



## The Effect of Physical Exercises with Auditory Stimuli on Motor Response Speed and Improving Certain Aspects of Attention Among School Students

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### Abstract

The research aimed to identify the effect of physical exercises with sequential auditory stimuli on raising the level of motor response speed among school students aged 9-11 years. The researcher employed the experimental method using a one-group pre-test/post-test design due to its suitability for the nature of the research. The research population was determined as primary school students (ages 9-11) in schools affiliated with the General Directorate of Education of Baghdad Karkh Second, for the academic year (2024-2025). After presenting, analyzing, and discussing the results, the researcher concluded that the use of physical exercises accompanied by sequential auditory stimuli has a positive and effective impact on developing the motor response speed of school students (9-11 years). There is a close relationship between physical training based on reaction and the development of attention aspects (concentration, acuity, stability), as the program led to a noticeable improvement in the mental processes accompanying performance. The researcher recommends the necessity of adopting exercises that rely on variable auditory and visual stimuli within physical education curricula in primary schools, and not merely relying on static, stereotypical exercises.

**Keywords:** Motor Response Speed, Aspects of Attention, School Students.

### 1. Introduction

Physical fitness is considered one of the essential components of an individual's health. Improving the level of health-related physical fitness is one of the most important goals of physical education due to its positive association with many vital areas, enabling the individual to perform life requirements and functions optimally. This is due to its link to personal health and posture; therefore, developed countries work to develop it among members of society, especially in early age stages, particularly primary school stages. It is one of the important dimensions in comprehensive fitness, which in turn includes physical, health, emotional, social, and mental aspects, as well as physical growth.

In the field of academic achievement, studies have proven the existence of a direct relationship between intelligence and elements of physical fitness such as balance, agility, accuracy, and response. Furthermore, it contributes to developing the individual socially, which is a fundamental factor accompanying an individual's growth, because fitness allows the individual to acquire social experiences that help form their personality. It is also indicated that it works to ensure freedom from various organic and functional diseases and the proper functioning of body organs, with the individual's ability to control their body and withstand arduous work for a long time without fatigue. It has become a basic requirement for the individual in facing the danger resulting from lack of movement, which leads to the spread of many diseases such as diabetes, heart disease, blood pressure, respiratory diseases, and kidney diseases, and the accompanying aches and pains. Physical fitness has become a goal to achieve and develop human health for a better life.

The significance of the research lies in the fact that physical fitness and its basic elements are the cornerstone for all sports activity practitioners, whether for sports specialization or personal health. It is necessary to pay attention to this aspect through the use of physical and cognitive exercises to raise the level of motor response speed and develop mental processes by raising the level of certain aspects of attention, targeting beginner age



groups represented by school students, for the purpose of enhancing mental processes of perception, movement speed, and attention towards stimuli that may require rapid responses.

## 1-2 Research Problem

Through the researcher's work in the field of training, teaching, and supervision, and observing students during application, a lack of comprehension and attention was noticed among some students in schools, as well as a weakness in physical and motor capabilities in performance in general. This hinders the process of skillful performance. Therefore, the researcher decided to use certain auditory stimuli, focusing on the speed of motor responses and attention to those stimuli, by applying these exercises to a sample of primary school students aged 9-11 years.

## 1-3 Research Objectives

- To identify the effect of physical exercises with sequential auditory stimuli on raising the level of motor response speed among school students aged 9-11 years.
- To identify the effect of physical exercises with sequential stimuli on raising the level of certain aspects of attention among school students aged 9-11 years.

## 2. Methodology

### 2-1 Research Method

The researcher used the experimental method with a one-group pre-test/post-test design due to its suitability for the nature of the research (Hammood et al., 2024; Mohammed et al., 2025; Omar et al., 2025).

### 2-2 Research Population and Sample

The research population was determined as primary school students (ages 9-11) in schools affiliated with the General Directorate of Education of Baghdad Karkh Second, for the academic year (2024-2025).

The research sample was selected deliberately, consisting of (20) students from the research population who do not represent school teams and do not engage in any sports activity in the school class. Table (1) shows the characteristics of the sample in terms of height, weight, and age.

Table (1) Characteristics of the study sample in terms of height, weight, and age

No.	Variable	Mean	Standard Deviation
1	Height / cm	115	1.86
2	Weight / kg	35	1.23
3	Age / year	10	0.93

### 2-3 The Program

The researcher prepared a program aimed at developing motor response speed and developing aspects of attention. It is applied at a rate of three training units per week, with a training unit duration of 35 minutes, extending for eight weeks beginning with the second semester of the academic year 2024-2025. On the first day, the researcher performed the test, and the same tests were repeated on the last day of the program implementation for the post-measurement.

### 2-4 Tests Used in the Research

#### 2-4-1 Motor Response Speed Test

**Name of the test:** Saqr Test.

**Purpose:** To measure the motor response time of the visual stimulus. (Note: The text here mentions the visual image of the device's mechanism, although the training uses audio.)

**Method of Action:** The applicant stands in front of the device and to the side at an approximate distance (30-40 cm). When a beep or command is heard from the lab, the requester moves to pass the device and turns off the optical sensor, which will send an optical signal to one of four colors (lights). The requester must tap that

color using the stop button based on the target color mounted on the cone and then return to the front of the device. The interpretation is repeated six times, calculating the time of each iteration separately using an electronic timer on the device that starts counting electronically from the time the command is given and stops when the cone is touched. The motor response time of each examinee is extracted by taking the best attempt time of the three attempts. Note that the distance between the device and the cones, and between one cone and another, is (2) meters.

**Performance conditions:** The applicant stands in front of the machine and focuses his attention on the person who will do the test and who will give the start order.

The lab records the time of each tap to extract the time it takes in 6 taps.

The test is repeated only if the examinee is injured or falls after a sufficient period of rest.

**Method of registration:** The contact time (6) is calculated individually and the best time is taken to try.



Figure 1: Illustrates the Motor Response Speed Device

## 2-4-2 Tests for Aspects of Attention

### 2-4-2-1 Attention Acuity Test:

- **Instructions:**

1. With the word "Start," the player turns over the test form at the moment the watch is started and begins crossing out the number (47).
2. The test time is one minute only.

- **Correction and Scoring Method:**

1. Count the total number of digits the examinee reached during the one minute of the test, i.e., the Total Volume of the viewed part, symbolized by (A).
2. Count the number of (47) digits that the examinee crossed out in the viewed part, symbolized by (C), extracted using the test key (image attached in Appendix 2).
3. Count the number of omitted digits that the examinee did not cross out (i.e., missed from the crossing rate in the viewed part), symbolized by (O).
4. Count the number of digits the examinee crossed out by mistake in the viewed part, symbolized by (W).
5. The level of attention acuity for the examinee is extracted using the following formula:

$$\text{Attention Acuity (U1)} = A \times \frac{C - W}{C + O}$$

- **Note:** The higher the acuity result, the higher the level of acuity for the players (Hussein & Mohammed, 1999, p. 195).

### 2-4-2-2 Attention Concentration Test:

- **Instructions and Tools:**

1. The performance system is the same method used in measuring attention acuity, but with the presence of a (Metronome-Flasher) device as shown in Figure (6), which gives (60) sound beats and (12) light flashes per minute (i.e., a sound beat every second with a light flash every 5 seconds).
2. The number chosen for this test is (97).
3. The test time is one minute.

- **Correction and Scoring Method:**

1. The same equation used in attention acuity is used in concentration.
2. The net productivity of work in attention acuity is symbolized by (U1), i.e., without a stimulus.
3. The net productivity in concentration (i.e., acuity with the presence of a stimulus) is symbolized by (U2).
4. Attention concentration is extracted in the final result via the following formula:

$$K = U1 - U2$$

*Attention Concentration = Test without stimulus – Test with stimulus*

- **Note:** The lower the significance (the result), the higher the level of attention concentration; meaning, the smaller the final value of attention concentration, the higher the concentration, and vice versa. That is, the closer (U1) is to (U2), the better the concentration (Hussein & Mohammed, 1999, p. 195).

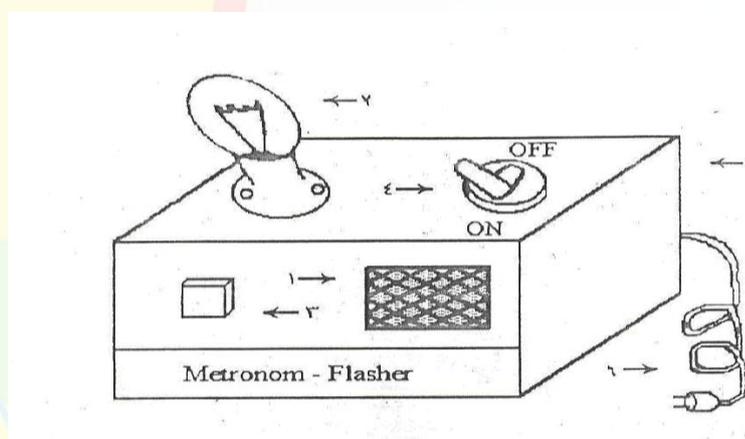


Figure 2: Metronome Flasher Device for Measuring Attention Concentration

Device designed by Prof. Dr. Wadih Yassin Al-Tikriti, used in Master's theses by Mohammed Haider Suleiman, Sabhan Mahmoud Al-Zuhairi, and Abdul Moneim Abu Tabanja. A similar device was used by researcher Amir Hanna Marqos (1994).

### 2-4-2-3 Attention Stability Test

- **Instructions:**

- The performance system is the same method used in measuring attention acuity.
- The number chosen for this test is (92).
- The test time is two minutes.

- **Correction and Scoring Method:**

- The net productivity of attention stability is extracted according to the following formula:

$$S = \frac{C - W}{C + O}$$



- **Note:** The higher the attention stability result, the higher the level of stability for the player (Hussein & Mohammed, 1999, p. 195).

## 2-5 Pilot Study:

Before starting the implementation of the main experiment, the researchers conducted a pilot study on (11/2/2025) on a sample consisting of (4) students selected randomly from the research population and outside the main sample. The aim of this experiment was:

1. To ensure the validity and efficiency of the (Saqr) device for measuring motor response speed.
2. To ensure the clarity of instructions for attention aspects tests (Bourdon-Anfimov) and the students' understanding of the method of crossing out numbers.
3. To know the time taken to execute tests for each student to organize time in the main experiment.
4. To diagnose obstacles and negatives that researchers might face during field work to avoid them.

The results of the pilot study showed the validity of the devices and tools and the suitability of the tests for the age group of the sample. Thus, the researchers became ready to start the main experiment.

## 2-6 Main Experiment:

The field experiment procedures included the following stages:

### 2-6-1 Pre-tests:

Pre-tests were conducted for the research sample of (20) students before the start of the program, on 16/2/2025.

The following variables were measured:

- Measurements of height, weight, and age (for homogeneity).
- Motor response speed test (Saqr test) (Al-Alwani & Ali, 2023; Hummadi et al., 2024).
- Tests for aspects of attention (Concentration, Acuity, Stability) (Adham Ali et al., 2022; Saeed et al., 2024).

The researchers ensured the stabilization of test conditions in terms of place, time, and tools used to ensure equal opportunities in the post-tests.

### 2-6-2 Application of the Training Program:

The proposed training program, including physical exercises with auditory stimuli, was applied to the experimental sample members for the period from 19/2/2025 to 16/4/2025. The implementation of the program took (8) weeks with (3) training units per week. The duration of the training unit was (35) minutes. Gradual increase in training load was observed to suit the age group (9-11 years).

### 2-6-3 Post-tests:

After completing the application of the training program, post-tests were conducted on 20/4/2025 on the same sample and under the same conditions and procedures followed in the pre-tests, for the purpose of obtaining data and processing it statistically to determine differences.

### Statistical Means:

For the purpose of processing the obtained data, the researchers used the Statistical Package for the Social Sciences (SPSS), version (V.26). The following statistical laws were adopted: Arithmetic Mean, Standard Deviation, Paired Samples T-Test, Percentage (Abdullateef AbdulJabbar et al., 2025; Ali et al., 2024; Fayyad et al., 2025; Khalaf et al., 2025).

## 3. Results

### 3.1.1 Presentation and analysis of motor response velocity results between pre- and post-experimental group tests



Table (2) Arithmetic Mean, Standard Deviation, Mean Difference, Difference Standard Deviation, Calculated (t) Values, and Significance of Difference between Pre and Post Test Results for Motor Response Speed of the Experimental Group

Variables	Unit	Pre-Test (Mean)	Pre-Test (SD)	Post-Test (Mean)	Post-Test (SD)	Mean Diff	Diff SD	Calculated (t) Value	Significance
Motor Response Speed	Second	1.66	0.31	1.09	0.14	0.45	0.08	15	Significant

When comparing the calculated (t) value of (15) with the tabular (t) value of (2.86) at a degree of freedom (19) and a significance level of (0.01), we find that the calculated value is greater than the tabular one. This indicates the existence of statistically significant differences between the pre and post tests in favor of the post test.

### 3.1.2 Presentation and analysis of the results of the intertest attention tests before and after the experimental group

Table (3) Arithmetic Mean, Standard Deviation, Mean Difference, Difference Standard Deviation, Calculated (t) Values, and Significance of Difference between Pre and Post Test Results for Attention Aspects Test of the Experimental Group

Variables	Unit	Pre-Test (Mean)	Pre-Test (SD)	Post-Test (Mean)	Post-Test (SD)	Mean Diff	Diff SD	Calculated (t) Value	Significance
Attention Concentration	Score	2.336	1.076	2.551	1.050	0.215	0.234	4.11*	Significant
Attention Acuity	Score	0.289	0.876	0.598	0.350	0.309	0.210	6.58*	Significant
Attention Stability	Score	0.123	1.08	0.219	1.11	0.096	0.085	5.05*	Significant

Looking at Table (6), we observe that the calculated (t) values for the variables of attention aspects (attention concentration, attention acuity, attention stability) have reached statistically significant values, as they all exceeded the tabular (t) value of (2.86) at a degree of freedom (19) and a significance level of (0.01).

This clearly indicates the significance of the differences between the pre and post tests in favor of the post test.

## 4. Discussion

### Discussion of Motor Response Speed Results:

The results in Table (5) showed a significant development in motor response speed. The researcher attributes this development to the nature of the training program, which linked physical performance with sudden auditory stimuli.

From a physiological perspective, Schmidt and Lee (2011) indicate that continuous training on response speed reduces Reaction Time by improving the efficiency of neural pathways and increasing the speed of nerve impulse transmission from sensory receptors (the ear) to the central nervous system and then to the effector muscles. Furthermore, the use of "auditory stimuli" requires rapid processing in the temporal lobe of the brain, and training on it works to reduce the so-called "Latent Period."



This also agrees with Harre (1982) that repeating the exercise in variable conditions (such as changing direction based on sound) leads to automatization of the response, where the player becomes able to make a motor decision in the shortest possible time due to neuromuscular adaptation. This was achieved in the research sample through running exercises and changing directions according to sound signals.

### **Discussion of Attention Aspects Results (Concentration, Acuity, Stability):**

The results of Table (6) clarified a noticeable improvement in aspects of attention. This is due to the close link between physical effort and mental processes.

Magill (2007) points out in motor learning theories that attention is not just an isolated mental process, but a skill capable of development through training that requires "attention distribution" and "switching."

The exercises used in the research forced the students to maintain **Attention Stability** to anticipate the sound signal, and raise the level of **Attention Acuity** to distinguish the type of sound and determine the required direction, which increased their Attention Capacity.

In addition, scientific sources confirm that training requiring accuracy and speed simultaneously increases the flow of oxygenated blood to the brain, which activates the areas responsible for concentration and mental alertness (Allawi, 2002; Hussein & Mohammed, 1999).

The improvement in the "Bourdon-Anfimov test" and "Saqr test" reflects the success of the program in integrating environmental stimuli (auditory) with motor response, which enhanced the student's ability to isolate distractors and focus on the primary stimulus, which is the essence of the "Concentration" process.

## **5. Conclusions**

### **4-1 Conclusions:**

- The use of physical exercises accompanied by sequential auditory stimuli has a positive and effective impact on developing the motor response speed of school students (9-11 years).
- There is a close relationship between physical training based on reaction and the development of attention aspects (Concentration, Acuity, Stability), as the program led to a noticeable improvement in the mental processes accompanying performance.
- The interval and repetitive training method used contributed to improving neuromuscular coordination and reducing the motor decision-making time for students.

### **4-2 Recommendations:**

- The necessity of adopting exercises that rely on variable auditory and visual stimuli within physical education curricula in primary schools, and not merely relying on static, stereotypical exercises.
- Paying attention to developing the mental aspect (attention and perception) alongside the physical aspect when training young age groups, as it is the stage of skill foundation.
- Conducting similar studies dealing with a comparison between the effect of visual stimuli and auditory stimuli to determine which is more effective in response speed for this age group.
- Using standardized and locally modified tests (such as the Saqr test and modified attention tests) periodically to evaluate the students' physical and mental development.

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