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ORIGINAL STUDY

The Contribution Rate of Certain Cognitive and Visual Abilities to the Performance of Forehand and Backhand Skills in Tennis

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Abstract

The significance of the study lies in identifying a scientific and objective indicator that clarifies the extent to which key cognitive and visual abilities contribute to skill performance in tennis. This enables coaches and instructors to design scientifically based educational and training units that incorporate these abilities according to their level of contribution, thereby positively impacting technical performance. The abundance of stimuli in tennis and the difficulty of controlling performance, due to the sport's ongoing developments, require a high level of cognitive and visual abilities. The researchers aimed to examine the problem of inadequate organization in educational content, where one aspect is emphasized over others, and the actual contribution rates of these abilities remain unknown, despite their being fundamental in a sport that demands high levels of concentration, attention, and movement variability. The study aimed to identify the percentage contribution of selected cognitive and visual abilities to the performance of the forehand and backhand strokes in tennis, and to examine the relationship between these abilities and skill performance. The researchers used the descriptive method with a survey and correlational approach. The sample consisted of 30 third-year female students from the College of Physical Education and Sport Sciences for Women at the University of Baghdad. Cognitive and visual tests selected by experts were administered after confirming their validity. The results showed that cognitive and visual abilities play an active role in the performance of the forehand and backhand strokes. Kinesthetic perception, attention, and depth perception made notable contributions, confirming their effectiveness in improving the tennis skill performance of the students. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Backhand stroke skill in tennis, Forehand stroke skill in tennis, Some mental and visual abilities.

1. Introduction

The world is witnessing a scientific renaissance in the field of sports in general and in the game of tennis in particular. The advancements in the sport are largely a result of sound planning and the application of scientific and training methods and approaches. Tennis is among the individual sports characterized by intense competition, requiring the execution of skills with specific technical attributes in an open environment, along with precise technique and complex tactical strategies. The skill component plays a pivotal role, especially when players are evenly matched in physical, psychological, and tactical aspects. This is achieved through continuous training using specialized exercises that demand the player's thorough understanding and ability to respond quickly to dynamic game situations.

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Players analyze gameplay scenarios through their cognitive and visual abilities, responding to current and anticipated stimuli from the opponent. The amount of information received by the player through focused attention contributes directly to selecting the most appropriate response, highlighting the importance of cognitive and visual capacities. These abilities are essential components that must be cultivated throughout all stages of player development. Visual ability, in particular, is one of the core factors underpinning both motor and tactical performance across various sports. Each sport develops distinctive visual traits among players according to its specific requirements, and the need for visual ability varies in degree depending on the nature of the sport.

Khudair et al. (2025) research mentioned "Most developed and developing countries are interested in sports, whether individual or team-based, as sports add elegance, enjoyment, and beauty, which increases the excitement for fans watching these games in various local, international, and continental tournaments and forums". Sun (2023) defined tennis is an open-skill dynamic sport in which players over a limited period of time have to process and integrate complex visual information. and Dana and Gozalzadeh (2017) referred to "Mental abilities such as attention, visual perception, and mental imagery are considered fundamental factors in the game of tennis, especially in performing forehand and backhand strokes. Studies indicate that these abilities significantly contribute to enhancing technical performance and making quick decisions during gameplay." Visual abilities are considered fundamental factors in the performance of tennis players, especially in executing forehand and backhand strokes. Studies indicate that visual training significantly contributes to enhancing technical performance and making quick decisions during play.

For example, a study Die and Sukumaran (2024)"found that eight weeks of visual training led to noticeable improvements in hand-eye coordination, reaction speed, and decision-making ability in tennis players. The study included dynamic visual exercises using a specialized training application, which resulted in an average performance score increase of 40.80 points after the training period." And Fernandez-Fernandez et al. (2017) "Visual training was found to be effective in improving on-court performance among junior tennis players. The results showed significant improvements in the timing of movements between the split step and shoulder rotation during forehand and backhand strokes, as well as in reaction time to the serve." Accordingly, the two researchers pointed out Khudair and Arbinaga (2025)" Scientific research and studies in various sports serve as a fundamental pillar for advancing athletes' high performance, as they represent a scholarly link that contributes to uncovering new facts, which can be a genuine addition that helps in improving performance."

The significance of this research lies in its focus on cognitive and visual abilities, examining their role and contribution to the fundamental skills in tennis. It is a necessary study grounded in a sound scientific approach that seeks to highlight the importance and influence of these abilities within the context of the game. Tennis, as a sport, captivates audiences due to the distinctive aesthetic and technical qualities demonstrated by players. At the same time, it demands specific physical, cognitive, and visual requirements, as it is characterized by rapid situations and continuous tracking of play. This necessitates that the player—or student—remain focused, attentive, and strategically minded in returning the ball to the opponent in order to win points during gameplay. Accordingly, cognitive and visual abilities emerge as critical components due to the game's inherent complexity and speed.

As such, the player or student must demonstrate attentiveness, quick reaction time, and effective movement toward the incoming ball to handle sudden situations during rallies and to maintain high-performance levels throughout the match. The importance of the research also lies in developing a scientific and objective indicator for coaches and instructors to assess the extent to which core cognitive and visual abilities contribute to skill performance in tennis. This allows for the preparation of scientifically structured educational and training units that integrate these abilities in accordance with their proportional impact, ultimately enhancing the level of technical performance.

The research problem is cantered on the fact that tennis is a fast-paced sport characterized by multiple stimuli that influence the flow of the game. Moreover, it is a strategy-based sport due to its reliance on open skills that vary according to numerous and diverse gameplay variables, all of which significantly affect both playing style and performance. The complexity of the game arises from the interplay of several factors that challenge the regulation of play, instruction, and training—among them: the opponent's movements, the speed of the ball, its direction, and its trajectory height. These variables collectively contribute to the difficulty in controlling performance in light of the sport's continuous development, which demands a high level of cognitive and visual capabilities.

Accordingly, the problem can be formulated through the following research questions:

1. Do cognitive abilities correlate with the performance of the forehand and backhand strokes in tennis among female students?
2. Do visual abilities correlate with the performance of the forehand and backhand strokes in tennis among female students?
3. To what extent do cognitive and visual abilities contribute to the performance of the forehand and backhand strokes in tennis among female students?

The objectives of the study were as follows:

1. To identify the percentage contribution of selected cognitive and visual abilities to the performance of the forehand and backhand strokes in tennis among the study sample.
2. To examine the relationship between certain cognitive and visual abilities and the skill performance of the forehand and backhand strokes among the study sample.
3. To determine the percentage contribution of specific cognitive and visual abilities to the skill performance of the forehand and backhand strokes in tennis among the study sample.

The research hypothesis stated: There are statistically significant differences between certain cognitive and visual abilities in the performance of the forehand and backhand strokes in tennis.

- **Human domain:** The research sample consisted of third-year female students for the academic year 2023–2024 from the College of Physical Education and Sport Sciences for Women.
- **Time domain:** The duration of the study extended from December 3, 2023, to April 25, 2024.
- **Spatial domain:** The study was conducted at the tennis court of the College of Physical Education and Sport Sciences for Women, University of Baghdad.

2. Methodology and procedures

The researchers used the descriptive method in the survey and correlation approach due to its suitability to the nature of the research problem.

2.1. Research population and sample

Defining the research population is a crucial stage, as noted by Obaid et al. (2024) since the nature of the research its hypotheses and its design determine the steps of implementation and the selection of tools such as the necessary tests. The research population consisted of third-year female students at the College of Physical Education and Sports Sciences for Women for the academic year 2023–2024, totaling 54 students. A random sampling method was used to select the research sample. Five students were selected for the pilot study while 30 students were chosen for the main experiment. The sample thus represented 64.81% of the total research population.

2.2. Instruments, tools, and equipment used in the research

To achieve the field research procedures and make use of the devices, tools and supporting resources Internet access, Arabic and foreign sources, expert survey form (Appendix 3) and (Appendix 4) recording form (Appendix 6) supporting work team (Appendix 2) 30 tennis rackets 30 official tennis balls adhesive tape, colored chalk, measuring tape, fabric pieces (1 meter in height and 12 meters in width) two tripod stands to hold the fabric, pens, and an Apple laptop computer.

2.3. Field research procedures

After reviewing the relevant sources references and studies related to the research topic, and following consultations with the researchers a questionnaire form (Appendix 3) was prepared to survey the opinions of experts and specialists (Appendix 1) in order to identify the most important mental and visual abilities specific to tennis. The questionnaire included a set of mental and visual abilities. After distributing the form to experts and specialists and collecting the data the results indicated the selection of three key abilities: (sensory-motor perception, attention, and depth perception).

2.4. Determination of ability tests

After reviewing the scientific sources related to tests and measurement as well as similar studies and with the assistance of experts and specialists in testing measurement and tennis the tests that received a 100% agreement rate were adopted. These tests were identified through a questionnaire form for mental and visual ability tests (Appendix 4) which was presented to the experts and specialists (Appendix 1).

Firstly: Sensory Motor Perception Test (Ouda, 2016)

Test Name: Test of Perception for the Ball's Landing Location in Forehand and Backhand Ground strokes.

Test Objective: To measure sensory-motor perceptual abilities related to the location and distance of the ball's landing in forehand and backhand ground strokes in tennis.

Used equipment: Includes a regulation tennis court, tennis racket, tennis balls, colored chalk, adhesive tape, measuring tape, registration form, pens, fabric pieces measuring 1 meter in height and 12 meters in width, two tripods with stands to fix the fabric, and an assistant to throw balls to the test subject

Test procedures: The test areas are divided as follows:

- The opposite side of the court is divided into seven (7) zones by drawing lines parallel to the baseline with a distance of 1.25 meters between each line.
- The fabric is fixed to the stands, and the stands are placed on both sides of the court outside the doubles sidelines and at a distance of 3 meters from the net inside the court, in such a way that the test subject has no visibility of the opposite side of the court.

2.5. *Performance method*

- The test is explained and a demonstration of the performance is given before administering it to the participants.
- Before starting the test, a warm-up period of no less than 5 minutes is performed on the court.
- The participant stands in the center of the court on the baseline and receives balls from the assistant, who throws them to the participant. Two practice attempts are performed before placing the fabric in front of the player to prepare for the actual test trials.
- The participant performs the test after looking at the opposite court for 20 seconds, then the fabric is raised in front of the player for the actual test performance.
- Each participant is given 10 attempts: 5 attempts for forehand ground strokes and 5 attempts for backhand ground strokes.

2.6. *Scoring*

- Each valid ball is awarded the score of the area where it lands, as shown in Fig. 1.
- Invalid balls (out of bounds or in the net) receive a score of zero.
- The attempt is repeated for balls that touch the net and land in the opposite court.
- Balls that land on the line between two areas are awarded the score of the higher zone.
- The highest score for one skill is 40 points and the lowest score is 0 points.
- If the score is for both skills, the highest score is 80 points.

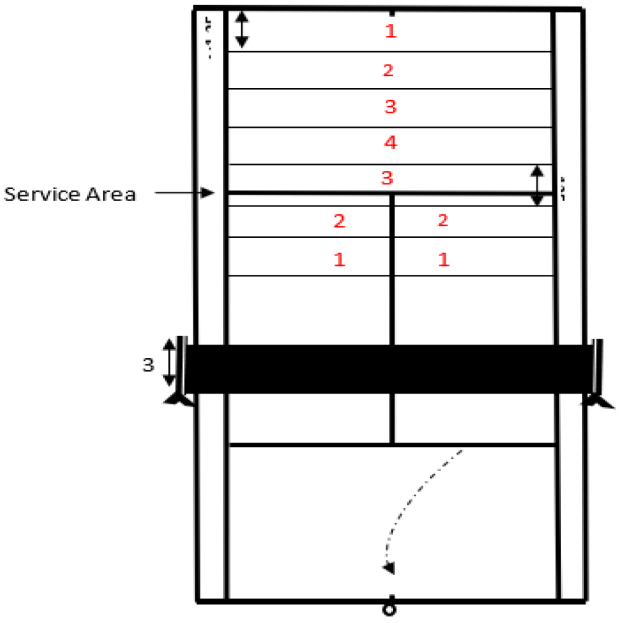

Fig. 1. Illustrates the court layout for the sensory motor perception test of forehand and backhand groundstrokes.

The Fig. 1 illustrates the court layout for the kinesthetic perception test of forehand and backhand groundstrokes. This setup is used to evaluate the player's ability to accurately direct strokes toward specific target zones on the court.

Purpose of this layout:The aim is to test the player's accuracy in directing strokes to designated target areas, and to assess the level of kinesthetic perception skills related to controlling the ball in terms of force, direction, and timing during motor performance.

Secondly: **Attention Test** Sports Library (2019).
Test Name: Bordon-Anfimov Test. (Appendix 5).

2.7. *Test Description:*

The test consists of a printed sheet of white paper containing (31) lines of Russian letters (which are similar to English letters). Each line contains (40) forty letters making the total number of letters in the sheet 1240. The letters in each line are arranged in groups, with each group consisting of (5) letters. These letters have been arranged in a sequential and standardized manner with care taken to ensure that their distribution is organized but not equal in order to prevent memorization

2.8. *Instructions and test application method*

The test is to be conducted in a quiet place. A pencil and a sample of the test are placed in front of the participant. After explaining the test instructions and

how to perform it the sample remains face down until the start command is given.

When the participant hears the command (Start) they flip the sample as the stopwatch starts and begin searching and striking through the letters (BC) marking them with a slash.

The participant should attempt to strike through as many of the letters as possible within the test duration. The test time is only one minute.

When the participant hears the word (Stop) they mark a vertical line next to the letters they have reached.

2.9. Method of correcting the test

Count the total number of items the participant reached during the one-minute test period (i.e., the total size of the visible section) denoted by the symbol (A).

Count the number of (BC) letters that the participant struck through in the developed section denoted by the symbol (C).

Count the number of letters that the participant mistakenly crossed out in the visible section denoted by the symbol (W).

Count the number of letters that the participant did not strike through (i.e., those that were missed in the strike rate in the visible section) denoted by the symbol (O).

The level of attention intensity of the participant is determined by the following formula:

$$A \times U = C - W / (C + O)$$

Thirdly: **Depth perception test**
Test Name: Visual Depth Perception Test

Objective of the Test:
To measure the depth perception of the participants.

2.10. Tools

Tennis court, rackets, tennis balls, colored adhesive tape. A rectangular area is drawn within the tennis court divided into five zones each measuring (30 × 30) cm and each zone is numbered.

2.11. Method of performance

The participant stands in the starting area holding the racket and performs a forehand stroke directing the ball to the zone corresponding to the number mentioned before hitting the ball. The participant continues hitting the ball to different zones without repeating any zone.

2.12. Scoring

1. The participant is given five balls, one for each zone.
2. If the ball lands within the designated zone (2) points are awarded.
3. If the ball touches the lines of the designated zone (1) point is awarded.
4. If the ball is outside the designated zone (0) points are awarded.
5. The maximum score for the test is (10) points.

Notes: The participant is not allowed to repeat a zone number.

2.13. Performance evaluation of the forehand and backhand strokes

To evaluate the performance of the forehand and backhand strokes in tennis among the students, the researchers relied on the scores assigned by the course instructors[1] during the first academic semester. The highest possible evaluation score was 10 points.

3. The pilot study

The researchers conducted the pilot study on Sunday December third two thousand twenty-three on a sample of five female students It is worth noting that the pilot sample was part of the research population but was excluded from the main experiment.

The purpose of conducting this pilot study was to

- Determine the time required for each test and the total duration for all tests
- Identify potential obstacles the researcher might face during the main experiment
- Ensure the functionality and reliability of the tools and equipment to be used in the tests
- Assess the suitability of the tests for the participant's level
- Evaluate the efficiency of the assisting work team
- Verify the scientific validity of the tests

3.1. Scientific foundations of the tests

3.1.1. First: Validity

To verify the validity of the proposed tests, the researchers assessed content validity by presenting the questionnaire form to a group of experts. This

[1] Course instructors: Prof. Dr. Warda Ali Abbas and Asst. Prof. Dr. Nazek Subhi.

Table 1. Shows the Reliability and Objectivity Coefficients of the Proposed Tests.

Tests	Reliability Coefficient	Sig	Objectivity Coefficient	Sig
Sensorimotor Perception	0.862	0.000	0.928	0.000
Attention	0.895	0.000	0.911	0.000
Visual Depth Perception	0.848	0.000	0.908	0.000

type of validity is often established through logical judgment regarding the presence or relevance of the targeted trait, in order to determine whether the proposed measurement tool effectively captures it or not.

3.1.2. Second: Reliability

To verify the reliability of the test which refers to the degree of accuracy with which the test measures the phenomenon under study the researchers employed the test-retest method. The simple correlation coefficient was calculated between the results of the two tests. The tests were repeated seven days after the initial pilot experiment, specifically on 10/12/2023. The results showed that all tests had a high reliability coefficient as illustrated in Table 1.

3.1.3. Third: Objectivity

To verify the objectivity of the proposed tests, the researchers utilized the scores given by the judges during the test-retest phase. The simple correlation coefficient between the judges' scores was calculated, and the results indicated that all tests demonstrated high objectivity as shown in Table 1.

The table shows the reliability coefficients and objectivity coefficients for the selected tests, along with their statistical significance (Sig).

- Reliability Coefficient: All values are high (above 0.80), indicating that the tests are reliable and produce consistent results over repeated applications.
- Objectivity Coefficient: Also high (approximately above 0.90), suggesting that the test results are evaluated in a standardized and unbiased manner.
- Statistical Significance (Sig = 0.000): Indicates that the results are statistically significant (values below 0.05 are typically considered significant), confirming the validity of the calculated coefficients.

The three tests (Kinesthetic Perception, Attention, and Visual Depth Perception) demonstrate high reliability and objectivity, and the results are statistically significant, making them suitable for use in measurement or evaluation in the intended field.

3.2. Main experiment

The main experiment was conducted on a sample of 30 female students on Sunday and Monday 17th and 18th of December 2023 with the assistance of the support team (Appendix 2). The sensor motor perception and attention tests were administered on Sunday at 10:00 AM while the visual depth perception test was administered on Monday at 10:00 AM. The tests were explained to the participants, including the procedure and a warm-up session, followed by the collective data recording in forms. The data was then prepared for statistical analysis

3.3. Statistical methods

The researchers used the SPSS statistical software to analyze the data. The following statistical measures were employed: mean, median, percentage, standard deviation, correlation coefficient, and contribution ratio.

4. Results and discussion

The statistical estimates for the investigated variables.

4.1. Presentation of results and discussion: Statistical estimates of the investigated variables.

Table 2 indicates that the test results achieved a normal distribution. This is evidenced by the standard error index, as its values across all tests fell within an acceptable range, indicating a good distribution of the sample participants. Additionally, the skewness

Table 2. Shows the Statistical Estimates for the Research Variables.

Variables	Arithmetic Mean	Standard Deviation	Standard Error	Skewness Coefficient
Sensorimotor Perception	54.83	1.567	0.554	0.325
Attention	117.54	8.956	3.166	0.850
Visual Depth Perception	6.27	0.948	0.444	0.374

Table 3. Shows the results of the correlation coefficients between cognitive and visual abilities and performance.

Variables	Calculated R Value with Performance	sig	Statistical Significance
Sensorimotor Perception	0.649	0.000	significant
Attention	0.677	0.000	significant
Visual Depth Perception	0.592	0.000	significant

coefficient values were all less than (±1), which suggests that the data distribution is approximately normal.

4.2. Presentation and discussion of the correlation results between cognitive and visual abilities and the performance of the forehand and backhand skills

Table 3 illustrates the correlation coefficients between cognitive and visual abilities and the performance of the forehand and backhand tennis strokes among female students. The results in Table 3 indicate a significant and positive correlation as evidenced by the sig values being less than 0.05.

The researchers believe that cognitive abilities are an essential factor in determining performance level due to their significant role in the execution of the forehand and backhand strokes in tennis. The students require perceptual motor awareness and attention during the execution of these skills as both perception and attention are cognitive abilities that play a crucial and effective role in skill performance. This aligns with the view of Al-Jabbar (2002) who stated that the cognitive abilities required by the player to acquire and master skills contribute to coordinating movements and conserving effort.

Hossam (1997) emphasized that a student must possess sensory-motor perception and good attention in order to produce appropriate motor behavior. Mental abilities such as attention sensory motor perception and decision making at the right moment play a significant role in the successful performance of both forehand and backhand strokes in tennis. These cognitive abilities contribute to faster thinking and better preparation for hitting the ball. Researchers argue that mastering forehand and backhand strokes in tennis requires a connection between aspects of attention and visual decision making. Furthermore, poor visual decision making negatively affects the perception and execution of these skills as it plays an active role in receiving images of performance and focusing attention on the motor aspects of skillful execution. Al-Bahi (1999) stated that the connection between aspects of attention and visual abilities constitutes one of the fundamental requirements for performance especially since motor performance is associated with the sharpness of attention which results in a proper reaction and correct motor response.

4.3. Presentation and discussion of the results regarding the contribution ratios of certain cognitive and visual abilities to the performance of forehand and backhand strokes in tennis

Table 4 shows the contribution percentage of cognitive and visual abilities in performing the forehand and backhand skills. The contribution percentage is considered good confirming the clear and significant effect of cognitive and visual abilities on performance. The importance of cognitive abilities in tennis is evident in controlling and managing actions to organize motor behavior which positively affects skill performance. Mousa (2004) emphasized that studies indicate that attention focus, mental imagery, and kinesthetic perception are correlated with athletic achievement and performance level in sports events. Moreover, the athlete's perception of the required variables for hitting the balls and where they land helps direct her to the effective areas.

Hassan and Radwan (2000) stated that a high-level athlete in terms of kinesthetic perception is more efficient than others in the process of motor memory which distinguishes performance with accuracy and fluidity. Fathi (2005) confirmed that the ability to activate visual and sensory perception requirements enhances the effectiveness of mental processes which play a role in skill performance and are an important part of the information processing system. Similarly, Abbas (2020) pointed out that the ability of high level players to perceive the required force to block the

Table 4. Shows the values of the regression coefficients for cognitive and visual abilities.

Variables	Coefficients		Correlation Coefficient	Calculated F-value
	Coefficient Nature	Coefficient Value		
Sensorimotor Perception	Stability	4.165	0.649	8.180
Attention	A	1.562	0.677	6.214
Visual Depth Perception	B	0.145	0.592	9.116

ball and anticipate its landing spot or redirect it to effective areas of the opponent's court, from a sensorimotor perception standpoint is more efficient than others in terms of motor memory which distinguishes performance by its accuracy and fluidity.

Furthermore, studies have shown that "biomechanical analyses indicate that forehand and backhand strokes in tennis heavily depend on mental and physical coordination as the interaction between motor memory and quick decision-making is what sets elite players apart" (Yin & Gou, 2024).

Bonato et al. (2020) emphasized that mental and visual training can significantly enhance stroke performance in tennis contributing to a tangible improvement in players' skills during competitive matches.

Hegazy et al. (2015) also confirmed that effective performance in tennis strokes relies on the coordination between mental and physical processes where both motor memory and quick decision making play a crucial role in achieving accuracy and efficiency.

Finally, research shows that motor memory for tennis strokes significantly affects the accuracy of executing forehand and backhand shots as it requires the ability to recall correct movements under fast and changing conditions (Deng et al., 2024).

5. Conclusions

1. The mental and visual abilities of the subjects play an active and positive role in the performance of the forehand and backhand strokes in tennis among female students.
2. The contribution rate of kinesthetic perception attention and depth perception was significant confirming their effectiveness in the results of the forehand and backhand stroke performance in tennis among female students.

6. Recommendations

1. Teachers should pay greater attention to enhancing students' cognitive and visual abilities during lessons.
2. A portion of the lesson should be dedicated to exercises that develop attention focus, mental imagery, perceptual motor awareness and visual concentration due to their effective role in improving skill performance outcomes.
3. A study should be conducted to explore the relationship between cognitive and visual abilities and other fundamental skills that have not yet been examined.
4. Future studies should include students from other colleges or universities to broaden the scope of the research.

Author's declaration

The authors formally declare that the content of this paper is the original work of themselves

Conflicts of interest

None We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Statistician

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Authors' contributions

Prof. Dr. Huda Shihab and Asst. Lect. Maryam Abdul Jabbar were responsible for drafting the manuscript, collecting and processing visual data, and conducting statistical analysis. They also coordinated the research process, compiled the reference list, reviewed the manuscript, and provided critical commentary.

The authors declare that there are no conflicts of interest related to this study.

All tables and figures included in this article are original works created by the authors.

All research contributions were made by the following scholars:

Prof. Dr. Huda Shihab, Asst. Lect. Maryam Abdul Jabbar, Asst. Prof. Dr. Wissam Dhahbi, and Prof. Dr. Fateh Hazar.

Ethical approval

Ethical approval for this study was obtained from [College of Physical Education and Sports Sciences for Women, University of Baghdad] on (1 /12 /2025).

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Appendix 1: The names of experts and specialists who were consulted

No	Name	Specialization	Workplace
1	Prof. Dr. Sahira Razzak	Psychology	College of Physical Education and Sports Sciences for Women
2	Prof. Dr. Intisar Owaid	Motor Learning	College of Physical Education and Sports Sciences for Women
3	Prof. Dr. Zahra Shahab	Tests and Measurement	College of Physical Education and Sports Sciences for Women
4	Prof. Dr. Suad Abdul Hussein	Rehabilitation	College of Physical Education and Sports Sciences for Women
5	Prof. Dr. Luma Samir	Motor Learning	College of Physical Education and Sports Sciences for Women
6	Prof. Dr. Warda Ali	Tests and Measurement Racket Sports	College of Physical Education and Sports Sciences for Women
7	Prof. Dr. Abeer Dakhil	Training Physiology / Racket Sports	College of Physical Education and Sports Sciences for Women
8	Asst. Prof. Dr. Naima Zidan	Tests and Measurement	College of Physical Education and Sports Sciences for Women
9	Lect. Dr. Nazik Sobhi	Racket Sports	College of Physical Education and Sports Sciences for Women
10	Lect. Dr. Raghda Fouad	Racket Sports	College of Physical Education and Sports Sciences for Women

Appendix 2: Names of the supporting team

No	Name	Workplace
1	Prof. Dr. Warda Ali Abbas	Subject Instructor / College of Physical Education and Sports Sciences for Women
2	Asst. Lect. Ghufran Basheer Hamza	College of Physical Education and Sports Sciences for Women
3	Asst. Lect. Sara Hikmat	College of Physical Education and Sports Sciences for Women

Appendix 3: Expert and specialist opinion survey to identify cognitive and visual abilities relevant to the research

Dear Professor . . ..
Greetings. . .. .

I am planning to conduct the research titled "The Contribution of Certain Cognitive and Visual Abilities in the Performance of Forehand and Backhand Skills in Tennis." As you are an expert and specialist in this field we kindly request your valuable opinion regarding the selection of cognitive and visual abilities that are suitable for this research. Please mark (✓) next to the test you consider appropriate or feel free to suggest other abilities that might fit the requirements of the research topic.

We appreciate your cooperation.

Academic Title:
Specialization:
Signature:
Date:

Abilities	Cognitive and Visual Abilities	Suitable	Not Suitable
Cognitive	Attention		
	Sensorimotor Perception		
	Reaction		
	Memory		
Visual	Visual Depth Perception		
	Visual Search		
	Visual Focus		

Appendix 4: Expert and Specialist Opinion Questionnaire to identify cognitive and visual ability tests that can be used in the research

Dear Professor . . ..
Greeting

I am planning to conduct the research titled "The Contribution of Certain Cognitive and Visual Abilities in the Performance of Forehand and Backhand Skills in Tennis." As you are an expert and specialist in this field we kindly request your valuable opinion regarding the selection of cognitive and visual abilities that are suitable for this research. Please mark (✓) next to the test you consider appropriate or by suggesting other abilities that align with the requirements of the research topic. We appreciate your cooperation.

Academic Title:
Specialization:
Signature:
Date:

Abilities	Cognitive and Visual Ability Tests		Valid	Not Valid
Cognitive	Attention	1. Bourdon-Anfimov Test (Modified) for Attention 2. Landolt Test for Measuring Attention Stability		
	Sensorimotor Perception	1. Perception Test for Ball Landing in Forehand and Backhand Ground strokes 2. Sensorimotor Test with Throwing Distance		
Visual	Depth Perception	1. Visual Depth Perception 2. Sensorimotor Perception with Fixed Ball Passing Distance to a Specific Area		

Appendix 5: Bourdon–Anfimov Test Form: Attention Sharpness

Name:
Age:
Type of Sport Practiced:
Club:
Years of Experience in the Sport:

BCXH KXCB NAE KCBHX BHCX BCXK EAN KBCHX KCXB BXCH XBCHK NEA BCXK BXCH NAE KCXB BXCK BXHC BCXH KHCBX EAN BCXN KCXB KHBCX BCXK BXCH EAN BHCX BXCH BXCHK KCXB BCXK NEA BXCH KBCHX BXCN BCXB BCXH BXCK BCXH BCXH KHBCX BCXH BHCX BXCH KCBHX KCXB EAN BCXK EAN KBCHX BXCH KCXB NAE BCXH XBCHK EAN BCXK NAE KHCBX NEA BCXK KHBCX KCXB BXCK NAE KCBHX EAN BCXH XBCHK KCXB BXCH KXCB KHBCX NAE BCXH EAN BXCH KHBCX BXCK EAN BCXK NEA KCBHX EAN KHBCX XBCHK KBCHX EAN BCXB KHCBX NAE KCXB NAE KBCHX BXCH EAN KBCHX KCBHX EAN KXCB EAN KCBHX BXCH KCXB NAE BCXB BCXK BXCH KBCHX KHCBX BXHC NAE XBCHK BCXK BXCK BXCH NAE BCXH KCBX EAN BHCX BXCH BCXB KHBCX NAE BCXK KCXB XBCHK BXCH BXCK KCBX EAN BCXK BCXH KCXB BCXH KHCBX BXCH BCXK HCXK KHBCX BCXH BXCH BMCX KCBHX EAN KCXB EAN BCXH XBCHK BCXK KCXB NAE BXCH KHCBX EAN BCXK KBCHX NAE NAE KHBCX BCXK KCXB NAE BCXH KCBHX BXCH EAN XBCHK KHCBX KCXB BXCH KXCB BXCK KHCBX BXHC ENA BCXH NAE BCXK EAN KCBHX KBCHX EAN BCXH NAE XBCHK KHCBX EAN BXCH KBCHX KCXB ENA KHCBX EAN NAE KBCHX NAE KCBHX KCXB BXCH KBCHX EAN BCXK BHCX KCBHX NAE KCXB BCXH KHCBX BCXH BXHC BXCK KCXB NAE BXCH BCXK NEA XBCHK EAN BXCH BCXK KHBCX KCXB BCXH EAN XBCHK BXCH BHCX BCXK BXCK BCXH KCXB BXCH KHCBX BCXH NAE BCXK KCXB ENA BCXK EAN KCXB KCBHX BXCH BHCX BCXK KHBCX BCXH KHCBX NAE BCXK EAN XBCHK BCXH NAE KCXB BXHC KBCHX XBCHK BCXH EAN KCBHX NEA BXCH KCXB KHCBX BCXK NAE BXCK KHBCX BXHC ENA BCXH NAE KHCBX KXCB BXCH KCXB BCXH EAN KBCHX XBCHK KHBCX EAN KCBHX NAE BCKX EAN NAE KCBHX KBCHX EAN BXCH KBCHX NAE KCXB ENA KHCBX KBCHX BXCH BCXK BCXH NAE KCXB BXCH KCBHX EAN KXCB

Appendix 6: Data Collection Form

No	Student Name	Attention Test	Sensorimotor Perception Test	Visual Depth Perception Test	Forehand Skill	Backhand Skill
1						
2						
3						
4						
5						
6						
7						
8						
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14						
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