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Reliability and Validity of ÇAĞIN Hand and Foot Reaction Tests Protocol

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Abstract

The present study aims to test the reliability and validity of ÇAĞIN Hand and Foot Reaction Tests. A total of 120 athletes, 60 under the age of 18 and 60 over the age of 18 who were actively playing soccer, participated in the study. ÇAĞIN Hand and Foot Reaction Tests were applied to the athletes participating in the study 3 times with 2-week intervals using FitLight Trainer and BlazePod devices. In order to determine the validity of the data obtained from the athletes by applying ÇAĞIN Hand and Foot Reaction Tests, two measurements made with the FitLight Trainer device at different times were compared, and in order to determine the reliability, measurements made with the FitLight Trainer and BlazePod device on different days were compared and analyzed. Paired Simple T-Test in SPSS 26.0 package program was applied to determine both validity and reliability. According to the findings obtained, the validity and reliability correlation coefficients of all 6 tests in the ÇAĞIN Hand and Foot Reaction Tests were found to be r>0.70 (p<0.05). In the light of these findings, it was determined that the validity and reliability of ÇAĞIN Hand and Foot Reaction Tests were very high (r= 0.70-0.90).

Keywords: ÇAĞIN, reaction test, reliability, validity, soccer.

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ÇAĞIN El ve Ayak Reaksiyon Testleri Protokolünün Güvenirlik ve Geçerlilik Çalışması

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Öz

Bu çalışmanın amacı; ÇAĞIN El ve Ayak Reaksiyon Testlerinin geçerlilik ve güvenirliğini test etmektir. Araştırmaya aktif olarak futbol oynayan 18 yaş altı 60 ve 18 yaş üstü 60 olmak üzere toplam 120 sporcu katılım göstermiştir. Araştırmaya katılan sporculara ÇAĞIN El ve Ayak Reaksiyon Testleri 2 hafta arayla FitLight Trainer ve BlazePod cihazları kullanılarak 3 kez uygulanmıştır. ÇAĞIN El ve Ayak Reaksiyon Testleri uygulanarak sporculardan elde edilen verilerin geçerliliğini tespit edebilmek için FitLight Trainer cihazı ile gerçekleştirilen iki ayrı zamanlarda yapılan ölçüm karşılaştırılmış, güvenirliğini tespit edebilmek içinse FitLight Trainer ve BlazePod cihazı ile farklı günlerde yapılan ölçümler karşılaştırılarak incelenmiştir. Hem geçerlilik hem de güvenirlilikleri tespiti için SPSS 26.0 paket programında bulunan Paired Simple T-Testi uygulanmıştır. Elde edilen bulgulara göre ÇAĞIN El ve Ayak Reaksiyon Testlerinin içerisinde bulunan 6 testin de geçerlilik ve güvenirlik korelasyon katsayılarının tamamı r>0,70 olarak bulunmuştur (p<0.05). Bu bulgular ışığında ÇAĞIN El ve Ayak Reaksiyon Testlerinin geçerlilik ve güvenirliliğinin çok yüksek (r= 0,70-0,90) olduğu tespit edilmiştir.

Anahtar Sözcükler: ÇAĞIN, reaksiyon testi, güvenirlilik, geçerlilik, futbol.

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Introduction

The concept of reaction is expressed as the behavior given against a signal (stimulus) perceived by the organism. Reaction time refers to the time between the arrival of the signal and the behavior given to this incoming signal. In order to determine the reaction time, a warning signal is usually sent to prepare the individual and then the actual reaction signal is sent and the behavior is requested (Magill & Anderson, 2010). To give an example of this situation from short-distance running competitions; after the athlete settles into the wedge on command, the attention (set) command, which is the second stage, is given, and then the gun is fired, indicating that they should start the race, and the athletes try to exit by showing the fastest reaction. Magill categorizes reaction time into three different classes: simple reaction time, selective reaction time and discrimination reaction time (Magill & Anderson, 2010).
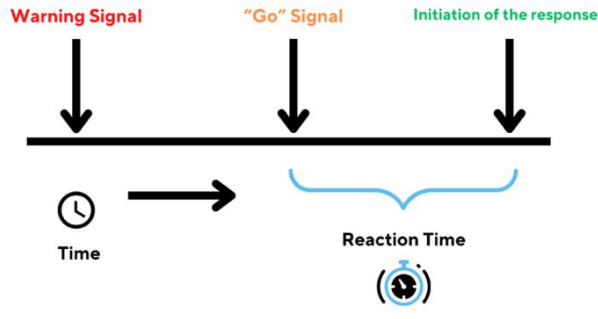

Figure 1. *Reaction Time*

Simple Reaction Time

In this reaction time, there is only one stimulus and only one response to this stimulus. This can be given as an example of a blue light on the computer screen and the subject's behavior by pressing the letter C every time the blue light is on.
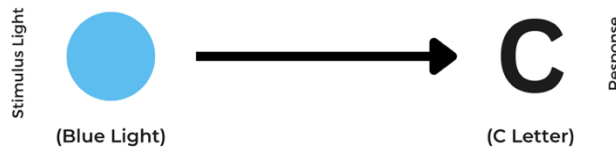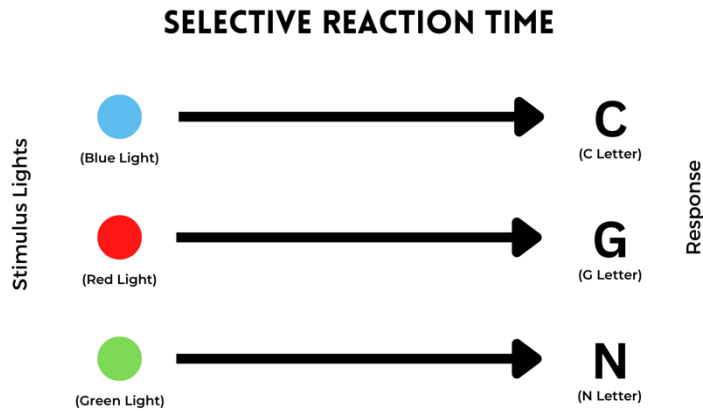
SIMPLE REACTION TIME

Figure 2. *Simple Reaction Time*
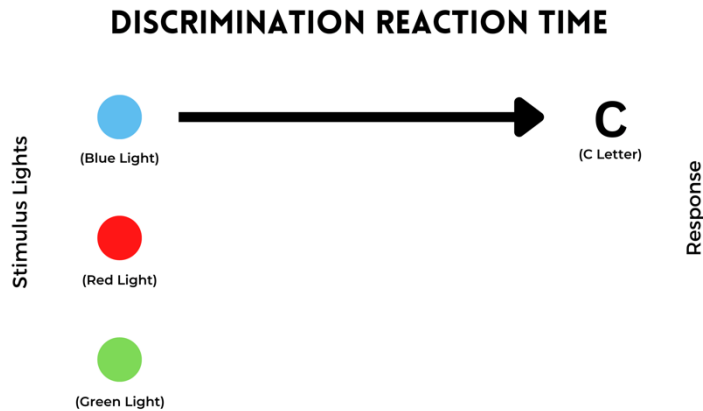
Selective Reaction Time

In this type of reaction time, there is more than one stimulus and a different behavior for each stimulus. An example of this situation can be given as the subject's behavior by pressing the letter C every time the blue light turns on the computer screen, G every time the red light turns on and N every time the green light turns on.

SELECTIVE REACTION TIME

Figure 3. *Selective Reaction Time*

Discrimination Reaction Time

In this type of reaction time, there is more than one warning but only one behavior. An example of this situation is when blue, red and green colors light up on the computer screen, but only when the blue color lights up, the user acts by pressing the letter C.

DISCRIMINATION REACTION TIME

Figure 4. *Discrimination Reaction Time*

The concept of reaction is considered to be of great importance in determining sportive performance as it includes both biomotor and cognitive activations (Klotz et al., 2012; Chiu, Chen, & Muggleton, 2017). When reaction performance is examined from a biomotor perspective, it is observed that it is closely related to intermuscular and intramuscular coordination skills (Blanpied & Oksendahl, 2006). When reaction performance is examined cognitively, it is closely related to attention and decision-making skills (Noorani & Carpenter, 2016; Reigal et al., 2019). If the importance of reaction performance is examined in terms of sports branches, the goalkeeper in soccer saves the ball by reacting quickly and accurately to penalty shots, the athlete reacts faster to the exit signal in short distance running and wins the competition in milliseconds, and the athlete in taekwondo protects himself by reacting quickly to the kicks from the opponent.

When sports branches are analyzed in terms of reaction time, the type of reaction time required by each branch may differ. For example, in short-distance running, simple reaction time is known to start the run with only one stimulus (the sound of a pistol) at the exit from the wedge, in tennis, selective

reaction time is known to react separately to the balls coming from the opponent at different intensities and angles, and in volleyball, discrimination reaction time is known to be at the forefront in terms of reacting only to the balls that can fall into the line and not reacting to the balls that will go out. Considering that the currently used reaction time tests measure only simple reaction time, it is thought that there is a need for tests that measure all types of reactions in the field. Although there are light sensor meters such as FitLight Trainer (FitLight Corp, Ontario, Canada), BlazePod (Play Coyotta Ltd., Tel Aviv, Israel) and Witty-SEM (Microgate, Bolzano, Italy) that can measure all reaction times, it is not possible to compare the measurements obtained from these devices in a healthy way since there is no common reaction test protocol. In terms of standardizing both hand-foot and all reaction types with all personalized norms, it is thought that ÇAĞIN Hand and Foot Reaction Tests will increase the compatibility in reaction time measurements and usability in the field and better analysis and evaluation of the results can be made.

Problem and Sub-Problems in the Research

This research will be important for the functional evaluation of the data obtained from light sensor measurement equipment such as FitLight Trainer, BlazePod and Witty-SEM. It is aimed to create all norm values of hand and foot and all reaction tests individually and to contribute to this field for future studies. An answer to the problem question 'Is the validity and reliability of CAGIN Hand and Foot Reaction Tests high?' was also sought. In the process of answering this problem, the above question and the following sub-questions were formulated and tried to be answered.

1) Are ÇAĞIN Hand Reaction Tests highly reliable?
2) Are ÇAĞIN Foot Reaction Tests highly reliable?
3) Is the validity of ÇAĞIN Hand Reaction Tests high?
4) Is the validity of ÇAĞIN Foot Reaction Tests high?

Methods

The subjects who participated in the study were divided into 4 groups: girls under the age of 18, girls over the age of 18, boys under the age of 18 and boys over the age of 18. For the measurement of each group, one day of the week was determined and the first measurements were taken, the second measurements were taken 14 days after the first measurement and the third measurements were taken 14 days after the second measurement on the same day and time.

The measurements were carried out in April and the air temperature during the first and second measurements was between 18-21 degrees Celsius. The measurements were also carried out in normal daylight in an indoor gymnasium. Subjects were instructed not to consume any stimulant foods (tea, coffee, high-caffeine foods) until 24 hours before both the first and second measurements and not to eat anything until 3 hours before. Before the measurement, the subjects were warmed up by being asked to turn off the lights with their hands for 5 minutes and with their feet for 5 minutes. ÇAĞIN Hand and Foot Reaction Tests were performed with FitLight Trainer (FitLight Corp, Ontario, Canada) in the first measurement, with BlazePod (Play Coyotta Ltd., Tel Aviv, Israel) in the second measurement and again with FitLight Trainer (FitLight Corp, Ontario, Canada) in the third measurement.

Table 1

Mean and Standard Deviation Values of the Descriptive Characteristics of the Subjects

Age	Demographic Variables	N	X̄	S
U 18 Women	Age	30	12.03	2.042
	Height	30	152.80	8.919
	Weight	30	41.57	8.697
	Sports age	30	2.00	1.640
	Total	**30**		
U 18 Man	Age	30	13.73	1.081
	Height	30	160.63	8.838
	Weight	30	49.73	8.971
	Sports age	30	4.97	2.428
	Total	**30**		

18 + Women	Age	30	18.43	1.382
	Height	30	157.45	29.85
	Weight	30	55.27	7.119
	Sports age	30	6.07	3.403
	Total	**30**		
18 + Man	Age	30	18.27	.450
	Height	30	178.77	6.061
	Weight	30	68.63	5.524
	Sports age	30	7.73	1.893
	Total	**30**		
	All Group	**120**		

Participants

A total of 120 soccer players, 60 under the age of 18 (30 girls and 30 boys) and 60 over the age of 18 (30 girls and 30 boys), participated in the study. The sample group consisted of individuals who had a license for at least 4 years and were actively playing soccer. All athletes were in good physical condition and had no recurrent injuries in the last six months. Participants were informed about the nature of the study and were also informed that participation was voluntary and that they could withdraw at any time.

Table 2

Measurement Schedule of the Subjects

Groups	Measurement I	Measurement II	Measurement III
U 18 Women	Monday 13.00-16.00	Monday Two Weeks After Measurement I 13.00-16.00	Monday Two Weeks After Measurement II 13.00-16.00
18 + Women	Tuesday 13.00-16.00	Tuesday Two Weeks After Measurement I 13.00-16.00	Tuesday Two Weeks After Measurement II 13.00-16.00
U 18 Man	Wednesday 13.00-16.00	Wednesday Two Weeks After Measurement I 13.00-16.00	Wednesday Two Weeks After Measurement II 13.00-16.00
18 + Man	Thursday 13.00-16.00	Thursday Two Weeks After Measurement I 13.00-16.00	Thursday Two Weeks After Measurement II 13.00-16.00

Measurements

Body weight and height

The height of the subjects was measured with a stadiometer (SECA, Germany) with a precision of 0.01 m and the body weight was measured with an electronic scale (SECA, Germany) with a precision of 0.1 kg.

Measurement I	→	FitLight Trainer
Measurement II	→	BlazePod
Measurement III	→	FitLight Trainer
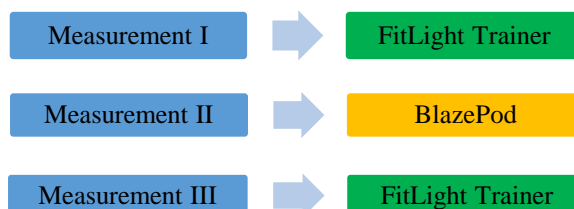
Figure 5. *Devices used for ÇAĞIN Hand and Foot Reaction Tests and measurement Sequence*

Measurement of Reaction Performances

Reaction performances of the subjects were measured with FitLight Trainer (FitLight Corp, Ontario, Canada) and BlazePod (Play Coyotta Ltd., Tel Aviv, Israel) lighted reaction meters. The stimuli to which the subjects were asked to react were sent both visually and auditorily simultaneously.

ÇAĞIN Hand and Foot Reaction Tests

ÇAĞIN Color Blindness Test

Before both the hand and foot reaction tests, the ÇAĞIN Color Blindness Test is administered to determine whether the subject is fit to take the test. The subject is randomly shown the colors yellow, red, blue and green and asked which color they are. The person who gives 2 correct answers for each color is included in the test. If the subject gives more than 1 wrong answer, they are not included in the test.
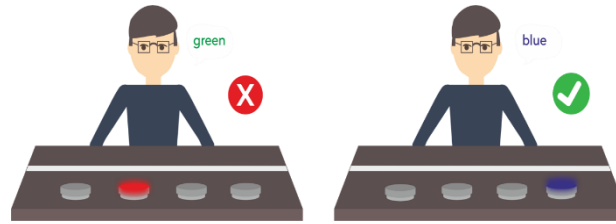

Figure 6. *ÇAĞIN Color Blindness Test*

ÇAĞIN Hand Reaction Tests

Step 1: The subject sits on a chair and raises his/her arms at shoulder level.

Figure 7: *Step 1 for ÇAĞIN Hand Reaction Test*

Step 2: Then the elbows are positioned to form a 90º angle and the distance between the two middle fingers is recorded.
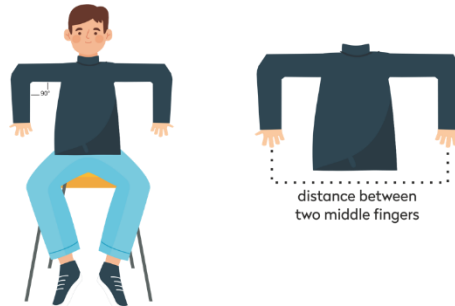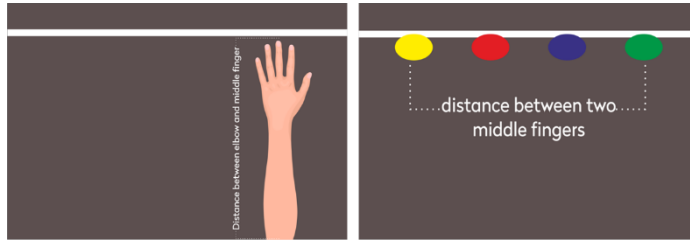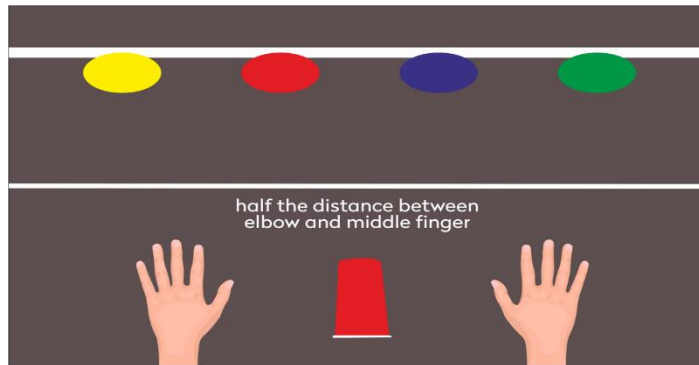

Figure 8. *Step 2 for ÇAĞIN Hand Reaction Test*

Step 3: The distance between the elbow and the middle finger is recorded by placing the elbow at the starting level of the table. The sensors are then positioned horizontally at equal intervals according to the distance between the two middle fingers and vertically according to the distance between the elbow and middle finger.

Figure 9. *Step 3 for ÇAĞIN Hand Reaction Test*

Step 4: After the distance between the elbow and the middle finger (e.g., 70 cm) is determined and the lights are positioned, a line is drawn in the middle (e.g., 35 cm) and a glass is placed close to the subject.

Figure 10. *Step 4 for ÇAĞIN Hand Reaction Test*

ÇAĞIN Hand Simple Reaction Test

A blue cup is placed in front of the subject and blue lights are turned on randomly from the sensors for 20 seconds. The lights are set to be turned off only by touching the lights (This device also has a close proximity turn-off mode, so only the touch turn-off mode should be turned on). The subject is asked to turn off the blue light with the cup by taking the cup in one right and one left hand as fast as possible for 20 seconds. After each light turning off, the cup has to be touched to the part separated by a line, close to the subject. If one light is turned off and the other light is turned off without touching the rest of the line, it is noted as 1 error point. If a light is turned off repeatedly with the same hand, 1 error point is scored. The test is administered twice and the best time is taken into account. At the end of 20 seconds, the reaction time, how many lights the subject turned off and how many errors he/she made are recorded and analyzed.

Figure 11. *ÇAĞIN Hand Simple Reaction Test*

ÇAĞIN Hand Selective Reaction Test

Blue, green, red and yellow glasses are placed in front of the subject and one of these 4 lights is turned on randomly from the sensors for 20 seconds. The lights are set to be turned off only by touching the lights (This device also has a close proximity turn-off mode, so only the touch turn-off mode should be turned on). The subject is asked to turn off the light for 20 seconds as fast as possible by picking up

the cup in the color of the light with one right and one left hand. After each light turning off, the cup has to be touched to the part separated by a line, close to the subject. If one light is turned off and the other light is turned off without touching the rest of the line, it is noted as 1 error point. If a light is turned off repeatedly with the same hand, 1 error point is scored. If a light is turned off with the wrong cup (e.g. blue light turned off with a green cup), it is scored as 1 error point. The subject is given the test twice and his/her best performance is taken into account. At the end of 20 s, the reaction time, the number of lights turned off, and the number of errors made are recorded and analyzed.

Figure 12. *ÇAĞIN Hand Selective Reaction Test*

ÇAĞIN Hand Discriminative Reaction Test

A red cup is placed in front of the subject and these 4 lights are turned on at the same time for 20 seconds randomly from the sensors. The lights are set to be turned off only by touching the lights (This device also has a close proximity turn-off mode, so only the touch turn-off mode should be turned on). The subject is asked to turn off only the red light by picking up the red cup with the right and left hand as fast as possible for 20 seconds. After each light turning off, the cup has to be touched to the part of the line separated by a line, close to the subject, and the hand has to be changed. If one light is turned off and the other light is turned off without touching the rest of the line, it is noted as 1 error point. If a light is turned off consecutively with the same hand, 1 error point is scored. If the wrong light is turned off (other colors instead of red), 1 error point is scored. The test is administered twice and the best time is taken into account. At the end of 20 seconds, the reaction time of the subject, how many lights he/she turned off and how many errors he/she made are recorded and analyzed.
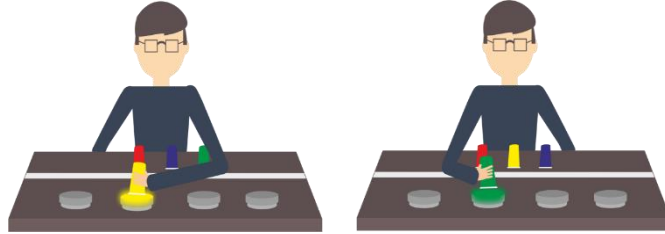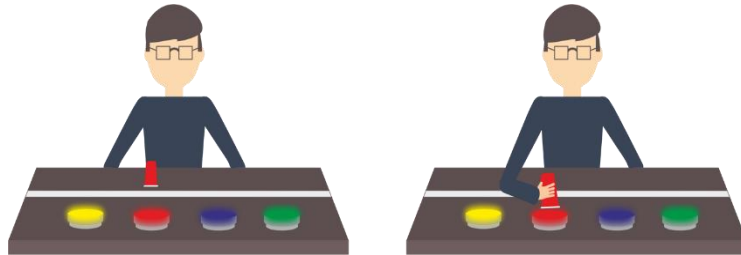
Figure 13. *ÇAĞIN Hand Discriminative Reaction Test*

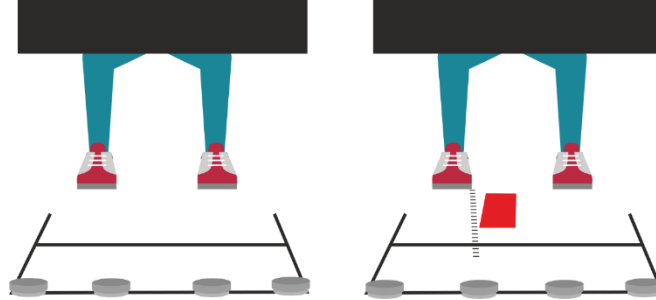**ÇAĞIN Foot Reaction Tests**

Step 1: The subject is seated on a chair with knees at 90° degrees and shoulder width. After the desired angle is achieved, the location of the outer part of the heels is marked. The length from the medial condyle (the hard protrusion at the end of the tibia bone) to the sole of the foot is determined.

**Figure 14.** *Step 1 for ÇAĞIN Foot Reaction Tests*

Step 2: A double-sided vertical line is drawn from the marked point on the outside of the heel to the distance between the medial condyle and the sole of the foot (e.g. 40 cm). A horizontal line is drawn at the end of the vertical lines and sensors are placed on this horizontal line at equal intervals. A horizontal line is drawn in the middle part of the determined length (e.g. 40 cm) (for example, if the total length is 40 cm, the middle part is determined as 20 cm) and the area is divided into two sections.

Figure 15. *Step 2 for ÇAĞIN Foot Reaction Tests*

ÇAĞIN Foot Simple Reaction Test

A blue colored rectangular paper is fixed to the middle part of the section that is close to the subject. One foot is raised above the blue colored paper and the other foot is raised high enough to break contact with the ground. The sensors are set to randomly illuminate blue light for 20 seconds. The lights are set to be turned off only by touching the lights (This device also has a close proximity turn-off mode, so only the touch turn-off mode should be turned on). The subject is asked to turn off the blue light with one right and one left foot as fast as possible for 20 seconds. After turning off each light, the foot has to touch the blue paper in the center. If one light is turned off and the other light is turned off without touching the rest of the line, 1 error point is scored. If a light is turned off with the same foot consecutively, it is scored as 1 error point. The test is administered twice and the best time is taken into account. At the end of 20 seconds, the reaction time of the subject, the number of lights turned off and the number of errors made are recorded and analyzed.
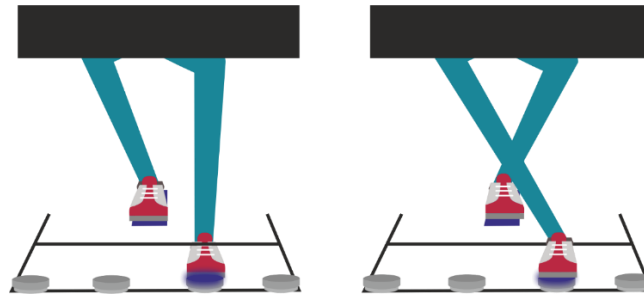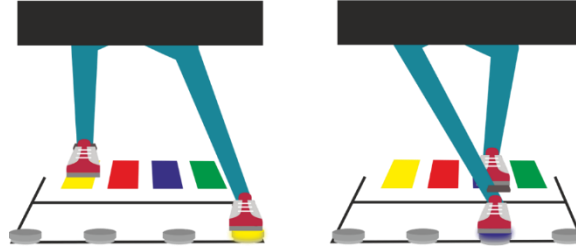
Figure 16. *ÇAĞIN Foot Simple Reaction Test*

ÇAĞIN Foot Selective Reaction Test

Rectangular papers colored blue, green, red and blue are fixed to the part close to the subject from the sections divided into two in the middle so that they are in line with the sensors. Both feet are positioned so that they are in the air at a height high enough to break contact with the ground, and when the first light turns on, the right foot goes to the paper in the lit color and the left foot to the lit color. One of these 4 lights is turned on randomly from the sensors for 20 seconds. The lights are set to be turned off only by touching the lights (This device also has a close proximity turn-off mode, so only the touch turn-off mode should be turned on). The subject is asked to turn off the light by touching the light-colored paper with his/her right and left foot as fast as possible for 20 seconds. After turning off each light, the foot has to touch the part separated by a line, close to the subject. If one light is turned off and the other light is turned off without touching the rest of the line, it is noted as 1 error point. If a light is turned off consecutively with the same foot, 1 error point is scored. If a light is turned off incorrectly (e.g., the blue light is turned off by touching the green paper), it is scored as 1 error point. The test is

administered twice and the best performance is taken into account. At the end of 20 s, the reaction time, the number of lights turned off and the number of errors made are recorded and analyzed.

Figure 17. *ÇAĞIN Foot Selective Reaction Test*

ÇAĞIN Foot Discriminative Reaction Test

A red colored rectangular paper is fixed to the middle part of the section close to the subject. One foot is raised above the red colored paper and the other foot is raised high enough to break contact with the ground. For 20 seconds, blue, green, red, and yellow lights are turned on simultaneously from the sensors in a randomized manner. The lights are set to be turned off only by touching the lights (This device also has a close proximity turn-off mode, so only the touch turn-off mode should be turned on). The subject is asked to turn off only the red light with one right and one left foot as fast as possible for 20 seconds. After turning off each light, the foot has to touch the part of the light separated by a line, close to the subject, and the foot has to be changed. If one light is turned off and the other light is turned off without touching the rest of the line, it is noted as 1 error point. If a light is turned off with the same foot in succession, 1 error point is scored. If the wrong light is turned off (other colors instead of red), 1 error point is scored. The test is administered twice and the best time is taken into account. At the end of 20 seconds, the reaction time, the number of lights turned off and the number of errors made are recorded and analyzed.
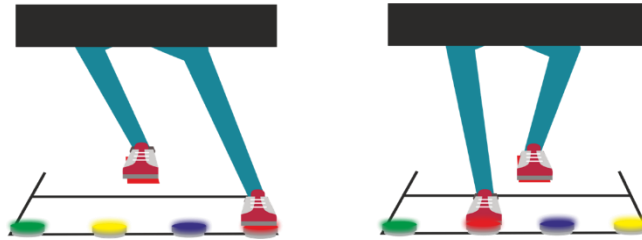
Figure 18. ÇAĞIN Foot Discriminative Reaction Test

Statistical Analysis of ÇAĞIN Hand and Foot Reaction Tests

ÇAĞIN Hand and Foot Reaction Tests can determine the subjects' average reaction time, total number of touches and number of errors. With these data, the subject's average reaction time, correct and incorrect reaction rate can be determined.

Mean Reaction *Time*

Automatically determined by the FitLight Trainer or BlazePod device after 20 seconds of testing (e.g. 0.444 ms).

Correct and Incorrect Reaction Rate

The ratio between the subject's total number of taps and the number of errors is taken into account. For example, if the subject touched 20 times and made 5 errors, the correct reaction rate of the subject is determined as 75% and the incorrect reaction rate is determined as 25%.

Data Analysis

The data obtained were transferred to SPSS 26.0 program and Paired-Samples T Test and descriptive statistics were applied. The validity of the ÇAĞIN Hand and Foot Reaction Tests was determined by comparing the results of the 1st and 2nd measurements made with the FitLight Trainer, and the reliability was determined by comparing the measurements made with the FitLight Trainer and BlazePod device. Statistical significance level was accepted as $p < 0.05$. The intraclass correlation coefficients were interpreted according to the table below (Elsworthy et al., 2021; Jukic et al., 2022).

Table 3

Classification of Intraclass Correlation Coefficients

Trivial	*≤0.10*
Small	0.10-0.29
Moderate	0.30-0.49
Large	0.50-0.69
Very Large	0.70-0.89
Almost Perfect	≥0.90

Ethical Procedures

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Gazi University (Code: 2022-1470).

Results

According to the 1st and 2nd measurement comparisons of the ÇAĞIN Hand and Foot Reaction Tests performed with the FitLight Trainer (FitLight Corp, Ontario, Canada), the intraclass correlation coefficients of all tests were found to be $r > 0.70$ and the significance level was $p < 0.05$ in both males and females under 18 years of age and males and females over 18 years of age (Tables 4-5). In this context, the validity of ÇAĞIN Hand and Foot Reaction Tests was found to be very high ($r = 0.70-0.89$). According to the comparisons of the measurements of ÇAĞIN Hand and Foot Reaction Tests with FitLight Trainer (FitLight Corp, Ontario, Canada) and BlazePod (Play Coyotta Ltd., Tel Aviv, Israel) devices, the intraclass correlation coefficients of all tests were found to be $r > 0.70$ and the significance level was $p < 0.05$ in both males and females under 18 years of age and males and females over 18 years of age (Tables 6-7). In this context, the reliability of the ÇAĞIN Hand and Foot Reaction Tests was found to be very high ($r = 0.70-0.89$).

Table 4

Comparison of the 1st and 2nd Measurement Results of ÇAĞIN Hand and Foot Reaction Tests with FitLight Trainer Device in Soccer Players under 18 Years of Age

Age	ÇAĞIN Hand and Foot Reaction Tests Measurements (FitLight Trainer)	N	X̄ (ms)	S	r	p
U 18 Soccer Players	1. Measurement Simple Hand Reaction Time	60	.678	.168	.885	.000
	2. Measurement Simple Hand Reaction Time	60	.637	.165		
	1. Measurement Selective Hand Reaction Time	60	1.202	.183	.846	.000
	2. Measurement Selective Hand Reaction Time	60	1.149	.198		
	1. Measurement Discrimination Hand Reaction Time	60	.621	.128	.836	.000
	2. Measurement Discrimination Hand Reaction Time	60	.581	.116		
	1. Measurement Simple Foot Reaction Time	60	.785	.155	.898	.000
	2. Measurement Simple Foot Reaction Time	60	.735	.161		
	1. Measurement Selective Foot Reaction Time	60	1.277	.195	.869	.000
	2. Measurement Selective Foot Reaction Time	60	1.258	.207		
	1. Measurement Discrimination Foot Reaction Time	60	.759	.132	.809	.000
	2. Measurement Discrimination Foot Reaction Time	60	.723	.134		

Table 5

Comparison of 1st and 2nd Measurement Results of ÇAĞIN Hand and Foot Reaction Tests with FitLight Trainer Device in Soccer Players over 18 Years of Age

Age	ÇAĞIN Hand and Foot Reaction Tests Measurements (FitLight Trainer)	N	X̄ (ms)	S	r	p
18 + Soccer Players	1. Measurement Simple Hand Reaction Time	60	.594	.105	.802	.000
	2. Measurement Simple Hand Reaction Time	60	.539	.092		
	1. Measurement Selective Hand Reaction Time	60	.983	.125	.723	.000
	2. Measurement Selective Hand Reaction Time	60	.991	.140		
	1. Measurement Discrimination Hand Reaction Time	60	.557	.090	.754	.000
	2. Measurement Discrimination Hand Reaction Time	60	.550	.107		
	1. Measurement Simple Foot Reaction Time	60	.686	.109	.838	.000
	2. Measurement Simple Foot Reaction Time	60	.633	.102		
	1. Measurement Selective Foot Reaction Time	60	1.045	.128	.825	.000
	2. Measurement Selective Foot Reaction Time	60	1.014	.120		
	1. Measurement Discrimination Foot Reaction Time	60	.657	.123	.861	.000
	2. Measurement Discrimination Foot Reaction Time	60	.646	.135		

Table 6

Comparison of the Results Of ÇAĞIN Hand and Foot Reaction Tests Performed with Fitlight Trainer and Blazepod Device in Soccer Players Under 18 Years of Age

Age	ÇAĞIN Hand and Foot Reaction Tests Measurements	N	X̄ (ms)	S	r	p
U 18 Soccer Players	FitLight Trainer Simple Hand Reaction Time	60	.753	.150	.841	.000
	BlazePod Simple Hand Reaction Time	60	.699	.136		
	FitLight Trainer Selective Hand Reaction Time	60	1.330	.195	.807	.000
	BlazePod Selective Hand Reaction Time	60	1.249	.183		
	FitLight Trainer Discrimination Hand Reaction Time	60	.785	.104	.713	.000
	BlazePod Discrimination Hand Reaction Time	60	.751	.102		
	FitLight Trainer Simple Foot Reaction Time	60	.949	.172	.831	.000
	BlazePod Simple Foot Reaction Time	60	.948	.192		
	FitLight Trainer Selective Foot Reaction Time	60	1.428	.182	.833	.000
	BlazePod Selective Foot Reaction Time	60	1.382	.168		
	FitLight Trainer Discrimination Foot Reaction Time	60	.841	.109	.715	.000
	BlazePod Discrimination Foot Reaction Time	60	.822	.098		

Table 7

Comparison of the Results of ÇAĞIN Hand and Foot Reaction Tests Performed with Fitlight Trainer and Blazepod Device in Soccer Players over 18 Years of Age

Age	ÇAĞIN Hand and Foot Reaction Tests Measurements	N	X̄ (ms)	S	r	p
18 + Soccer Players	FitLight Trainer Simple Hand Reaction Tim	60	.730	.113	.770	.000
	BlazePod Simple Hand Reaction Time	60	.696	.146		
	FitLight Trainer Selective Hand Reaction Time	60	1.122	.170	.755	.000
	BlazePod Selective Hand Reaction Time	60	1.119	.163		
	FitLight Trainer Discrimination Hand Reaction Time	60	.735	.112	.796	.000
	BlazePod Discrimination Hand Reaction Time	60	.704	.127		
	FitLight Trainer Simple Foot Reaction Time	60	.888	.231	.896	.000
	BlazePod Simple Foot Reaction Time	60	.902	.246		
	FitLight Trainer Selective Foot Reaction Time	60	1.212	.177	.841	.000
	BlazePod Selective Foot Reaction Time	60	1.197	.149		
	FitLight Trainer Discrimination Foot Reaction Time	60	.786	.121	.774	.000
	BlazePod Discrimination Foot Reaction Time	60	.802	.120		

Discussion, Conclusion, and Recommendations

The purpose of the present study was to determine the reliability and validity of ÇAĞIN Hand and Foot Reaction Tests. ÇAĞIN Hand and Foot Reaction Tests determine hand simple, selective, discriminative and foot simple, selective, discriminative reaction times. In line with the findings obtained in the study, it was determined that both the validity and reliability of all of these tests were very high. Various tests are applied to determine reaction time in the field (Schmidt & Dark, 1999; Mercer et al., 2009; Günay, Tamer, & Cicioğlu, 2010; de-Oliveira et al., 2021; Prelević, Dopsaj, & Stančin, 2023). Some of these tests are computer-based using only fingers, some of them are performed using equipment such as ruler, ball, paper, etc., some of them are performed with sensors but without any standardization and only measure simple reaction time. Considering that multiple muscle groups move simultaneously in order to react in sports branches, it is not thought that computer-based reaction performances can provide healthy data at the point of determining the reaction in terms of sport. In addition, in a period when technology and measuring instruments have developed so much, it can be said that making reaction time measurements with equipment such as ruler, ball paper, etc. does not comply with the requirements of the age for scientific studies and does not reach enough targets in the field. Although there are various devices with light sensors that measure reaction time in athletes today, there is no common reaction test protocol.

Generally, in the reaction time tests performed in the field, the tests in the device where the measurement is performed are applied, but these tests cannot provide standardization according to the anthropometric characteristics of the person and only measure simple reaction time. The lack of standardization in reaction time measurements made by means of sensors can be limiting in the objective comparison of reaction time tests performed in different periods and groups. In this context, the "ÇAĞIN Hand and Foot Reaction Tests" developed in this context is in the direction of the idea that it can meet the common test protocol needed in the field by completing the mentioned deficiencies since it can be applied in different measurement devices and provides conformity and standardization according to the anthropometric characteristics of the person. In addition, in the tests used in the field, there were no reaction tests with validity and reliability in both under 18 and over 18 age groups. The fact that the reliability and validity of the ÇAĞIN Hand and Foot Reaction Tests are very high both above and below the age of 18 may indicate that the tests have a suitable format for both adolescent and professional athletes.

While determining the sample group for the validity and reliability study of the ÇAĞIN Hand and Foot Reaction Tests, various branches were examined and as a result, the soccer branch, in which both hands and feet are actively used, was preferred. The fact that the validity and reliability of the tests were very high in the soccer branch, where both hand and foot are actively used, created the opinion that ÇAĞIN Hand and Foot Reaction Tests can be easily used in all sports branches.

In conclusion, it can be said that "ÇAĞIN Hand and Foot Reaction Tests" developed by the researchers can be used as a valid and reliable test method for athletes both under and over the age of 18 in other branches, especially in soccer. It is also noteworthy that it can be a test method that can be adjusted according to the person and his/her characteristics, has high standardization and can determine more optimal performance levels in accordance with the requirements of our age in the field. The developed "ÇAĞIN Hand and Foot Reaction Tests" can be used in different sports branches, assuming that simple, selective and discrimination reaction times are important in the performance monitoring of athletes and can provide more complete and detailed data compared to other tests. Although the test battery has been developed specifically for athletes, deeper validity and reliability studies in sedentary individuals may increase the use of the test in various fields.

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