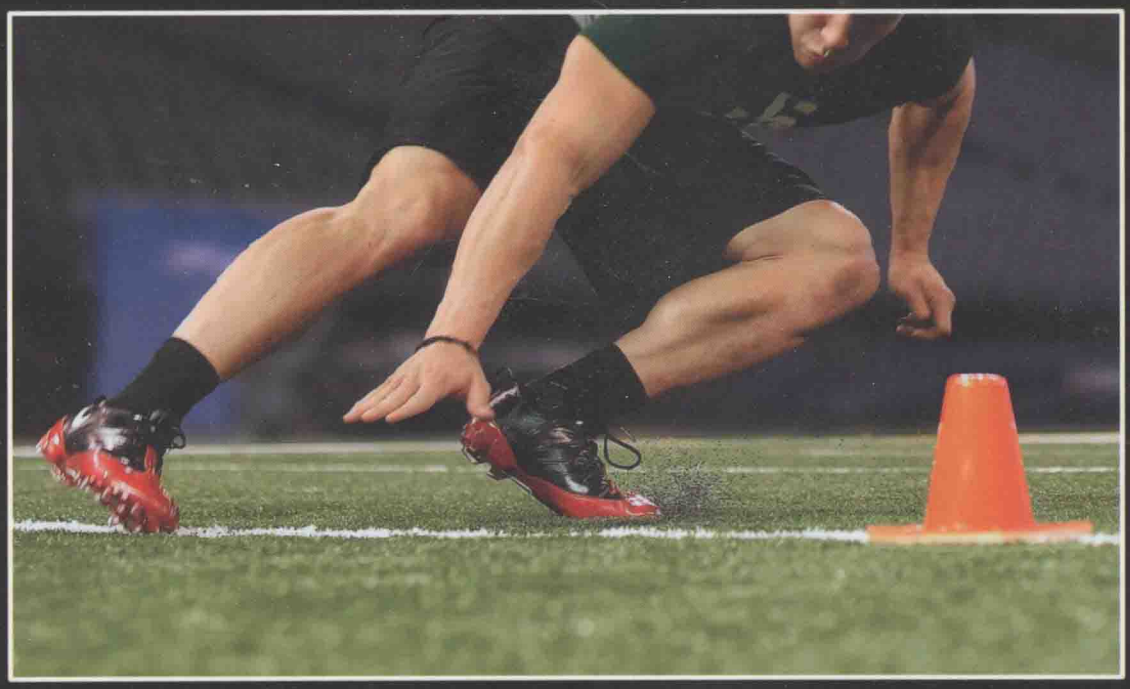
SPORT PERFORMANCE SERIES

# Developing Agility and Quickness



NSCA™
National Strength and Conditioning Association

Jay Dawes • Mark Roozen
Editors

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Human Kinetics

**Library of Congress Cataloging-in-Publication Data**

Developing agility and quickness / Jay Dawes, Mark Roozen, editors.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-0-7360-8326-3 (soft cover)
ISBN-10: 0-7360-8326-X (soft cover)
1. Sports sciences. 2. Sports--Physiological aspects. 3. Motor ability. 4. Motor learning. I. Dawes, Jay. II. Roozen, Mark, 1961- III. National Strength & Conditioning Association (U.S.)
GV558.D45 2011
613.71--dc23

2011025357

ISBN-10: 0-7360-8326-X (print)
ISBN-13: 978-0-7360-8326-3 (print)



The web addresses cited in this text were current as of June 2011, unless otherwise noted.

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We thank the National Strength and Conditioning Association in Colorado Springs, Colorado, for assistance in providing the location for the photo shoot for this book.



Printed in the United States of America 10 9 8 7 6 5 4 3 2 1

The paper in this book is certified under a sustainable forestry program.

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E4818

# Developing Agility and Quickness

# Introduction

For all athletes, the ability to quickly change direction is often the difference between success and failure. Virtually all sports involve whole-body movements that require athletes to rapidly and instantly accelerate, decelerate, or change direction in response to game situations. The reality is that in most sports, the ability to quickly change direction is more important than great straight-line sprinting speed. For this reason, many coaches and athletes are interested in finding effective ways to improve agility and quickness. The purpose of this book is to assist sports coaches, athletes, and strength and conditioning professionals in accomplishing this goal.

In 2002, Young, Jones, and Montgomery attempted to identify the most significant factors influencing agility performance. In particular, these authors divided agility performance variables into two main areas: change of direction speed and perceptual and decision-making factors.[7] Within these two main components, several subcomponents exist, as outlined in figure 1. Agility and quickness are complex sporting skills that include both physical and cognitive components.[1, 2, 3, 4, 5, 6, 7] An example is a kick or punt returner in American football waiting patiently to receive a ball who must immediately decide which way to maneuver through the defense to gain yardage. Or, imagine a point guard who dribbles down the lane and must determine whether to continue dribbling, pass the ball, or shoot. These are prime examples of how athletes must move and think fast to achieve lightning quickness on the field or court. Therefore, to maximize performance, athletic training programs must address both the physical and cognitive components of agility and quickness. Only then will athletes be able to truly bridge the gap between practice and competition.

Chapter 1 discusses factors that influence agility, such as change-of-direction speed, proper technique, body position, and physical attributes. It also covers the essential components of developing rapid force, high power output, and explosive movement, as well as how these fundamental attributes influence athletes' ability to achieve high-level performance.

Chapter 2 explores perceptual and decision-making skills (i.e., quickness factors), such as information processing, knowledge of situations, anticipation, and arousal and anxiety levels. Athletes with high-level agility performance are better at recognizing and capitalizing on task- and game-relevant cues that give them a competitive advantage over their opponents. In many cases, these skills separate elite performers from everyone else.

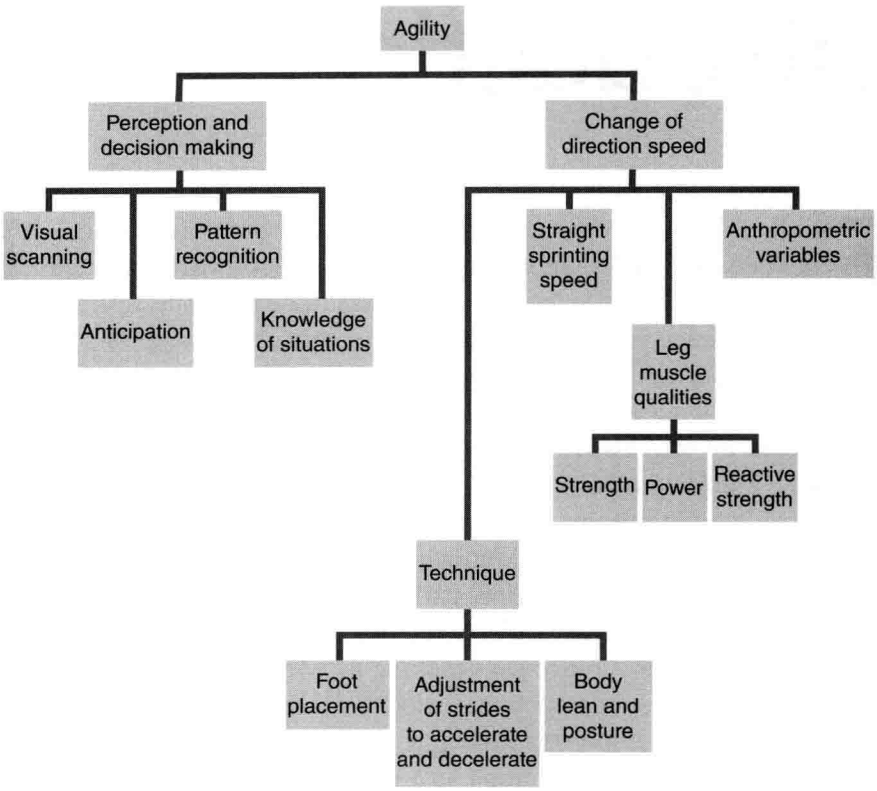



**Figure 1** Components of agility.

Adapted, by permission, from W.B. Young, R. James, and I. Montgomery, 2002, "Is muscle power related to running speed with changes of direction?" *Journal of Sports Medicine and Physical Fitness* 42(3):282-288.

As with any training program, athletes must be physically prepared for the demands of training. Agility and quickness training is no different. Therefore, prior to the chapters with specific drills to enhance agility and quickness (chapters 4 and 5), chapter 3 discusses techniques to evaluate an athlete's readiness in detail. This chapter also presents methods for monitoring athletes' progress with both qualitative-movement assessments and tests that predict agility performance.

Chapters 4 and 5 present a wide variety of drills to improve agility and quickness. Many of these drills develop general motor programs and improve fundamental movement skills for future athletic success. These chapters also include suggestions and specific training drills that incorporate cognitive

decision-making tasks into athletes' training programs once they have mastered the techniques. These unplanned, or *open,* drills require athletes to process information from the environment and to respond quickly with accuracy and precision.

The selected drills provide a solid base of information to assist in the development of athlete-specific and sport-specific training programs. Chapter 6 explores the basic foundations of designing agility and quickness programs. In chapter 7, professionals from a variety of sports share their personal philosophies on agility and quickness training and their favorite drills for improving sport performance at a variety of skill levels. The drills in this chapter add sport-specific training stimulus to the program, which better prepares athletes for the chaotic nature of sport and competition.

This book serves as a basic guide and resource for the safe and effective development of comprehensive training programs for agility and quickness. It is an absolute must-have resource for coaches and athletes who are serious about taking performance to the next level. It is loaded with invaluable training tips and information that the experts in this book have taken a lifetime to develop. The authors hope that athletes, coaches, and performance enthusiasts will gain an appreciation and a better understanding of what it takes to improve agility and quickness. Excellence is not an accident!

# Key to Diagrams


Step with left foot


Step with right foot

Numbers indicate order of steps


Foot touch or tap (no weight transfer)


Cone


Sprint


Side shuffle


Backpedal


Bear crawl


Carioca

X Defensive player or any player

O Offensive player

# Contents

CHAPTER 1

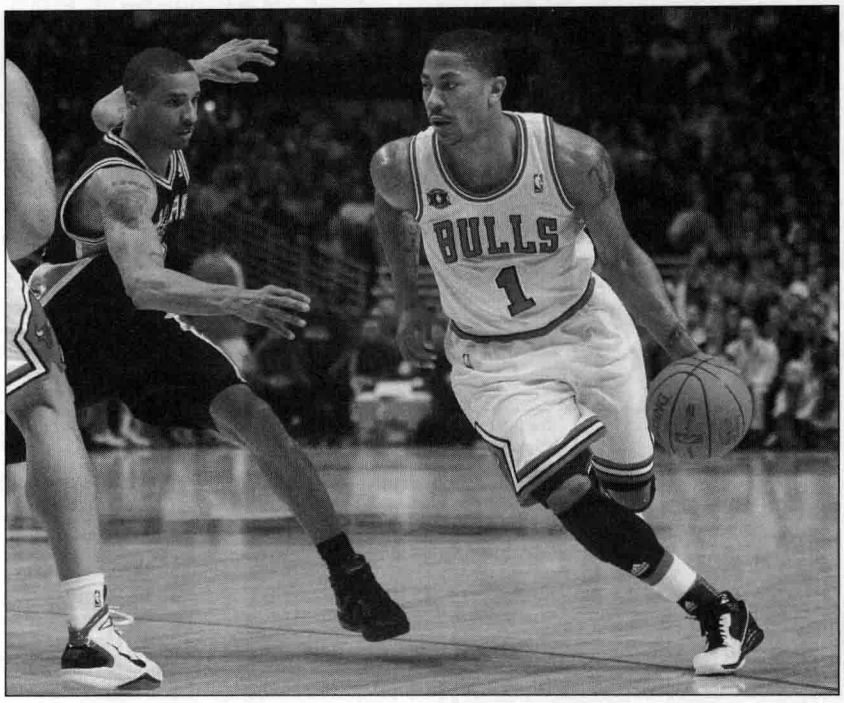
# Factors Determining Agility

Mark Roozen
David N. Suprak

Most team sports, such as basketball, American football, and soccer, are characterized by rapid acceleration, deceleration, and changes of direction within a 10-yard (9 m) window.[45] Furthermore, court sports, like tennis and volleyball, also require multidirectional first-step quickness and changes of direction within a 4- to 10-meter (4–11 yard) span.[40] According to numerous coaches and sport scientists, an agility task is a rapid, whole-body change of direction or speed in response to a stimulus.[41, 53] Agility can be broken down into subcomponents made up of both physical qualities and cognitive abilities.[53] This chapter examines the physical qualities of speed, strength, power, and technique, as well as the qualities of leg muscles.

## SPEED

Athletes who can move faster than their opponents have an advantage. For example, a faster athlete may be able to get to a ball more quickly than a competitor or may even outrun a pursuer. For this reason, athletes in most sports value speed highly. Speed is often measured by using linear (straight-line) sprinting over a distance between 40 and 100 yards (37–91 m). However, it is important to remember that in most sports, athletes rarely sprint more than 30 yards (27 m) in a straight line before they must make some type of directional change. Unless an athlete is a 100-meter sprinter, focusing a great deal of time and attention on straight-ahead speed may not result in optimum performance. On the other hand, since most sports require acceleration from a static state or when transitioning between movements, straight-line speed is still a valuable asset that athletes should focus on when testing and training for sports.




AP Photo/Charles Rex Arbogast

Derrick Rose accelerates past an opponent.

Linear sprinting is a physical skill that most people have performed since their second year of life with some level of proficiency.[22] For decades, many coaches believed that linear speed was mostly related to genetics and could not be significantly improved by training. However, appropriate training does improve running speed, even at the elite level. The combination of stride rate (the number of strides per unit of time) and stride length (the distance covered in a single stride) primarily determines linear speed. So, athletes can improve linear speed by increasing stride rate while maintaining stride length, increasing stride length while maintaining stride rate, or doing a combination of both.

Most sports, with the exception of track-and-field sprinting, involve short sprints (<30 yards) and rapid changes of direction, followed by rapid accelerations. For this reason, it makes little sense to focus a large proportion of training time on improving speed capabilities for athletes who will rarely reach maximum speed in competition. It makes more sense for these athletes to focus their attention on training to accelerate.[33] Acceleration is the rate of change in velocity, so this phase of sprinting is critical for changing directions as rapidly and efficiently as possible.

Optimal technique for linear sprinting in the acceleration phase involves four factors that maximize stride length and frequency:[34]

1. The body should have a pronounced forward lean that results in a lower center of mass. Consequently, momentum in a linear direction increases. This position initiates foot contact with the ground under or slightly behind the center of mass, reducing forces that cause an athlete to slow down or brake.[38]
2. When pushing off the ground during the propulsion phase, the foot touches the ground in a cocked position, with the ankle flexed upward at approximately 90 degrees (dorsiflexion) and the toes pointed back toward the shin. Once the foot makes contact with the ground, the athlete extends the hip, knee, and ankle simultaneously with as much force as possible (see figure 1.1). This movement is known as triple extension.[47]
3. During the recovery phase, the ankle of the free leg should be dorsiflexed while the knee and hip are bent, or flexed. This allows the foot to pass directly under the buttocks and a more rapid turnover at the hip.
4. The athlete should make certain to initiate arm swing at the shoulder with the elbow flexed to 90 degrees. He should work on swinging the arm forcefully backward to let the body's stored elastic energy and stretch reflex provide much of the arm's forward propulsion.[10]

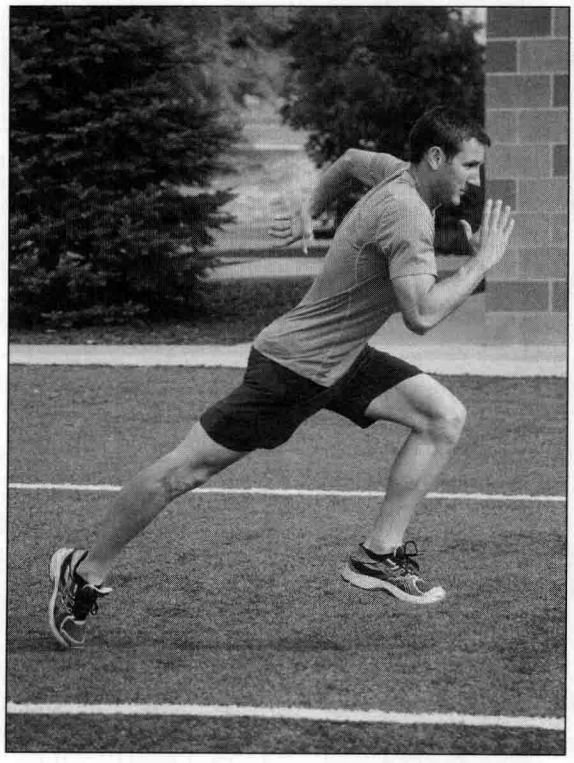


**Figure 1.1** Proper technique for straight-ahead sprinting.

In the propulsion phase, the power output and rate of force development of the muscles that make up the hip extensors and the quadriceps muscles contribute to both stride length and frequency.[20] In the recovery phase of the sprint, the hip flexor muscles (located on the front side of the hip) and the hamstring muscles (located on the backside of the upper thigh) are the major contributors to stride frequency. The strength and power of the hip flexors are important factors in rotating the hip quickly from an extended position to a flexed position in preparation for subsequent foot contact.

The hamstrings have an important role as a multijoint muscle group. Because the hamstring muscles cross over both the hip and the knee, they are responsible for slowing down, or ***decelerating***, the lower leg during the recovery phase in preparation for contact with the ground. At the same time, they also immediately transition to help the hip extend for the propulsion phase of sprinting.[55]

In contrast to straight-ahead sprinting, during backpedaling, the hamstring muscles are less active and the quadriceps muscles are more active.[15] Lateral movements involve more activity from the hip abductors than forward sprinting does. These muscles take the leg away from the body. Therefore, programs focused on improving agility performance should pay particular attention to developing strength in the hip flexors, the hamstrings, and the muscles that surround the hips.

Another important factor contributing to optimum speed is joint flexibility. If the hamstrings are excessively tight, athletes may not be able to bring the knee up as high during the recovery phase of sprinting, hindering hip flexion and speed. Furthermore, tight hip flexors may restrict the ability to extend the hip through the full necessary range of motion, thereby reducing power output during the triple-extension phase of propulsion. Proper flexibility of the involved joints contributes to movements that are more fluid and coordinated, resulting in longer and faster strides and greater speed.

## STRENGTH

***Strength*** is the maximum force that a muscle or muscle group can generate.[27] In most activities, athletes are unable to reach their optimal strength levels because of the speed at which they are moving. Strength is important, but so is the ability to use that strength to generate force. Force is calculated with the following equation:

$$\text{Force} = \text{Mass} \times \text{Acceleration}$$

Therefore, force can be altered by increasing the mass of the object being moved, increasing the acceleration of a given object's mass, or with a

combination of both. Often coaches and athletes increase mass to improve force. However, as mass increases, or as weight is gained, athletes must be sure to maintain their ability to accelerate or move quickly. Gaining weight, even if it is lean mass, does not necessarily improve performance if it causes the athlete to lose a significant amount of speed.

Strength is an important contributor to agility and to athletic success. In agility development, increasing force to move the body more quickly relates directly to strength. Therefore, relative strength (strength in relation to body mass) is more important than absolute strength (the ability to move a given resistance regardless of body weight or mass). Important aspects of strength to consider when designing a program for improving agility include concentric, eccentric, and stabilization strength.

## Concentric Strength

Concentric strength refers to the force exerted by a muscle as it shortens. Think of doing a biceps curl and bringing the weight upward. Lifting the weight requires a concentric movement of the biceps. Positive work (the force exerted against external resistance results in joint movement in the same direction as the force or in the opposite direction of the external resistance) also characterizes concentric muscle actions. An example is the push-off during a running, jumping, or cutting movement that is followed by powerful extension of the hip, knee, and ankle (this is ***triple extension***; refer to figure 1.1 on page 3). Here, gravity works on the body to pull it down. However, with a powerful extension (straightening the ankles, knees, and hips), athletes can overcome the force of gravity and can more effectively run forward, jump, or make a cut. This will help them improve performance levels.

Theoretically, the more force the foot exerts against the ground during running or jumping, the greater the acceleration of the body mass will be. Likewise, the greater the force developed by the hip flexors during the recovery phase of running, the greater the forward acceleration from the hip. Increased force from the hip flexors also allows the athlete to position the foot more quickly for contact with the ground. This results in greater stride frequency during straight-line sprinting and directional changes.[13]

Scientific literature demonstrates a strong relationship between muscular strength and explosive movements, such as vertical[8] and horizontal jumping,[28] sprinting,[52] and agility[37] movements. The relationship between concentric strength and explosive movements is even more pronounced when relative strength is considered. Relative strength factors in the size and weight of an athlete. With absolute strength, if two athletes both squat 300 pounds (136 kg), they have the same maximum lift. If one of the athletes weighs

150 pounds (68 kg) and the other weighs 275 pounds (125 kg), the lighter athlete's relative strength is much greater than the teammate's. The heavier athlete would need to improve relative strength in order to be more explosive.

However, the relationship between concentric strength and explosive movements becomes less apparent when considering elite level athletes.[54] This suggests a threshold in strength at which further improvements in explosive movement performance are more closely related to the rate of force development (or in other words, the speed at which the necessary amount of force can be produced). Maximum concentric strength is especially important in the acceleration phase of sprinting.[52] Since acceleration is an integral factor in optimal agility technique, the role of concentric strength in maximizing agility performance is critical.

## Eccentric Strength

Eccentric strength refers to the force exerted by a muscle as it lengthens. Negative work (the force exerted against external resistance results in joint movement in the opposite direction of the force or in the same direction as the external resistance) characterizes eccentric muscle actions. A simple example is lowering the weight back to the starting position during a biceps curl.

An athlete with high eccentric strength can quickly and effectively decelerate his body while maintaining dynamic balance in preparation for a directional change. The ability to decelerate the body quickly and with control is another important contributor to movements that involve rapid directional changes. Inadequate eccentric strength can slow deceleration and reduce the ability to quickly change direction. The relationship between eccentric strength and the ability to decelerate is exemplified by the movements in a stretch-shortening cycle (see page 11). In order to minimize contact time with the ground during a stretch-shortening cycle (and during agility-type movements), adequate eccentric strength is crucial for decelerating the body mass quickly so it can be accelerated in a new direction.

The ability to decelerate is important for both performance and for injury prevention. Athletes can attain the greatest amount of force during eccentric muscle action.[21] Most injuries occur during joint deceleration.[16] One of the main contributors to proper deceleration is eccentric strength of the involved musculature. If these structures are not strong enough to withstand force during movement, poor body mechanics can lead to improper body position, increasing the chance of injury. However, resistance and plyometric training of the eccentric strength allows athletes to augment their ability to decelerate body mass. This can translate into improved agility and athletic performance.