

# RELATIONSHIPS BETWEEN ILLINOIS AGILITY TEST AND REACTION TIME IN MALE ATHLETES

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## Abstract

Change-of-direction speed is an important quality to performance in multi-direction sports. To assess change-of-direction speed in their athletes, field sport coaches could use reliable and valid tests. Illinois agility test (IAT) was designed to assess field sport change-of-direction speed. This study analyzed the reliability and validity of IAT, through comparisons to Illinois agility test (IAT) and reaction time (RT) performance in highly-trained junior football players. **Methods:** Totally, 20 high school soccer (age:  $24.04 \pm 1.45$  years; height:  $175.75 \pm 4.95$  cm; body mass:  $70.91 \pm 8.90$  kg), completed three tests. IAT was evaluated using photoelectric cells timing gates. The software "REACTION" was used to measure RT in response to visual stimulus. For the validity analysis, Pearson's correlations ( $p \leq 0.05$ ) analyzed between-test relationships. **Results:** IAT was significantly correlated with RT ( $r = 0.55$ ;  $p < 0.05$ ). This study indicates that RT could be used as a valid predictor of IAT in field sport athletes.

**KEYWORDS:** Change of direction. Reaction. Football. Reliability.

## 1. INTRODUCTION

In many sports, such as football codes, sprints are generally short and of varying distances. Athletes in these sports will accelerate as much as possible in the shortest period of time. Agility and change-of-direction speeds are essential qualities for athletes who play field sports, such as soccer, American football, rugby league, rugby union and field hockey (Spencer, Bishop, Dawson, & Goodman, 2005). With the football codes, for example, short sprints occur throughout the game. Bloomfield, Polman, & O'donoghue (2007) reported that soccer players, on average, perform over 700 turns and swerves at different angles throughout a game. Therefore, sprint training for the type of sport, should include the need to accelerate (reaching the highest speed possible in the shortest time period), to decelerate and change direction throughout the game (Docherty, Wenger, & Neary, 1988).

Sports scientists, strength practitioners, and sports coaches habitually use testing of performance characteristics to monitor training adaptations, identify talent (Reilly, Williams, Nevill, & Franks, 2000), facilitate group selection (Vescovi, Murray, & VanHeest, 2006; Pyne, Gardner, Sheehan, & Hopkins, 2005), and differentiate between standards of play, such as youth versus professional (Leone, Lariviere, & Comtois, 2002). Significant correlations were found in soccer players between different physical fitness parameters and between changes in strength parameters and agility (Silva, Magalhães, Ascensão, Oliveira, Seabra, & Rebelo, 2011). Little and Williams (2005) reported that acceleration (10-m sprint times), top speed (flying 20-m sprint times), and agility were distinct motor characteristics in a group of professional male soccer players. Equally, significant correlations between performance in an agility T-test and 40-yard sprint time in both men and women have been established (Paule, Madole, & Lacourse, 2000). In contrast, Buttifant and Graham (1999) and Young et al. (1996) reported no significant correlations between straight sprinting and agility speed tests in either Australian soccer or Australian Rules football players. The results from these studies illustrate the difficulty in identifying how performances on various field tests can be related to one another.

Agility is an essential component in most field requiring high speed action (acceleration, maximal speed) and specially team sports competition. And agility is a combination of speed and coordination. Speed which provides movements, the speed and coordination is an elementary technical demand for sportive performance in football. In the same way, tests of agility have been shown to distinguish between playing standards in Australian rules football (Young, 1996) and netball (Reilly et al., 2000) as between different age groups and standards of play in rugby league (Gabbett et al., 2009).

The capacity of football player to produce varied high-speed actions and motor skills are known to impact performance. High-speed actions can be categorized into actions requiring maximal speed, acceleration, RT and agility. Therefore, there is no doubt that the cognitive component of agility is very important (Gabbett et al., 2008; Sheppard et al., 2006).

We thought that RT is an important cognitive component. RT is described as the interval between the onset of a signal (stimulus) and the initiation of a movement response (Magill, 2007). RT is one of the factors of great significance in competitive sports, especially in team games like football. To execute a correct movement a rapid response is required with minimal time interval due to the ball velocity and the physical proximity of the adversary (Shim, Chow, Carlton, and Chae, 2005). Thus, the RT of a player is considered as the key to performance. A decreased RT affords a player more time to consider the proper execution of an appropriate movement. The RT duration could be affected by several factors, but the most direct influences are external stimuli (Lin, 2001). For that, we considered that this cognitive component which is the RT could be associated to agility.

Thus, field tests used to control performance often include assessment of linear sprinting, the ability to change directions, agility, jumping, and aerobic capacity (Cronin & Hansen, 2005; little & Williams, 2005). However, to date, there are not or rare studies and discussions relating to agility and RT tests. Thus, the main purpose of this study was to examine if there is any relationship among Illinois agility and RT performance in male soccer players. IAT was selected because of its reported validity and reproducibility (Paoule et al., 2000; Roozen, 2004). Finally, we determined the coefficient of determination to indicate how much of the total variation in one test variable is explained by another. In our knowledge, the present study is the first investigation examining the importance of relationship between agility and other physical components such as speed with change of direction and RT in football players.

## 2. MATERIAL AND METHODS

**Subjects:** Participants included twenty student soccer male athletes (Characteristics in Table 1). All subjects were found to be in good health. The selected players possessed at least 8 years of experience in football training and competition, and took part in National championship at the time of the investigation. They thus continued football training three to four times per week (~ 90 min per session), and played one official game per week. The subjects were told that they were free to withdraw from the trial without penalty at any time. All procedures were approved by the Institutional Review Committee for the ethical use of human subjects, according to current national laws and regulations.

**Table 1:** Characteristics of experimental group (mean ± SD; n=20).

	Age (years)	Height (m)	Body mass (kg)	football experience (years)
mean ± SD	24.04 ± 1.45	175.75± 4.95	70.91 ± 8.90	10.3 ± 2.4

### Testing procedures

These tests were selected because of their reported validity and reproducibility (Roozen, 2004). All of the testing procedures were completed during the competitive season two months after the beginning of the national championship.

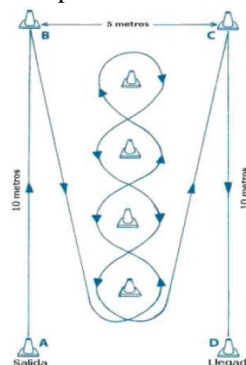
The Illinois agility test (IAT) was used to determine the ability to accelerate, decelerate, turn in different directions, and run at different angles (Figure 2).

The total testing session was approximately one hour for each subject which included warm-up, ten minute rest times between tests and approximately three minutes between reps. Each test was explained and demonstrated. Before testing, subjects were given practice trials to become familiar with the testing procedures. All tests were counterbalanced pre and post testing to ensure that testing effects were minimized. Before performing the field test, each player was instructed and verbally encouraged to give a maximal effort during all tests.

### Illinois agility Test

The Illinois agility test (IAT) was used to determine the ability to accelerate, decelerate, turn in different directions, and run at different angles (Figure 1).

Illinois agility tests: The length of the course was 10 m and the width was 5m. Four cones were used to mark the start, finish and the two turning points. Another four cones were placed down the center an equal distance apart. Each cone in the center was spaced 3.3m apart. The player lies in the prone position with his chin touching the surface of the starting line. The first light sensor is placed at the start line, 50cm above the ground. The light sensor will be activated as the subject moves from the prone position. The second light sensor is placed at the finish line. Timing gates were placed at the start and finish lines at a height of 0.30 m (Vescovi & Mcguigan, 2007) (Figure 2). On the researchers “Go” command the stopwatch was started and the participant got up as quickly as possible and ran around the course in the direction indicated while attempting to avoid any contact with the placed cones. He then runs towards the starting line’s middle cone, zig-zags through the cones downward and again upwards, sprints to the last cone on the far side and finishes at the finish line. Upon crossing the finish line the timing was stopped. Subjects performed two maximal attempts at each exercise with at least 2 min rest between tests and trials. The faster time taken and recorded in seconds.



**Figure 1:** Illinois agility Test (Cureton, 1951).

**Measurement of the reaction time (RT)**

The software “REACTION” was used to measure the time of reaction using values (the value considered here is the mean and the evolution of the deviation from the different RT). This software includes various tests: comparisons of forms, appearances of forms, a form of recognition among others. The user could choose the color of various geometric figures or even choose static images (flowers, books ...). In this experiment the test was chosen as the recognition of a “blue square” among other figures (circles, triangles, square, and rectangle) of the same color. Each patient was asked to click on assessed as quickly as possible when he saw that form. Throughout the experimental period the individual should keep the same test with the same color and same shape. On the test day, all subjects were asked not to drink coffee, tea, cola and other drinks considered to have stimulant effects (21). In addition, we asked all subjects to sleep at night at the same time (21 h). All subjects evaluated in this study have never used the software before. Testing sessions were conducted at the same time of the day (at 12H 30 min), and under the same experimental conditions. Therefore a meeting of the recognition software was conducted during which each subject performed a familiarization trial in the two days prior to the main testing. All individuals were subjected to the test under the same conditions and have completed three trials during the test. Each trial consisted of ten times of reaction. All participants were tested using identical protocols and the tests were completed in a fixed order. Subjects performed each test 3 times and the results were averaged.

**Statistical Analyses**

Data are reported as mean ± standard deviation (SD). Before using parametric tests, the assumption of normality was verified using the Shapiro-Wilk W test. Pearson correlation (*r*), linear regression analysis and the coefficient of determination (*r*<sup>2</sup>: used for interpreting the meaningfulness of the relation) were used to examine the relationships between IAT and reaction time. Significance was assumed at 5% (*p* ≤ 0.05). Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) (version 14.0 software for windows).

**3. RESULTS**

**Table 2: shows the mean (Mean ± SD), Min and Max values of IAT and RT obtained in the subjects. The range of IAT varied from 16.810 19.100 sec, while the RT score varied from 428 to 602 msec.**

**Table 2: Mean values (mean ± SD) of IAT and RT in the experimental group (N =20).**

	IAT (msec)	RT (msec)
<b>mean ± SD</b>	18.007 ± 0.688	525.350 ± 53.149
<b>Min</b>	16.810	428.000
<b>Max</b>	19.100	602.000

The correlation coefficient and coefficients of determination between IAT and RT tests are shown in Table 3. According to this table 3, A bivariate correlation matrix revealed a significant relationship between IAT and RT (*r* = 0.52; *p* < 0.05). This significant relationship was illustrated with a regression curve (figure 2). A significant positive partial correlation implies that as the values of RT increase, the values on the second variable (IAT) also tend to increase

**Table 3: The correlation coefficient (r) and coefficient of determination (r<sup>2</sup>) values between IAT and RT test in the experimental group (N=20).**

		Illinois Agility Test (sec)	Reaction Time (msec)
Illinois Agility Test (sec)	Pearson Correlation (r)	----	0.525(*)
	Coefficient of determination (r <sup>2</sup> )	----	0.27
	Signification (2-tailed)		0.017
	N	20	20

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

**Table 4: The standardized and unstandardized Coefficients of correlation values (B and Beta) obtained about the linear regression between IAT and RT test in the experimental group (N=20).**

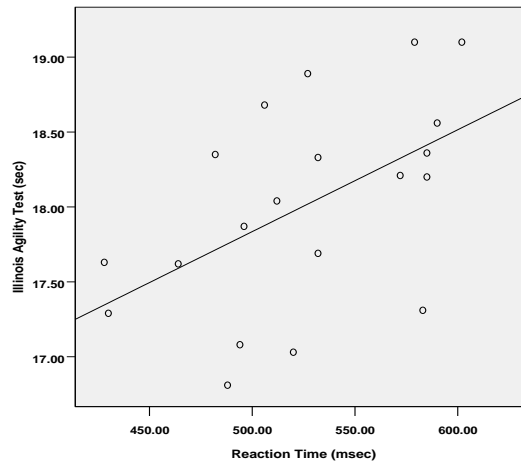
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14.435	1.372		10.518	.000
	Reaction Time (msec)	.007	.003	.525	2.616	.017

Dependent Variable: Illinois Agility Test (sec)

A linear regression analysis was conducted on the bivariate data set to evaluate the prediction of IAT average from the subject s score of the RT. The results indicated that there is a linear relationship between the two variables. As the subject s score on the RT increased, their IAT performance also tended to increase. The regression equation for predicting the IAT is:

**Predicted IAT = 0.007 RT + 14.435**

The correlation between IAT and RT performance = +0.52 ( $p < 0.05$ ). This result explained that approximately 52% of the variance in the IAT performance was accounted for by its linear relationship with score of the RT (Table4).



**Figure 2:** Relationship between Illinois Agility Test (IAT) and the reaction time (RT). ( $r = 0.52$  ;  $p < 0.05$ ).

#### 4. DISCUSSION

There are few validated change-of-direction speed tests that assess an athlete's ability to sprint linearly, while also performing direction changes. IAT was designed for use in field sport athletes (Spencer et al., 2005). Our first objective in the study was to investigate the relationship between IAT and RT to provide some measure of validity. For the present study there was a positive correlation between the RT and agility ( $p < 0.05$ ). In other words, the greater the RT, the more will be the agility and vice versa. The results of this study are parallel to other researches in this field and a meaningful relation between agility and showing reaction to a stimulant.

Young, McDowel, and Scarlett (2001) explain agility as the shifting action in various sports, starting an action, chasing or escaping the opponent, moving ball with a ball, stopping skills and showing reaction. Equally, the performance of agility could be defined as a response to a stimulant and for that a relation between agility and reaction is considered.

Baruwal (1983) suggested that RT could be related to *physical activity* patterns and to the athletic training degree. They found that sportsmen high level and athletes normally had shorter RT than non-athletes and continuous participation in sports at higher level did reduce RT. Also team game players had quicker RT than others. The abilities to perceive the meaning of a stimulus, react correctly and to move to the required spot within less time are of vital importance in handball, basketball, volleyball, tennis, football, etc.

On the other hand, the results of Akarsu, Çaliskan, and Dane (2009) support the view that exercise is beneficial to eye-hand reaction time and visuo-spatial intelligence. Their findings showed that Athletes have faster eye-hand visual reaction times and higher scores on visuo-spatial intelligence than non-athletes. In addition, it can be stated that all sports are beneficial for the enhancement of cognitive function (Colcombe & Kramer, 2003), because there was not any difference among different sports mentioned in this study such as soccer, basketball, volleyball, running, and skiing.

Çömük and Erdem (2010), in their study on agility and reaction scores on ice-skaters determined that children playing sports had better reactions and agility and athletes with better reaction times were also getting high agility scores. The same findings were observed by and Ölçücü (2007) in his study on the factors affecting the development of tennis playing skills on 10 to 14 year old children.

The study of Büyükipekçi and Taşkın (2011) where the change on RT, agility and anaerobic performance of female volleyball players was researched, they emphasized how important RT was on the action the players made instantly both in defense and offence and how important agility was to be able to move the whole body rapidly and correctly. Besides, the study demonstrated that players with good reactions had developed agility features, too.

To explain the RT in terms of motor control, researchers assume that there are three stages in information processing. The first stage concerns the stimulus identification in response to sensory inputs. When this stage is completed, information is passed to the response selection stage and finally to the third stage, response programming, until an action (output) occurs (Schmidt & Wrisberg, 2004). Several sources of stimuli such as a flying ball or court illumination may influence a player's information processing time. The time cost associated with each of these three stages determines the length of the RT.

#### 5. CONCLUSION

The results from this study demonstrated that although there were some limitations, the RT revealed acceptable reliability and validity for field sport testing. The significant relationships observed between IAT and RT provides evidence to support the view that RT can detect moderate performance changes in change-of-direction speed in field sport athletes. The coaches could



use the measurement of RT as an important indicator in predicting Illinois agility performance in football players.

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