

AN EVALUATION OF THE EFFECTIVENESS OF SPEED DEVELOPMENT  
DRILLS AND TRAINING AIDS

by

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A Project  
Submitted to the  
Graduate Faculty  
of  
George Mason University  
in Partial Fulfillment of  
The Requirements for the Degree  
of  
Master of Science  
Sport and Recreation Studies

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Date: \_\_\_\_\_ Fall Semester 2015  
George Mason University  
Fairfax, VA

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## **DEDICATION**

This is dedicated to all the wonderful track and field coaches that have mentored and inspired me throughout my years as an athlete and beyond.

## **ACKNOWLEDGEMENTS**

I would like to thank all the wonderful professors at George Mason University that engaged with me throughout my graduate experience. A special thanks to Dr. Rodgers for believing in my potential. A huge thank you goes to my wonderful committee Dr. Atwater as my project chair, and Drs. Rodgers and McDowell for taking the time to go through this process with me and giving me their successful wishes. Lastly, a very special thank you to my mother for always supporting me and giving me that extra push I sometimes may need.

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## ABSTRACT

### AN EVALUATION OF THE EFFECTIVENESS OF SPEED DEVELOPMENT DRILLS AND TRAINING AIDS

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George Mason University, 2015

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The purpose of this investigation was to determine coaches' perceptions of the best drills and training aids for developing elite sprinters. Through various books and publications, numerous workouts, drills, and training aids have been suggested. An understanding of which methods successful coaches are actually using and the perceived effectiveness and utility of these drills and training aids, however, has not been investigated. In this instrumental case study, interviews with track coaches were used to compare and contrast the different drills and training aids used in their speed development programs. Findings of this study may serve future coaches and athletes by helping them choose the most effective drills and training aids for the production of elite sprinters.

## **CHAPTER ONE: INTRODUCTION**

### **Background for the Study**

Running has not only become a popular method of exercise, but it is growing in popularity as a sport. Running speed is an essential component of most major sports. Often, it is the determining factor in the outcome of a sporting event. Thus, the ability to enhance running speed is of prime importance to coaches and athletes alike—especially those in track and field. Most people think running is easy, but it takes great effort. For a distance runner, it takes a great deal of endurance; whereas, for a sprinter, it takes considerable power. As observed by Cissik (2004), “possessing a greater percentage of fast twitch muscle fibers means that one has the potential to produce greater amounts of force more quickly than individuals with a greater percentage of slow twitch muscles” (p. 24). Given that elite sprinters have a higher percentage of fast twitch muscle fibers, compared to slow twitch, it is commonly stated that “A sprinter is born, not made.” Being a track athlete, I have heard it several times and do believe that sprinters have some natural abilities; yet with the right coaching and training methods a runner can be trained to become faster.

### **Overview of the Study**

There are several ways to train a runner. This study focused on sprinters. The outdoor season in track and field was the focal point. During the Spring season, the sprint races are the 100 meter dash and the 200 meter dash. The 400 meter and 4x100 and 4x400 meter relays were not included because the researcher wanted to focus on the individual events and those of the shortest distance. The 400 meter is a sprint, but it also

combines endurance and an athlete will undergo different training methods than those for the 100 meters or 200 meters. This investigation determined the most effective drills and training aids coaches can use when working with a sprinter. It also discussed techniques that have been used, yet do not produce positive results. In order to determine which drills and training are most successful, interviews were conducted with eight Track and Field coaches. The interviews consisted of questions based on background, philosophies, and training techniques in regards to drills and training aids. The participants were successful coaches that have produced top quality sprinters in Virginia high schools and colleges, as well as Olympians.

Based on previous studies, it has been concluded that there are several techniques a coach can use when training a sprinter. Research states that, while there are many different approaches a coach can take when training a sprinter, only few have actually shown positive results. Each technique is centered on what will help the athlete run faster. Research within this study was monitored by the most effective drills and training aids that, while in training, help a sprinter to run faster. The following questions were posited:

1. Which drills and training aids are perceived as having high utility and effectiveness in the training of elite sprinters?
2. Which drills and training aids are perceived as having low utility and effectiveness in the training of elite sprinters?
3. Are there differences in the preferred drill and training aids among high school, collegiate, and professional coaches?

The findings of this research can be used to create an effective speed development program.

### **Overview of Literature**

The three essential components of speed development, as identified by Cissik (2004) and Delecluse (1997), are technical knowledge, speed strength training, and strength training. It has been said that an athlete can only run as fast as his or her technique allows. According to Cissik (2004), “technique is a major limiting factor for running fast” (p. 25). Having technical knowledge and knowing how to apply it makes the motions more fluid, efficient, and faster. There are four components of technical knowledge: posture, hip position, ground contact, and arm action (Cissik). It is a coach’s responsibility to educate the athlete on each component and ensure they execute them correctly. Having technical knowledge/technique prevents injuries that could result from excessively loading tissues due to bad form.

Many training methods are used to improve sprint acceleration ability, including various forms of plyometric training and assisted and resisted sprint techniques. As Delecluse (1997) points out, “in developing training strategies, the coach has to keep in mind that strength, power, and speed are inherently related to one another, because they are all the output of the same functional systems” (p. 1510). Overspeed and overload training techniques are used in an attempt to develop explosive power: “In sprinting, it is clear that strength and speed are inherently interrelated and different kinds of strength seem to exist” (Delecluse, 1997, p. 152). Power output, states Stone (1991), “is likely to be the most important factor in separating sports performances” (p. 220). Power is de-

defined as moving with great speed or force. Force production in sprinting requires the contraction of several muscles or muscle groups across multiple joints: “So, in strength training, a sprinter has to aim partly for selective hypertrophy of fast twitch muscle fibers” (Delecluse, 1997, p. 150). The three areas of focus for strength training are weight lifting, hypertrophy training, and neuronal activation training (Delecluse, 1997). Combining these training techniques will provide positive results in sprinting.

### **Statement of the Problem**

Little research has been done on speed development programs or the effects of drills training aids on sprinters. Many studies focus on one particular training technique (e.g. strength training, weightlifting, acceleration phase); but one single method of training is not enough to achieve significant results (Delecluse, 1997). Drills and training aids combined should be used with a speed development program. While it may be impossible to create a speed development program that is successful for every sprinter (due to no runner being exactly the same), it is logical to find a combination of techniques that has produced positive results and create an “ideal” speed development program for sprinters. Extant research, however, does not provide a good indication of which drills are the most effective for speed development. To address this gap in the literature, a qualitative study was conducted to see which drills and training aids were perceived by coaches as the most effective.

### **Rationale for the Study**

The purpose of this study was to determine which drills and training aids are the most effective when coaching a sprinter (i.e., make a sprinter run faster). By interview-

ing coaches, this study contributed to a coaches' knowledge of training techniques to produce a faster sprinter. Prior research has only provided vague perceptions or has failed to explain why coaches do not use certain drills and techniques. The objective of this study was to give a more in-depth view of drills and training aids that can be combined into a speed development program for sprinters. By analyzing the results, future coaches/athletes will be able to produce a speed development program targeted towards sprinting faster, which means athletes will be stronger and smarter.

### **Delimitations**

The results of this study are only indicative of the small sample of coaches interviewed; and hence, may not be generalizable to the larger population of track and field coaches. A small sample was chosen in this investigation, as this was an exploratory student. The study was also delimited in the type of interview questions asked. Specifically, the interview questions were formulated around a list of drills and training aids the researcher developed. All dialogue pertained to the list of drills and training aids, with no discussion of other methods or techniques used. This decision was made so as to focus solely on the most popular training drills and techniques.

## CHAPTER TWO: LITERATURE REVIEW

A sprinter performing in a speed development program must learn the core movements of running and have the ability to execute those movements properly. Having an understanding of the technical knowledge of running, to include drills used, speed strength training, and speed training will enable a sprinter to break each one down and master the technique at hand. The following paragraphs will explain each of these core components in more detail.

### **Technical Knowledge**

Saralandis (2000) observes; “Of all human skills, speed is the hardest and most difficult to improve when compared to other factors such as strength and endurance” (p. 1). Many attempts have been made by coaches to invent new training techniques in order to improve the speed of their athletes. When thinking of what it takes to become a top sprinter, it goes beyond the physical. It starts with one’s teacher, the coach. Coaches play the most important role because it is through their knowledge that an athlete learns. It begins with a coach’s technical knowledge. Technical knowledge can be defined as the vital characteristics a coach considers to be necessary for top-level sprinting: “Due to the fact that technique can limit an athlete’s ability to run fast, it is important to understand what should be occurring during ‘ideal’ sprinting technique” (Cissik, 2004, p. 25). Therefore, in order to be a top sprinter, one must first learn exactly how to sprint. The following paragraphs discuss four technical characteristics that are significant to top level sprinting: posture, hip position, ground contact, and arm action. Knowledge of these characteristics and the proper utilization leads to good sprint mechanics.

**Posture.** Coaches have identified posture as being integral to having good sprint technique. According to Thompson (2009), “posture is referred to as the athlete’s ability to control the muscles within the trunk, thus maintaining a fairly rigid position while sprinting” (p. 857). It can also be referred to an athlete’s ability to control his or her dynamic, desired body position. In the words of one coach, “correct posture is having total body control to maintain the optimum sprinting action for the whole duration of the run” (Thompson, 2009, p. 857). An athlete must have a very strong trunk in order to be a good sprinter.

Core stability and core strength are also terms that relate to posture. The core is the region from the chest down to the waist. Core stability and core strength are referred to as “the ability to control the muscles within the trunk allowing for preservation of an unyielding position while sprinting” (Thompson, 2009, p. 857). This definition of core stability echoes that put forward by Kibler (2006), who viewed the concept as being “the ability to control the position and motion of the trunk” (p. 325). This locates core stability very close to that of posture itself.

Flexibility is another term that is affiliated with posture. “Flexibility will allow an athlete to move the limbs through a full range of motion without impediment” (Cissik, 2004, p. 24). This will serve to make the running motion more fluid and efficient and can increase stride length and frequency. Static stretching may be used to improve flexibility; the greatest carryover to running will occur if dynamic flexibility exercises are used. Therefore, the more flexible an athlete is, the better their posture, which will in turn aid in increasing running speed.

**Hip Position.** Along with good posture, a sprinter must have good hip position. Proper hip position is described as “the athlete maintaining a high centre of mass with a slight forward tilt of the pelvis during sprinting” (Thompson, 2009, p. 857). Hip position impacts sprint technique in terms of maximal sprinting. Thompson (2009) surmised that if hip position is not maintained during maximal sprinting, body parts cannot attain specific relative positions” (p. 858). Moreover, in the words of a coach, as cited in Thompson (2009):

High hips enables the knees to come up and through and it gives the clearance for it (i.e. desired stride length and frequency), whereas if you’re squatting down it brings your stomach down, which means you’re running to the ground. (p. 858)

Findings in this study echo those of Collier (2002) when discussing the foundational concepts of sprinting stated the need to obtain and maintain an “upright posture” or “tall running position” during the maximum velocity stage (p. 507).

**Ground Contact.** Ground contact is important for having good sprint technique: “It is referred to the time from the instant when the foot makes contact with the ground until the instant the same foot is lifted from the ground” (Thompson, 2009, p. 858). There are sub-notions associated with ground contact, one being “the position of the foot” at instant touchdown. Foot contact should not occur too far ahead of the body’s center of mass, which would cause detrimental braking forces. Mann (1985) highlighted “the need to minimize the distance between the point of contact with the track and the athlete’s centre of mass at touchdown, with the point of contact needing to occur approximately 0.15m in front of the centre of mass” (p. 151).

Contact time is another sub-notion, which is the time an athlete's foot remains in contact with the ground. It needs to be fast: "Work investigating the role of contact time has indicated that elite sprinters spend less time on the ground in comparison to sub-elite sprinters" (Thompson, 2009, p. 858). The last sub-notion is movement pattern of the foot. A sprinter should have rapid hip extension and knee flexion before and during ground contact in order for the athlete to pull the foot under the body, thus generating powerful forward drive (which is also known as "clawing back the track").

**Arm Action.** The arms are a critical part of running. In order to synchronize an optimum movement pattern, the arms and knees have to be in total synchronization. The arms have to work efficiently. The specific role of the arms in the running process is that the arms offer balance to the sprinter: "the arms serve as a balancing factor that help stabilize the trunk, thus working in tandem with correct posture" (Thompson, 2009, p. 859). There are four technical points of an optimal arm action. The key aspects are open arms, 90 degree arms, synchronized arms, and big range. According to Thompson (2009):

Arms should be swung exclusively in the sagittal plane, not across the body. The elbow angle should be maintained close to 90 degrees of flexion, while the movements of both arms should be the same, although in the opposite direction; that is, they should be corresponding and complementary. (p. 859)

The need to attain big range with the arms is related to large shoulder flexion and extension angles during maximal sprinting. The total range of the shoulder motion should be close to 90 degrees. Thompson continues, "coaches also argued that an increased arm range of motion could improve lower leg mechanics, including stride length and knee

lift” (p. 859). The following describes speed training techniques and various exercises used to help develop maximal sprinting.

### **Technique Drills**

As aforementioned, technique is a major limiting factor for running fast. In addition to making sure that athletes have technical knowledge about what should be occurring during “ideal” sprinting technique, a coach can also include technique drills into a speed development program. Technique drills are used to break the sprinting motion down into more manageable components. This is important because breaking down the skills into parts and mastering them first at slow speed and then at faster ones make them easier to learn. Cissik (2004), notes “eventually, the athlete can transfer the techniques of the parts (i.e. the drills) to the whole (i.e., sprints at maximum speed)” (p. 27). There are several categories of drills that are used to teach aspects of the sprinting motion. These include arm swing drills, ankling, heel kicks, high-knee drills, A drills, and B drills.

**Arm Swing.** The arm swing is an important and often overlooked aspect of technique training. During sprinting, the arms act in opposition to the legs serving to prevent upper-body rotation, which could lead to a loss of balance and timing:

When coaching the arm swing, the emphasis should be on avoiding the arms crossing the midline (which would contribute to upper body rotation), having the hands travel from the hip to the height of the shoulder, driving the arms back forcefully. If the arms are driven back forcefully, the stretch reflex at the shoulder will recover the arms forward- which will also serve to reduce the number of

things the athlete will have to think about when running at high speeds (Cissik, 2004, p. 26).

There are several common errors seen with the arm swing. First, athletes may not swing the arm from the shoulder; they may swing by locking the upper arm into place and only moving the lower arm. This is called beating the drum or milking the cows. According to Cissik (2004), it “does not allow the athlete to move his or her arm quickly enough during his speed sprinting” (p. 26). Second, athletes may allow their arms to cross the midline of the body, which will increase the rotation of the upper body while running. This is called running like a chicken. Third, athletes may swing the arms too high or may not swing back far enough. This can affect arm speed negatively. Coach the athletes to move the arms hip to shoulder.

**Ankling.** Ankling teaches how to lift the feet off the ground and how to put them down during sprinting. As Cissik (2004) argues:

This is an important skill as proper positioning of the foot will minimize the amount of time spent on the ground, minimize power lost into the ground by providing more rigid ankle joints, and minimize injuries that could be caused by improper foot placement. (p. 27)

When coaching foot action during sprinting, plantar flexion or dorsiflexion is emphasized as the hips pass over the foot to push the body forward. When the back foot breaks contact with the ground, it should immediately be cast. Casting refers to dorsiflexing the ankle to approximately 90 degrees while pulling the big toe up. The foot should remain in the cast position until it is again on the ground and the hips are passing over it. In an-

klung, the foot will be driven forward from the hips, and the outside of the forefoot will make contact with the ground and will pull the body over it.

Besides having difficulty achieving and maintain the casting position, the most common errors with foot placement involve running on the toes or running heel to toe. Running on the toes is a frequent problem when one attempts to teach the cast position and having the forefoot contact the ground first. Running heel to toe is problematic because often the structures of the lower limb are unable to absorb the forces, and this can lead to hamstring injuries over time. Athletes need to be encouraged to cast the foot, stay off the heels, and allow the forefoot to contact the ground.

**Heel Kicks.** Heel kicks are designed to build upon the mechanics taught by ankle drills. Heel kicks teach the athlete to bring the heel to the hip immediately following plantar flexion. As Cissik (2004) observes, “This serves to shorten the lever so that the mass of the leg is closer to the axis of rotation, allowing the leg to be cycled forward more quickly during sprinting” (p. 27). Heel kick drills begin at a walking pace (like ankle) and begin by focusing on one leg at a time (e.g., the right leg). The athlete is to keep the left leg stiff and step forward. As the hips move over the right foot, the right ankle should plantar flex as it breaks contact with the ground. When the foot breaks contact with the ground, it should be “cast” and immediately lifted up to the right hip. As the heel is lifted up, the right hip will flex to approximately 45 degrees. Once proficiency is achieved in that drill, it should be performed by alternating between right and left sides.

Athletes that lack good flexibility will have trouble bringing the heel to the hip during this drill, which will make correct technique difficult to visualize. A frequent er-

ror with this drill is that many athletes will perform this drill by pointing the knee down toward the ground. Athletes also will lose the cast to their foot while it is brought to the hips. Athletes are to be reminded that they should not allow their foot to “dangle” and that the ankle must remain rigid.

**High Knee Drills.** High knee drills help to teach front side mechanics while reinforcing casting the foot and also help to condition the hip flexors. These are initially taught at walking speeds, focusing on one leg at a time. Cissik (2004) stated that:

To perform the high knee drill with the right leg, the right ankle will plantar flex as the hips pass over it. As the foot leaves contact with the ground, it should be cast as the right knee is lifted high (parallel to the ground). Keeping the foot cast, place it on the ground slightly in front of the hips so that the outside of the fore-foot contacts on the ground. The foot should be driven to the ground from the hips. (p. 28)

Initially, the arm swing is not emphasized during this drill. However, after the athlete has perfected the hip and ankle motion, the arm swing can be introduced.

Cissik (2004) also noted that there are two errors commonly seen with this drill. First, an athlete with weak hip flexors and core muscles may have trouble staying tall while performing these drills. This will be seen as they will flex the trunk as they lift the knee. Coaches should emphasize that athletes must “stay tall” while performing these exercise. A second error is that athletes will lose the cast to their ankle while the foot is being brought to the hips (p. 28).

**A Drills.** A drills combine high knee drills with heel kicks. Initially, the drill is performed as a walk, focusing on one leg at a time. When focusing on the right leg, the right ankle will plantar flex as the hips pass over it. As the foot leaves contact with the ground, the foot should be cast and immediately brought to the right hip (as in heel kicks). Cissik (2004) explains:

Keeping the heel in contact with the hip, the right leg should be cycled forward (the athlete should focus on stepping over the opposite knee). As the leg is cycled forward, the knee will be lifted high (as in the high knee drill), and the leg will begin to unfold. (p. 28)

From that position, the foot should be driven down from the hips as in the high-knee drills. Once the drill is perfected, the athlete can begin to alternate between the two sides. Advanced athletes will perform the drill with a skip.

**B Drills.** B drills combine the A drill with an active foot strike. They are an advanced sprinting exercise that teaches how to exert more force against the ground. Like A drills, these exercises are frequently recommended for inclusion in a sprinting program. As with many of the drills, this drill is initially performed as a walk focusing on one leg at a time. Basically, the athlete will perform an A drill. However, as the leg is cycled forward, the hamstrings are relaxed. The combination of the relaxation of the hamstrings and the forward of the knee will cause the leg to extend at the knee. The extended leg is then driven down (from the hips) much like the other drills.

One of the most frequent errors seen when learning this drill is to lean backwards while extending the knee: “This should not be encouraged because, if it is carried over to

actual sprinting, it can result in “over-striding” which can cause the athlete to spend more time on the ground and brake while running” (Cissik, 2004, p. 28). Athletes should be encouraged to stay tall while performing B drills. As mentioned before, technique drills are useful for breaking down the sprinting motion and developing aspects of it. It is worth mentioning that if drills are not performed perfectly and if they are not mastered in the proper sequence, then they will waste the athlete’s time because they will not know the core movements of the sport.

A final caution with technique drills is that they are not a substitute for sprinting. Though technique drills will help develop aspects of technique, they are performed at much slower velocities than sprinting, and this means they do not duplicate sprinting from a kinematic standpoint. In other words, technique drills would be useful as warm-up exercises, but not as part of the main workout.

### **Speed Strength Training**

Speed strength training involves explosive movements with the use of free weights or bodyweight. Executing these movements properly will result in increased strength. Speed strength training should always be performed using a time check to assess the quality of training. In previous research:

Tidow proved experimentally that in the case of inter-set intervals of 5 minutes’ duration of the intra-set rest intervals, should be varied in a load related way.

This seems to be necessary to keep the slowing down of the speed movement as low as possible and thereby to guarantee a training effect which conforms with the goal of speed-strength training. (as cited in Delecluse, 1997, p. 154)

Aside from increasing strength output, speed strength exercises allow an athlete to save a greater amount of metabolic energy, which is highly important in sprinting. According to Markovic (2007), this can be reached through the use of plyometrics, overspeed training, and resistance (overload) training (p. 543).

**Plyometrics.** Plyometrics is used to improve athletes' explosiveness and dynamic performance. As Markovic (2007) noted, "this training method improves leg extensor power and strength, as well as high power dynamic movement performance" (p. 543). Delecluse (1997) observes, "for sprinters, cyclic forward bounding exercises with force-time characteristics similar to those of sprint running are preferable" (p. 152). Plyometric exercises are an essential part of top level sprint preparation. However, these exercises can only be performed in a safe and correct way when the athlete is well prepared by means of strength training methods.

**Overspeed.** Delecluse (1995) contends that "in order to establish an efficient transfer between strength training and fast running, there is still a need for specific sprint exercises that reproduce fast running and include a strength component" (p. 1205). In overspeed or facilitated running, the athlete is made to run faster than he normally can by artificial means. Some of the overspeed techniques used include downhill running, high speed treadmill running, cords, elastic bands, and towing/pulley systems using either a motorized device or another runner. It was concluded that it is possible to achieve a higher stride rate in overspeed or supramaximal running as compared with normal maximal running.

In Australia, two popular overspeed devices are the Speed Belt and the Ultra Speed Pacer: “The Speed Belt is valuable in that it allows the athlete to practice starts, accelerations, and supramaximal running velocity” (Faccioni, 1986, p. 1). For short distance accelerations, two athletes can be attached to one device, and for top speed running athletes can be towed over distances greater than 100 meters. Limitations are that it is quite hard to control the speed with which the athlete is being towed. Also, it is not possible to slow down quickly when at top speed (which may be required if the athlete detects any muscular problems). From personal experience in high school, we used a device similar to this; one day at practice the researcher was being towed by another athlete who was faster. Needless to say, the researcher could not catch her stride which caused her to fall and was dragged at least 15 meters down the track before she noticed. While these devices are great for training, coaches should make sure they pair athletes with similar running speeds.

The second device, the Ultra Speed Pacer, uses a pulley system that can lead to overspeed sprint running. Faccioni (1986) noted:

Advantages of this device over the Speed Belt are that the front athlete does not need to run too hard to give the required effect to the rear towed athlete, allowing a better control of the towing speed of the athlete (p. 1). If the athlete feels they are going too fast by pulling up, the system has a safety catch that will release and allow the athlete to slow down before leading to a muscle strain. Faccioni continues, disadvantages are that the Ultra Speed Pacer requires a solid immovable object to be attached, requires two athletes to work the device, can only have one

athlete at a time being towed, and can only be towed over a maximal of 100m. (p. 3)

Researchers have found increases in stride rate, ground reaction forces, muscles stiffness, stored elastic energy, and increased efficiency of muscle contraction and running skill during overspeed training. However, a study done by Mero (1994) highlighted a potential problem with overspeed training in that many of the athletes initially were allowing the towing device to pull them along and were themselves running submaximally, as indicated by decreased stride rate. Maximal speed training must be performed regularly; but even this training modality, if performed too regularly, can lead to speed plateaus, making continued speed improvement very difficult. Faccioni (1986) suggests:

To ensure these plateaus do not occur, the athlete should use specific speed development exercises that can be divided into two major groups, those of assisted speed exercises that allow the athlete to increase speed or frequency of movement, and resisted methods to increase the force required to run at speed (p. 3).

The assisted method allows all the systems of the body to adapt to high speed movements that are then transferred to non-assisted competitive movements. The resisted speed exercise recruits more muscle fibers and greater neural activation that is then transferred to the competitive situation.

**Resistance (Overload).** For most sports, resistance exercise is an integral part of training for improving performance: “Resistance pulling has been the basic training practice of some very successful sprinters such as Koch, Gohr, Ashford, Krabbe, and Christie” (Saraslandis, 2000, p. 1). Resisted sprint running is a common training method for

improving sprint specific strength. Types of resisted sprint training aids are sleds, parachutes, weight belts, weighted vests, car tires, and uphill running. A car tire or a special sled (resistance towing) can be used to improve the strength of the muscles that contribute to sprinting. Adding weight to the object that is being pulled will produce greater results. It forces the athlete to use more strength.

Fundamentally, overload training is exercise that goes beyond normal levels of physical performance. Indeed, Stone (n.d.) contends, “an overload stimulus will have some level of strength (intensity), frequency and duration of application” (p. 79). The classic overload technique is uphill running. Observed Delecluse (1997):

For this, a slope of  $\leq 3$  degrees is advisable. An interesting method for overload running is the speed chute. The athlete pulls a small, medium, or large parachute while sprinting. This results in a resistance to the order of 4 to 10kg, depending on the size of the chute. (p. 149)

High resistances are used to improve the acceleration phase, medium resistance to increase speed endurance and the smallest parachute is used in the phase of maximum running speed. All methods of overload running aim at increasing stride length.

In a study by Cronin (2008), a comparison of two commonly used resisted sprinting techniques (weighted vests and sled towing) both which involve an athlete sprinting with added load was conducted. Generally, sled towing and vest sprinting are used with little consideration given to their specific effects on sprint kinematics. Cronin’s study concluded that sled towing and vest sprinting both resulted in acute changes in sprint kin-

ematics during the accelerations phase of sprinting, but in a different matter when the same relative load (% of body mass) was added:

Vest sprinting has less of an effect on trunk angle, with the athlete remaining more upright, and consequently long-term changes in sprint techniques are less likely. Furthermore, vest sprinting may result in a greater load on the eccentric braking phase at the beginning of the stance phase. As braking forces are a more significant component of the stance phase during the maximum speed phase of sprinting, it seems that vest sprinting may be a more appropriate mode of resistance training for the latter stages of the acceleration phase and the maximum speed phase. (p. 168)

Sled towing resulted in greater thigh extension and trunk lean, enabling the athletes to place themselves in an optimal position to minimize braking forces. Furthermore, sled towing may be a more appropriate training modality for the early stages of the acceleration phase of sprinting.

It is important to note that speed training should not take place under fatigued positions. Fatigue will interfere with a muscle's ability to shorten quickly. According to Cissik (2004), "this means that as the athlete becomes more tired, he or she will slow down; as a result, training may inadvertently teach the athlete to run at slower speeds" (p. 28). Fatigue will also interfere with coordination, which will affect that athlete's ability to run with proper form. This situation could develop and reinforce bad habits. It could also result in injury from bad form.

## **Strength Training**

It is generally accepted that sprint performance can improve considerably with training. Strength training especially, plays a key role in the process. Sprinting has three phases: the acceleration phase, maximum running speed phase, and a transition phase in between. Delecluse (1997) notes:

Immediately following the start action, the powerful extensions of the hip, knee and ankle joints are the main accelerators of body mass. However, the hamstrings, adductor magnus, and the gluteus maximus are considered to make the most important contribution in producing the highest levels of speed. Different training methods are proposed to improve proper output of these muscles. (p. 150)

Sleivert (1995) argued:

Force production in sprinting requires the contraction of several muscles or muscle groups across multiple joints. The magnitude of force produced is a function of the mass of agonistic and synergistic muscles and it is dependent on the extent to which these muscles can be activated by the nervous system. (p. 1658)

Therefore, in training, a sprinter has to aim partly for selective hypertrophy of fast twitch fibers and especially for specific adaptations of the nervous system. In order for a sprinter to reach maximum speed when strength training studies are based on the following three areas: weightlifting, hypertrophy training, and neuronal activation training.

**Weightlifting.** Weightlifting is a necessity for any sports training program.

While the present study focuses on drills and training aids, it is important to mention that weightlifting is an essential component of a speed development program. Lifting weights

is how an athlete gets strength and/or power: “Strength can be defined as the ability to produce force” (Stone, 1993, p. 10). The more force an athlete produces, the stronger they will become. In terms of power, “power output is likely to be the most important factor in separating sports performances (i.e., who wins and who loses)” (Stone, n.d., p. 80). Lifting exercises that are detrimental to running, especially for sprinters, are squats, cleans, and leg curls. Stone (n.d.) observed, “free weight training can produce superior results compared to training with machines” (p. 80). However, both are needed for a well-rounded and successful training program. The next two training techniques discussed are types of weightlifting.

**Hypertrophy Training.** According to Sleivert (1995), the main goal of hypertrophy training is:

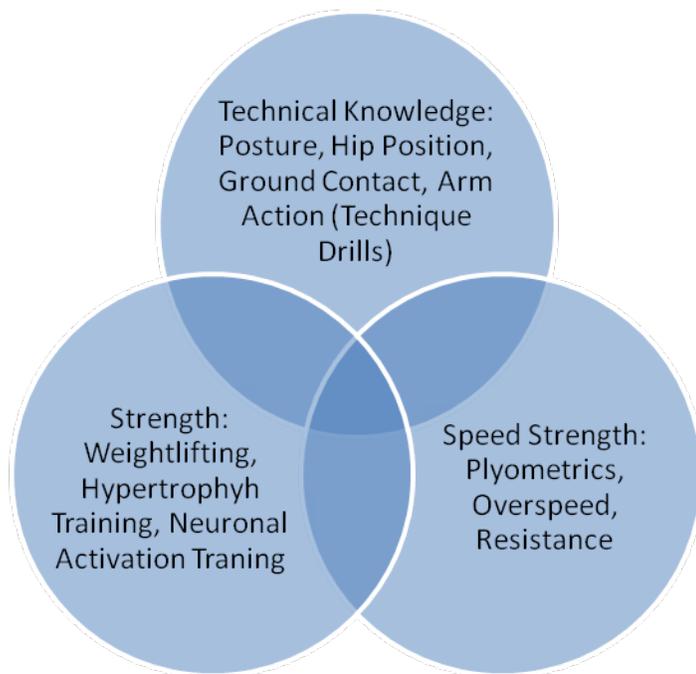
To increase the mean cross-sectional area of muscle fibers. Hypertrophy training is performed by most athletes in their preparatory period as a method to improve quantity of the muscle mass prior to training for speed of neuromuscular activation and/or muscular contraction. (p. 1660)

Hypertrophy training is characterized by a large number of sets of repetitions with sub maximal loads of 60 to 80%, where 100% is the maximum weight that can be handled in a dynamic situation. The execution of the movement is rapid to slow and ends in a dynamic situation. For sprinters, the main objective is to realize hypertrophy of fast contracting fibers. If fast twitch fibers are recruited and overloaded, they tend to undergo hypertrophy very readily. However, “it is evident that the use of hypertrophy training for

sprinters must be limited and combined with other strength training methods” (Delecluse, 1997, p. 150).

**Neuronal Activation Training.** According to Mero (1994), “this training method makes use of short term and extremely fast maximal actions against near maximum loads (90 to 100) %), or in the case of eccentric actions, against supra-maximal loads” (p. 151). In these exercises, the action velocity of the muscle is maximal. Mero (1994) adds, “As these training methods emphasize neuronal output, they should be practiced in a rested state with each action being executed as fast as possible” (p. 4). Repetitions of these exercises are limited to a maximum of 3. This method enables the athlete to integrate higher ranking fast twitch fibers. High contractility is very important in sprinting. Following the hypertrophy and neuronal activation methods, accompanied by speed strength methods, will prevent slowing of contraction, thus making a sprinter faster.

Based on these findings and previous research, the researcher has developed a conceptual model of effective sprint training techniques that a speed development program should include in Figure 1. The center of the figure represents optimal training. A combination of technical knowledge, strength training, and speed strength training based on the coaches’ discretion should be implemented in a speed development program to achieve desired results.



*Figure 1- Researcher's Model of Interrelated Effective Sprint Training Techniques*

### **Synthesis of Literature**

An examination of the literature reveals that several training techniques go into training a top sprinter. It is clear that specific adaptations following any strength training technique are related to the loadings, intensity, the movement velocity, the movement specificity, the number of repetitions, the number of sets and the inter- and intraset recuperation times. Indeed, “because there are so many variables determining specific training effects, it is impossible to produce a general, instant training program” (Delecluse, 1997, p. 154). Training effects can either be positive or negative depending upon the quantity within a training session and the time ratio and recovery periods.

A good coach observes the quality of the training performances of his athlete and recognizes when recovery and progressive loading are out of balance. This means that working with top level sprinters necessitates an individualized strength training approach:

“For example, athletes with a relatively high proportion of slow twitch fibers in specific muscles have to perform a great deal of speed strength training and plyometrics to aim for selective hypertrophy” (Delecluse, 1997, p. 154). When determining a strength training approach for sprinters, coaches have to be aware of the multi-dimensional performance structure and the changes in muscle involvement from start to finish. Coaches should always take into consideration that there is no specific mechanism that is solely responsible for speed, strength, or even endurance. Given this, the research within this study will contribute to previous research by discovering what drills and training aids are the most effective for sprinting.

## **CHAPTER THREE: METHODOLOGY**

### **Research Questions**

The research questions developed for this study were designed to get an understanding of particular drills and training aids a coach may use and why and how that technique is effective. The semi-structured questions left room for further explanation if necessary. The questions were as follows:

Research Question 1: Which drills and training aids are perceived as having high utility and effectiveness in the training of elite sprinters?

Research Question 2: Which drills and training aids are perceived as having low utility and effectiveness in the training of elite sprinters?

Research Question 3: Are there differences in the preferred drills and training aids among high school, collegiate, and professional coaches?

### **Research Design and Implementation**

A qualitative design was selected for this study. All questions were approached through a qualitative interview protocol. The questions in the interviews were developed to determine what drills and training aids a coach uses in their speed development program and are how effective they are for a sprinter (i.e, running faster). The drills and training aids that were not used were also discussed in order to see if a coach has no knowledge of it or if it simply is not effective. A semi-structured protocol was used for the interviews and it allowed the researcher and the coach to formulate our own ideas and expand on statements.

Eight coaches (male and female, ages 28-65) were interviewed for this study. The coaches chosen are at the high school level, collegiate level, and professional level in order for the study to be well-rounded. The chosen coach respondents have been successful at each level producing elite runners that have broken records, excelled in championship meets, and have received accolades. All the coaches listed, minus one, have played a part in the researcher's career as a track athlete and beyond.

### **Research Setting**

This study was conducted in the state of Virginia during the month of June 2015. Most teams had concluded their spring outdoor seasons. All coaches were interviewed face-to-face or via Skype. A total of 7 coaches were interviewed face-to-face, with one coach being interviewed via Skype. The interviews lasted no longer than 30 minutes.

### **Sample**

Eight track coaches were purposefully sampled to participate in this study. These eight coaches were selected based on their success with athletes in the sport. They have all won championships, as well as produced state champions, national champions, and Olympians. Coaches' history with track and field ranged from 3 to 35 years. All coaches have been former athletes participating in events such as sprints, jumps, javelin, and pole vault. The participants included six males and two females. Of the participants, six are high school coaches, one is a collegiate coach, and one is a professional coach. This was done in order to represent the different levels of training within the sport. All names and information that could be used to identify the schools or any other locations were re-

moved and coded. All identifiable elements of individual participants were also removed and coded. The final participants and levels represented were:

- |                              |                                |
|------------------------------|--------------------------------|
| 1. Male Coach 1- Collegiate  | 5. Male Coach 5- Professional  |
| 2. Male Coach 2- High School | 6. Male Coach 6- High School   |
| 3. Male Coach 3- High School | 7. Female Coach 7- High School |
| 4. Male Coach 4- High School | 8. Female Coach 8- High School |

Coaches have been in the sport ranging from three to thirty five years. The researcher was personally coached by four of the coaches that were interviewed. Additionally, the researcher had interactions with three coaches, as they were former competitors. Lastly, for a fresh outlook on speed development programs, the researcher selected a relatively new coach as a part of the study.

### **Data Collection**

When this study was conducted, it will met all guidelines set forth by George Mason University Institutional Review Board (IRB) for academic research. All protocols, safeguards and guidelines were reviewed, approved and followed. No research was conducted prior to IRB approval. Data were collected through face-to-face interviews during the month of June of 2015. Interviews were expected to last 30 minutes to an hour. The interviews were conducted using a semi-structured protocol. The goal of this study was to develop a greater knowledge for the different techniques a coach may use for their sprinters, which could be tweaked and implemented by future coaches and athletes to produce high quality sprinters. Sample questions within the study are: What speed strength training aids do you feel have a positive impact on an athlete's performance?

How did you learn about different drills and training aids? What do you think is the most important component of a speed development program? Refer to Appendix A for a list of all interview questions.

### **Data Analysis**

Once all the interviews were conducted, responses were color coded for similarities and repetitions in training techniques. Based on coaches' responses, the researcher had the ability to connect strategies, drills, and training aids. The researcher was also able to compare and contrast the different coaching styles. The results may also show that certain drills and training aids are beneficial at certain levels of competition (i.e., the techniques used in high school may not be necessary at the professional level). Credibility of this study comes from personal experience, due to the fact that the researcher was personally coached by some. Mainly, as an insider to their programs, I had knowledge of what training drills and techniques were used. Thus the drills and training aids being implemented in their speed development programs were easily identifiable and verified.

## CHAPTER FOUR: RESULTS

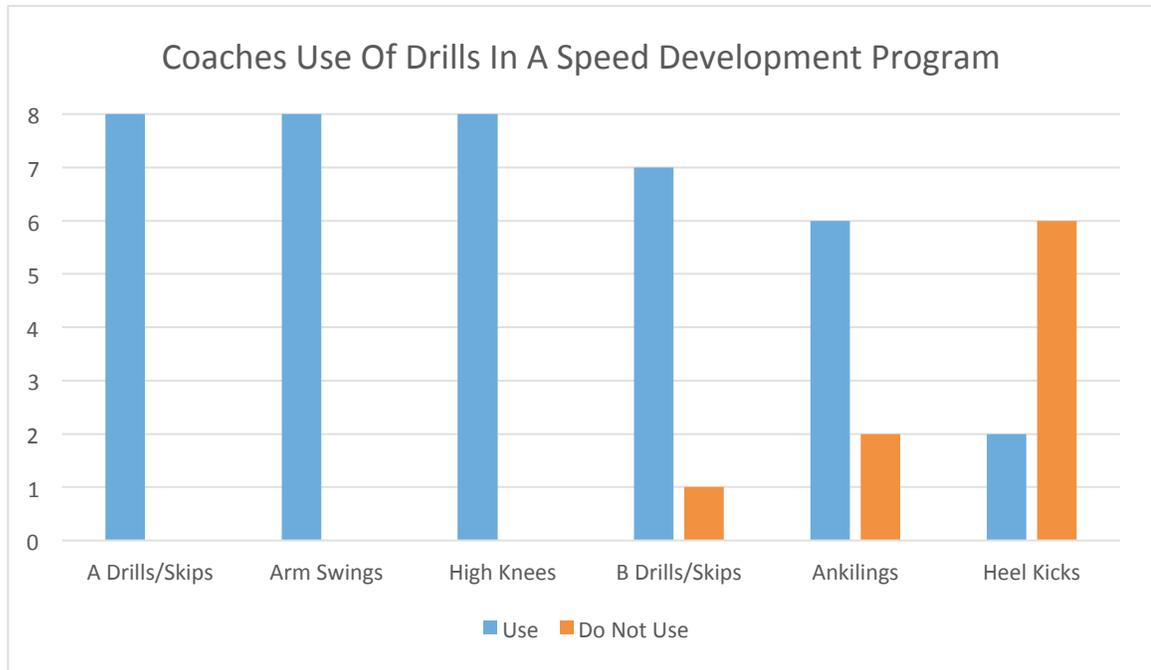
Coaches interviewed discussed drills and training aids used within their speed development programs. These discussions created a list of drills and training aids perceived as having high and low utility and effectiveness. Comparisons in speed development programs were also made between high school, collegiate, and professional coaches.

### **Drills and Training Aids Perceived as Having High Utility and Effectiveness**

Coaches implement drills and training aids into their speed development programs with the expectation of increasing an athlete's stride length. In the words of Male Coach 1, "if an athlete is able to increase their stride length, their times will become faster." Based on the interviews, coaches measure the effectiveness of drills and training aids by comparing before and after video, repeating workouts and using time, and athletes meeting standards to qualify for conferences, regionals, or states. Effectiveness is also measured by setting personal records at meets. In regards to measuring effectiveness, Male Coach 4 stated, "it's a matter of watching their form and measuring their starting point output without the training devices and compare them later on at certain points in the training year."

Figure 2 shows the drills that are perceived as having high utility and effectiveness based on the measures stated above. A drills/skips, arm swings, and high knees are used by all coaches in their speed development programs. "These drills are imperative to a speed development program because they reinforce good mechanics and running technique" stated Male Coach 5. Ankling and B drills/skips can also be noted as effective.

Although, they are not used by all coaches interviewed, the majority implement them into their speed development programs. The coaches that have chosen to not use these drills credit it to difficulty of executing the drill correctly.



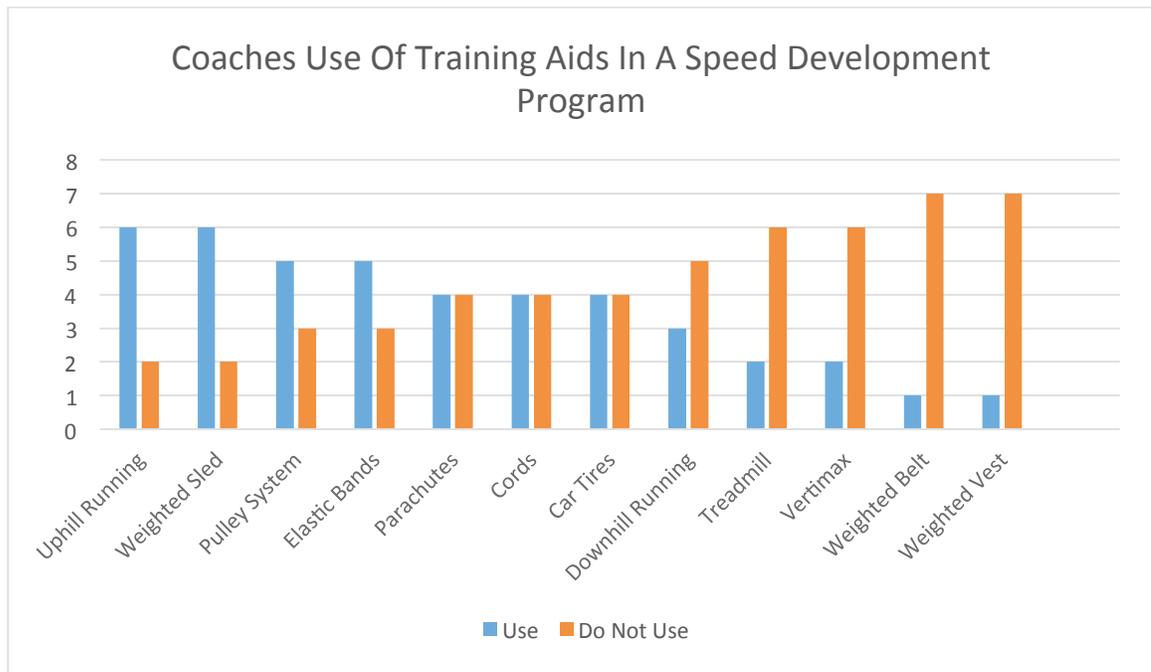
*Figure 2- Coaches' Use of Drills*

In Figure 3, training aids perceived as having high utility are uphill running and weighted sleds. These aids have shown the most improvement with increasing stride length. Female Coach 8 stated:

For training aids we look for power development to aid in speed and endurance over the season. To measure the effectiveness we repeat the workouts during the training cycle and use time as a measure to see if their fitness levels have improved over time and if they are getting stronger overall. More often than not

when the training cycle is written out correctly, all drills and aids assist the athlete with desired individual outcome.

The coaches that do not use uphill running or weighted sleds report this is simply due to not having the resources. Female Coach 7 stated, “while I used weighted sleds as an athlete, now being a coach, the program is only allotted so much money, so I would rather spend our funds on uniforms, travel, and essentials like starting blocks or batons.” “I would incorporate uphill running into our training, but we have no hills at our school” stated Male Coach 5. It should also be noted that pulley systems and elastic bands are effective in speed development programs if the coach has the knowledge to execute use of the aids correctly. Male Coach 1 stated that pulley systems “train mechanics and neural sequencing to allow for improvements in unassisted maximal speed”; however, they should be used sparingly. Parachutes, car tires, and cords are used in some speed development programs, but do not produce the highest effectiveness. Coaches who do not use these aids credit it to adding too many variables and not helping form. When asked if parachutes were used in his speed development program, Male Coach 5 stated, “Oh hell no, they are unreliable depending on weather and do not give the smooth transition needed for sprint success.”



*Figure 3- Coaches' Use of Training Aids*

### **Drills and Training Aids Perceived as Having Low Utility and Effectiveness**

The drills commonly used in track are anklings, arm swings, A drills or skips, B drills or skips, high knees, and heel kicks. As noted in the literature review, these drills are the core of a speed development program in that they teach an athlete correct running posture and technique. “These drills reinforce all the good habits an athlete should have while in practice and competition,” stated Male Coach 3. Figure 2 shows that majority of the coaches interviewed, however, do not use heel kicks.

The expected outcome of any drill or training aid is to make athletes faster (increase stride length) and stronger. According to Male Coach 1, heel kicks are perceived as having low utility and effectiveness because this drill is not a sprinting action and leads to poor mechanics. Male Coach 3 stated, “the reason I do not use heel kicks in training is because I feel that this drill reinforces the wrong mechanics and form which I

want to achieve in the other drills that I enforce.” Male coach 5 agrees, stating that “heel kicks teach bad mechanics.” While heel kicks are not considered an effective component of a speed development program, it exists in the sport for jumping events in that it is useful for developing range of motion in the quadriceps and strength in the hamstring. Coaches that do incorporate heel kicks in practice do so for an introduction into the sport when an athlete is unsure of what event to participate in. Male Coach 3 who was a former jumper stated that, “I use heel kicks for all my athletes if it is their first time in the sport of track and field. If they aren’t a jumper, I tend to stop using it. Seems strange, but I think all athletes should know what a heel or butt kick is. It’s my personal coaching choice.”

Male Coach 1, a collegiate coach, was the only coach that did not incorporate B drills/skips into his speed development program, stating that, “because of the knee extension phase of this drill, it is often confusing to the athlete and incorrectly executed.” All other coaches that use B skips/drills had responses that ranged from “it’s what I’ve always done” to “its good for use to help warm the muscles.” Female Coach 7 stated that, “All of my previous coaches used B skips. I was coached that way and I am a creature of habit so I don’t see any harm in the drill.”

Figure 3 shows coaches’ use of training aids within their speed development programs based on a list the researcher compiled from personal use as being a former sprinter. The list of training aids includes uphill running, downhill running, parachutes, weighted vests, weighted belts, weighted sleds, treadmill, vertimax, pulley system, cords, elastic bands, and car tires. These training aids can be classified into two categories, re-

sistance training or overload, and assisted training or overspeed. According to Cronin (2008), “Resisted sprint training is used to increase force output at the ankle, knee, and hip in an effort to increase stride length” (p. 168). The training aids in this category are uphill running, car tires, weighted belts, weighted sleds, weighted vests, parachutes, and the vertimax. Assisted methods of training are used to produce an overspeed effect. Delecluse (1995) surmised, “overspeed training, running at a faster pace than the body is accustomed, promotes the neuromuscular system to adapt to contracting at higher rates thereby improving stride rate and maximum velocity speed” (p. 1205). The training aids in this category are downhill running, cords, elastic bands, pulley systems, and the treadmill.

Of the drills listed, weighted vest and weighted belts were perceived by coaches as having the lowest utility and effectiveness for a speed development program. The majority of coaches do not use these training aids because they slow transition and do not help with form, which is counter effective of a speed development program. Male Coach 1 stated that “artificial weight/resistance slows the eccentric-to-concentric transition which is counter to the primary training goal of plyometric training.” He added that an athlete will have a hard time handling the load of added weight and with that can come injuries, typically shin splints. Male Coach 5 noted that, “weighted vests and belts are pointless. Why slow your athlete down when you want them to get faster.” Other training aids that should be noted as also having low utility and effectiveness are downhill running, treadmill, and the vertimax. Of the training aids not implemented into speed development programs, three high school coaches said it was because they had no

knowledge of the vertimax, two high school coaches said there is no budget for the vertimax which costs \$2,300, and one high school coach said the treadmill is against policy for safety purposes. Female Coach 8 stated: “Administrators will not allow us to train on the treadmills for fear of injury. I get it. I have seen people fall on treadmills before, but even if I was allowed I wouldn’t use them anyway.” Male Coach 2 also agrees that he wouldn’t use treadmills. He stated: “Athletes should train in their natural running environment. A treadmill serves no purpose.”

All drills and training aids used by coaches cater to the specific needs of an athlete or group. In the words of Male Coach 1, “I use what I know works best for each athlete.” Male Coach 5 stated that he often asks himself if the drill or aid will facilitate development or waste time. In order to determine which drills and aids are effective, coaches use visuals/video to check posture and alignment. Heel kicks, weighted vests, and weighted belts have low effectiveness because they do not reinforce the good habits an elite sprinter should possess.

### **Differences In Preferred Drills and Training Aids Among Coaches**

There are minor differences in preferred drills and training aids among high school, collegiate, and professional coaches. For most athletes, high school is typically the introduction into track and field, which could explain why all drills and training aids (if available) are implemented in some form across the field. According to Male Coach 1, a collegiate coach, he focuses on what works for each athlete; speed development programs seem to typically be more focused and dedicated to athlete’s strengths at the collegiate and professional level. At those levels, coaches and athletes should know what

works and what does not work, unless it is a drill or training aid they have not yet been introduced to. This could also be why certain drills and training aids are not used at these levels. Most trial and error occurs at the high school level considering most athletes are new to the sport.

Table 1 can be used to compare the differences in preferred drills and training aids among coaches. While heel kicks were considered the drill with the lowest utility and effectiveness, Table 1 shows that high school coaches are the only ones utilizing heel kicks. Collegiate and professional coaches do not include heel kicks in their speed development programs. Collegiate and professional coaches also do not use parachutes, whereas three high school coaches use them. A professional coach was the only one to use the vertimax. This is mostly contributed to other coaches not having the funding for the equipment or not having the knowledge of the training aid.

Uphill running, weighted sleds, weighted vests, weighted belts, vertimax, parachutes, and car tires are training aids that are considered to be resistance or overload training. Cords, elastic bands, treadmill, downhill running, and pulley systems are training aids considered to be assisted or overspeed training. High school coaches tend to use more overspeed training. Collegiate and professional coaches use overspeed training, but resistance or overload training based on the training aids used is most prominent.

*Table 1- Differences in Drills and Training Aids Among Coaches Levels*

Drill/Training Aid	High School Coaches	Collegiate Coaches	Professional Coaches
A Drills/Skips	6	1	1
B Drills/Skips	7	0	1
High Knees	6	1	1
Heel Kicks	3	0	0
Anklings	4	1	1
Arm Swings	6	1	1
Parachutes	3	0	0
Cords	3	1	1
Elastic Bands	4	0	1
Pulley System	4	1	0
Car Tires	3	0	0
Uphill Running	4	1	1
Downhill Running	3	0	0
Treadmill	3	0	0
Vertimax	0	0	1
Weighted Vest	1	0	0
Weighted Sled	4	1	1
Weighted Belt	3	0	0

### **Summary of Qualitative Findings**

Coaches interviewed discussed drills and training aids used within their speed development programs. These discussions created a list of drills and trainings aids perceived as having high utility and effectiveness and low utility and effectiveness. Comparisons in speed development programs were also made between high school, collegiate, and professional coaches. Those drills and training aids perceived as having high utility, (A drills/skips, B drills/skips, high knees, arm swings, weighted sled, and uphill running) aid in a coaches ultimate goal of increasing stride length.

There is a concern among coaches that inappropriate use of drills and training aids will induce detrimental changes in technique that will be transferred to sprinting. For that

reason, the drills and training aids with the lowest utility and effectiveness are heel kicks, downhill running, weighted vests, and weighted belts. Coaches measured the effectiveness of drills and training aids by visuals (watching athletes execute movements), before and after video, times in practice/competition, and achieving qualifying standards for championship competition.

Findings revealed that when comparing high school, collegiate, and professional coaches, high school coaches are the only ones to include heel kicks into their programs. Collegiate and professional coaches do not use parachutes. This is due to coaches seeing no need to use these drills or training aids as they do not benefit the athlete with increasing stride length. High school coaches stated that coaching runners is a sport or trial and error, which contributes to why majority of all drills and training aids are used at that level. Those that are not implemented is due to no knowledge or not having the resources (budget) to obtain equipment. Comparisons also showed that high school coaches utilize more overspeed training, whereas, collegiate and professional coaches utilize more overload training.

## CHAPTER FIVE: CONCLUSION

This study was conducted in order to determine which drills and training aids are the most effective when coaching a sprinter (i.e., make a sprinter run faster). By interviewing coaches, this study contributed to a coaches' knowledge of training techniques to produce a faster sprinter. The objective of this study was to provide an in-depth view of drills and training aids that can be incorporated into a speed development program for sprinters. Coaches discussed drills and training aids used within their speed development programs, which resulted in a list of drills and trainings aids perceived as having high or low utility and effectiveness. Comparisons were also made between high school, collegiate, and professional coaches.

As noted in Chapter 4, the majority of coaches' use A drills/skips, B drills/skips, high knees, arm swings, weighted sled, and uphill running in their speed development programs to increase an athlete's stride length which in turn creates a greater running velocity. Male Coaches 1, 2, 4 and 5 all stated that these drills are the core of any speed development program. Coaches are concerned that inappropriate use of drills and training aids will create unfavorable changes in technique that will be transferred to sprinting. For that reason, the majority of coaches did not use downhill running, weighted vests, and weighted belts. Coaches measured the effectiveness of drills and training aids by visuals (watching athletes execute movements), before and after video, times in practice/competition, and achieving qualifying standards for championship competition.

Findings revealed that when comparing high school, collegiate, and professional coaches; only high school coaches include heel kicks into their programs. Collegiate and

professional coaches do not use parachutes due to coaches seeing no need to use these drills or training aids as they do not benefit the athlete with increasing stride length. High school coaches stated that coaching runners is a sport of trial and error, which contributes to why majority of all drills and training aids are used at that level. The drills and training aids that are not implemented in coaches speed development programs is due to no knowledge or not having the resources to obtain equipment. Comparisons also showed that high school coaches apply more overspeed training in their speed development programs, whereas, collegiate and professional coaches apply more overload training.

### **Research Question #1 Findings**

Which drills and training aids are perceived as having high utility and effectiveness in the training of elite sprinter?

Drills and training aids having high utility and effectiveness are those that reinforce the best running mechanics. Coaches implement drills and training aids into their speed development programs with the expectation of increasing an athlete's stride length. Coaches measure the effectiveness of high utility drills and training aids by comparing before and after video, repeating workouts and using time, and athletes meeting standards to qualify for conferences, regionals, or states. Effectiveness is also measured by setting personal records at meets. The drills and training aids perceived as having high utility and effectiveness based on the measures above were A drills/skips, arm swings, high knees, weighted sleds, and uphill running. The drills listed here are used by all coaches in their speed development programs. Female Coach 8 stated, "in order to measure the effectiveness we repeat the workouts during the training cycle and use time as a measure

to if their fitness levels have improved over time and if they are getting stronger overall. More often than not, when the training cycle is written out correctly all drills and training aids assist the athlete with desired individual outcome.”

When asked how you chose training methods, Male Coach 2 stated, “I consider the source and look at the level of difficulty. One of the most important factors is we can execute the drill correctly. Does it facilitate development or waste time?” Male Coach 4 agrees with his statement that “I try to train them in ways to not have wasted movement or unnecessary added negative effects to their potential.” Coaches want to reinforce good mechanics and believe A skips/drills, B skips/drills, high knees, and arm swings accomplish this.

Weighted sleds and uphill running were perceived as having high utility because these aids are used to enhance an athlete’s strength. When asked about weighted sleds, Male Coach 3 stated, “These aids are used at specific times during the training cycle and designed to enhance whatever we are developing during the cycle. The best results will come during the peak period.” When asked what is the most important component of a speed development program, Female Coach 8 said, “developing stride length and frequency.” Weighted sleds and uphill running seem to aid the most with that.

Research findings also noted that pulley systems and elastic bands are effective in speed development programs if the coach has the knowledge to execute use of the aids correctly. Male Coach 6 stated that, he would implement these aids into his programs if he had more coaches on his team that were knowledgeable of their use. Elastic bands and pulley systems are classified as overspeed training. Overspeed training, running at a fast-

er pace than the body is accustomed, promotes the neuromuscular system to adapt to contracting at higher rates thereby improving stride rate and maximum velocity speed. Male Coach 1 stated that acceleration was the most important component of a speed development program, adding that “attaining maximal speed requires perfectly executed acceleration.” Pulley systems are used in his program because they reduce strain required to maintain maximal speed. He stated that the pulley system “trains mechanics and neural sequencing to allow for improvements in unassisted maximal speed.” Female Coach 8 agrees and said she used the pulley system in her speed development program because the aids help with power development. Coaches implement drills and training aids that will work best for their athletes and produce desired results.

### **Research Question #2 Findings**

Which drills and training aids are perceived as having low utility and effectiveness in the training of elite sprinter?

Of the drills and training aids commonly used in the training of elite sprinters, overall findings concluded that heel kicks, weighted vests, and weighted belts were perceived as having low utility. Male Coach 1 stated that heel kicks often lead to poor sprint mechanics. Male Coaches 3, 4, 5, and 6 agreed. The expected outcome of any drill or training aid is to make athletes faster by increasing stride length. Heel kicks are perceived as having low utility and effectiveness because this drill is not a sprinting action and leads to poor mechanics. The most important component of a speed development program according to Male Coach 3 is technique and form. He feels heel kicks are counterproductive to this. Weighted vests and belts are classified as resistance or overload training.

Weighted vests and weighted belts were perceived by coaches as having the lowest utility and effectiveness for a speed development program because they slow transition and do not help with form, which is counter effective of a speed development program. Male Coach 6 stated: “Adding weight to what an athlete already carries is counter-productive.” Male coach 1 agreed, stating “most athletes have a hard time handling plyometric loads with their own weight, let alone under extra load.” This may lead to injuries such as shin splints. Male Coach 1 stated that his father was very involved in his coaching education: “I learned from him and followed his lead to learn from every source I could find.” He also refers to technical journals, clinics, and collaborations with other coaches. Through this he learned the growing discontent of weighted vests and belts and made the choice to not implement them in his speed development program.

Other training aids noted as also having low utility and effectiveness were downhill running, treadmill, and the vertimax. Coaches stated these training aids were not implemented into their speed development programs because they had no knowledge of the aid, there is no budget for the aid, or they are against policy for safety purposes. Female Coach 7 stated, “I do not use the vertimax or treadmill in my program. Reason being that the treadmill is county policy and will not allow students to use motorized cardio equipment on school property and the vertimax is not in our budget.” Male Coach 3 stated, “I am not very knowledgeable of the vertimax.” He further added: “I learned about different drills and training aids through former coaches, clinics, but mostly through being creative and a heavy dosage of trial and error.” He never used the vertimax during his time as an athlete and doesn’t see the need for it. All drills and training aids used by coaches cater

to the specific needs of an athlete or group. Mann (1985, p. 153) noted that, “elite sprinters run in a more upright position than good sprinters, and therefore we suspect that trunk lean must be carefully monitored when training with resisted sprint devices so that an inappropriate angle is not induced and reinforced.” Male Coach 5 agrees which is his reasoning for not incorporating weighted vests or weighted belts into his program: “These aids do not help with desired trunk lean or upright running position.”

Coaches often ask themselves if the drill or aid will facilitate development or waste time. In order to determine which drills and aids are effective, coaches monitor trainings with visuals/video to check posture and alignment. Heel kicks, weighted vests, and weighted belts have low effectiveness because they do not reinforce the good habits an elite sprinter should possess.

### **Research Question #3 Findings**

Are there differences in preferred drills and training aids among high school, collegiate, and professional coaches?

Based on findings within the study, heel kicks was considered the drill with the lowest utility and effectiveness. Only high school coaches utilize heel kicks. Male Coach 2 stated, “most kids that come here never ran before. I try to introduce them to all aspects of the sport when possible. Once they figure out what they are good at, we will focus.” Collegiate and professional coaches do not include heel kicks in their speed development programs. Male Coach 5 stated, “heel kicks teach bad mechanics.” He also added that he learns from reading, clinics, and other coaches. Once coaches began to transition from heel kicks, he followed. Collegiate and professional coaches also do not use parachutes,

whereas three high school coaches use them. In regards to not using parachutes, Male Coach 1 stated, “parachutes add too many variables to resisted running. Other options are better.” However, Male Coach 2, a high school coach, states that parachute use is critical to sprinting. A professional coach was the only one to use the vertimax. This is mostly contributed to other coaches not having the funding for the equipment or not having the knowledge of the training aid, as stated earlier.

When asked what is a typical practice like for your sprinters, Male Coach 2 responded, “easy warm-up jog, dynamic stretching, drills, block/exchange work, endurance work (300 meter breakdown), acceleration work, cool down, and abs.” Female Coach 7 had a similar response with, “2 lap warm up, dynamic stretching, drills, 350 meter breakdown, and cool down.” Whereas, the professional coach responded with, “it depends on what training phase we are in. In the fall we spend three days on conditioning and two days on technique. As time progresses we spend three days a week on speed work and technique, lifting lower body.” The collegiate coach response was “dynamic warm-up/drills tailored to the training focus, primary focus of technical development, secondary focus depends on needs of the athlete, weight room, and core/flexibility.” Here we can see that high school coaches train as a whole, meaning all athletes do the same thing regardless of weaknesses or strength, whereas, at the collegiate level coaches begin to focus on the needs of each athlete independently. Differences in speed development programs among the different levels also showed that high school coaches tend to use more overspeed training. Collegiate and professional coaches use overspeed training, but resistance or overload training based on the training aids used is most prominent. This may be due

to high school coaches not having the resources or funds needed for those training aids. When asked how you chose training methods, Male Coach 1 stated, “most protocols evolve from the specific needs of a particular athlete or group. While the methods may be very effective for that athlete at that time in their career, it may not work for another athlete or at another stage in the athlete’s development.” At this level, coaches begin to cater to each athlete’s needs.

There are slight differences in preferred drills and training aids among high school, collegiate, and professional coaches. For most athletes, high school is typically the introduction into track and field, which may explain why all drills and training aids (if available) are implemented across the field. If an athlete runs at the collegiate or professional level, speed development programs are typically more focused and dedicated to athlete’s strengths, which may explain why particular drills and training aids are not used at these levels.

### **Study Limitations**

There is no training program that will undoubtedly produce an elite sprinter. While coaching techniques play a key role, simply having talent is also a strong factor. At times, issues arise outside of coaching such as an athlete being prone to injuries or simply not grasping the concept on how to execute drills or use training aids. Coaches must also understand that it takes time to develop an elite sprinter and the process may be slow. Setbacks include injury, disagreements, and outside behaviors (i.e., eating habits or other recreational activities).

Limitations within this study exist due to perceptions being based on the coaches interviewed. There may be other drills and training aids used by coaches not interviewed that are favorable and produce positive results as well. The number of coaches interviewed may also be considered a limitation due to the amount being so small. Track and field is a large sport and interviews from eight coaches is only a small representation. Another limitation found within this study stems from not all coaches on the original list being willing to participate, which led to unequal representation with the number of coaches interviewed at each level. The high school level contained six coaches, whereas the collegiate and professional levels contained only one coach. While results may have only varied slightly due to this, the representation should have been more equally distributed.

Lastly, the list of drills and training aids provided (based on research) does not contain every drill and training aid that is used within the sport. There may be other drills and training aids implemented in coaches' speed development programs that increase stride length and provide coaches with the results they are seeking for their athletes. Track and field is a sport of trial and error; therefore, the results of this study may not be exhibited within each athlete.

### **Recommendations for Future Studies**

By replicating the research conducted within this study, the drills and training aids perceived as having high and low utility may be challenged or reinforced. The instrumentation and protocol were designed in a way that is universally applicable, yet most training studies are not designed to analyze the effect on sprint running. Therefore, future

studies may include quantitative results which will allow coaches to organize tests with training drills in order to follow up on utilization and effectiveness. Thus a mixed methods study may be in order. Additional studies of interest could also include weightlifting. Several coaches mentioned that weightlifting was imperative to getting the best results in a speed development program. This study focused on drills and training aids; however, weightlifting does contribute to the success of an athlete. By adding more variables in future research, a deeper understanding of what works best in developing elite sprinters can be attained.

### **Conclusion**

Of all human skills, speed is the hardest and most difficult to improve when compared to other factors such as strength and endurance. For this reason, many attempts have been made by coaches to invent new training methods in order to improve the speed of their athletes. By utilizing a semi-structured interview protocol in this study, drills and training aids that were utilized in speed development programs were discovered as being of low utility and effectiveness or high utility and effectiveness.

Based on findings in the study, coaches should no longer include heel kicks in their speed development programs, being that the drill does not reinforce good sprint mechanics. Those coaches that do not incorporate uphill running or weighted sleds into their speed development programs should reconsider, being that coaches have measured the effectiveness of these training aids and have seen stride increases within their athletes sprinting. All coaches use the drills considered as being the most effective, as those drills are considered being the core of the sport. The findings of this study have contributed to

what was previously known about speed development programs. A coach has to always take into consideration that there is no specific drill or training aid that is solely responsible for speed. While there is significant work and research still to be done, perceptions, measures, and factors associated with better understanding towards speed development programs are beginning to be uncovered. Several of these perceptions, measures, and factors were reported in this study. Understanding these perceptions and measures and using these factors to further hone additional research has tremendous potential.

## APPENDIX A

### INTERVIEW PROTOCOL

1. What is your history with track and field?
  2. How many years have you been coaching and what do you specialize in?
  3. What is your coaching style or philosophy?
  4. Talk to me about technique or training drills. How do these drills help an athlete's performance? How do you measure the effectiveness of these drills? Do you feel that these drills are effective?
  5. What speed strength training aids do you feel have a positive impact on an athlete's performance?
  6. How did you learn about different drills and training aids?
  7. How did you choose training methods?
  8. What do you think is the most important component of a speed development program?
  9. What is a typical practice like for your sprinters (100 meter and 200 meter runners)?
- \*Afterwards, go through my list of drills and training aids and ask about those they did not mention.
10. Have you ever used....? What was the expected outcome? How did you measure the effectiveness? Did it meet the outcome?

11. If they never used the drill or technique...did you not know about this drill or training aid? If yes, why did you choose not to use it?

## **APPENDIX B**

Invitation to Participate in Study (Sent via email)

Greetings Coach,

My name is Candace White. I am a current graduate student at George Mason University. I am majoring in Sport and Recreation Studies with a concentration in Sport Management. Upon concluding my graduate work at George Mason, I have decided to do a project/study entitled “An Evaluation of the Effectiveness of Speed Development Drills and Training Aids”. Being a former track athlete and having aspirations of being a coach, I have a strong desire for this information as I hope to one day design my own training program. The interview (which contains open-ended questions) may be done in person or via skype. Interviews should take no longer than 30 minutes. Participation in this study is voluntary, but would greatly be appreciated to help me with my scholarly studies. Please let me know if you would like to participate so that we may set up a day/time, etc. Thank you for your time and consideration.

I look forward to interviewing you soon!

Candace White

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## **BIOGRAPHY**

Candace White graduated from Osbourn Park Senior High School, Manassas, Virginia, in 2004. She received her Bachelor of Arts from Christopher Newport University in 2008. She is currently employed as a Head Children's Leader for the Prince William County Department of Parks and Recreation as well as a Site Director for AlphaBEST Education. In the summer of 2016, she will coach her first summer track camp for Prince William County. She received her Master of Science in Sport and Recreation Studies from George Mason University in 2015.