THE RELATIONSHIP BETWEEN REACTION TIME, AGILITY AND SPEED PERFORMANCE IN HIGH-LEVEL SOCCER PLAYERS

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ABSTRACT

Purpose: *In soccer, reaction time (RT), speed and agility are important athletic skills that affect the performance of athletes. The aim of our study was to examine the relationship between these three athletic skills.*

Materials and methods: *In this study, 73 high-level, active soccer players having at least 5 years of game experience (training age 10.7±2.9 years) participated voluntarily. The physical characteristics of the soccer players were: height (177.8±5.5 cm), weight (73.6±8.1 kg), and age (22.0±2.7 years). The participant's tests which were taken on non-consecutive days measured RT (Visual reaction test, Lafayette, Multi-Operational Apparatus for Reaction Time (MOART) system), speed (15 m, Fusion Sport, Smart Speed) and agility (open skills (OS) and closed skills (CS), Fusion Sport, Smart Speed).*

Results: *A significant correlation was found between agility (CS) and speed ($p<0.05$) however, there was no significant relationship between reaction time and agility (OS and CS) ($p>0.05$).*

Conclusion: *The important athletic skills of speed and quick change of direction were shown to have an effect on each other. It may be of benefit to add change of direction drills to training programs in order to improve the speed performance of the athletes.*

Keywords: *Zig zag test, football, sprint, visual reaction.*

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Introduction

In soccer, an athlete completes 1000-1400 short-term activities during the match and varies these activities every 4-6 seconds. These activities are of high-intensity and include sprinting and agility containing activities such as change of direction, meeting with the ball, interceptions and tackles(1). Agility can be described as the change of initial direction towards a second direction(2) and includes reactiveness(3). During reactive actions, an athlete performs offensive and defensive actions, both of which place the body in the position of an opponent and apply technical ability on the pitch. During the application of these sport-specific movements, the athlete performs deceleration, stopping and reacceleration activities. Sheppard and Young further described agility to include perceptional and cognitive abilities, defining agility as "rapid body movement with change of velocity or direction in response to the stimulus"(4). Acceleration indicates the rate of change of velocity or how quickly an athlete increases the velocity of motion(5, 6). The acceleration phase is the first 10 m of speed activity(7, 8). Acceleration activities are performed by soccer players many times during a game(9-12). Another factor that affects agility performance is deceleration which decreases the rate of velocity before change of direction(7). Deceleration activities are seen as often as acceleration activities in a game(9, 11).

Speed is another factor that directly influences performance(13). Speed can be described as the ability to cover the distance within a short time[14]. Speed consists of acceleration (0-10 m) and maximal velocity (10-30 m) phases[8]. A soccer player covers distances between 10-12 km during a game[10, 15]. Overall, players sprint between 93-213 m[10, 12] with respect to their playing positions in a game[10].

Sprint activities in soccer are performed over distances shorter than 30 m[1]. During soccer games, a professional soccer player sprints between 0-10 m (7%±0.9), between 10-20 m (48%±16) and across a distance of more than 20 m (45%±17)[16]. As indicated by the data, the majority of sprinting is performed over 10-20 m.

Reaction time is expressed as the time spent for the stimulus to produce a response and includes perceptional and cognitive abilities such as visual scanning, knowledge of the situation, recognition of movement pattern and anticipation[4]. Studies performed in the field have associated reaction time with movement time[17]. Despite the number of citations mentioned above and their widespread acceptance, there have been few published articles showing the relationship between reaction time, speed and specific agility drills (closed or open) in high-level, active soccer players. It is hypothesised that having a high-level of agility in specific drills might be useful in identifying the two important parameters of speed and reaction time which in turn will help to profile good soccer players. Therefore, the purpose of this study is to examine the relationship between speed, agility and reaction time in soccer players.

Materials and methods

Subjects

In this study, 73 high-level, active soccer players having at least 5 years of game experience (training age 10.7±2.9 years) participated voluntarily.

The physical characteristics of the soccer players were: height (177.8±5.5 cm), weight (73.6±8.1 kg), and age (22.0±2.7 years).

Methodology

This study meets the guidelines of the Declaration of Helsinki. Athletes were informed about the test procedures prior to the test. Permission was obtained from the Ethics Committee of Manisa Celal Bayar University (permission reference number: 2013/13.467.246). The tests were performed on non-consecutive days at Manisa Celal Bayar University's soccer field. The participants warmed up with respect to the recommendations of Gelen (18). All test measurements were taken between 12:00-14:00. In the 15 m speed and agility tests, data were obtained using the official mobile application of Fusion Sport, Smart Speed.

15 m Speed Test

Participants ran the entire 15 m from the first Smart Speed photocell gate to the second Smart Speed photocell gate. The test was performed twice and the best result was accepted. A 15 m track was chosen because the highest percentage of sprint activities performed during a soccer game (48%) were between 10-20 m[16].

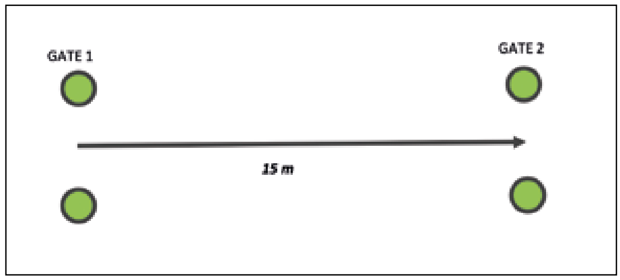

Figure 1: 15 m Speed Test.

CS Agility Test

Zigzag agility tests were performed by the players. Two Smart Speed photocell gates were used for the 30 m zigzag course in the CS agility test. The distance between the poles was 5 m. Participants ran the slalom course twice and the best result was accepted. Mirkow et al. reported that the coefficient of variation was 2.5%, the intraclass correlation coefficient was 0.84 and the typical error of measurement was 0.098 for the zigzag agility test[19].

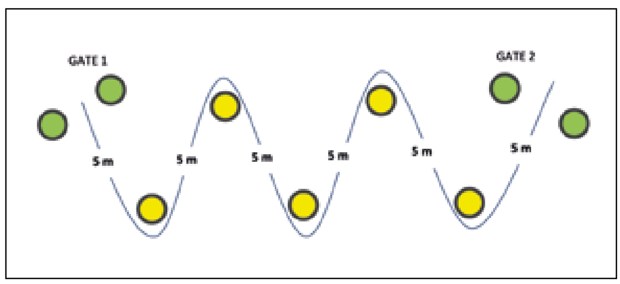

Figure 2: Closed Skill Agility Test.

OS Agility Test

Four Smart Speed photocell gates were used for the OS agility test. The distance between the first and second gates was 5 m and the distance between the second gate and the reaction gate was also 5 m. In the OS agility test, when the participant passed the second gate there was a colourful flash of light in either the left or right reaction gate. The test was performed twice and the best result was accepted[20].

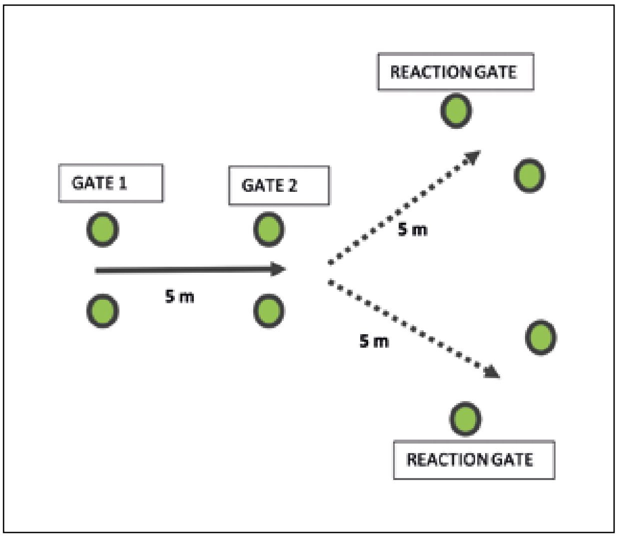

Figure 3: Open Skill Agility Test.

Visual Reaction Test

The visual reaction test was performed in a silent room that did not include any disturbing stimuli. Data were obtained using the control panel of the Lafayette MOART system.

Participants placed their hands approximately 30 cm away from the device on the table. The participants were asked to anticipate the LED light reaching the target by pressing a button with the thumb of their dominant hand to coincide with the arrival of light at the target.

Five measurements were taken from participants and overall scores from the best three results were accepted.

Statistical analysis

Correlations between results were made using Pearson's Correlation Analysis. For all statistics the significance level was set at p<0.05. Data were analysed using the Statistical Package for Social Sciences (SPSS) MS Windows Release 13.0.

Results

The mean test time for the 15 m speed test was 2.36±0.13 s, for the CS test was 9.89±0.33 s, for the OS test was 2.45±0.26 s and for the reaction time test was 409.51±47.00 ms.

The correlation coefficient between CS agility and speed ability was significant (p<0.05, r=0.258), however, there was no significant correlation between CS agility and visual reaction time. According to the OS agility skill test result, there was no significant correlation between OS agility and speed or between OS agility and reaction time.

		CS agility	OS agility	15 m speed	Reaction test
CS agility	*r value*	1.000	NA	0.258*	0.165
	p value		NA	0.036	0.169
OS agility	*r value*	NA	1.000	-0.016	0.034
	p value	NA		0.902	0.779
15 m speed	*r value*	0.258*	-0.016	1.000	0.082
	p value	0.036	0.902		0.508
Reaction test	*r value*	0.165	0.034	0.082	1.000
	p value	0.169	0.779	0.508	

Table 1: Correlation between agility, speed and reaction time.

**Correlation is significant at the 0.05 level (2-tailed).*

Discussion

This study aimed to examine the relationship between speed, agility and reaction time. In soccer, these abilities are performed as part of a complex task. In this regard, if the relationship between these abilities can be clarified, this might be beneficial for helping to create effective training programmes.

In this study, a significant relationship between agility (CS) and 15 m speed, (p<0.05) was found. Previous studies either found a significant correlation between agility (CS) and speed(21) or did not find a significant correlation between agility (CS) and speed(22). We hypothesised that agility and speed should affect each other's performance. An athlete repeats deceleration and reacceleration abilities over the 5 m slalom in a CS agility course. While performing these abilities, the athlete generates force eccentrically during the phase of deceleration and concentrically during reacceleration(23).

In this study group, the forces generated by the soccer players during the deceleration and reacceleration phases are likely to have been strong, since the agility performance of the soccer players would have been affected if deceleration and reacceleration abilities were not advanced.

During the acceleration phase, the force applied to the ground increases(6) and the athlete further benefits from the triple extension position of the body(2). The high amount of force applied to the ground(24) and the mobilisation of the ankle joint(25) are two important factors that influence speed performance. The two courses in our study both contained acceleration and deceleration phases(7).

If an athlete accelerates their body mass quickly in the speed course it is hypothesised that the athlete's CS agility performance might be of a high level as well. If an athlete cannot explosively decelerate their body mass by eccentric contraction, the acceleration performance of the athlete might be affected. If time is lost while decelerating their body mass, the acceleration and reacceleration phases will also be reduced. In our study, we did not directly test acceleration and reacceleration. It is recommended that future studies directly measure this ability by setting up a photocell system between 5 m slaloms.

Despite the hypothesis of this study, no significant correlation was found between reaction time and the OS or CS agility test (p>0.05). A possible explanation is that the visual reaction test was not similar enough to a soccer player's sport-specific reaction task. The tests were performed in a sitting position with movement of the upper body, however in soccer, players react to a stimulus by moving their whole body on the pitch.

One of the main reasons for this mechanism is the specialization of the nervous system to sport-specific movement patterns. Learned movement patterns are coordinated easily and neural pathways are activated more quickly, creating movement in a short time because specific movement patterns are repeatedly used by the athletes on the pitch during training and games[26].

Practical applications

Agility and speed are two abilities that have been shown to influence each other. Although each of these abilities benefit the performance of each other, either, these abilities should be trained separately, or drills containing sport-specific movement patterns should include both of these abilities.

If drills that include reactiveness are carried out using sport-specific training, they might both improve performance and result in the design of more effective training programs for practitioners.

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Author's contributions:
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