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Design and Standardization of a Device to Measure Attentional Control for Futsal Players

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Abstract The study aimed to devise a tool for gauging attentional control in futsal players, discerning their varying levels of attentional control, and establishing standardized benchmarks for this attribute. In order to meet these targets, a descriptive approach that incorporated surveys and standard studies, was employed. The research involved players, including those hailing from government and private universities and colleges in Babylon province, encompassing a total of 75 participants across five universities during the academic year 2022-2023. During the attention control test on the devised device, we determined the sample distribution using the extracted range (7) and the base length (1.4). The first category, indicative of a very good level, spanned from (9-7.6), while the second category, representing a good level, extended from (7.5-6.1). The third level, signifying a moderate level, had a range of (6.0-4.6), the weak level ranged from (4.5-3.1), and the ultimate level, indicating a very weak level, ranged from (3.0-1.6). The distribution of the sample across these levels disclosed that 16% attained a very good level (12 participants), 25.33% reached a good level (19 participants), 36% secured an average level (27 participants), 12% were at a weak level (9 participants), and 10.66% were at a very weak level (8 participants). Drawing from these findings, the researchers concluded that futsal players from government and private universities and colleges generally demonstrate commendable attentional control. They successfully engineered a device tailored for assessing attentional control in futsal players and determining standardized scores for the attention control test on this device. Moreover, the futsal players were categorized into five levels to evaluate their attention control.

Keywords Attentional Control, Standardizing, Standards, Levels, Futsal

1. Introduction

Attaining success in sports is a holistic process that involves physical, mental, and psychological readiness. The primary goal is for players to maximize their mental faculties and focus on specific stimuli, necessitating the exclusion of any other stimuli that may affect performance accuracy. It is crucial to isolate any stimuli that could interfere and lead to dispersion, hindering the completion of the motor duty expected from the player. "Futsal, a sport with an open and varied environment, demands quick and precise responses to fast, variable, and sudden inputs."

The capacity to perform under high-pressure situations is a critical determinant of success in sports [1]. Recent developments in sport psychology emphasize that difficulties in maintaining optimal performance under pressure stem from an athlete's inability to sustain adequate attention control [2,3]. Experiments aim to demonstrate whether training attentional control, proven to enhance cognitive task performance, can also effectively enhance sporting tasks. According to recent models of working memory [4,5], attentional control involves the efficiency of main executive functions, including inhibition (resistance to distraction), shifting (within-task control), and updating (memory-based information updating). The processing efficiency of these executive functions plays a pivotal role in goal-directed behavior in general [6].

As the cornerstone of the attention process, it screens out crowded stimuli in the environment, with the chosen stimulus being the most important for the player. Physical qualities such as density, clarity, and capacity are crucial factors in choosing the stimulus. Capacity controls the amount of information the learner can select, imposing constraints on what is allowed into the player's consciousness [7].

Athletes may differ not only individually in their ability to stay focused and avoid distraction. This suggests that the same athlete may vary in the situational availability of focused attention. Research suggests that focusing attention in interference-rich environments depends on contingent upon the existence of sufficient in self-control resources [8].

Individuals with high planning exhibit strong attentional orientation toward the desired goal [9]. While few studies have explored how attentional demands directly relate to movement and how this might differ based on skill level, such insight is crucial for understanding the differences between novice and highly-skilled performers. It may also offer insights into optimizing skill learning and preventing skill breakdown after achieving high-level performance [10].

The mastery of motor skills in futsal depends not only on physical and skill training but also on the psychological aspect, whether mental or emotional, which is a fundamental pillar for improving players' physical, skill, and tactical levels. Through ongoing research, the discovery of a shortage in devices for measuring mental abilities in the game negatively impacts player performance. Diagnosing, evaluating, and examining these abilities influences players' physical, skill, and planning levels, including the team's overall performance. Therefore, the value of this research lies in discovering new ways to contribute to the activation of models and approaches to measuring mental abilities accurately. This task involves designing a device to measure attentional control with specific standards and levels tailored for futsal players**.**

1.2. Objectives

1. Developing a device to assess futsal players' attentional control.
2. Recognizing futsal players' attentional control.
3. Identifying standard degrees and levels of attentional control in futsal players.

2. Materials and Methods

2.1. Research Area and Duration

The total research schedule as a whole is from November 1, 2022 to April 20, 2023. The research area took place in the sports hall of the National Center for Talent Nurturing in the Ministry of Youth and Sports in Babylon Governorate

2.2. Research Methodology

Various methodologies are employed in scientific research. The choice of methodology hinges on the study's nature. In this context, the researcher has opted for the descriptive approach using survey and standardized study methods, aligning with their suitability for the current study.

2.3. Research Sample

"The research sample included players from university and college teams in both public and private institutions in Babylon province for the academic year (2022-2023). There were (75) players representing 5 universities, as shown in Table 1.

Table 1. The study sample is shown in

N	Name of university	Affiliation	Players' number
1	Babylon university	government	**15**
2	Al-Qasim Green University	government	**15**
3	Hilla University College	private	**15**
4	Al-Mustaqbal University College	private	**15**
5	Islamic university	private	**15**
Total			**75**

2.4. Specifications Attention Control Test

2.4.1. Input Group

a) KeyBad:

It is a collection of electronic input keys arranged in four rows and four columns that intersect to form sixteen independent input keys. These keys can be programmed to the test-takers preference. The input panel has been programmed to control the time of the stimulus's presentation (time) and the number of times the stimulus appears (Loop) according to the coach's or player's preferences. Similarly, the keys (A, B, C, and D) were assigned to run pre-programmed test programs, while two keys (* and #) were assigned to control the number of repetitions (Loop) and the amount of lighting time for one lamp (Time) in a row and in an open manner, as shown in Figure 1.

Figure 1. KeyBad

b) Foot Pressure Sensor:

A compact electronic key is situated at the center of an expansive foot pressure sensor base crafted from PVC. This sensor base is strategically positioned on the ground, designed to withstand the player's weight without causing any damage. The primary objective of the electronic key within the foot pressure sensor is to produce a swift pulse of electronic power, precisely at 5 volts, within a time frame not exceeding 10 milliseconds – equivalent to one percent of a second. This rapid response time is crucial for the electronic system, as illustrated in Figures 2 and 3, ensuring efficiency and eliminating any potential time loss, which holds significant importance in the testing process.

Figure 2. Foot Pressure Sensor

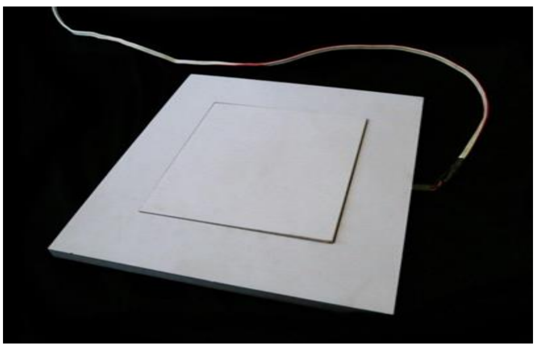

Figure 3. The foot Pressure Sensor base

2.4.2. Operating and Processing Group

a) Arduino Board:

The Arduino is an electronic control board equipped with a Microcontroller, akin to those found in computers, albeit with fewer capabilities and options. It possesses a limited number of outputs and inputs for digital and analog signals. This device incorporates a USB input for communication with a computer and can be programmed using a straightforward language (C++) to regulate signal transmission through outputs or receive and process data from inputs swiftly. Its applications range from tasks such as operating gates, and managing electrical currents for specific durations, to reading data from sensors.

The Arduino Mega 2560 was selected for its capacity to handle intricate projects. With control over 54 digital inputs and outputs (in/out-digital) and 16 analog inputs, along with a more substantial memory space (256 MB), it can accommodate larger and more complex programs. This makes it an ideal choice for implementing the current project, particularly in efficiently controlling the attentional control test device. It seamlessly links and manages all its components in terms of performance speed, as well as the random lighting and extinguishing of lamps over time. The figure illustrates how the specified time is recorded, and the results are easily depicted in Figure 4.

Figure 4. The Arduino Board

b) Pulse Filter:

The attention control test device incorporates six-foot pressure sensors, generating a significant number of electronic impulses when pressed repeatedly by the player. To ensure accurate processing, it is crucial to filter and cleanse the signal from the foot pressure sensors, preventing noise interference and maintaining signal integrity. Therefore, a compact electronic unit known as an Electrical Signal Processing and Filtering Unit (Pulse Filter) must be constructed. This unit is responsible for collecting signals from the foot pressure sensors, filtering, and processing them before transmitting them to the Arduino Board, as depicted in Figure 5.

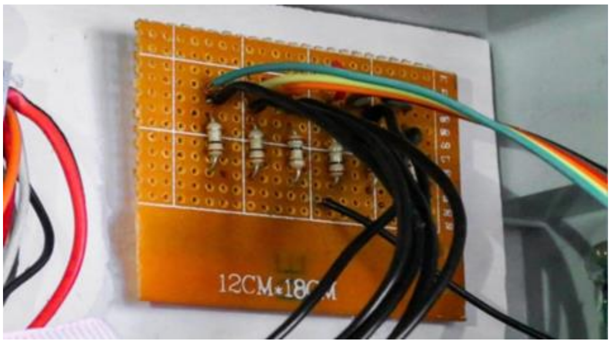

Figure 5. Pulse Filter

c) Power Bank and charging system:

The attention control test device is equipped with an energy tank boasting a substantial capacity of 8000 mA and an electrical impulse comparable to 12 volts. Essentially, the device integrates an energy storage unit and a recharging system, allowing for its installation and testing in open playgrounds and enclosed halls where proximity to a power source may not be feasible. The energy storage unit can power the device for a continuous four hours without requiring access to electricity. Following this period, the internal electric charging system efficiently recharges the battery, as illustrated in Figures 6 and 7.

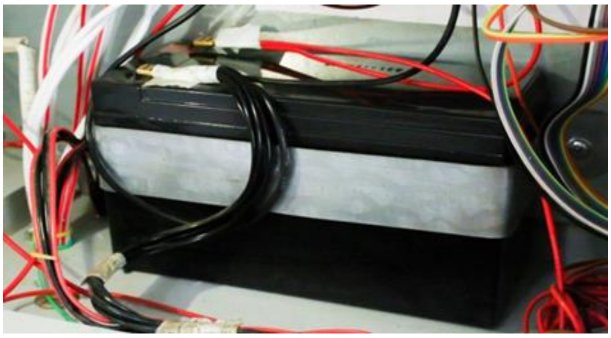

Figure 6. The power Bank

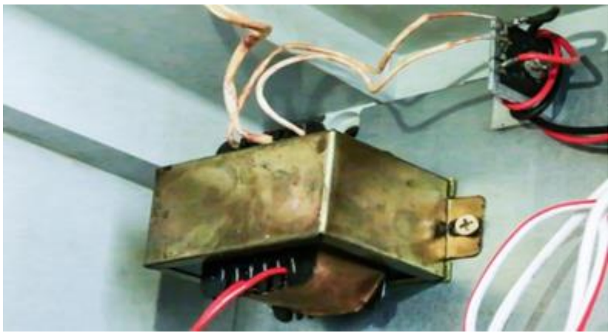

Figure 7. Charging system

d) Voltage Regulator:

It's a compact device designed to convert the incoming voltage for the Arduino and its supporting components from a higher voltage (12V) to a lower voltage (5V). This transformation ensures alignment with the operational requirements of the electronic processing unit, as depicted in Figure 8.

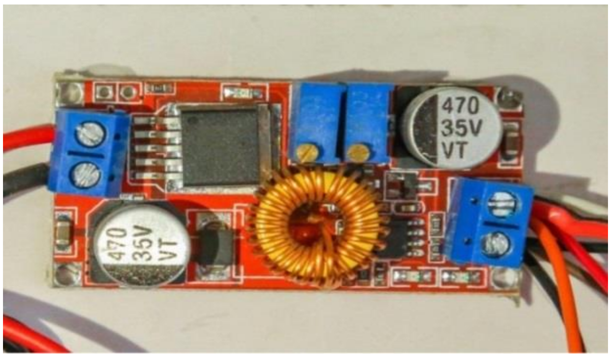

Figure 8. The Voltage Regulator

e) Current Amplifier:

Although the Arduino can handle a considerable number of outputs, its capacity to drive an electric current exceeding (20mA) is limited. This current is inadequate to sufficiently power and illuminate lamps. Consequently, the system requires a current amplifying unit, as illustrated in Figure 9.

Figure 9. The Current Amplifier

2.4.3 Output Group

a) LCD – Screen:

It is a four-line electronic display screen (LCD) with 20 characters per line, providing the coach with the capability to program and read information transmitted from the electronic control unit. The screen indicates the number of inputs from the keyboard and displays results upon the completion of each player's attempt. Moreover, the screen showcases the customized program (A, B, C, and D) or utilizes the two keys (* and #) to control the number of repetitions (Loop) and the lighting time for one lamp (Time). All of these functions are coordinated with the input keyboard, as depicted in Figure 10.

Figure 10. LCD - Screen

b) Main Play Board:

The main playground screen is made up of six LED lights distributed along the edges of a wooden board, positioned on the loading stand. The loading stand is a border stand that can be raised and lowered, carrying both the main playground screen (Figure 11) and the electrical control board responsible for managing all electronic devices (Figure 12). This board is elevated to the player's height, creating a virtual laboratory playground.

Figures 11. Main Play Board

In this setup, one of the six lights randomly and arbitrarily illuminates for a specific period predetermined by the coach. This aims to assess the player's control over attentional processes. The player is required to press the corresponding ground sensor within a specified time frame, matching the location of the illuminated lamp. Failure to do so within the allotted time results in a loss of points. The device then proceeds to light a new lamp in a different spot, either due to the player's pressure on the sensor or the expiration of the time limit.

The device can be switched off and restarted using the main operation switch, as depicted in Figures 11, 12, and 13.

Figures 12. Electronic electrical control board

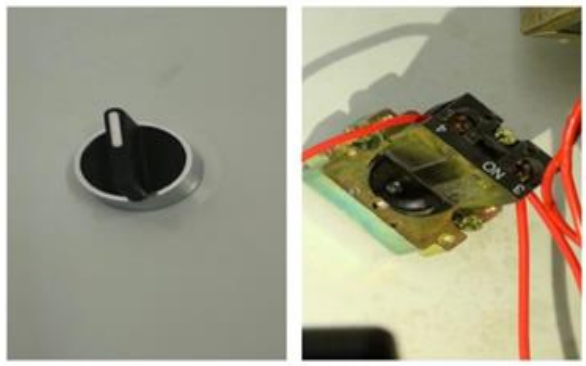

Figure 13. Master of the power key

2.5. The Mechanism of the Attentional Control Device

The device comprises a playground-shaped screen with six electrical lights (LED) positioned along the borders of a wooden board. This board is securely fixed on an iron stand that can be raised and lowered, supporting the main playground screen (Figure 14). To enhance interactivity, six-foot pressure sensors are connected to the screen, and strategically placed within a 4x4 m area, creating an interactive playground environment.

Specifically, three sensors are located on the right side, and three on the left side of the playing space. This configuration enables the player to respond to the appearance of lights on the wooden board. Interaction with lights positioned at the top of the board (playground) occurs on the player's left, while responding to lights at the bottom of the board is facilitated on the right side of the player.

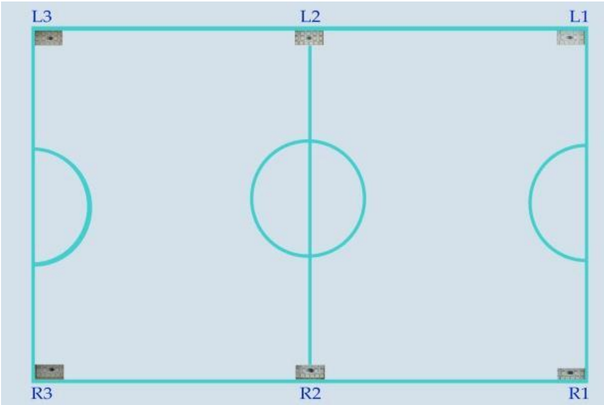

Figure 14. The main playground screen

For instance, when the stimulus appears in the L1 lamp, the player's response is directed towards the pressure sensor located near the main screen. Conversely, if the stimulus emerges in L3, the response and pressure on the sensor can occur either on the side near the main screen or on the side near the starting line. The appearance of the stimulus in L2 results in the response being directed at the middle-pressure sensor on the left. This pattern is mirrored for stimuli in (R1), (R3), and (R2) on the player's right.

When the player positions themselves in the middle of the starting line, facing the main screen, and initiates the program stored in the system by pressing the (D) button on the software keyboard, they begin responding to randomly appearing stimuli on the main screen. The player presses the ground sensors corresponding to the stimuli displayed on the main screen. It's essential to note that each test consists of 10 different stimuli presented in the loop, and the duration of stimulus appearance is set at 3 seconds. Failure to respond within the 3-second timeframe prompts the system to display a different stimulus randomly, requiring the player to respond in a different area.

Scoring is based on a total of 10 points, with each correctly presented and appropriately responding to the stimulus earning the player 1 point.

2.6. Psychometric Properties

The researchers introduced the fundamental concept of the test to a panel of fifteen (15) experts and specialists to validate its effectiveness in measuring the intended criteria and to ascertain its apparent validity. The confirmation of the hypothesis's correctness is further supported by the test's ability to discern proficiency, as illustrated in Table 2 through the comparison of the two terminal groups.

The reliability coefficient is further affirmed through the test and retest method, involving a seven-day interval between the initial and subsequent tests. The researchers computed the reliability of the test using the Pearson simple correlation coefficient between the results of the first and second tests. The coefficient yielded a value of (0.91), indicating a very high stability index.

Table 2. The arithmetic mean and standard deviation of both the upper and lower groups, along with the estimated T-value and statistical significance.

test	the upper group		The lower group		T-value	statistical significance
	m	Std.	m	Std.		
attention control	8.69	0.48	2.84	1.06	17.99	0.000

2.7. Statistical Analysis

The researchers utilized the twentieth edition of the Statistical Package for the Social Sciences (SPSS) for data analysis. The analysis in this study employed the SPSS version 24.0 to examine the collected research data, encompassing calculations such as arithmetic mean, standard deviation, standard error, t-test for independent samples, t-test for one sample, and coefficients of skewness, kurtosis, and variance.

3. Results

3.1. Presentation and Analysis of the Results of Identifying the Statistical Parameters of the Attention Control Test for Futsal Players

Table 3 presents the scores from the attentional control test, showing an arithmetic mean of 6.022 and a standard deviation of 0.99, accompanied by a small standard error of 0.23. The small standard error suggests that the sample size was sufficient, and the studied population was reliable.

Comparing the average scores of the research sample on the attentional control test with the hypothetical average of (5), it became evident that the sample exhibited a higher level of attentional control than the hypothetical average. This indicates a high level of attentional control within the sample.

To assess the statistical significance of the differences between the two means, the researcher employed a t-test for one sample. The calculated t-value was (4.44), with a significance level of 0.00 (less than 0.05), and a degree of freedom of 74. This suggests that the observed differences are statistically significant, reinforcing the conclusion that the research sample demonstrates a significantly higher level of attentional control compared to the hypothetical average.

Table 3. Statistical description of the attentional control test results.

sample number	arithmetic mean	hypothetical mean	standard deviation	standard error	Value (t)	significance level
75	6.02	5	0.99	0.23	4.44	0.00

3.2. Presentation and Analysis of the Findings of Relative Dispersion Measures (Skewness, Kurtosis, and Variation Factors

In Table 4, the skewness coefficient for the attentional control test is (0.54), and the Kurtosis coefficient is (0.01). Both coefficients fall within the range of (+1, -1), indicating a moderate distribution of scores among the research sample members in the studied test.

Table 4. The findings of the measures of relative dispersion of the attention control test

Variables	skewness	Kurtosis	variation factors
attention control	0.54	0.01	14.9%

To assess the proportion of dispersion within the group, the researchers employed the coefficient of variation. The coefficient of variation for the attentional control test's sample scores was 14.9 percent. This small value suggests homogeneity among the research sample members' scores. "The closer the coefficient of variation is to one percent, the higher the homogeneity; in contrast, if it approaches thirty percent, the sample is considered not homogeneous, indicating that the values are dispersed" [11].

3.3. Presentation and Analysis of the Designed Attentional Control Test's Raw Scores, Standard Scores, and Modified Normative Scores

The levels of attentional control, measured on a scale ranging from 2 to 9, demonstrated a diverse range of scores. The arithmetic mean was computed as 6.02, accompanied by a standard deviation of 0.99. To establish the standardized levels for the attentional control test, the following steps were undertaken":

The player's maximum value - the player's minimum value

9-2=7

The following equation is used to determine the base length of each level:

$$\text{The base length of a level} = \frac{\mathit{The\ difference\ between\ the\ two\ tests\ results}}{\mathit{The\ required\ number\ of\ levels}} = \frac{7}{5} = 1.4$$

The results are in Table 5.

In Table 5, the standard scores (Z-scores) reveal an arithmetic mean of (0) and a standard deviation of (1). These scores fall within the range of (+1, -1), signifying alignment within the mean level (Natural). These standardized values are derived from the player's raw score obtained through their performance on the attentional control device.

Standard scores, which include Z-scores and modified T-standard scores, play a crucial role in identifying an individual's position within their group. T-scores, a form of modified standard scores, provide the most accurate representation by converting raw scores relative to the mean divided by the standard deviation. This method maintains the exact numerical relationships of the original raw scores and is employed for two significant reasons:

1. Eliminating fractions that may result from standard scores.
2. Eliminating negative standard scores.

Thorn-dike made an adjusted to overcome these two problems, and the adjustment includes:

- Working to eliminate fractions by multiplying the standard score by 10.
- Dealing with negative signs by adding 50 to the standard score after multiplying it by 10 [12].

Table 5. A test's raw scores, frequencies, standard scores, and modified standard scores

N	raw scores	Frequencies	Z.Scores	T.Scores
1	2	4	-2.01-	29.86
2	3	5	-1.51-	34.87
3	4	8	-1.01-	39.87
4	5	12	-0.51-	44.87
5	6	15	-0.01-	49.87
6	7	12	0.49	54.87
7	8	8	0.99	59.87
8	9	11	1.49	64.87
Rang	7			
Base length	1.4			

3.4. Presenting the Results of the Standard Levels of the Attentional Control Test

Table 6. The standard levels for a research sample of the attentional control test

N	standard levels	level base length	
		From	To
1	Very good	9	7.6
2	Good	7.5	6.1
3	moderate	6.0	4.6
4	Weak	4.5	3.1
5	Very weak	3.0	1.6

Table 6 illustrates the distribution of the sample based on their performance in the attention control test, conducted on the device designed with a specified range (7) and a base length of (1.4). The categories are defined as follows:

- Very Good: Ranging from (9-7.6)
- Good: Ranging from (7.5-6.1)
- Moderate: Ranging from (6.0-4.6)
- Weak: Ranging from (4.5-3.1)
- Very Weak: Ranging from (3.0-1.6)

Table 7. The sample's standard levels, the number of persons at each level, and the percentages obtained at each level for the attentional control test

S	standard levels	number of persons at each level	percentages obtained at each level
11	Very good	12	16%
22	good	19	25.33%
33	moderate	27	36%
44	weak	9	12%
55	Very weak	8	10.66%

Table 7 illustrates the distribution of the sample across various levels. Notably, 16% of the participants demonstrated a very good level (12 individuals), while 25.33% achieved a good level (19 individuals). The majority, comprising 36% of the sample, attained an average level (27 individuals). A weaker level was observed in 12% of the participants (9 individuals), and the very weak level was represented by 10.66% of the sample (8 individuals).

The table distinctly shows that the sample distribution corresponds to an average distribution. As we move away from the middle, both the percentages and the number of individuals at each level decrease, indicating that the majority is concentrated in the middle. Consequently, the study has effectively fulfilled its primary objectives of establishing standard degrees and levels of attentional control for futsal players.

4. Discussion

Confirming the research results and their accuracy is contingent on each player's ability to control their attention. Since the test adhered to scientific principles, scientific rigor, and discriminatory capability, it effectively differentiated between players' mental abilities and levels, providing clear evidence of result accuracy.

The researchers attribute the achieved high level of attentional control in the sample to the players' adeptness at swiftly shifting attention between stimuli and selecting the appropriate location for their motor responses. During the test, players exhibited unique speed in meeting attentional requirements when transitioning between stimuli. This aligns with Eysenck and Calvo's theory of cognitive processing efficiency (ACT), which asserts that shifting attention demands a proportional effort, directly tied to readiness and preparation to respond to various stimuli. The more prepared a player is, the greater the opportunities to invest effort and distribute it appropriately according to each stimulus's requirements [13].

Additionally, the researchers consider chronological and training age as contributing factors. These factors endow players with mental abilities that enable the analysis of extensive information. Players adept at adjusting to changing game situations and making strategic decisions, as suggested by Derryberry, exhibit effectiveness in executing motor responsibilities that involve unifying external or internal sensors, formulating action plans, and adapting to involving game conditions strategic decisions [14].

The observed variation in players' placement within standard levels from very poor to very good is attributed to the dynamic futsal environment, featuring numerous external stimuli. Players must maintain attention control to accurately respond to these stimuli. Some players, despite excelling in other areas, may lack high excitability or activation due to lower levels of attention control. As Abdul-Sattar Jabbar al-Damd noted "high excitability or activation contributes to short-term attention focus, whereas low excitability affects attention concentration" [15].

The researchers highlight continuous training emphasizing the value of focused attention as a crucial factor. Focusing attention is identified as a teachable and developable skill through consistent effort. Given that the outcome of a match often hinges on brief mistakes, achieving a high degree of voluntary control, characterized by the fine flow of attention, positively correlates with sports achievement.

5. Conclusions

1. Futsal players representing university public, and private college teams demonstrate a commendable level of attentional control.
2. The manufactured device is suitable for measuring attentional control in players from university, government, and private college futsal teams.
3. Establishing standardized scores for the attentional control test on the manufactured device.
4. Futsal players were categorized into (5) levels created for testing attentional control.

6. Recommendation

1. Employ the designed device to assess the performance of others teams in various public and private universities in Iraq, comprehend their proficiency levels, and conduct comparisons.
2. The developed device can be utilized to evaluate others samples from applicants, youth, and futsal clubs for both genders. Conduct comparative studies

within these categories to identify strengths and weaknesses in attentional control.

3. The created device can be embraced as a training tool for futsal players.
4. There is a need to conduct similar research on other disciplines and sample groups.

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