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Original Article

The relationship between reaction time and agility performance in young athletes: A study using perception–action technological devices

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Abstract:
Aim. This study explored the correlation between the hexagon agility test (HAT) and two basic reaction time (RT) tests for visual stimuli that measure quick upper limb (RTs UL) and lower limb (RTs LL) movements. The effectiveness of these tests was assessed using a portable wireless measurement system (Fitlight Trainer™ Sports Corp, Canada). Materials and Methods. During a summer camp in southern Italy, 200 students participated, of whom 44 were chosen for inclusion in the study using a utility-based sampling approach. The students and their parents or legal guardians were informed about the experimental design and study procedures, and informed consent was obtained through signed forms. The study adhered to the Declaration of Helsinki and received approval from the Institutional Ethics Committee of Pegaso Telematic University (PROT/E 002466, 29/03/2024). Results. The observed correlations between RT and HAT support the hypothesis that RTs contribute to agility levels in young athletes. Despite the relatively small sample size, this study demonstrated that using perception–action devices such as Fitlight to measure RTs can effectively predict performance in field-based agility tests such as the HAT. The reliability and precision of these devices in assessing RTs are valuable for coaches, educators, and practitioners. In essence, these tools allow coaches and educators to monitor individuals' agility performance with greater accuracy, ensuring that observed improvements are attributed to the athletes' development rather than potential inconsistencies in the equipment. Conclusions. The results support incorporating targeted RT training into agility exercises, with the potential to enhance overall athletic performance.
Keywords: agility test, reaction time, sensor device, young student, coordination

Introduction

The interrelationships between motor coordination, reaction capacity, and agility continue to be explored in the field of physical education and sports science. This study explored the interplay of these factors and their impact on performance in both sports and daily life. Despite a substantial body of research, empirical data linking reaction times (RTs) to specific agility tests, particularly among young athletes, remains limited. Minimizing motor RTs to adapt specific motor tasks to diverse environments is essential in both everyday life and sports. Many researchers recognize reaction capacity as a pivotal element in motor coordination (Chilom et al., 2024; Moroșanu et al., 2024; Moscatelli, Toto, et al., 2023; Örs et al., 2019; Shapie et al., 2023). In many sports, motor reaction speed is vital in various situations because athletes must make quick decisions to increase their likelihood of success (Göral et al., 2012). Agility, often referred to as coordination, is a complex, specific, and cross-disciplinary quality that is closely related to speed, motor creativity, and rapid information processing. Contemporary definitions of agility in the context of sports describe it as "a rapid movement of the whole body with a change of speed or direction in response to a stimulus" (Sheppard & Young, 2006).

Therefore, agility is an important quality that contributes considerably to successful sports performance (Sekulic et al., 2017; Turna, 2020). The reason for this study stems from the increasing need to assess and develop specific methodologies to enhance RT and agility among individuals engaged in sports. These qualities are essential for sports that require fast decision-making and rapid directional changes. By focusing on students involved in regular sports activities, the research aimed to elucidate the correlation between simple RT and agility.

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The ability to quickly and accurately change direction is widely regarded as integral to motor and sports performance (Lloyd et al., 2013; Paul et al., 2016). This ability is closely related to reaction capacity.

Thus, it is apparent that minimizing RT and increasing speed in directional changes are essential qualities for high performance in numerous sports, particularly those that involve multi-directional movements. Consequently, developing these abilities from an early age is of paramount importance.

This study aims to examine the relationship between the hexagon agility test (HAT), a field agility test, and the simple RT tests (RT UL and RT LL), which measure upper and lower limb RTs, respectively. A group of students actively involved in various sports (N = 44) participated in this study. A quantitative approach was employed, using statistical methods to analyze the relationships between these variables. Data were collected through standardized tests, and the coefficient of determination was calculated to determine the degree to which changes in RTs account for changes in agility. When evaluating motor agility, RT and the speed of motor responses are essential cognitive factors to consider. RT represents the interval between the onset of a stimulus and the commencement of a response. It serves as an indicator of the cognitive system's information-processing capacity (Jensen, 2006; Kuang, 2017).

In athletic settings, RT encompasses the time required to perceive, recognize, and respond to an external stimulus with appropriate movement. RT comprises two components: reaction time (the time required to perceive and process the stimulus) and movement time (the time required to execute the response). RT is the response speed to an environmental stimulus (Miller & Low, 2001), whereas agility is defined as "rapid whole-body movement with a change of speed or direction in response to a stimulus" (T. J. Gabbett et al., 2008; Sheppard & Young, 2006). In this study, RT encompasses the time required from the presentation of the visual stimulus until the completion of a rapid upper (hand) or lower (foot) limb movement, expressed as: RT = Reaction time + Movement time. To ensure accurate and reliable measurements, the methodological framework used standardized testing conditions for both the HAT and RT assessments. These procedures allowed a comprehensive examination of the relationship between the cognitive and physical aspects of performance. Extensive research has consistently demonstrated that physical activity and sports participation are positively correlated with improvements in RT (Mancini et al., 2024; Moscatelli et al., 2020; Nuri et al., 2013).

Materials and Methods

Participants

At a summer camp in a southern Italian city with 200 participants, a utility sampling method was used to select 44 students. The characteristics of these groups are outlined in Table 1.

Table 1. Group characteristics: Boys (mean ± SD; n = 23) and Girls (mean ± SD; n = 21). Values are expressed as mean ± standard deviation.

Parameter	Boys	*p*-value	Girl	*p*-value
Age (years)	11.48 ± .51	<.0001	11.52 ± .51	<.0001
Height (cm)	147.30 ± 7.05	.0603	147.67 ± 4.84	.4480
Body mass (kg)	39.99 ± 4.92	.5538	42.33 ± 3.32	.7310
Body mass index (BMI)	18.38 ± 1.30	.0465	19.40 ± 1.02	.2726

(cm) = centimeters; (kg) = kilograms

Prior to the commencement of the study, all participating students and their parents or legal guardians were informed about the study's design and experimental methodology. Subsequently, they provided their informed consent in writing. The study strictly adhered to the principles outlined in the Declaration of Helsinki and was formally approved by the Institutional Ethics Committee of Pegaso Telematic University (PROT/E 002466, 29/03/2024).

In clusion criteria were evaluated through a questionnaire and included the following:

- ✓ Age between 11 and 12 years.
- ✓ Participation in competitive sports or organized extracurricular sports activities.
- ✓ Experience with and practice of at least three different sports disciplines.
- ✓ Regular participation in physical education classes at school (2 hours per week).

The exclusion criteria were as follows:

- ✓ Recent injuries requiring medical treatment.
- ✓ Adverse neurological events such as epileptic seizures.

The decision to restrict the participants' age range to 11–12 years was made to minimize the potential impact of substantial growth and physiological maturation, which have been reported to influence the variables examined in this study, such as simple RT and motor agility (Horníková et al., 2019)

In the specified age range of 11–12 years, it is noteworthy that substantial enhancements in both cyclic and acyclic speed are generally not observed. Consequently, the main components of speed experience minimal changes during this developmental stage (Lehmann, 1993; Moscatelli, De Maria, et al., 2023; Weineck, 2009).

Procedure and Testing Protocol

To minimize potential circadian influences, measurements were performed in a consistent time frame, between 2 PM and 4 PM. Moreover, the testing environment was controlled to ensure consistency. Motor RT estimation tests were performed in a quiet room with minimal light exposure, using the Fitlight Trainer™ (Fitlight System, 2022), which employs LED lights (T. Gabbett & Georgieff, 2007). The HAT was administered in an air-conditioned gymnasium with a parquet sports floor. Before the test, participants abstained from strenuous physical activity for a 24-h period. Furthermore, participants refrained from consuming any food or beverages, except for water, within a 3-h window prior to the test. Before the commencement of testing, participants engaged in a 15-min warm-up session consisting of dynamic stretching exercises. Each test was explained and demonstrated to ensure clear understanding. Participants were also provided with practical trials to familiarize themselves with the testing procedures. To mitigate any potential order effects, the tests were counterbalanced. Prior to the initiation of the tests, each participant received specific instructions and was verbally encouraged to exert maximum effort during the testing process.

Motor Test: Hexagon Agility Test (HAT)

The HAT is widely recognized as "a measure of foot agility and speed that involves balance and coordination abilities" (Baechle et al., 1994; Roetert et al., 1992). This test is considered reliable and practical, requiring minimal resources in terms of time, costs, and space. These attributes enhance its usability across diverse physical and sports environments (Beekhuizen et al., 2009; Pauole, K., Madole, k., Garhammer, J., Iacourse, M., & Rozenek, 2000).

In this study, a modified version of the original hexagonal agility test was utilized (Beekhuizen et al., 2009), which used two sequences instead of three. The procedure involves the participant facing forward and standing at the center of a hexagon marked on the ground using adhesive tape. Each side of the hexagon measures 24 inches (60.96 cm), and the internal angles are all 120 degrees. At the center of the hexagon (Figure 1), a stable conductance platform connected to a timing system (*Chronojump System, Barcellona*, n.d.) was securely placed on the ground. This platform connects directly to a laptop computer, with all operations controlled by software (Chronojump 2.2, www.chronojump.org) that allows for precise timing measurements in seconds and milliseconds.

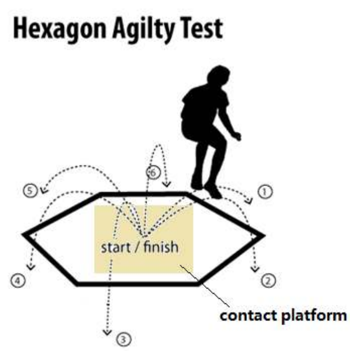

Figure 1. Schematic representation of the hexagonal agility test

The participant assumes a position on the contact platform located at the center of the hexagon, with their feet naturally positioned together and facing the front line. The initiation of the test is not prompted by a verbal command; instead, the participant begins the movement independently, triggering the timing mechanism automatically upon lifting their feet off the platform. They execute six consecutive jumps, returning to the center after each jump while crossing each side of the hexagon. The first jump is directed toward the front line, followed by the sidelines in sequential order. The stopwatch automatically stops when the participant completes the entire circuit and returns to the center on the contact platform. To ensure reliability, the test is performed in both clockwise and counterclockwise directions, with a one-minute break between each circuit.

Scoring: To determine the average time, the total times recorded during the clockwise and counterclockwise circuits are summed and subsequently divided by two. Each participant performs two complete attempts, with a two-minute recovery interval between them. The best average time between the two attempts is selected as the representative score.

Comments: The test is repeated if the participant jumps over the wrong line or lands on a line.

Cognitive–Motor Tests

The FitLight Trainer (Fitlight System, 2022) is a portable device that offers a diverse range of options for measuring RTs and can be adapted for use with both upper limbs (ULs) and lower limbs (LLs). Its versatility extends to a variety of settings, encompassing laboratories, clinics, and both indoor and outdoor sports facilities. The system comprises a control tablet and mobile discs that operate wirelessly, serving as a platform for cognitive–motor training and assessment, including the evaluation of simple and complex RTs. Each disc, measuring 10 cm in diameter, is designed to emit light or sound signals in accordance with the selected program and is equipped with proximity sensors to enhance its functionality.

The system operates by deactivating the lights (yellow, green, red, dark blue, light blue, and purple) through either proximity sensors (triggered by passing over the sensor) or direct contact with the hands or feet. The system enables the measurement and recording of times in milliseconds with each contact. A set of variables (encompassing color/light choice, timeout signal, and delay or sound deactivation) can be modified to customize a specific exercise or test to the desired requirements.

In this study, specific tests using the FitLight Trainer LED light system (Fitlight Corp., USA) were selected. This decision was based on prior research, where a battery of tests was proposed for measuring perceptual–cognitive function during sports movement activities through a test–retest process. The reliability of the test–retest procedure was established using the intraclass correlation coefficient (ICC > .5, $p < .05$) (Wilke et al., 2020).

Two tests were designated for measuring simple RTs of the dominant ULs and LLs. Each test was administered twice for each participant, with a three-minute break between the tests. The tests involved simple basic movements executed in relatively controlled positions, relying solely on visual stimuli.

Simple Reaction Time, Upper Limb Dominant (RT UL)

RT UL is a test designed to assess simple RTs of the ULs (ICC/Rho: 0.81* (95% Confidence Interval (CI): 0.48–0.94), $p < .001$) (Wilke et al., 2020). It requires a high level of focus and rapid responses to visual cues. During the assessment, the participant assumes an upright stance and positions the palm of their dominant hand—defined as the hand typically used for sports activities such as throwing or pushing—on a table set at elbow height. A sensor is placed on the table at a distance equal to the length of the participant's forearm. The objective of this test is to deactivate the sensor as quickly as possible by moving over it once it lights up (Figure 2) without making direct physical contact. Each trial consists of 20 activations with varying intervals between stimuli. Upon deactivating the light sensor, the participant must return their hand to the neutral starting position on the table.

Response times are measured in seconds and milliseconds for every attempt, and a single trial takes approximately one minute to complete. The final result of the test is the average of the response times. Each participant completes two trials, and the analysis uses the lower average time in seconds from the two trials.

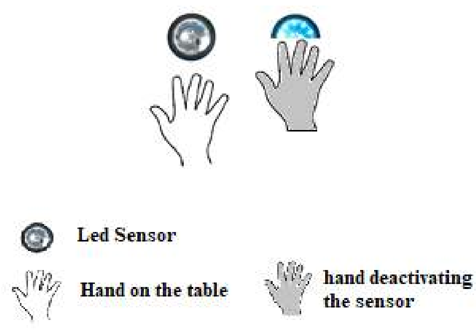

Figure 2. Schematic illustration of the simple reaction time for upper limb dominant (RT UL). The figure shows tasks performed with the upper extremity.

Simple reaction time, lower limb dominant (RT LL)

The RT LL test measures simple RTs of the LLs (ICC/Rho: 0.89* (95% CI: 0.67–0.97), $p < .001$) (Wilke et al., 2020) and involves a task similar to that of the UL assessment. In this test, the participant stands upright with their feet positioned parallel at shoulder-width apart, and a sensor is placed in front of their feet. The distance to the sensor is adjusted based on the length of each participant's foot, measured from the tip of the big toe to the heel. The participant's objective is to deactivate the sensor as quickly as possible by stepping over it once it lights up (Figure 3) without making direct contact with the sensor.

They use their dominant foot, which is defined as the foot typically used for sports activities such as kicking a ball or jumping with the leading leg.

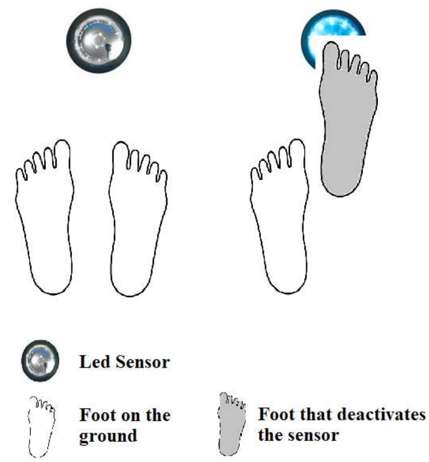

Figure 3. Schematic illustration of the simple reaction time for lower limb dominant (RT LL). The figure shows tasks performed with the lower extremity.

Each trial consists of 20 sensor activations with varying intervals between stimuli. After deactivating the light sensor, the participant must return to the neutral starting position while maintaining contact with the ground. RTs are recorded in seconds and milliseconds for each repetition. A single trial takes approximately one minute to complete. The test result is determined by calculating the average of the recorded RTs. Each participant completes two trials, and the lower average time in seconds from the two trials is used for analysis.

Statistical Analysis

The results are presented as mean ± standard deviation (SD). The Shapiro–Wilk test was used to assess the assumption of normality before performing parametric tests. Pearson's correlation coefficient (r), linear regression analysis, and the coefficient of determination (r^2) were used to analyze the relationships between the tests, particularly between RTs UL and HAT, as well as RTs LL and HAT, and to interpret the significance of these relationships. A significance level of 5% ($p \leq 0.05$) was established. Statistical analyses were performed using IBM SPSS version 25 for Windows.

Results

The correlation coefficient and coefficient of determination are statistical measures used to assess the relationship between two variables. In comparing the HAT and RTs, these measures help determine the strength and degree of association between the results of the two tests.

Table 2 presents the results of the average times (mean ± SD) and the minimum (Min) and maximum (Max) values of the administered tests. The range of times for dominant UL RTs varies from 0.342 to 0.523 s, while those of dominant LL RTs vary from 0.447 to 0.612 s. The HAT times range from 4.203 to 7.482 s.

Table 2. Mean values (mean ± SD) of upper limb simple reaction times (RTs UL), lower limb simple reaction times (RTs LL), and hexagon agility test (HAT) in the group (N = 44)

	RTs UL dominant (s)	**RTs LL dominant (s)**	**Hexagon test (s)**
Mean ± SD	.423 ± .052	.524 ± .048	5.717 ± .939
Min	.342	.447	4.203
Max	.523	.612	7.482

(s) = seconds; SD = standard deviation

The average time recorded for the dominant LL RT test (0.524 ± 0.048 s) is greater than that for the dominant UL RT test (0.423 ± 0.052 s), resulting in a difference of 0.101 s. Table 3 presents the correlation coefficient and coefficients of determination for the HAT tests, dominant UL RTs, and dominant LL RTs.

Table 3. Correlation coefficient (r) and coefficient of determination (r^2) values between the hexagon agility test (HAT) and upper limb simple reaction times (RTs UL), as well as between the HAT and lower limb simple reaction times (RTs LL), for the group of 44 participants (N = 44)

		RTs UL (s)	RTs LL (s)
Hexagon test (s)	Pearson correlation	.916**	.888**
	Coefficient of determination (r^2)	.839	.788
	Sign. (two-tailed)	.000	.000
	N	44	44

** the correlation is significant at the .01 level (two-tailed); (s) = seconds

A bivariate correlation matrix revealed a significant relationship between HAT and dominant UL RTs (r = .916; p < .05) and between HAT and dominant LL RTs (r = .888; p < .05). These significant relationships were visually represented using regression curves (Figures 4 and 5).

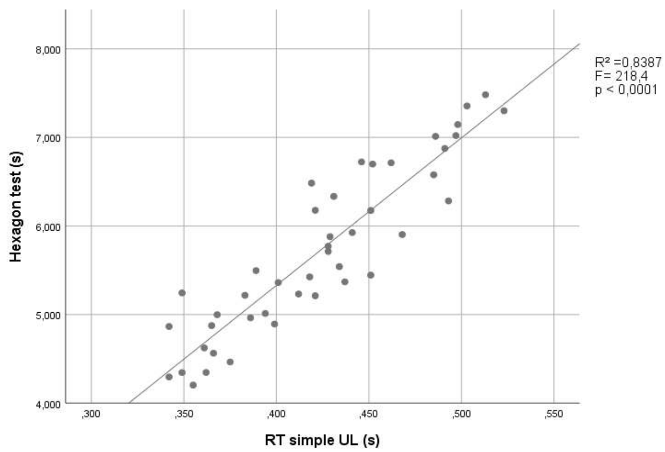

Figure 4. Simple dispersion with fitted curve of hexagon agility test (HAT) for simple upper limb dominant reaction times (RTs UL) in all participants (N = 44); (s) = seconds

Figure 4 shows a significant positive correlation ($R^2 = .8387$; $p < .0001$), indicating that lower minimum time values (s) for the HAT are associated with lower minimum time values (s) for the RT UL variable. Conversely, higher time values (s) for the HAT correspond with higher time values (s) for the RT UL. This suggests that as the values for RT UL increase, the values for HAT also tend to increase.

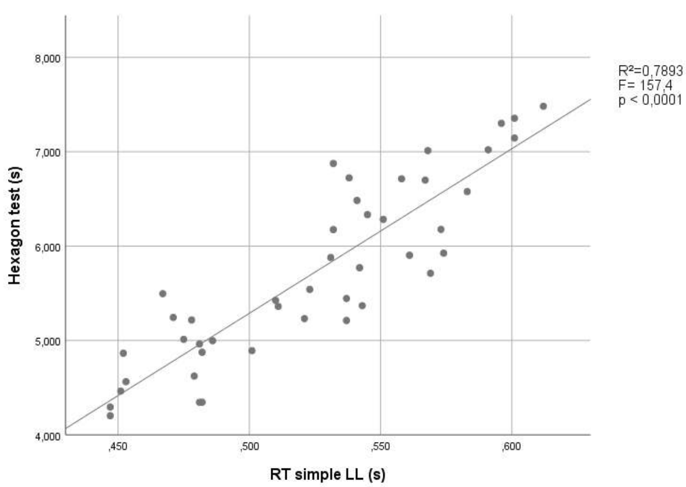

Figure 5. Simple dispersion with fitted curve of hexagon agility test (HAT) for simple lower limb dominant reaction times (RTs LL) in all participants (N = 44); (s) = seconds

Figure 5 shows a significant positive correlation ($r^2 = .7893$; $p < .0001$), suggesting that lower minimum time values (s) for the HAT correspond with lower minimum time values (s) for the RT LL variable. Similarly, higher time values (s) for the HAT are linked to higher time values (s) for RT LL. This indicates that as the values of the dominant LL RTs (s) increase, the values for the HAT variable tend to increase as well. A linear regression analysis was performed on the bivariate dataset to assess the predictive power of the scores from the dominant UL RTs (s) on the HAT chronometric values. The results, presented in Table 4, reveal a linear relationship between the variables. The regression equation for predicting HAT is expressed as:

$$HAT = 16.657 \times \text{RTs UL dominant (s)} + (-1.334)$$

Table 4. Standardized and unstandardized regression coefficients (B and Beta) for the linear regression between hexagon agility test (HAT) and simple reaction time upper limb dominant (RTs UL) in the experimental group (N = 44)

Model		Unstandardized Coefficients B	Standard error	Standardized coefficients Beta	t	Sign.
1	(Constant)	−1.334	.481		−2.776	.008
	RTs LL dominant (s)	16.657	1.127	.916	14.778	.000

Dependent variable: Hexagonal test; (s) = seconds

The HAT performance is significantly correlated with the RTs UL ($r = .916$, $p < .05$). This means that 92% of the variation in HAT scores can be attributed to the linear relationship with RTs UL (Table 4). A linear regression analysis was performed to determine the predictive ability of RTs LL on HAT chronometric values. The results (Table 5) showed a linear relationship between the variables. The regression equation predicts HAT performance based on RTs LL as follows:

$$HAT = 17.438 \times \text{RTs LL dominant (s)} + (-3.431)$$

Table 5. Standardized and unstandardized regression coefficients (B and Beta) for the linear regression between hexagon agility test (HAT) and simple reaction time lower limb dominant (RTs LL) in the experimental group (N = 44)

Model		Unstandardized coefficients B	Standard error	Standardized coefficients Beta	t	Sign.
1	(Constant)	–3.431	.732		–4.686	.000
	RTs LL dominant (s)	17.438	1.390	.888	12.544	.000

Dependent variable: Hexagonal test; (s) = seconds

The correlation between HAT performance and RTs LL is significant ($r = .888$, $p < .05$), indicating that 89% of the variance in HAT test results can be explained by the linear relationship with RTs LL dominant (Table 5).

Discussion

Agility is a "multiplanar or multidirectional" ability that involves acceleration, explosiveness, and responsiveness (Sheppard & Young, 2006). Few studies focus on the development of reaction abilities during the pre-pubertal period, although similar studies have been performed for boys and girls up to 10 years of age (Feč, 2010) or for adults (Der & Deary, 2006; Luchies et al., 2002). The mean values of the reaction tests RTs UL dominant (.423 ± .05) and RTs LL (.524 ± .048) in the analyzed sample are consistent with studies in the literature for the same age group (Bloomfield et al., 1994). RT, defined as the time interval between the presentation of a stimulus and the athlete's response, is essential for effective sports performance. Shorter RTs allow athletes to respond quickly to various stimuli during competition. Conversely, longer RTs to visual stimuli have been associated with an increased risk of injuries (Brinkman et al., 2020).

Anthropometric factors (age, weight, and height) were primarily used to assess the homogeneity of the reference sample because these factors have a relatively minor impact on the reaction capabilities being analyzed. Reaction skills tend to improve with age.

The period from seven years through the pre-pubertal and pubertal stages (ages 11–12 and 13–14) is considered a critical time for the enhancement of these abilities (Horníková et al., 2019). The ability to perform movements quickly and accurately in response to external stimuli is crucial for athletic performance (Galpin et al., 2008).

In the context of motor skills and sports, paradigms concerning RTs to visual stimuli are increasingly linked to methodological decisions that shape the analysis and design of motor tasks involving open skills. In these paradigms, participants must respond to a visual cue by rapidly activating a sensor using movements from either the UL (Wilkerson et al., 2017) or the LL (Yildirim & Kizilet, 2020).

The HAT is characterized as "a measure of foot agility and speed that involves balance and coordination abilities" (Baechle et al., 1994; Hernández-Davó et al., 2021; Paprancova et al., 2024; Pratama et al., 2023). Its high reliability in assessing agility reinforces its role as a valuable tool for evaluating athletic performance and LL agility (Beekhuizen et al., 2009).

Pearson correlation (r), linear regression, and coefficient of determination (r^2) were used to analyze the correlations between RTs UL and HAT, as well as RTs LL and HAT. These statistical methods help determine the significance of the relationships.

The results obtained from the sample of 44 participants revealed positive correlations between RTs UL and HAT ($p < .05$) and between RTs LL and HAT ($p < .05$). Gender differences did not affect the results (Figures 4 and 5). These findings are consistent with other studies that have demonstrated significant relationships between agility and RT tests involving visual stimuli for both ULs and LLs. Simple RT to visual stimuli is a measure of the efficiency of the neuromotor system (Chieffi et al., 2018; Moscatelli, Monda, et al., 2023; Platonov, 2004).

The structural components of agility that are related to the reaction capabilities of the ULs and LLs operate independently because they are associated with different body structures and their respective functions. Consequently, each component can have either a positive or negative influence on overall agility.

Research suggests that engaging in activities that promote motor reactions, particularly those relevant to defensive and offensive phases during competitions and training, can enhance reaction capabilities to visual stimuli and improve agility (Kucukipekci & Taskin, 2011).

Physical exercise and sports participation have positive effects on the RTs of both the ULs and LLs (Akarsu et al., 2009; Moscatelli et al., 2024). This information may encourage coaches and teachers to design specific motor exercises or tasks that can influence agility development.

The findings have practical implications for sports training and education. Coaches and physical educators should consider incorporating RT drills that engage both the ULs and LLs into their training programs. These drills could involve visual stimuli to enhance the neuromotor response, potentially leading to improved agility. Leveraging modern technological devices, such as the Fitlight Trainer™, offers accurate measurements and feedback, enabling the creation of more personalized and effective training programs.

Integrating contemporary perception–action devices into training or teaching processes is a promising area for future exploration. These devices, which seamlessly combine sensory input with motor output, have the potential to revolutionize training by providing real-time feedback and enhancing motor performance.

Further research could evaluate the extent to which these devices contribute to motor performance improvement and investigate whether their benefits extend beyond athletes to include the general population and individuals with specific training requirements.

Conclusions

The substantial correlations noted between RT and motor agility (HAT) corroborate the hypothesis that RT impacts agility in young athletes. Despite the limitations imposed by the sample size, this study showed that RT assessments with perception–action tools such as Fitlight could serve as statistically significant predictors of performance in field tests such as the HAT.

The accuracy and precision of these tools in measuring RTs are essential for coaches, educators, and other professionals. These tools allow coaches and teachers to effectively monitor individuals' agility performance, ensuring that observed changes are genuinely attributable to the individuals themselves rather than fluctuations in the device's functionality.

This reliability is crucial because alternative testing tools may exhibit varying levels of consistency when used in different contexts. Coaches may use RT measurements as valuable indicators to predict agility performance. In summary, this study underscores the complex relationship between agility and RT in young athletes, highlighting the significance of neuromotor efficiency in athletic performance.

The results suggest that incorporating specific reaction time training into agility exercises could enhance overall athletic performance.

Future research should continue to explore these relationships across diverse populations and training contexts to enhance our understanding of optimizing physical and cognitive training in sports. Furthermore, it is necessary to examine whether comparable correlations exist between sedentary individuals and those who do not engage in sports. Determining if non-athletic populations exhibit similar relationships between RT and agility could provide insights into how physical activity influences neuromotor efficiency across different demographics.

Additionally, exploring these correlations in individuals specializing in a single sport discipline would be valuable. Research has demonstrated that multidisciplinary and multilateral sports activities yield statistically significant improvements compared to single-discipline or sedentary groups. Therefore, examining whether athletes who focus on one sport exhibit different levels of agility and RT compared to those engaged in multiple sports would be beneficial.

Conflicts of interest

The authors do not have conflicts of interest to declare.

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