

Relationship between psychomotor skills and game performance in youth soccer players

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Abstract

Introduction: Identification of talent in soccer is a continuous process, and searching for new tools enables the selection of future professional players. Because perceptual–cognitive abilities are crucial for the mastery of soccer, there should be tools enabling the identification of those skills. **Objective:** The aim of the study was to define the prognostic value of a laboratory test for assessing psychomotor skills in the selection of 11–14-year-old elite soccer players. **Materials and methods:** In total, 64 players in four age categories (U12–U15) participated in this study. They were selected from among a group of 432 players based on their results in physical fitness tests. The study was conducted in two one-day research sessions. On the first day, using the Determination Test (DT) from the Vienna Test System, the levels of the players' psychomotor performances were assessed, and on the second day, their soccer skills were assessed in 4 vs. 4 games with goalkeepers on a pitch with an artificial surface. The players were randomly divided into teams of four (with unchanging goalkeepers), and each of them played six 7-minute matches. Their game was evaluated by five expert coaches using the Soccer Game Performance Assessment Instrument observation sheet (SGPAI). Pearson's linear correlation was used to examine the correlation between the results of the DT test and the expert rating. **Results:** Satisfactory correlation between the number of correct reactions obtained by the DT test and the expert rating of their game skills was found in players of all ages, except for the oldest group, and the strength of this relationship decreased with the tested players' ages. **Conclusions:** The Vienna Test System determination test is a useful tool in the selection of young soccer players, especially those in the youngest age categories.

Keywords: soccer, perceptual–cognitive abilities, game performance

Introduction

For many years, there has been a continuous scientific discussion on talent identification in soccer (Berkamp et al., 2019; Williams et al., 2020). Researchers search for anthropometric, physiological, motor, technical, tactical, and psychological indicators that allow early recognition of future masters (Gil et al., 2007; Mujika et al., 2009; Le Gall et al., 2010; Kannekens et al., 2011; Ford & Williams, 2012; Huijgen et al., 2014; Hirose & Seki, 2016). In the practice of soccer, various research tools are used to select young players, i.e., field tests (Svensson & Drust, 2005; Huijgen et al., 2013; Dodd & Newans, 2013) and small-sided games (Figueiredo et al., 2009; Fenner et al., 2016; Rowat et al., 2017; Van Maarseveen et al., 2017). Their diagnostic value is compared (Chamari et al., 2004) and a need for their rational use, i.e., the selection of those that best assess specific individual properties (Williams et al. 2020), has been indicated. For example, it has been confirmed that locomotor speed most strongly determines a soccer player's level, regardless of his biological development (Murtagh et al., 2018) or the level of competition (Gonaus & Muller, 2012). However, unambiguous determination of the value of selection indicators is impossible due to the individual dynamics involved in the development of personal properties (Johnston et al., 2018; Murr et al., 2018a). The importance of motor field tests in the selection process has been emphasized (Dodd & Newans, 2018), especially for young players (Reilly et al., 2000; Lipińska & Swarc, 2016; Tvrđy et al. 2020); however, their prognostic value should be considered in the context of biological (Malina et al., 2000; Gil et al., 2007; Rubajczyk & Rokita, 2018) and psychomotor (Kannekens et al., 2009) development and usefulness for play in a specific position (Mendez-Villanueva et al., 2013; Gil et al., 2014; Schumacher et al., 2018). Additionally, talent identification is a lengthy process, and the earlier the talent level is determined, the greater the risk of erroneous prediction (Gonçalves et al. 2012; Williams et al. 2020).

Team sport games, especially soccer, are characterized by frequent changes in the game situation that require quick and adequate reactions from the players. It is believed that a player is better and makes decisions that are more effective in increasingly difficult game situations (Roca et al., 2012; Akenhead & Nassis, 2016; Kiss & Balogh, 2019). It has been emphasized (Murr et al., 2018b) that perceptual–cognitive abilities are of particular importance in the talent identification process in soccer. Kannekens et al. (2011), Huijgen et al. (2014), and Andrade et al. (2020) recognized tactical skills (positioning and deciding) as predictors of young

players' future successes. Anticipation, perception, attention properties, quick decision-making, and response should be considered the most important determinants of soccer talent. Moreover, it must be remembered that in the selection process of young players it is necessary to take into account many different factors that determine their physical, motor, mental, and sociological potential (Christensen, 2009; Vandendriessche et al., 2012; Unnithan et al., 2012; Murr et al., 2018a; Berkamp et al., 2019; Kelly & Williams, 2020).

The purpose of this study was to determine the prognostic value of the decision-making test in the selection of elite male youth soccer players (12–15 years old). The following research question was formulated: what is the strength of the correlation between results achieved by youth elite soccer players of different age categories in the test of a complex differential reaction and their game skills as assessed by experts in small-sided games?

Material & methods

Participants and Procedure

In total, 64 young soccer players aged 11 to 14 participated in the study. The research group was previously selected from 432 young soccer players from 8 clubs from Gdansk (Lechia Gdańsk, Gedania 1922 Gdańsk, Pomerania Gdańsk, Jaguar Gdańsk, Portowiec Gdańsk, Olimpia Osowa Gdańsk, EX Siedlce Gdańsk, Sparta Gdańsk) based on their results in special physical fitness tests: the 30-m race, standing long jump, driving the ball in slalom, and shots on the goal (PZPN, 2016). The selected study participants were divided into four groups of sixteen according to their calendar age (U12 – U15), and then they were tested for selected psychomotor skills using the Determination Test from the Vienna Test System (Schuhfried, 2013) and expert assessment of game skills using the Soccer Game Performance Assessment Instrument observation sheet (Szwarc et al., 2015).

Measurements and Instruments

Determination Test (DT)

The Determination Test (Decision Test, i.e., a test of general abilities, which assesses stress tolerance and complex reactions to continuous, rapidly changing stimuli and detects a reduction in attention) was used to evaluate psychomotor skills. Form S1 (adaptive short) with the adaptive mode of change was used for the study. The test lasted 8 minutes. The subject's task was a motor response to visual and sound stimuli switched with increasing speed. The following were assessed: the number of correct reactions, the number of incorrect reactions, and the number of missed responses.

Expert assessment of game skills (SGPAI)

The Soccer Game Performance Assessment Instrument was used to assess the skill levels of the examined players (Appendix). Each player's game was evaluated by five expert coaches (2 with an UEFA Pro license, 3 with an UEFA A license) in six 7-minute matches. The matches were played in the 4 vs. 4 + GK formula (with unchanging goalkeepers, playing field 46 × 30 m, goals 5 × 2 m). After each match, teams were randomly selected for the next meeting. Based on the arithmetic mean of expert ratings, players were ranked according to their game skills.

Statistical analysis

All statistical analyses were conducted using Statistica 13.0 (Tulsa, OK, USA, 2016). The data sets were assessed using the Shapiro–Wilk test for normal distributions. Possible relations between test results and match performance were calculated using the Pearson correlation.

Results

According to the criteria for assessing the strength of the correlation proposed by Chan (Chan, 2003), no strong or very strong linear correlations between the number of correct reactions obtained in the Determination Test and the expert assessment of game skills was found in any group of the tested players (Table 1). In contrast, in three out of the four age groups, a satisfactory correlation was found ($r = 0.361$ in the U14 category, $r = 0.403$ among U13 players, and $r = 0.59$ for players in the U12 category). In the oldest group (U15), the strength of the correlation was weak and was 0.258. Of note, for players of all ages together, the strength of the correlation was satisfactory ($r = 0.3450$), but it decreased with the examined players' age.

In addition, the DT test showed a strong and very strong negative linear correlation between the mean (median) results of the stimulus response time and the number of correct responses in all studied groups (PCC was 0.722 among players from the U13 category—a strong correlation; in the remaining groups, PCC was above 0.80—a very strong correlation).

This means that as the average response time to a stimulus was becoming shorter, and young players of all ages executed more correct responses to the given optical and audio signals (Fig. 1, Tab. 1). In turn, a satisfactory negative linear correlation between the number of correct reactions and the number of missed responses to stimuli (weak in the oldest group of subjects U15) seems obvious—with a greater number of correct answers, the number of signals to which the players did not respond decreased.

Table 1. Correlation matrix (PCC) between the results of the determination test (DT) and the results of the expert game assessment (SGPAI) for the examined players from particular age categories

All respondents U15 U14 U13 U12	Arithmetical mean	Standard deviation	DT – correct reactions	DT – incorrect reactions	DT – missed stimuli	DT – median of response times	SGPAI – game assessment
DT – correct reactions	234.733	33.566		0.193	-0.521*	-0.842***	0.345*
	244.500	34.011		0.125	-0.267	-0.825***	0.258
	245.947	23.465	1.000000	-0.066	-0.354*	-0.802***	0.361*
	226.600	26.005		0.357*	-0.305*	-0.722**	0.406*
	222.166	43.844		0.290	-0.727**	-0.884***	0.594*
DT – incorrect reactions	30.933	14.278	0.193		-0.091	-0.298*	0.007
	28.944	8.285	0.125		-0.176	-0.173	0.149
	33.316	14.275	-0.066	1.000000	0.336*	-0.206	-0.015
	28.900	11.369	0.357*		-0.135	-0.395*	-0.348*
	32.667	20.976	0.290		-0.245	-0.400*	0.156
DT – missed stimuli	17.413	5.898	-0.521*	-0.091		0.184	-0.140
	16.167	5.148	-0.267	-0.176		-0.038	-0.232
	16.684	4.372	-0.354*	0.336*	1.000000	-0.245	0.091
	17.650	5.254	-0.305*	-0.135		-0.038	0.040
	19.167	8.262	-0.727**	-0.245		0.399*	-0.441*
DT – median of response times	0.766	0.086	-0.842***	-0.298*	0.184		-0.267
	0.743	0.078	-0.825***	-0.173	-0.038		-0.342*
	0.740	0.068	-0.802***	-0.206	-0.245	1.000000	-0.333*
	0.775	0.064	-0.722**	-0.395*	-0.038		0.028
	0.806	0.117	-0.884***	-0.400*	0.399*		-0.560*
SGPAI – game assessment	6.240	9.241	0.345*	0.007	-0.140	-0.267	
	3.722	7.442	0.258	0.149	-0.232	-0.342*	
	6.684	8.907	0.361*	-0.015	0.091	-0.333*	1.000000
	6.450	10.313	0.406*	-0.348*	0.040	0.028	
	8.056	10.149	0.594*	0.156	-0.441*	-0.560*	

***very strong ($r \geq 0.80$); **moderately strong ($r = 0.60-0.79$); *fair ($r = 0.3-0.50$)-

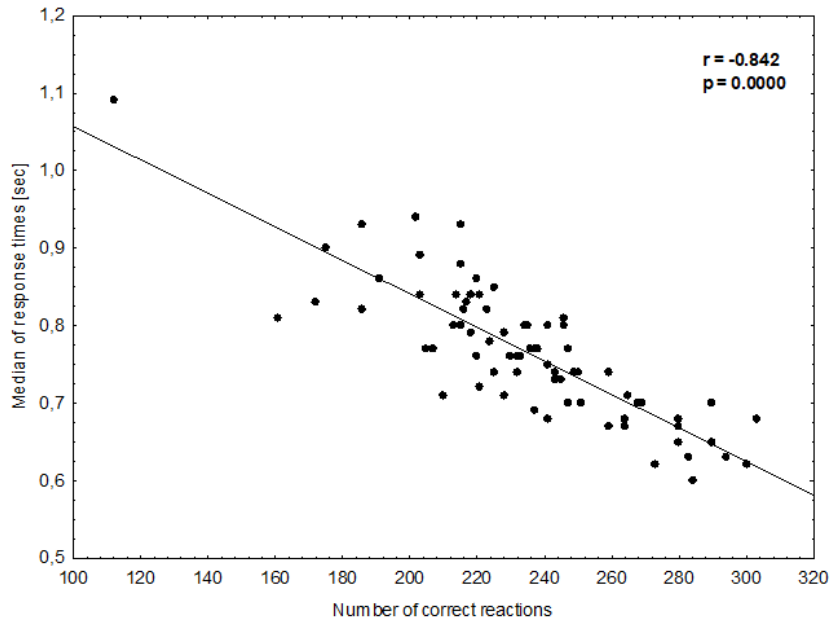


Fig. 1 Correlation between mean results of the stimulus response time and the number of correct responses in all the studied groups

Discussion

A high level of psychomotor skills is an important determinant of success in team sports games, including soccer (Reilly et al., 2000; Kannekens et al., 2011; Huijgen et al., 2014; Huijgen et al., 2015; Schumacher et al., 2018; Akenhead & Nassis, 2016; Murr et al., 2018). Therefore, the purpose of this study was to determine the prognostic value of the determination test (DT) in the selection of 11–15-year-old soccer

players. This study of psychomotor skills was conducted in accordance with the research methodology of the Vienna Test System (Schuhfried, 2013), which are tests frequently used to determine the psychomotor potential of athletes in various sports disciplines (Johne et al., 2013; Vila-Maldonado et al., 2014; Wilczyńska, 2016; Kiss & Balogh, 2019) but rarely used in studies on soccer players (Schumacher et al., 2018; Baláková et al., 2015). In turn, the levels of young players' soccer competences were evaluated with the use of SGPAI by tracking their efficiency of individual and group actions in 4 vs. 4 small-sided games (Szwarc et al., 2015), a format that is considered optimal in shaping physical capacity and improving soccer skills (Sarmiento et al., 2018).

The assessment of the level of psychomotor skills in 64 elite youth soccer players (U12–U15) made with the DT test indicated a very strong negative linear correlation between the median response time to the provided optical and audio signals and the number of correct responses (all subjects $PCC = 0.842$). This means that young players, combined with the increasing time limit, made more decisions that were correct. Of note, the examined players were characterized by a very high level of soccer competence. They were selected from a group of 432 boys practicing soccer; thus, it could be assumed that their achievements in DT would be very good. The results of this study confirmed this assumption.

Roca et al. (2012) found that the average number of hours spent on soccer training in youth strongly determines the players' subsequent achievements. This is evidenced by the results achieved by adult soccer players in anticipation and decision-making tests. In turn, Schumacher et al. (2018) noted, when they studied selected perceptual–cognitive abilities using the VTS, that age and soccer experience significantly differentiates sustained attention among elite youth soccer players (they studied players in 8 age categories from U12 to U23). Searching for soccer talent indicators (a study of 91 players aged 13 divided into two groups by 40 experts using the Talent questionnaire), Balákowa et al. (2015) noticed that only 1 out of 16 cognitive abilities (time/movement anticipation) assessed by the VTS tests significantly differentiated the players in the talented group from players considered less talented. Vätinen et al. (2010) confirmed that the level of general perceptual motor skills increases with young soccer players' maturation (the study used laboratory tests of soccer players in the U10–U14 age categories), but these are soccer-specific perceptual abilities that become stronger predictors of sporting success with the young player's age. Adding Wilczyńska's findings (2016), who examined highly qualified rowers, confirmed that their high resistance to stress strongly positively correlated with the number of correct decisions in DT and helplessness in a difficult situation with a lack of response to stimuli. Thus, the training experience and the high level of certain discipline-specific psychological and psychomotor dispositions are important determinants of an athlete's sport proficiency. This conclusion was also confirmed by the results of our study. The strength of the correlation between general perceptual motor abilities (measured by the number of correct reactions and missed responses in the DT test) and expert assessment of game skills (an assessment of soccer-specific perceptual abilities in the game) decreased with age and as soccer experience was gained by the studied players (PCC – satisfactory and the highest in the youngest group of subjects (U12), satisfactory but weaker in groups U13 and U14, and weak in group U15). The decreasing strength of the correlation between the results of the DT test and achievements in small-sided games in the groups of increasingly older players may mean that with age and training experience of boys talented in soccer, the importance of the DT test in identifying their soccer talent also decreases.

Conclusion

The aim of rationally conducted sport training in team sports is the systematic development of dispositional and situational abilities of the competitor. In this context, controlling the level of select components of physical fitness is an extremely important issue. A diagnosis of the state of personal disposition of a player should be conducted in a wide range because efficient performance in games depends not only on their sports level but also on the ability of compensating the level of some dispositions by a higher state of other ones and on the ability for individual performance and cooperation (*compensation phenomenon*).

In our study, we confirmed the findings of other research teams that the importance of general perceptual motor abilities in achieving sport successes decreases with age and increases with time devoted to training and sports experience. Therefore, we recognize that testing psychomotor skills with a use of VTS can help identify soccer talent, especially among players in the youngest age categories.

Conflicts of interest - There were no potential conflicts of interest.

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Appendix - Observation sheet Soccer Game Performance Assessment Instrument

Player's number	Player	Individual actions						Group/team actions				Total score	
		Positioning of the game	Creating situations to score goals	Scoring goals	Gaining control of the ball	Interrupting actions	Interfering in gaining the field of play	Positioning of the game	Creating situations to score goals	Counteracting the positioning of the game	Counteracting creating situations to score goals		Counteracting scoring a goal
1													
2													
3													
.....													

Individual actions performed in a 1-on-1 game:

- a) *positioning of the game* (ball possession and gaining the field of play) – action of the player with the ball against a rival within the so-called reach of play (field around the player with the ball in a 2-m radius), as a result of which the competitor is moving with the ball or ball possession—dribbling, controlling, shielding with the ball, and bounding the ball off the opponent
- b) *creating a situation to score a goal* – action of the player with the ball against a rival within the reach of play, as a result of which the competitor gains an opportunity to shoot—dribbling, controlling, and shielding with the ball in a 1-on-1 game
- c) *scoring a goal* – action of the player with the ball taken against a rival within the reach of play whose aim is to shoot or to gain temporary freedom to shoot—leg shot, headshot, situational shots, performed with the opponent’s attendance or in a situation of free actions
- d) *gaining control of the ball* – action of a player without the ball within the reach of play of the rival with the ball, as a result of which the player gains control of the ball—overtaking—takeover of the ball, retrieving the ball, forcing the opponent to make a mistake, and blocking and pushing the opponent
- e) *interrupting actions* – action of a player without the ball who is within the reach of play of the rival with the ball, as a result of which the player is kicking out—overtaking—kicking the ball out, blocking a pass/shot, and forcing the opponent’s mistake (ball still in the rival’s possession)
- f) *interfering in gaining the field of play* – action of a player without the ball being within the reach of play of the rival with the ball, as a result of which the one having the ball is forced to hold in place or to move with it in a direction parallel to the goal line or towards his own goal or to pass it to a partner – covering and positioning himself against the opponent, blocking, and pushing out

Actions performed in conditions of cooperation:

- a) *positioning of the game* (ball possession and gaining the field of play) – passing the ball between offensive players to possess it in a situation of a rival’s/rivals’ counteraction—keeping the ball and crossing, playing the ball without a pass (first-time pass), moving to an open space, supporting the ball carrier, clearing out of the field for another player to come in, overlapping run, and screens
- b) *creating a situation to score a goal* – passing the ball between offensive players in a situation of opponents counteracting, as a result of which the competitor gains an opportunity to shoot or to pass the ball enabling his partner to shoot at the goal—assistance (perpendicular, crosses), playing the ball without a pass (first-time pass), moving to an open space, supporting the ball carrier, clearing out of the field for another player to come in, blocks, and changes in the area of action
- c) *counteracting the positioning of the game* (ball possession and gaining the field of play) – action of players without the ball, as a result of which competitors effectively prevent the opponent from ball possession or gaining the field of play—duplication, tripling, play to offside, shortening and narrowing the field, blocking players, assistance and passing, and eliminating the opponent’s temporary advantage
- d) *counteracting creating situations to score goals* – action of players without the ball, as a result of which competitors prevent an effective pass to the competitor that is in a situation enabling him to score a goal—duplication, tripling, play to offside, blocking a player with or without the ball, assistance, and passing.
- e) *counteracting scoring a goal* – action of players without the ball who are within reach of play of the rival with the ball, as a result of which competitors prevent scoring a goal—simultaneous duplication, consequent duplication, blocking, and pushing the rival (retrieving the ball, stopping action)
- f) *cooperation in set pieces of the game* – in defense: taking position, blocking players, assisting partners, "active zone" (organized migration towards the player with the ball); in offense: changes in the area of action, creating temporary advantage and free areas, screens