

10th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

OPATIJA, CROATIA, SEPTEMBER 12-15, 2024



CURRENT TRENDS AND INNOVATIONS IN KINESIOLOGY RESEARCH: *PROCEEDINGS*

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Dario Novak and Dario Škegro

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FOREWORD



Dear Conference participants,

With great pride and enthusiasm, we present the Proceedings of the 10th International Scientific Conference on Kinesiology, titled "Current Trends and Innovations in Kinesiology Research." This milestone event marks the tenth jubilee gathering since our inaugural conference in 1997 in the historic city of Dubrovnik. Over the years, this conference has grown in scope and significance, becoming a pivotal platform for exchanging knowledge and ideas in the field of kinesiology.

This year, we are delighted to feature more than 200 papers and abstracts, which will be presented in oral and poster formats. These contributions reflect the diverse and dynamic nature of current research in kinesiology, spanning a wide array of topics. We are honored to host ten invited lectures by esteemed scientists from around the globe, who will share their insights in the following sections: Adapted Physical Activity and Kinesitherapy, Medicine of Sport and Exercise, Biomechanics and Motor Control, Physical Education, Sports Recreation, Top-level Sport, Social Sciences and Humanities, Physical Conditioning and Injury Prevention, Management of Sport, Research Methodologies, Data Science, and Emerging Research Methods. We hope that everyone will find topics of interest and will advance their scientific and practical knowledge.

This conference brings together over 350 participants from 29 countries, underscoring the international appeal and collaborative spirit of our scientific community. Besides the fact that our institution educate professionals for Physical Education system wich is of crucial importance to us, we also educate professionals in the field of top-level sports. Some of those professionals were on the teams of Croatian athletes who won seven Olympic medals at the recent Olympic Games and we are especially proud of it.

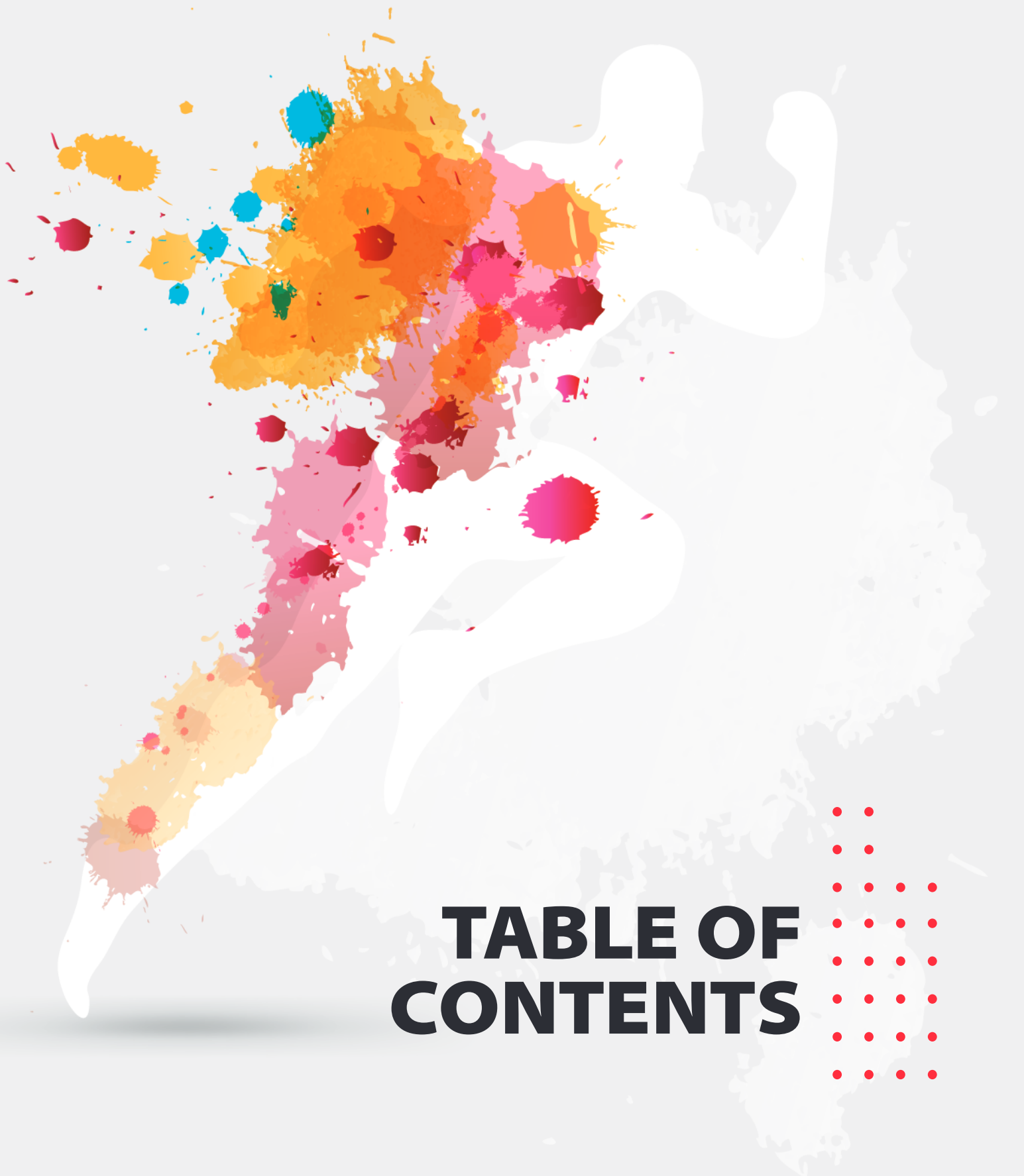
For the first time, the conference is co-organized with the Croatian Academy of Sciences and Arts, the most esteemed scientific institution in Croatia. This collaboration, along with our seven partner institutions: Masaryk University of Brno Faculty of Sport Sciences; Comenius University Bratislava Faculty of Physical Education and Sport; University of Novi Sad Faculty of Sport and Physical Education; Sports University of Tirana; University of Split Faculty of Kinesiology; Josip Juraj Strossmayer University in Osijek Faculty of Kinesiology; Beijing Sport University, and our collaborating institution, University of Ljubljana Faculty of Sport, exemplifies the strength and unity of our academic network.

We extend our heartfelt gratitude to all the authors, more than 500 of them, for their invaluable contributions. Special thanks go to the section editors for their tremendous editorial work, the technical editors of the Proceedings book, and all the individuals involved in organizing this successful scientific event. Your dedication and hard work have made this conference a great success.

This conference not only showcases the latest scientific advancements but also enhances the visibility of the Faculty of Kinesiology, University of Zagreb, on the world scientific map. We look forward to continuing this journey in 2027.

Editors

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THE RELATIONSHIP OF SKILLS, REACTION AGILITY AND COGNITIVE ABILITIES IN FOOTBALL

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Abstract

Introduction: The purpose of this study was to investigate the relationship of physical, technical, and cognitive parameters in specialized football classes. One hundred football players (dec. age 11.17y to 14.8y) performed a test of ball dribbling, reactive agility, and a test of divided attention. **Methods:** Differences in terms of age were determined using the Kruskal-Wallis' test and T-test. Spearman's correlation analysis was used to determine relationships between variables (slalom with the ball, reaction agility with the ball, response time, and decision efficiency). **Results:** Differences by age were found in the level of ball dribbling ($p=0.006$) and reaction agility with the ball ($p=0.003$), differences in the level of divided attention were not found. Relationship analysis confirmed a negative relationship between decision efficiency and response time ($r=-0.978$ to 0.881); special skill and reaction agility time ($r = 0.721$ to 0.452). **Conclusions:** It was found that reaction agility time with the ball was not predicted by cognitive abilities. In conclusion, the mutual conditionality of ball dribbling, reactive agility with the ball and divided attention was only selective and unique. These findings suggest that special skills and decision-making are likely to have different predictors.

Keywords: *football, cognitive abilities, divided attention, special skills, reactive agility*

Introduction

Achieving the best possible result in sports is connected with the acquisition of motor skills of players, which directly affect the performance of movement, i.e. speed, automation, accuracy and adaptability (Wei & Luo, 2010). Demanding sports require extraordinary physiological abilities combined with excellent abilities in motor control, perception and cognitive functions (Nimmerichter et al., 2016; Scharfen & Memmert, 2019). These refer to the ability to identify and obtain information about the game environment in order to integrate it with existing knowledge (Marteniuk, 1976). It is generally known that all gaming activities of the player are not isolated but are always connected with other factors. However, the relationship between them is discussed in the literature, respectively. share of individual factors. Some studies have found strong, positive relationships between physical activity and cognitive outcomes (Fedewa & Ahn, 2011; Paško et al., 2021), while other studies report small, negative associations (Baláková, Boschek & Skalíková, 2015; Granacher & Borde (2017). In general, there are many studies that confirm that athletes are characterized by a better level of cognitive abilities than non-training people (Nakamoto & Mori, 2008; Ghuntla et al., 2012). Although the relationship between reaction agility and cognitive abilities has been proven (Yaktas, 2019), new tests of reactive agility that are designed according to the type of sports specialization are needed.

Huijgen et al. (2015) also demonstrated that cognitive abilities depend on the training level of young soccer players. However, it should be noted that previous research has focused mainly on the cognitive abilities of elite adult athletes (Mann et al., 2007; Voss et al., 2010), but there are far fewer studies on youth elite players - especially in the age range from 9 to 14 years. In addition, number of studies have been carried out at the level of brain and functional operations, so they should also be analyzed at the level of behavior. Current knowledge supports the thesis that the improvement of motor and cognitive skills is related not only to general movement activity, but also to specific skills related to the ball (Alesi et al., 2015). Acquiring skills associated exclusively with planned activities does not provide an optimal environment for their development, because young players are not confronted with the need to make a correct, fast and effective decision.

Activities with the ball are mostly associated with decision-making processes because they combine mental components and physical structures. Football stimulates not only simple technical elements during training, but also motor and cognitive growth, specifically attention skills. Focusing consciousness on certain objects allowing optimal information reception is a process of attention (Gregor, 2013). Already at the age of 9, soccer players show lower reaction times and more increased decision-making abilities than their sedentary peers (Chang et al., 2013). The exact decision was in the work of Baker, Cote & Abernethy (2003) identified as an important factor of successful performance in team sports. However, there is a hypothesis that the quality and accuracy of decisions can be influenced by various covariates, such as physical and sports age, expertise (Sierra-Diaz et al., 2017; Araújo et al., 2017), as well as acute factors such as fatigue (Russel et al., 2019).

Following on from the above, the aim of this study was to determine the relationship between soccer dribbling speed, reaction agility and cognitive abilities (divided attention) in the age group of 11-14-year-old young soccer players.

The object of the research were young players ($n=100$) of the Nitra football academy aged 11-14 in three categories U11 ($n=20$; $x=148.1 \pm 2.7$ cm, 40.1 ± 2.2 kg), U12 ($n=37$; $x=151.5 \pm 3.7$ cm, 45.4 ± 3.9 kg) and U14 ($n=43$, $x=166.8 \pm 3.1$ cm, 53.9 ± 3.3 kg). For organizational reasons, the U13 category was absent. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and approved by the institutional review board. Participants and their parents were informed about the risks of the study and provided written informed consent to participate.

Study Design

The test procedures were performed indoors under standard light and temperature conditions. For reasons of maximum concentration, the cognitive test was performed at the beginning of the training, while the tested person was alone in the room in the presence of the administrator. After its completion, a 20-minute warm-up was performed, which consisted of jogging (5 min.), dynamic stretching of the lower limbs (10 min.) and 5 minutes of progressive speed running with and without a change of direction (50-90% max). The warm-up was followed by skill and agility testing. The research data were obtained using precise measuring equipment - a Witty electronic timer (with an accuracy of 0.01s), light semaphores Witty SEM (Micrgate) and common aids (meters, meter).

Three tests were performed:

1. Test of cognitive abilities - Divided Attention. The proband was assigned a task based on a predefined level. When two shapes are displayed on traffic lights B and C, the user selects one of the two responses by bringing the palm of the hand to one of the two traffic lights, e.g. answer "Y" (if you see two different shapes), or answer "N" (if you see two identical shapes).

2. Modified Y-Test (Lockie et al., 2014)

a) Special skill – slalom (Fig. 1). The proband had to cross the slalom between 4 goals, 1m apart from the start to photocell no. 2 (5m from the start – section I.).

b) Reactive agility: After passing photocell no. 2, the shape of an arrow (right or left) was displayed on the traffic light. The tested person guided the ball according to the specified direction through photocell no. 3 (section II.), 3 m away from photocell no. 2. Evaluation: In the slalom, we evaluated the proband's time in section I and in section II., with an accuracy of 0.01s. The test of ball control and reaction agility took place without interruption.

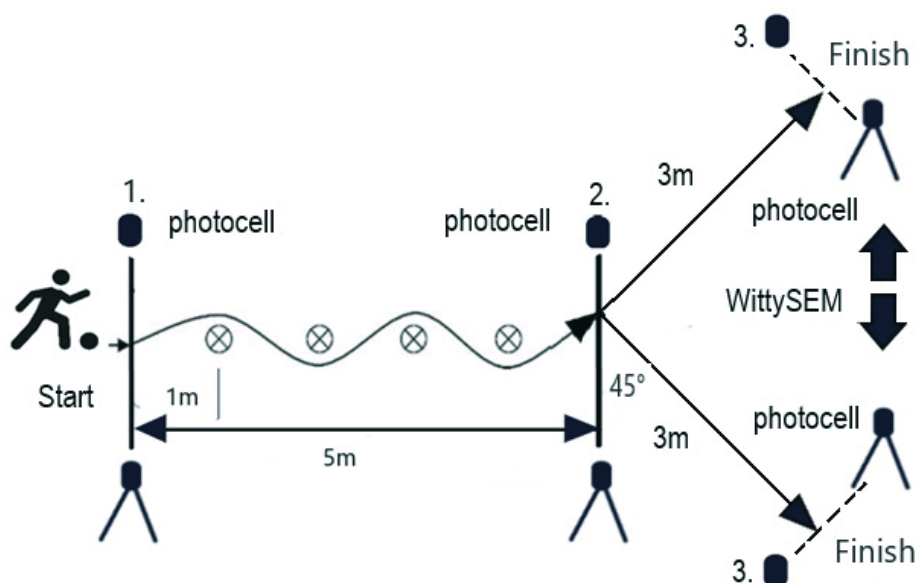


Figure 1 Modified Y agility test

Statistical Analysis

Analysis of data obtained from the study was analyzed using standard MS Office tools and statistical software SPSS version 16.0. Basic descriptive statistics were determined (means and standard deviations). A Shapiro-Wilk test was performed to verify that all data met the assumption of normality of data distribution. The agreement of the selection distribution functions of the compared sets was verified using one-factor analysis of variance - Kruskal-Wallis ANOVA test; the hypothesis of a difference in the means of two independent groups was verified by a two-sample t-test. An independent samples t-test was used to evaluate the difference in the means of two groups. In all cases, the significance level $p = 0.05$ was chosen. Spearman's correlation coefficient (ρ) was calculated to determine univariate associations between variables, while the age of the probands was not taken into account.

Results

In motor indicators, we found a gradual increase in performance (decrease in time) - ball control (5.20 - 4.08s) and reaction agility (2.71 - 2.39s). In cognitive indicators, there was a reduction in the reaction time of distracted attention (2.15 - 1.35s) and an increase in reaction efficiency with increasing age (61.95 - 66.97%). The significance of the differences between the three age categories (table 1) was found only in motor indicators: the level of skill - driving the ball ($p = 0.007$) and in reaction agility ($p = 0.013$), it was not demonstrated in the monitored cognitive indicators.

Table 1 Kruskal-Wallis ANOVA test (3 age categories)

Tests	Age category (U11 – U12 – U14)			
	χ^2	df	p	ξ^2
Divided Attention / time (s)	0,459	2	0,795	0,0094
Divided Attention / efficiency (%)	1,131	2	0,568	0,0231
Special Skills/dribbling/s	9,907	2	0,007	0,2022
Reactive agility Y test/s	11,54	2	0,013	0,2356

In the partial analysis of the differences between the individual categories (tab. 2), the statistical significance of the differences was found only in the case of the comparison of the U12 and U14 categories: ball control ($p = 0.006$) and reaction agility ($p = 0.003$).

Table 2 Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	df	Sig. (2-tailed)
Special Skills/dribbling/s	Equal var. assumed	3,506	0,036	427	0,006
	Equal var. not assum.				
Reactive agility Y test/s	Equal var. assumed	4,012	0,047	411	0,003
	Equal var. not assum.				

Correlation analysis (tab. 3) confirmed statistically significant relationships between cognitive factors. There was a strong dependence between effectiveness (DA/eff.) and reaction time in distracted attention (DA/time), ($\rho = -0.881$, $p < 0.01$), but with a negative polarity. We observed an equally strong dependence between reaction agility time (RA Y) and skill time ($\rho = 0.721$, $p < 0.01$). Among the other indicators, we did not find a significant association.

Table 3 Correlation analysis of factors – Divided Attention, Dribbling and Reactive agility

		DA / time (s)	DA/ eff./%	SS/dr./s	RA Y/s
DA/ time (s)	Spear. ρ	—			
	df	—			
	<i>p-value</i>	—			
DA / eff. (%)	Spear. ρ	-0,881	—		
	df	40	—		
	<i>p-value</i>	< .001	—		
SS/dr./s	Spear. ρ	-0,198	0,165	—	
	df	40	40	—	
	<i>p-value</i>	0,208	0,298	—	
RA Y/s	Spear. ρ	-0,227	0,219	0,721	—
	df	40	40	40	—
	<i>p-value</i>	0,148	0,163	< .001	—

Notes: DA/ time (s) - Divided Attention / time (s); DA / eff. (%) - Divided Attention / efficiency (%); SS/dr./s - Special Skills/dribbling/s; RA Y/s - Reactive agility Y test/s

Discussion

Our findings contribute to a comprehensive understanding of the approach to the sports training of young football players. The results confirm the continuous growth of skills, agility and cognitive abilities in all categories of football players. From the point of view of age, we found significant differences in the level of agility and dribbling, but not in reaction speed and success in the divided attention test. Our findings are consistent with Valente Dos Santos et al., (2012), who claim that overall skill performance in dribbling improves with age and training, and is predicted by body height, respectively, stage of maturity and experience (Malina et al., 2007). Similarly, Frensen et al. (2017) state that agility shows continuous development up to the age of 15 to 17 years. Our results indicate that agility performance accelerates more dynamically than dribbling, which may be a consequence of the fact that abilities are natural, but skills learned. We also found that efficiency in the divided attention test is inversely proportional to reaction time and that it does not associate with reaction agility, not even dribbling. Attention, as a regulatory mental phenomenon, accompanies these processes (Vişan, Stoica & Dreve, 2022).

The probable cause is the absence of wider contextual information of the game. However, research confirms that cognitive training can change the size or number of brain regions involved and change the pathways used by the skill (Posner & Patoine, 2009). Although there are different views in sports science on the causes of differences in player performance, the authors (França et al., 2022) agree that the primary factors are the specificity and volume of preparation, individual limitations, psychological factors, technical and tactical skills, anthropometric and physiological factors, influence of relative age, or socio-cultural influences.

Conclusion

The identification of performance requirements in the specific activities of a player in a match is essential to create appropriate training programs to optimize the load. This study provides further evidence of the interdependence of cognitive, or physical factors in performing complex (sports) motor skills. The results of this study indicate that (a) both physical and cognitive performances continuously increase with age; b) the dynamics have a progressive tendency, especially in physical parameters; c) reaction time and effectiveness in distracted attention are mutually associated, but negatively; d) performance in reaction agility and ball handling are mutually dependent. Physical and mental development have different dynamics, their mutual associations are currently not fully explored. Many studies suggest that certain aspects of cognitive abilities, including attention (such as divided attention), reach their peak between the ages of 20 and 30. However, divided attention (DA), as one of several cognitive abilities, does not appear to be a moderator of reactive agility performance, in part because physical components of performance may be prioritized over attentional components. The environmental conditions during testing probably did not provide the subjects with enough contextual information in the form of spatial and temporal stressors of the match. Since the content of the reaction agility test was based only on the speed and speed of reaction to light, and the performance was not related to cognitive factors, further studies should be conducted in order to investigate which other factors condition the player's decision-making in the context of the game.

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**CURRENT TRENDS AND INNOVATIONS
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