Sport specificity has become a term where the word specificity is often misunderstood by professionals in athletics. Training methods that are based on simulation can deviate from sound training principles and distort the true nature of goal-oriented training, in regard to sport. The objective of this article is to provide insight on the interactions between strength, power, speed, and agility for soccer players, examine the scientific evidence on improving athletic performance, and provide basic programming guidelines that adhere to current research and anecdotal experiences.

DEVELOPING BIOMOTOR ABILITIES USING THE PRINCIPLE OF DYNAMIC CORRESPONDENCE

For all sports, a comprehensive needs analysis is necessary to ensure that the goals of the training program are met and that the training is specific to that sport. With the growing body of non-empirical information, it is easy to deviate from established training principles and to start adopting the idiom “reinventing the wheel.” Basic principles, such as the SAID principle (Specific Adaptation to Imposed Demand), lay the foundation of any training program and need to be critically evaluated before developing a training program.

In order to develop adaptations into a positive transfer of training effect, the principle of dynamic correspondence needs to be applied. Training athletes is not simply lifting weights. There is an inherent relationship between biomechanical, physiological, and psychological factors when training athletes. Therefore, methods of training dictate training effects. As Mel Siff explained the concept of dynamic correspondence, he stressed that sport-specific movements are goal oriented and the expression of strength is specific to those movements (28). In other words, training methods need to be biomechanically and physiologically specific to the demands of the sport. To enhance motor qualities, Siff outlined the following criteria to achieve a positive training effect (28):

- Amplitude and direction of movement (the direction of force relative to the performed movement)
- Accentuated region of force application (positions in the movement where forces are the highest)
- Dynamics of the effort (whether a concentric max effort or eccentric slow effort is desired for each lift)
- Rate and time of maximum force production (being able to apply maximum force in less time)
- Regime of muscular work (task-specific strength in regards to the sport)

Siff identified three main target goals when applying dynamic correspondence to training: 1) to understand motor tasks/abilities involved in the sport, 2) to train those motor tasks with proper exercise selection, and 3) to apply biomechanical and metabolic specificity to elicit desired training effects (28).
DEVELOPING STRENGTH FOR SOCCER
When triangulating sport performance to its most common denominator, strength and power development takes focus in team sports. The outcome of strength training is not only improvement in physiological parameters, but also improvements in skill acquisition through motor control (15,26,28). Most athletes in team sports execute movements such as sprinting, change of direction, and jumping (10,29,31). These are all task-oriented skills that depend on neuromuscular efficiency that is largely dictated by strength (28).

The squat is a staple in most training programs simply due to the potential transfer to sprinting and jumping (14,20,22,34). The simple reason for using a loaded squat is that the athlete overloads hip extension with the goal of greater muscle recruitment. When the athlete needs to overcome inertia through continuous force production, motor task specificity, and the activation of high threshold motor units, it can be stimulated through the loaded action (15,28,36).

METHODS TO DEVELOP STRENGTH
A general guideline for developing strength is to lift a load equal to or greater than 85% of a one repetition maximum (1RM) (4). This recommendation is not absolute and may vary for each athlete; therefore, it should only serve as a guideline that can be adjusted accordingly. Three items that need to be considered when training for strength are: 1) select exercises based on motor tasks related to the sport, 2) increase muscle recruitment and firing rate, and 3) improve muscular strength of movements used in sport tasks (i.e., sprinting, jumping, and changing of direction).

DEVELOPING POWER FOR SOCCER
The ability to achieve maximum velocity rapidly can be the difference between scoring a goal and conceding one (11). High power output also relates to sprinting and jumping, and therefore, is an important factor for athletic performance in soccer (14,18,29,32). There is a positive relationship between strength and power that suggests that power training requires an emphasis on both force and velocity (18). While slow movements that require high force output should increase power, the training status of the athlete must be considered. For instance, commonly performed slow speed movements such as heavy squats and deadlifts, performed with high force production, have a positive effect on power in athletes with relatively low levels of strength; however, a negative relationship exists for trained athletes as they require ballistic accelerative efforts to improve power (9,13,33).

In soccer, two main components that affect athletic performance are the rate of force development (RFD) and impulses. Simply stated, how fast can high forces be generated and in what direction are the forces being generated. According to the force-time curve, powerful motor tasks, such as sprints or change of direction, require quick contraction times that are usually executed within 100 – 200 ms (26). Because the contraction time for powerful activities is generally less than 300 ms, maximal strength production through heavy strength training cannot be executed within that timeframe. Therefore, the goal of training should be to move the curve up and to the left so that high forces can be achieved rapidly (1,26).

METHODS TO DEVELOP POWER
Using the stretch-shortening cycle (SSC) via plyometric-specific movements is an excellent way to improve power production (2,23,33). Plyometric training uses the SSC to perform high-speed movements with the goal of improving concentric power production. Plyometric training can be divided into two response times: 1) short response movements (< 250 ms) such as depth jumps and 2) long response movements (> 250 ms) such as countermovement jumps (26). Both methods should be incorporated with the target goal of developing strength and reactive ability through the SSC (26,29).

Olympic-style weightlifting produces high power outputs as compared to other strength training exercises (12). In addition, a positive relationship exists between Olympic-style weightlifting and sprint performance, which is why these exercises can be very useful in many sports (14). The complexity of this type of training requires skill acquisition (i.e., improved intramuscular and intermuscular coordination, improved muscle recruitment, and synchronization through performing the lifts) (28,36). However, there is a problem with Olympic-style weightlifting in regards to the prescription of loads and the effort given to complete the lift. Put simply, the effort (applied force) needs to be velocity specific if maximal neural adaptations are desired (5,9). So, if these skills have not been acquired, the execution and the benefits of such lifts will be negatively affected.

Depending on the season and training goal, the general guidelines for developing power ranges from 0 – 90% of 1RM with a repetition range of 1 – 5RM (8,9,16). This recommendation is not absolute and may vary for each athlete; therefore, it should only serve as a guideline that can be adjusted accordingly. There are two main goals when developing power that need to be addressed so that safety and effectiveness are maintained. These two goals are: 1) exerting maximal effort regardless of the load and 2) maintaining technique since quality overrules quantity when performing technical lifts or tasks.

DEVELOPING SPEED AND AGILITY
Speed and agility are essentially two distinct qualities and should be trained separately depending on the level of the athlete (19). The main factor that limits high power output in regards to repeated efforts of sprinting is fatigue (3,21,27). Therefore, training soccer-specific speed should use a comprehensive approach that places an emphasis on anaerobic conditioning, resistance training, and running mechanics.

In order to train agility, one must understand the underlying mechanisms of motor control and mechanical specificity in terms of direction of movement and the expression of strength throughout the specific task. The root effective movement is based on repeating the desired task with correct technique, which
can result in programmed skill acquisition (26,28). Therefore, when training for improved agility, the quality of movement takes precedence over the quantity.

**METHODS TO DEVELOP SPEED AND AGILITY**

Research examined the effect of a combination of resistance training, metabolic specificity, and technique for overall improvement (17,26,35). Young, James, and Montgomery outlined a schematic for improving agility beyond resistance training, metabolic specificity, and technique by incorporating perceptual and decision-making factors. The schematic defined agility as an unpredictable open skill divided into two subcomponents: perceptual decision-making and change of direction speed (CODS) (35). CODS is planned within training sessions to improve the speed in which the direction is aimed, deceleration, and sprint technique. The research concluded that both subcomponents will need to be trained in order to improve agility (35).

In other words, agility is an open skill where an athlete’s response is based on the situation. Therefore, training the cognitive portion addresses the psychological factors of dynamic correspondence principles by requiring the athlete to make a decision based on an external stimulus or anticipation. This can thereby help the athlete make better decisions during one-on-one situations and ultimately improve their agility. Overall, the targeted goals for developing agility should be to develop sound movement technique (e.g., braking and accelerating) and matching metabolic and mechanical specificity of the sport.

**CONCLUSION**

The development of all the biomotor abilities and their interactions make training for soccer very complex. Table 1 illustrates a summarized guideline on how to develop biomotor abilities for soccer. The purpose of this article is to bring attention to the need for strength and conditioning professionals of the complex nature of developing task-specific biomotor abilities for soccer. When designing a specific program a “thinking outside the box” approach is recommended as long as safe principles and guidelines are followed.

**REFERENCES**


**ABOUT THE AUTHOR**

Farzad Jalilvand is a Certified Strength and Conditioning Specialist® (CSCS®) and a Registered Strength and Conditioning Coach (RSCC) with a diverse background in health, fitness, and sports performance. He holds a Bachelor’s degree in Kinesiology-Exercise Science as well as a Master’s degree in Kinesiology-Exercise Physiology. Jalilvand is currently the Sports Performance Director for the Institute for Performance Rehabilitation and Wellness. He serves as the Head Strength and Conditioning Coach for Granada Hills Charter High School and he lectures at California State University-Northridge in the Department of Kinesiology. Additionally, Jalilvand has had professional soccer experience in Europe and his experience includes training male and female high school and Division I athletes in a variety of sports, such as soccer, basketball, baseball, football, volleyball, softball, and track and field.
### Development of Biomotor Abilities for Soccer

<table>
<thead>
<tr>
<th>Biomotor</th>
<th>Implementation</th>
<th>Rationale</th>
<th>Outcome</th>
<th>Compatibility</th>
<th>Exercise Examples</th>
<th>Testing Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>≥ 85% 1RM ≤ 6 repetitions 2 – 4x/week</td>
<td>Leg muscle quality, Eccentric strength, Neuromuscular coordination, Cross-sectional area of muscle, Myosin heavy chain IIX and IIA isoforms</td>
<td>Sprinting, Jumping, Strength, Effective force application, Force, Relative strength</td>
<td>Sprint training, Agility training, Anaerobic endurance training</td>
<td>Front squats, Back squats, Hex bar deadlift, Romanian deadlifts (RDL), Walking lunge, Bulgarian split squat</td>
<td>1RM testing protocols, Multiple RM testing protocols, Measure relative strength</td>
</tr>
<tr>
<td>Power</td>
<td>0 – 90% 1RM 1 – 5 repetitions 2 – 5 min 2 – 4x/week</td>
<td>Rate of force development, Neural drive, Rate coding, Intramuscular coordination, Intermuscular coordination</td>
<td>Acceleration, Jumping, Mechanical efficiency, Power output</td>
<td>Sprint training, Agility training, Strength training, Plyometric training</td>
<td>Hang power clean, Hang power snatch, Depth jumps, Counter-movement and squat jumps</td>
<td>Standing long jump, Vertical jump, Multiple RM clean or snatch, Measure power outputs</td>
</tr>
<tr>
<td>Speed</td>
<td>Volume ≤ 500 ms Work:rest 1:12 – 20 (metabolic demands of the sport should be met) 2 – 3x/week</td>
<td>Type II efficiency, Anaerobic power</td>
<td>Acceleration, Mechanics, Speed</td>
<td>Strength training, Plyometric training, Ballistic training</td>
<td>Falling starts 10-15-20 m*, Flying starts*, Cone jump to sprint*, Resisted and assisted training</td>
<td>10-15-20 m sprint test*</td>
</tr>
</tbody>
</table>
**TABLE 1. GUIDELINES FOR DEVELOPING BIOMOTOR SKILLS FOR SOCCER (6,15,24,25) continued**

<table>
<thead>
<tr>
<th>BIOMOTOR</th>
<th>IMPLEMENTATION</th>
<th>RATIONALE</th>
<th>OUTCOME</th>
<th>COMPATIBILITY</th>
<th>EXERCISE EXAMPLES</th>
<th>TESTING RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>AGILITY</em></td>
<td>Volume ≤ 5 - 25 repetitions per drill</td>
<td>✦Motor control</td>
<td>✦Ability to change direction</td>
<td>Technical training</td>
<td>Arrowhead drill (closed skill)</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>Work:rest 1:4 - 20 (metabolic demands of the sports should be met)</td>
<td>✦Anaerobic power</td>
<td>✦Movement mechanics</td>
<td>Tactical training (involves mixed approach for superior results)</td>
<td>One-on-one tag (open skill)</td>
<td>5-10-5 m shuttle</td>
</tr>
<tr>
<td></td>
<td>2 - 3x/week</td>
<td>✦Acceleration</td>
<td></td>
<td></td>
<td>Z-cone drill (closed skill)</td>
<td>Illinois test</td>
</tr>
</tbody>
</table>

* Max effort given
**Table adapted from Plisk, Issurin, Bompa, and NSCA Guidelines (6,15,24,25)