



Construction and Standardization a Test to Measure Motor Response Speed Based on Auditory Stimuli and Performance Response Analysis Among Fourth-Stage Students at Kirkuk University

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Abstract

This study aims to develop and standardize a test to measure motor response speed using auditory stimuli colors among fourth-year students at College of Physical Education and Sports Sciences, Kirkuk University. The researcher also analyzed characteristics of test, descriptive survey method was used, as it is suitable for nature of the research in developing and standardizing tests and measuring their scientific properties. This method relies on describing and analyzing phenomenon as it exists in reality without direct intervention, research population consisted of 130 students from College of Physical Education and Sports Sciences during academic year 2024-2025. These students were divided into a construction sample of 30 students for initial experiment and test development, and a standardization sample of 100 students to determine test's scientific properties. Statistical Package for Social Sciences SPSS was used to process data and extract results, including mean, standard deviation, and correlation coefficients, to test validity and reliability of test and analyze its results. research concluded that designed test is highly effective in measuring motor response speed and ability to differentiate between students' levels. This indicates that it possesses appropriate levels of validity, reliability, and suitability for use. The researcher recommends adopting test in evaluating motor response speed in selection and motor assessment processes. Further studies on different samples and age groups are needed to enhance possibility of generalizing and developing it.

Keywords: Construction and Standardization a Test, Motor Response, Auditory Stimuli, Performance Response Analysis.

INTRODUCTION

Testing and measurement occupy a fundamental place in field of physical education and sports science as scientific means by which level of physical, skill, and motor abilities of individuals is accurately and objectively identified. Reliance on scientific methods in measurement contributes to reducing personal assessments and individual impressions. It provides quantitative data that can be used in evaluation and decision-making process, and tests are practical tool for measurement. These are built on scientific foundations that ensure their accuracy, objectivity, and usability in comparing individual or tracking their development over time, importance of this field is highlighted by its active role in mathematical selection and classification processes. Evaluating educational and training programs, and diagnosing performance levels In addition to be

a fundamental tool for setting standards and levels by which competence of learners or athletes can be judged, with rapid scientific development in field of measurement and evaluation, need arose to build more accurate and objective tests based on statistical and scientific foundations in their preparation and standardization stages, thus ensuring a higher level of credibility in their results.

The development and standardization of modern tests are important for obtaining valid, reliable, and objective measurements that are appropriate for the characteristics of the target population (American Educational Research Association et al., 2014; Ghani, 2016). This increases validity and reliability of results". Standardization allows test scores to be interpreted using appropriate criteria and normative values, thereby facilitating the classification of individuals according to their performance levels (American Educational Research Association et al., 2014; Ghani, 2016). Whether in selection, guidance, or evaluation processes, it also contributes to development of educational and training programs by providing realistic and reliable data for identifying strengths and weaknesses of learners or players.

Need increases for development of standardized tests that are appropriate to nature of motor abilities to be measured. Among these is speed of motor response, which is considered one of important and influential abilities in athletic performance, speed of motor response is one of basic motor abilities in athletic performance, as it plays an important role in speed of an individual's reaction to different stimuli during motor performance. It requires a high level of attention, focus, and ability to make and execute appropriate motor decisions in the shortest possible time, importance of rapid motor response is highlighted in various sports and physical activities, as it is linked to an individual's ability to change direction and adapt to changing situations quickly and efficiently.

This positively impacts quality and accuracy of performance. Because it represents an important element in achieving appropriate response to sudden stimuli during performance, response requires high neuromuscular coordination and speed in processing sensory information and converting it into an effective motor response, motor response speed can be understood as the time interval between the presentation of a stimulus and the initiation of the corresponding motor response, reflecting the

processes involved in receiving and processing sensory information (Qaddouri, 2013). That is, time an individual needs from moment stimulus appears until required movement begins to be executed. This period reflects efficiency of nervous system in receiving and processing sensory information quickly. It also indicates individual's ability to convert nerve signals into an appropriate motor response in shortest possible time. Saadallah (2015, p. 152) states that "Speed of motor response is ability to perform a rapid movement directed towards a specific stimulus in a precise and organized manner. " This ability includes total time period from moment stimulus appears or enters individual's perceptual field Passing through stages of dynamic anticipation and decision-making, then reaction time And finally, time it takes to execute movement until required response is completed”.

Thus, it represents an integrated outcome of several neurological and motor processes working together to ensure speed and efficiency of response in different situations . Recent research has also demonstrated the development of motor reaction-time tests involving auditory stimuli and directional movement. Khamis and Ibrahim (2026), for example, developed an electronic test for measuring complex motor reaction time using combined auditory and visual stimuli, demonstrating the potential of stimulus-based testing for objectively assessing rapid motor responses. However, their test combined auditory and visual stimuli and required an electronic device, whereas the present study focuses specifically on multidirectional auditory stimuli using a simple field-based testing procedure.

They are received by auditory system, which converts sound waves into nerve signals that are interpreted in brain. These stimuli are characterized by their ability to elicit a response at a high speed. Because it is transmitted directly to nervous system and contributes to activating processes of attention and concentration It plays an important role in regulating an individual's motor behavior. Especially in situations that require an immediate and rapid response, and help to guide movement and adjust its timing appropriately . From above, importance of research becomes clear, as it seeks to build and standardize a scientific test to measure speed of motor response using auditory stimuli in an accurate and objective manner. This ensures provision of a reliable and trustworthy measurement tool for assessing individuals' levels and contributes to enriching field of sports testing and measurement by offering a modern

test that is appropriate to nature of motor abilities under study.

Motor response speed is an important component of sports performance because athletes are frequently required to perceive external stimuli and respond rapidly under changing conditions. Previous research by Kweir (2024) demonstrated that motor response speed can be developed through sport-specific exercises designed to expose athletes to rapidly changing tactical situations. This supports the importance of assessing motor response speed as an essential component of motor performance, particularly in situations requiring rapid perception and movement.

Despite numerous tests used in this field However, some of these tests are not compatible with nature of educational environment or characteristics of target group. In addition to scarcity of modern tests based on sound scientific principles in construction and standardization In particular, those that use auditory stimuli as a means of measuring motor response speed more accurately and objectively, based on researcher's field observations and research. A real need arose to develop a standardized test that could be relied upon to measure this ability scientifically and accurately. This contributes to providing an objective measurement tool that aids in diagnosis, evaluation, and decision-making processes in sports field, research problem is defined by following question : Is it possible to develop and standardize a test to measure motor response speed using auditory stimuli among fourth-year students at College of Physical Education and Sports Sciences – Kirkuk University?

Research objectives developing a test to measure speed of motor response using auditory stimuli among fourth-year students at College of Physical Education and Sports Sciences - Kirkuk University. Standardizing proposed test and verifying its validity according to scientific principles of measurement and testing. Analysis of test's characteristics in terms of validity, reliability, objectivity, and its effectiveness in distinguishing between individuals. Research hypotheses motor response speed test using auditory stimuli has a good degree of validity, test has a good degree of reliability when applied to members of sample, test has a suitable ability to differentiate between different performance levels of students.

RESEARCH METHODOLOGY

The researcher used descriptive survey method because it suited nature of research in constructing and standardizing tests and measuring their scientific

properties. This approach relies on describing and analyzing phenomenon as it actually is, without direct intervention, research population was determined purposively from students of College of Physical Education and Sports Sciences Kirkuk University for academic year (2024–2025), numbering (130) students. A construction sample consisting of (30) students was chosen randomly by lottery for purpose of initial experiment and building test, and a standardization sample consisting of (100) students was chosen to extract scientific characteristics of test , as shown in Table (1).

Table 1. Shows distribution of sample

Sample	Number	Objective
Exploratory experiment	10	Check clarity of instructions and detect errors
Construction (Basic Experiment)	20	Analysis of test items and approval of final version
Standardization	100	Extracting standards and building standard levels
Total	130	

Design of a motor response speed test

To check validity of search tool test was presented to a group of (5) experts and specialists in field of sports testing and measurement. This was done to gather their opinions on its suitability for research objectives and study sample. Their feedback was taken into account, and necessary modifications were made to some of test items and procedures. This contributed to enhancing validity, objectivity, and applicability of instrument in current research.

The test, Testing Motor Response Speed Based on Multidirectional Auditory Stimuli, aims to measure motor response speed by recording the time taken by a player to respond to an auditory stimulus. The equipment required includes five numbered cones, a stopwatch, a measuring tape, and a registration form. During the test, the player stands at the starting point and, upon hearing a number called by the tester, immediately moves toward the corresponding numbered cone before returning to the starting point. An attempt is considered valid only if the player moves in the correct direction toward the designated cone. Any attempt involving an incorrect direction is cancelled. Each player is given three attempts, and the best performance is determined by recording the lowest time achieved. To ensure test reliability and fairness, the

numbers must be called randomly, performance conditions must be standardized for all players, and no advance warning of the auditory stimulus should be given.

Pilot study

Before actual application of test began, the researcher conducted a pilot experiment on Monday, October 14, 2024, on a sample of (10) fourth-stage students from outside main research sample, with aim of identifying clarity of test instructions and ease of understanding them by test takers, and to ensure possibility of applying test practically without difficulties or obstacles, as well as to verify suitability of performance procedures, method of recording, and time taken to accurately implement test.

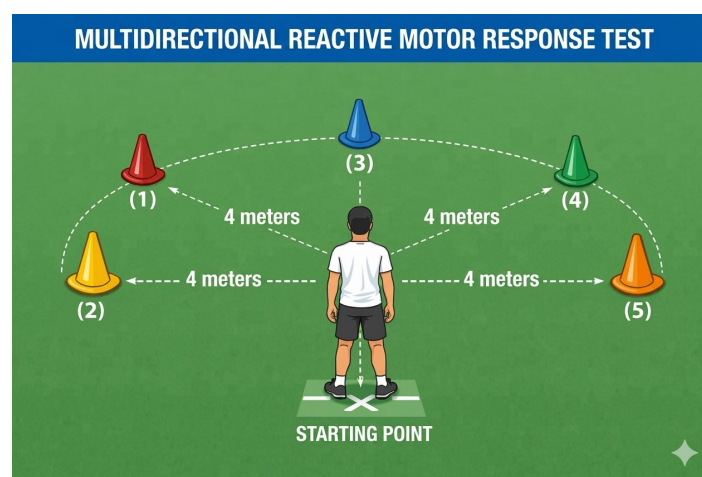


Figure 1. Motor response speed test

Applying test to a construction sample

After completion of pilot study test was administered to a sample of (20) fourth-year students from outside main research sample. This was on Monday, October 14, 2024, for purpose of finalizing test. and initial analysis of its results And to ensure its scientific properties such as validity, reliability, and ability to differentiate between members of sample This contributed to adoption of final version of test before moving to standardization stage.

Scientific Foundations of Test

Test validity: Test's validity was verified through face validity and content validity. test, in its initial form, was presented to a group of (5) experts and specialists in field of physical education and sports science , who approved test's suitability for measuring motor response speed. After making some minor adjustments Therefore, test is considered valid for measuring what it was designed to measure.

Test reliability: Reliability coefficient was calculated using test-retest method,

where test was administered to a sample of (20) students and then re-administered after (7) days on Monday, October 21, 2024, under same conditions, correlation coefficient between two applications was calculated using Pearson's correlation coefficient. reliability coefficient was (0.85), which is a high value indicating that test has a good degree of reliability.

Test objectivity: Objectivity of test was verified by using more than one referee to record time for same performance and then calculating correlation coefficient between referees' scores, results showed a high correlation, indicating that test has a high degree of objectivity.

Standardization of motor response speed test according to multidirectional auditory stimuli

The test in its final form, was applied to a standardization sample of (100) fourth-stage students on Monday and Tuesday, November 4-5, 2024, for purpose of extracting statistical criteria and building standard levels through which students' scores in motor response speed test can be interpreted according to multidirectional auditory stimuli.

Table 2. Shows the highest and lowest values for standardization sample

Index	Value (seconds)
Highest value (slowest time)	4.88
Lowest value (fastest time)	2.05
Range	2.83

Table (2) shows that highest value for motor response time was (4.88) seconds, while lowest value was (2.05) seconds, with a range of (2.83) seconds, which indicates a clear difference in response levels among sample members.

Table 3. Frequency distribution of time taken by the two test subjects

Time categories (Sec.)	Repetition	Percentage
2.05 – 2.50	12	12%
2.51 – 3.00	20	20%
3.01 – 3.50	28	28%
3.51 – 4.00	22	22%
4.01 – 4.50	12	12%
4.51 – 4.88	6	6%
Total	100	100%

Frequency distribution of motor response speed test scores was adopted for standardization sample of (100) students, results showed a clear variation in

performance scores among sample members, as largest percentage of students were concentrated within time range (3.01 – 3.50) seconds, with a percentage of (28%), which indicates that most of sample members have an average performance level in motor response speed, while the lower time ranges (2.05 – 2.50) recorded a percentage of (12%), which represents a high performance level, while percentages gradually decreased in higher time ranges, reaching range (4.51 – 4.88) seconds with a percentage of (6%), which reflects a weakness in motor response speed in this group, which indicates that distribution of scores took a form close to normal distribution, which enhances validity of test in standardization and building standard levels.

Table 4. Shows standard and percentile scores for motor response speed test.

Percentile	T-score	Time (Sec.)
99	75	2.05
90	68	2.50
75	60	3.00
50	50	3.45
35	42	3.80
15	34	4.20
1	25	4.88

The raw scores for motor response speed test were converted into standardized scores (T-score) and percentile scores based on statistical distribution of standardization sample, in order to build accurate standard levels that contribute to interpreting performance results in a scientific and objective manner.

Statistical methods

SPSS statistical package to extract and analyze the results including mean, standard deviation, Percentage, Frequency distribution, Pearson's correlation coefficient for determining reliability.

RESULTS AND DISCUSSING

Presenting and discussing results

Table 5. Descriptive statistics for standardization sample based on mean and standard deviation

Index	Value (Sec.)
Mean	3.45
Standard deviation	0.72
Sample size	100

Table (4) shows basic statistical values of standardization sample, as arithmetic mean reached (3.45) seconds, while standard deviation reached (0.72) seconds, which indicates a relative homogeneity in performance of sample members with an acceptable variance that serves purposes of standardization.

Table 6. Standard Levels for Motor Response Speed Test

Level	Time span (Sec.)	Interpretation
Excellent	2.05 – 2.50	Very high response speed
Very good	2.51 – 3.00	High response speed
Good	3.01 – 3.50	Average response speed
Middle	3.51 – 4.20	Below average response speed
Weak	4.21 – 4.88	Slow response time

Standard levels for motor response speed test were constructed based on range of raw scores of standardization sample, results were divided into five standard levels (excellent, very good, good, average, poor) in order to facilitate interpretation of student results and to determine their performance level accurately and objectively .

DISCUSSION

Results of current research reveal a clear variation in levels of motor response speed among standardization sample. Statistical values showed a disparity in response time among students, with scores ranging from high to low levels. This reflects individual differences in motor abilities related to speed of neural processing and response to auditory stimuli. The researcher attributes this variation to differences in level of neuromuscular coordination among students, as well as individual differences in speed of nerve signal transmission and response to external stimuli. Motor response speed is an ability that depends primarily on speed of sensory perception and motor decision-making in a short time, fact that most of sample fell within average level indicates that students possess an acceptable level of response speed, but it does not reach level of high performance. This is attributed to limited exposure to exercises that rely on multidirectional stimuli and develop response speed under varying conditions.

These results are consistent with what Magill & Anderson (2017) indicated "Speed of motor response is closely related to sensory perception, neural processing, and motor decision-making processes." Training with diverse stimuli contributes to improving speed of motor performance, and this is also consistent with what was

mentioned. Schmidt & Lee (2019) state that developing motor skills based on rapid response requires training environments that simulate real-life situations and offer multiple stimuli, leading to improved response time and reduced motor hesitation among learners, emergence of a small group of students among the high-achieving students indicates presence of individuals with exceptional motor skills.

This reflects natural individual differences in physical and motor abilities among students, as indicated by (Abd, O. M. (2024)) that "Motor performance is greatly affected by individual differences in cognitive and motor abilities". Based on above, the researcher believes that results do not only reflect speed of motor response among students. Rather, it emphasizes importance of using tests based on multidirectional auditory stimuli to accurately detect individual differences. This contributes to guiding training process scientifically towards improving speed of motor response and developing overall motor performance.

CONCLUSIONS

A valid scientific test was constructed to measure speed of motor response to multidirectional auditory stimuli, test demonstrated a good ability to differentiate between different performance levels among research sample. It was found that most of individuals in standardization sample possessed an average level of motor response speed, clear variation in motor response time among sample members reflects individual differences in motor abilities, standardization results proved possibility of adopting test in objectively and accurately assessing speed of motor response.

It is recommended to adopt a motor response speed test based on multidirectional auditory stimuli in measuring motor abilities. Incorporating special exercises based on auditory and multidirectional stimuli into training programs to develop motor response speed. Attention should be paid to developing neuromuscular abilities because of their direct role in improving speed of motor response. Using current test as an assessment tool in future studies on different age groups and sports. Conducting similar studies to develop other tests to measure motor abilities related to sensory perception and decision-making.

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