Jurnal Pendidikan Kepelatihan Olahraga: Pejuang
Volume 2 Nomor 3 Oktober 2026
E-ISSN: 3090-1278

The Effect of Fartlek Training on the Development of Reactive Agility and Motor Response Speed Among Players of Al-Farahidi University's Handball Team

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Article History
Received: 07-07-2026;
Reviewed: 03-08-2026;
Accepted: 23-09-2026;
Published: 27-10-2026;

ABSTRACT
The aim of this study was to investigate the effect of fartlek training combined with unexpected visual and auditory stimuli on the development of reactive agility and motor response speed among players of the Al-Farahidi University handball team. The researcher employed an experimental approach using a matched-pairs design, the experimental and control groups, each with pre- and post-tests, as this was appropriate to the nature of the problem. The sample consisted of 20 university students, who were randomly divided into two equal groups of 10 players each, after verifying the homogeneity of the sample and the equivalence of the two groups. A standardised fartlek programme was applied to the experimental group, combining changes in running speed and direction with responses to unexpected stimuli, for a period of eight weeks at a rate of three sessions per week, whilst the control group continued with their usual training regime. Reactive agility was measured using a field test based on response to a visual stimulus, and motor reaction time was measured using the reaction time to a simple visual stimulus. The data were analysed using the arithmetic mean, standard deviation and t-tests for paired and independent samples. The results showed a reduction in reaction time in the experimental group from (2.84) to (2.58) seconds, and a reduction in motor reaction time from 312 to 268 milliseconds, representing improvements of 9.2 per cent and 14.1 per cent respectively, with statistical significance in favour of the post-test. Furthermore, the experimental group outperformed the control group in the post-test for both variables. The study recommended the incorporation of fartlek training combined with unexpected stimuli into the training programmes of university handball teams, and the conduct of field studies on larger samples and other age groups.

Keywords: Fartlek; Reactive agility; Motor response time; Handball; Al-Farabi University team.

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ABSTRAK
Tujuan studi ini adalah untuk menyelidiki efek latihan fartlek yang dikombinasikan dengan rangsangan visual dan auditori yang tak terduga terhadap perkembangan kelincahan reaktif dan kecepatan respons motorik di antara pemain tim bola tangan Universitas Al-Farahidi. Peneliti menggunakan pendekatan eksperimental menggunakan desain pasangan yang dipasang, kelompok eksperimental dan kontrol, masing-masing dengan tes pra- dan pasca, sesuai dengan sifat masalah. Sampel terdiri dari 20 mahasiswa universitas, yang secara acak dibagi menjadi dua kelompok yang sama masing-masing terdiri dari 10 pemain, setelah memverifikasi homogenitas sampel dan kesetaraan kedua kelompok tersebut. Program fartlek standar diterapkan pada kelompok eksperimen, menggabungkan perubahan kecepatan dan arah lari dengan respons terhadap rangsangan tak terduga, selama delapan minggu dengan laju tiga sesi per minggu, sementara kelompok kontrol melanjutkan rutinitas latihan biasa mereka. Kelincahan reaktif diukur menggunakan tes lapangan berdasarkan respons terhadap rangsangan visual, dan waktu reaksi motorik diukur menggunakan waktu reaksi terhadap rangsangan visual sederhana. Data dianalisis menggunakan rata-rata aritmatika, standar deviasi, dan uji t untuk sampel berpasangan dan independen. Hasilnya menunjukkan pengurangan waktu reaksi pada kelompok eksperimen dari (2,84) menjadi (2,58) detik, dan pengurangan waktu reaksi motorik dari 312 menjadi 268 milidetik, masing-masing menunjukkan peningkatan sebesar 9,2 persen dan 14,1 persen, dengan signifikansi statistik yang lebih menguntungkan pasca-tes. Selain itu, kelompok eksperimental mengungguli kelompok kontrol dalam pasca-tes untuk kedua variabel tersebut. Studi merekomendasikan penggabungan pelatihan fartlek yang dikombinasikan dengan rangsangan tak terduga ke dalam program pelatihan tim bola tangan universitas, serta pelaksanaan studi lapangan pada sampel yang lebih besar dan kelompok usia lainnya.

Kata Kunci: Fartlek; Kelincahan reaktif; Waktu respons motorik; Bola tangan; Tim Universitas Al-Farabi.

INTRODUCTION

Handball is undergoing rapid development in terms of its tactics and playing styles; performance in the sport relies on a succession of rapid sprints, stops and sudden changes of direction, whilst facing the opponent and controlling the ball, A player cannot meet these demands without solid physical conditioning accompanied by motor skills training that enables them to adapt to changing game situations (Guimarães et al., 2026; Hermassi et al., 2019; Maen Ahmad Mahmoud Sha'lan, 2022; Musa & Menezes, 2023) . Consequently, training is no longer limited to developing physical attributes in isolation from cognitive aspects, but now encompasses the player's ability to read the situation and make the appropriate motor decision in the shortest possible time (Jabbar et al., 2026; Jakšić et al., 2023; Masada & Nakano, 2013; Sahli et al., 2024) .

Agility occupies an important position amongst the abilities required of a handball player. Sheppard and Young have defined it as a rapid movement of the whole body in which direction or speed changes in response to a stimulus (Sheppard & Young, 2006, p. 48). This means that it is not limited to the speed of changing direction, but also includes a cognitive component linked to perceiving the stimulus and making a decision; hence, pre-planned agility is distinguished from reactive agility, in which the player is unaware

of the required direction of movement until the stimulus appears – a scenario that most closely resembles what occurs in a match (Avramova, 2021; Hussein & Hrebid, 2023; Ríos et al., 2022) .

Given the importance of this type of agility, Spasic and colleagues proposed a protocol for measuring it in handball, based on the player's response to a visual stimulus involving forward, lateral and backward movements; this yielded acceptable to high stability coefficients (Spasic et al., 2015, p. 61). In the Arab world, Mushtaq and Habib studied the effect of reactive agility exercises on certain physical and technical abilities of indoor football players, and reported a positive effect (Mushtaq and Habib, 2023, p. 51); however, their study did not address fartlek training or handball.

Reactive agility is linked to motor reaction time, which is the interval between the presentation of a stimulus and the onset of the motor response to it. Khanjar examined the effect of a training programme on motor reaction time and the performance of certain basic handball skills among 16 players from the Army Club (Khanjar, 2010, p. 34), reflecting the focus of Iraqi studies on this variable. Its importance is particularly pronounced for goalkeepers and defenders, as a fraction of a second can determine the outcome of a situation.

As for fartlek, it is a Swedish term coined by Gusta Holmer in the 1930s, meaning 'speed games' (Zakarna, 2016, p. 5), and is defined as running over varying distances at changing speeds—from walking to maximum intensity—without prior planning of the changes in speed (Zakarna, 2016, p. 9). Zakarna implemented a fartlek programme involving 30 players from the Faculty of Physical Education at An-Najah National University; the programme lasted seven weeks, comprising three sessions per week, and included variables such as agility and transition speed (Zakarna, 2016, p. 27), whilst Suleiman and Ali investigated the effect of a proposed fartlek programme on certain physical and physiological variables in footballers (Suleiman and Ali, pp. 8–9). These two studies provide a basis for the use of fartlek with university athletes in team sports.

However, traditional fartlek does not in itself involve external stimuli to which the player must respond; the researcher therefore proposes fartlek training that integrates changes in running speed with sudden visual or auditory cues that determine the next movement. This training combines physical and cognitive aspects and approximates match conditions, This hypothesis requires empirical testing, which is the aim of this study.

The significance of this research lies in its focus on the Al-Farahidi University handball team, a group that requires physical and technical preparation commensurate with the demands of their studies and participation in competitions, It may provide coaches with a training method that is simple to implement and low-cost, utilising readily available visual and auditory cues. It also adds to the sports literature a study linking fartlek to reactive agility and motor response speed in handball—a link the researcher did not find in the sources consulted.

Research Problem

Handball requires the player to respond quickly to changing and unpredictable playing situations, which is expressed in the concept of reactive agility (Sheppard & Young, 2006, p. 39), and through the researcher's follow-up to the training of the Al-Farabi University team, he noticed that the preparation focuses on endurance and traditional exercise, without exercises in which movement is coupled with an

unexpected stimulus, and he used Fartlick to develop the physical variables of the players (Zakarneh, 2016), but he did not study, to the extent of the researcher's knowledge, to develop reactive agility and responsiveness in handball players, hence the problem asks: Does the vartlake training have an effect on these two variables?

Research Objectives

1. Preparation of proposed Vartlak trainings, combined with unexpected visual and auditory stimuli, for the players of the Al-Farahidi University handball team.
2. To identify the effect of these exercises on reactive agility in the experimental and control groups.
3. To identify its effect on the speed of motor response in both groups.
4. Identifying the significance of the differences between the experimental and control groups in the post-test of the two variables.

Research Hypotheses

1. There are statistically significant differences between the pre- and post-tests of the experimental group in reactive agility in favor of the post-test.
2. There are statistically significant differences between the pre- and post-tests of the experimental group in the speed of motor response in favor of the post-test.
3. There are statistically significant differences between the pre- and post-tests of the control group in the two variables in favor of the post-test.
4. There are statistically significant differences between the experimental and control groups in the post-test of reactive agility and motor response speed to the experimental group.

Research Areas

Human Field: The players of the Al-Farahidi University handball team for the academic season 2025-2026, numbering (20) players.

Temporal Domain: From 1/11/2025 to 31/1/2026, including the exploratory experiment, pre-tests, implementation of the program for eight weeks, and post-tests.

Spatial Area: Handball Hall/Field at AlphaRahedi University.

METHODS

Research Methodology

The researcher used the experimental method by designing the two equal groups (experimental and control) with pre- and post-tests, to suit the nature of the problem, which is the same method used by Khanjar in the study of the motor response in the handball (Khanjar, 2010, p. 100), and used by Mushtaq and Habib in the study of reactive agility (Mushtaq and Habib, 2023, p. 46).

Research population and sample

The research population was identified with the players of the Al-Farahidi University handball team for the academic season 2025-2026, numbering (24) players. (4) players were excluded: two players for their injury, and two players to conduct the reconnaissance experiment on them. Thus, the sample reached (20) players, with a percentage of (83.3%) of the population, and was randomly divided by lottery into two groups: experimental (10) and control (10).

Sample homogeneity

Table 1. Homogeneity of the sample in variables (age, height, mass, training age) (n = 20)

Torsion coefficient	Standard deviation	Broker	Arithmetic mean	Unit of Measurement	Variable
-0.14	1.05	20.50	20.45	Year	Age
-0.13	4.60	177.00	176.80	Poison	Length
0.10	5.90	73.00	73.20	Kg	Mass
-0.55	1.10	5.00	4.80	Year	Training Age

The values of the torsion coefficient ranged between (±1), which indicates the moderation of the distribution and the homogeneity of the sample.

Equivalence of the two groups

Table 2. Equivalence of the experimental and control groups in the variables under study (n = 10 for each group)

Significance	Significance Level	(v) Calculated	Officer (Q±)	Experimental (Q±P)	Unit of Measurement	Variable
Insignificant	0.84	0.21	20.40 ± 1.00	20.50 ± 1.10	Year	Age
Insignificant	0.92	0.10	176.70 ± 4.50	176.90 ± 4.80	Poison	Length
Insignificant	0.88	0.15	73.00 ± 5.80	73.40 ± 6.10	Kg	Mass
Insignificant	0.69	0.40	4.70 ± 1.00	4.90 ± 1.20	Year	Training Age
Insignificant	0.79	0.27	2.86 ± 0.17	2.84 ± 0.16	Second	Interactive Agility (Time)
Insignificant	0.73	0.35	315 ± 20	312 ± 18	Millisecond	Motor response speed

The tabular value of (v) at the degree of freedom (18) and the significance level of (0.05) is equal to (2.101), and all the calculated values are smaller than them, which indicates the equivalence of the two groups.

Research Variables

Table 3. Research Variables

Unit of Measurement	Variable	Variant Type
—	Combined Vartlake workouts with unexpected stimuli	Independent
Second	Interactive Agility	Follow (1)
milliseconds	Motor response speed	Follow (2)

Means of information collection, tools and devices

Devices and instruments: Wireless light signal system (such as FitLight or BlazePod), digital stopwatch, light timing gates if available, cones, tape measure and tape for charting, medical scale, restameter for measuring mass and length, pulse rate watch, and handballs.

Tests used

Interactive Agility Test

Objective: Measure the motor response time directed to a photostimulus with a change of direction.

Method: The test modified the Spasic et al. protocol designed for handball players, which relies on responding to a light stimulus with front, lateral and backward movements (Spasic et al. , 2015, p. 50).

Performance: The player stands at the starting point in standby mode, and three light devices are placed in different positions in front of him at a distance of about (4) meters. One of them lights randomly, and the player starts towards him, touches him, and then returns to the starting point, repeating this six times.

Registration: The total time is calculated in seconds to the nearest hundredth, and the best time is based on two attempts.

Motor Response Speed Test

Objective: To measure the motor response time of a simple light stimulus.

Performance: The player places his hand on the answering device, and when the light is on, he presses it as fast as he can.

Registration: (5) attempts are made and their average is calculated in milliseconds.

Scientific Basis of the Two Tests

The Spasic et al. protocol showed acceptable to high stability coefficients (Spasic et al. , 2015, p. 79) . In order to verify the stability of the two tests in the current research sample, (4) players from outside the core sample were recruited with a difference of one week.

Table 4. Stability and Validity Coefficient of Tests .

Self-Honesty Factor	Stability Coefficient (Retest)	Testing
0.94	0.89	Interactive Agility
0.95	0.91	Motor response speed

Self-truthfulness is calculated in the square root of the stability coefficient.

Exploratory experiment

The exploratory experiment was conducted on 1/11/2025 on (4) players from the research community, outside the core sample. The aim was to ensure the validity of the devices, the safety of the instructions of the two tests, the time of their implementation, and the appropriateness of the intensity of the vartlak training and its signals to the players.

Pre-tests

It was conducted on 8/11/2025 in the university's sports hall, after a unified warm-up of (15) minutes. The conditions (time, place, sequence of tests, and the support team) were proven to ensure that they applied the same in the post-tests.

Proposed trainings

The exercises were prepared on the basis that the athlete ran at variable speeds from walking to extreme intensity, without prior planning for the change in speed (Zakarneh, 2016, p. 9). Unexpected visual and auditory stimuli were added to it that determine the next stage of running and the direction of movement. The program was implemented according to the following:

The duration of the program is eight weeks, from 9/11/2025 to 1/1/2026, with three units per week (Sunday, Tuesday, and Thursday). The training module time is (60) minutes, including warm-up (15) minutes, main part (35-40) minutes, and cool-down (5-10) minutes. The units are carried out within the usual training of the national team, and are replaced by the physical part of the unit.

Table 5. Distribution of the proposed Vartlake exercises over the eight weeks

Self-Honesty Factor	Stability Coefficient (Retest)	Testing
0.94	0.89	Interactive Agility
0.95	0.91	Motor response speed

Post-tests

It was conducted on 3/1/2026, two days after the end of the eighth week, and under the same conditions and sequence as in the pre-tests.

Statistical methods

The data were analyzed statistically using the statistical program (SPSS), and by the following means: arithmetic mean, standard deviation, mean, torsion coefficient, simple correlation coefficient (Pearson), test (T) for correlated samples, and (T) test for independent samples. The significance level was set at (0.05).

RESEARCH RESULTS

Experimental group

Table 6. Arithmetic medians, standard deviations, and the value of (v) between the pre- and post-tests of the experimental group (n = 10)

Percentage of improvement	Significance	Significance Level	(v) Calculated	Deviation of Differences	Average spreads	Al-Baddi (Q±A)	Al-Qibli (Q±A)	Unit of Measurement	Variable
9.2%	Moral	< 0.001	11.75	0.07	0.26	2.58 ± 0.14	2.84 ± 0.16	Second	Interactive Agility (Time)
14.1%	Moral	< 0.001	11.59	12	44	268 ± 15	312 ± 18	Millisecond	Motor response speed

The tabular value of (v) at the degree of freedom (9) and the significance level of (0.05) is equal to (2.262).

It is clear from Table (6) that the reactive agility time decreased from (2.84) to (2.58) seconds, and the motor response time decreased from (312) to (268) milliseconds. Since the two tests measure time, the decrease means an improvement, and the calculated values of (v) were greater than the tabular, and this achieves the first and second assumptions.

Control group

Table 7. Arithmetic medians, standard deviations, and the value of (v) between the pre- and post-tests of the control group (n = 10)

Percentage of improvement	Significance	Significance Level	(v) Calculated	Deviation of Differences	Average spreads	Al-Badadi (Q±A)	Al-Qibli (Q±A)	Unit of Measurement	Variable
2.1%	Moral	0.042	2.37	0.08	0.06	2.80 ± 0.16	2.86 ± 0.17	Second	Interactive Agility (Time)
3.2%	Moral	0.018	2.87	11	10	305 ± 19	315 ± 20	Millisecond	Motor response speed

Table (7) shows small significant differences in favor of the post-test in the control group, and this achieves the third hypothesis.

Comparison of the two groups in the post-test

Table 8. Arithmetic medians, standard deviations and the value of (v) between the experimental and control groups in the post-test (n = 10 for each group)

Significance	Significance Level	(v) Calculated	Middle Teams	Officer (Q±	Experimental (Q±P)	Unit of Measurement	Variable
Moral	0.004	3.27	0.22	2.80 ± 0.16	2.58 ± 0.14	Second	Interactive Agility (Time)
Moral	< 0.001	4.83	37	305 ± 19	268 ± 15	Millisecond	Motor response speed

The tabular value of (v) at the degree of freedom (18) and the significance level of (0.05) is equal to (2.101). Since the two calculated values are greater than them, the fourth hypothesis is achieved in favor of the experimental group.

DISCUSSION

Discussion of the results of the pilot group

The results showed a significant improvement in reactive agility and motor response speed in the experimental group (Table 6). The researcher explains that the proposed Vartlick training combined a change in running speed and intensity with unexpected visual and auditory stimuli, so the athlete had to pick up the stimulus, make a decision, and then respond to it while running. This is consistent with the definition of agility as a change in direction or speed in response to a stimulus (Sheppard & Young, 2006, p. 31). Although Fartlik is originally based on changing the speed from walking to extreme intensity without prior planning (Zakarneh, 2016, p. 9), its combination with stimuli brought it closer to the reaction conditions measured by the reactive agility test (Spasic et al. , 2015, p. 52) .

The trend of this result is consistent with what Mushtaq and Habib pointed out about the positive effect of interactive agility exercises on the physical and skill abilities of futsal players (Mushtaq and Habib, 2023, p. 86), although the game and program are different. The improvement in response speed by (14.1%) is explained by the repetition of random stimuli during the three weekly units over a period of eight weeks, so that the player became faster in converting the stimulus into movement. This is close to Khanjar's interest in the effect of the training method on the motor response speed of handball players (Khanjar, 2010, p. 61).

In addition, the intensity, number of sets, and type of triggers of the program progressed from week one to eight (Table 5), which helped players gradually adapt without sudden loads.

Discussion of the control group's findings

The researcher attributes the slight improvement in the control group (Table 7) to the team's usual training methodology, which includes playing situations and skill exercises that develop these two variables to a lesser extent, and to the learning effect associated with repeating the two tests. The same degree of improvement was not achieved because its curriculum does not include structured unexpected stimuli.

Discussion of differences between the two groups

The results of the post-test (Table 8) showed that the experimental group was superior to the control group in the two variables, as the difference between the two groups was (0.22) seconds in reactive agility and (37) milliseconds in response speed. The researcher attributes this to the proposed program, for the parity of the two groups before (Table 2) and for the stability of the application and testing conditions. However, the results should be circulated with caution, due to the small sample (20 players) and its limitation to one university team

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The proposed fartlek training, combined with unexpected visual and auditory stimuli, contributed to a significant improvement in reactive agility in the experimental group, as the test time decreased from (2.84) to (2.58) seconds.
2. The same training sessions contributed to a statistically significant improvement in motor reaction time in the experimental group, with the time decreasing from (312) to (268) milliseconds.
3. The control group achieved a slight statistically significant improvement in both variables as a result of the team's usual training programme, but this was considerably less than the improvement seen in the experimental group.
4. The experimental group outperformed the control group in the post-test in terms of reactive agility and motor response time.
5. The programme, which was progressive in terms of intensity, number of sets and type of stimuli over an eight-week period, proved suitable for university handball players, without the need for complex equipment.

Recommendations

1. Fartlek training combined with unexpected visual and auditory stimuli should be incorporated into the training programmes of university handball teams.

2. Tests of reactive agility and motor response time should be used to assess players periodically, rather than relying solely on pre-planned agility tests.
3. Gradually introduce loads and stimuli when implementing the programme, starting with stimuli with a fixed trajectory and then moving on to randomised ones.
4. Conduct similar studies on larger samples, involving female players and other age groups, and across different team sports.
5. Conduct studies comparing fartlek combined with stimuli with other methods for developing reactive agility, such as high-intensity interval training.

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