essential. Training under load while maintaining proper body position increases general stride strength and overall sport performance. Under normal circumstances, on combined training days, speed work should precede your strength work. However, in this case, speed-strength training is designed to work on sprinting mechanics under load. The following five drills will improve lateral and linear running strength.

Lateral Step Ups *(figures 1 & 2)*

Stand to the left of an 18inch box. Step up with the right leg and press off it to bring the left leg up to the top of the box. Slowly lower back down and repeat for eight repetitions on each side. Once the basic movement is mastered with correct body position, step up and over and continue back and forth rotating legs for eight repetitions to each side.

Crouch Lunges *(figures 3 & 4)*

Compared to a regular lunge, these lunges tax the quadriceps slightly more as they are constantly under tension during the movement. The mechanics are similar to a regular lunge except the crouched position is maintained. These

can be done with dumbbells, barbells, or just bodyweight depending on your desired training stimulus. Alternate legs moving forward and perform eight repetitions or more to each side. This drill is also effective when performed moving backward.

Lateral Stretch-Band Steps

Starting in your sport specific position, with a band wrapped around your ankles, take a wide step to the left or the right and then bring the other leg in the same direction, resuming the sport specific position. Maintain sport position throughout. This is not a lateral lunge, rather a large shuffle step. The feet should never get closer than the starting sport position.

Clock Lunges

As the name implies, theses lunges are performed in a clock pattern. Generally, clock lunges are performed to the three, six, nine, and 12 positions, but other angles could be employed. To perform, lunge forward to 12 and backward to six positions, and use a lateral lunge step to the three and nine positions. In all movements, face forward, instead of turning and stepping. When using other "hours", for example, lunging to the eight position, take a diagonal backward lunge step while facing forward.

Lateral Resisted Shuffles *(figure 5)*

Set up in the shuffle position with a waist harness and tubing or some other means for providing resistance. Shuffle for 10 – 15 yards in each direction. Make sure to maintain proper mechanics. If your harness has the ability to swivel or can be loosely fitted, then adding a rotational component improves coordination. Once general steps are perfected, move from a lateral shuffle to a back pedal or to a forward run.

Speed Second

Quick feet are essential and can be trained using agility drills and agility ladders. Including transitional quick change movements during these drills emphasizes the need for the feet to get in the right position for the next step. Additionally, there are a few key drills that progress the strength moves discussed above to improve speed of execution of the kinetic chain as a whole. The following drills are designed to be executed with maximal velocity once proper technique and body position is controlled.

Rapid Resisted Hops *(figure 6)*

Stand in the vertical jump position with a harness fixed around the waist. Using resisted tubing anchored to floor or a device rapidly perform 10 repeated jumps. Instead of jumping for height, this exercise is designed to reduce ground contact time and improve hip speed.

Speed Shuffles

Building on the lateral resisted shuffles, remove the resistance and perform fast shuffles back and forth. There is nothing magical about this age-old drill, but many athletes still lack good lateral mechanics. Make sure to work form, watch that the feet do not cross, and stay low during the movement. Air time should not be the goal in shuffling.

High Leg Cross Over Step

This exercise is becoming more popular as it enhances hip rotation strength and speed. Using a crossover or carioca step, exaggerate the leg crossing over by pulling the knee up (flexing the hip) as high as possible while rotating the leg across the body. At first this exercise is difficult for many athletes to get their timing down, so practice the movement slowly before trying this for speed.

Diagonal Reverse Runs *(figure 7)*

Many coaches practice back pedaling, but many athletes do not run backward in their sport. Rather, they move backward looking forward while they chase down a fly ball or tennis shot. This type of movement requires good hip rotation mechanics and should be practiced with your regular speed drills. Proper performance of this movement pattern involves looking forward while the body is twisted and pointing in the direction the body is traveling. Push off the front foot, then pull it up, crossing the waist while simultaneously pushing off the other foot. Body position should stay the same with rotation occurring at the hips.

Hip Flexor Speed Step Ups *(figure 8)*

Perform a normal step up with the lead leg. The trail leg will have a tube attached to it with the other end held down. After stepping up with the lead leg, forcefully pull the trail leg up with the knee bent until the thigh becomes parallel with the box. Slowly lower the trail leg, step off the box, and repeat for eight repetitions before switching legs.

If performing these exercises on speed training day, they should be performed after your warm-up. On a strength training day, these exercises could be used as the warm-up, or after the warm-up as specific movement work.

Making Your Drills Explosive

Any of the exercises described above can be performed as full speed, explosive drills both under resistance and with bodyweight alone. If technique has been mastered, it is wise to progress to more explosive movements. A great way to build explosive burst speed is to use a release mechanism on the resisted drills.

Putting Your Program To Work

Use the drills discussed here to improve lateral strength first, then lateral speed. Incorporate a combination of lateral and linear speed work during your training week. Each of the exercises above should be trained like any other exercise in your routine. Three to four sets of at least eight to ten executions. Take longer rest intervals (two to three minutes) when perfecting technique, then drop rest time and speed up the drill as you progress. For those that are less proficient, these drills should come first after your warm-up. For those that are advanced, the drills can be used as warm-up, conditioning, or mechanics practice.

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Figure 1. Lateral Step Up
(Down Position)

Figure 2. Lateral Step Up
(Up Position)

Figure 3. Crouch Lunge
(Crouch Position)

Figure 4. Crouch Lunge
(Lunge Position)

Figure 5. Lateral Resisted Shuffle

Figure 6. Rapid Resisted Hop

Figure 7. Diagonal Reverse Run

Figure 8. Hip Flexor Speed Step Up

Make It a Habit

Suzie Tuffey Riewald, PhD, NSCA-CPT,*D

Many of us have areas in our lives where we are trying to create good habits and make positive changes, but it is tough to develop consistency. Efforts to eat healthy, lift regularly, do speed work, or bring more balance to your life can seem just that at times, efforts. It takes work and it is not always easy to develop a good habit (especially if you first have to break a bad one). However, establishing a plan of attack can help you as you set out to develop new habits that will help you with your training and improve your athletic performance.

First, it is important to know what you are getting in to. Most people need many months, if not longer, of engaging in a purposeful, specific behavior before it becomes a habit. Before the habit becomes hard wired, individuals are at risk of lapsing into old patterns of behavior. Have you ever tried to change a technique you use in your sport? Maybe it is your running form or your swimming mechanics. At slow paces it is pretty easy to maintain your new technique. But turn up the intensity and what tends to happen? If you are still within the habit forming window, more likely than not you fall back into your old technique. This is important because when you commit to changing a behavior, you will need to be vigilant and purposeful in your training efforts.

What behaviors are we referring to when we talk of behavior change? For athletes it can run the gamut from diet (e.g. eating fewer sweets or consuming more protein) to fitness (maybe incorporating speed training into your weekly workouts or adding aerobic workouts on Monday, Wednesday, and Friday) to sleep (getting 8 hours a night) and/or other lifestyle behaviors (better managing stress, drinking less alcohol, not working on Sundays). What are you working on? What behaviors are you trying to change to lead to improved athletic performance?

Regardless of the habit you are trying to develop, there are some strategies you can use that can help you in your efforts. Let us take a look at some of the things you can do to help in your efforts to change your behaviors and then to make these changes into healthy habits.

Strategically Place Cues or Prompts to Support Your Efforts

Janice swims at 5 AM a few mornings a week, which is a tough time to drag oneself out of bed. Knowing this, she hangs her swimsuit on the bathroom door, has her bag packed and places the alarm clock out of reach of the bed (so she has to get up to turn it off). These cues support her commitment to swimming regularly. Once out of bed, there is no excuse—swimsuit and bag are ready. What makes sense for you? There are a limitless number of cues or prompts you can use. For example, you could put pictures of healthy food on the refrigerator, tape notes with motivational sayings in spots you often pass or keep your running shoes in your car. Based on the behavior you are working on, identify the cues or prompts that would be most meaningful and beneficial to you.

Enlist the Support of Others

In working with a college team recently, we were having a discussion regarding their summer workouts. They recognized the importance of staying fit but noted that it was going to be quite a challenge to do it on their own. We talked about this challenge and ways they could manage it. Not surprisingly, the strategy they settled on was to provide support for each other from afar on a structured, regular basis. It is no surprise as social support can work wonders. This support can be in the form of encouragement from friends, a spouse, or family member. Ask for it from others. Social support can also be about finding "a partner in crime". Seek out someone who is trying to make a similar change. Having a partner can enhance your motivation and give you additional accountability or responsibility (making it less likely for you to skip a workout or miss a class).

Set Goals For Yourself

In past issues of this column, we have talked about the mental skill of goal setting and how it can be of value in achieving performance related goals. Goals, when appropriately set, can enhance motivation, tell you what you need to do, and provide feedback to help you recognize success or improvement. Goals can be equally effective in helping you in your efforts to change behavior change efforts. Set short term and long

term goals related to the behavior and, real important, monitor progress along the way so you can experience success and increase your confidence.

Provide Incentive

Rewards are powerful. To be effective, however, you must first identify meaningful rewards for you. For example, Barb may be highly motivated by indulgences to her sweet tooth, while her husband feels a Saturday with no yard work would do the trick. The reward or incentive can be a variety of things as long as it serves to keep you on task. Next, determine what you need to do to receive the reward (e.g. swim three morning for 45 minutes, eat fruits and vegetables at every meal for seven days, incorporate two speed training sessions each week). Reward yourself along the way to facilitate continued progress.

Change is not easy. And, making a habit of these desired changes is tougher yet. But, your efforts can be facilitated by implementing some of the suggested strategies. Use visual prompts or cues, get support from others, set goals, and reward yourself.

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Suzie Tuffey Riewald received her degrees in Sport Psychology/Exercise Science from the University of North Carolina – Greensboro. She has worked for USA Swimming as the Sport Psychology and Sport Science Director, and most recently as the Associate Director of Coaching with the USOC where she worked with various sport national governing bodies (NGBs) to develop and enhance coaching education and training. Suzie currently works as a sport psychology consultant to several NGBs.