Comparison of decision-making skills between Under-14, Under-16, and Under-17 soccer players

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Abstract:

The tactical component and the cognitive mechanisms associated with decision-making are considered to be fundamental to a higher sport performance in soccer. However, there are few instruments capable of evaluating cognitive aspects based on game concepts. Recently, the TacticUP® video test for soccer was developed and validated. This instrument helps to evaluate the ability to “read” the play and the response time of decision-making of soccer players according to the core tactical principles of soccer. The aim of this study was to compare the quality and response time of decision-making of Under-14, -16, and -17 soccer players affiliated with a Brazilian club. A total of 37 players were evaluated by TacticUP®. The Shapiro–Wilk test and one-way ANOVA with Tukey post hoc were applied, considering $p < 0.05$. The obtained results showed that there was no difference in the quality of decisions associated with tactical principles. However, there was difference in the response time of decision-making. The Under-16 and -17 players showed faster response time for decisions associated with the principles “Penetration”, “Width and Length with and without the ball” and “Offensive Unity” compared to their younger counterparts. The response time of Under-17 players was faster for the principles “Offensive Coverage” and “Depth Mobility” compared to Under-14 players. In addition, a faster response time was observed in Under-16 and -17 players for the principle “Concentration”. Finally, Under-17 players showed faster response for “Delay” and “Defensive Balance” compared to Under-14 players. It is concluded that Under-16 and -17 players make faster decisions in both offensive and defensive actions (both closer or further from the ball) compared to Under-14 players.

Keywords: Tactical, Response Time, Cognition, Evaluation

Introduction

In soccer, the tactical component and the cognitive mechanisms associated to decision-making are considered as fundamental to a higher sport performance (Karpa et al., 2021; Silva, Conte, & Clemente, 2021). In such context, scientific studies were conducted to show that tactical knowledge expressed by the players' actions are essential factors to success in soccer, whether on an individual or collective standpoint (Andrade & Teoldo, 2015; Popovych et al., 2021; Silva, Costa, Casanova, Clemente, & Teoldo, 2019) since players showing better tactical performance can adapt better to changes in situations of play (Silva, Lopes, Gonzáles-Villora, Sarmento, & Teoldo, 2021). In agreement to various concepts presented in the literature, tactics can be defined as the management of the space of play (through positioning and movement) by the players and teams (Teoldo, Guilherme, & Garganta, 2017).

Nevertheless, the management of the space of play depends on the player's game reading skills (Teoldo et al., 2017). Therefore, in addition to the analysis of the tactical component, researchers have investigated skills performed before tactical actions (Andrade, Machado, Gonçalves, Teoldo, 2021; Roca & Ford, 2020; Assis, Gonzáles-Villora, Clemente, Cardoso, & Teoldo, 2021). Amongst such skills, game reading refers to the player's ability to capture the information available in the environment through perception, processing of information and decision-making (Friedenberg & Silverman, 2006). In this context, decision-making can be defined as the choice of action and can be observed as a motor or verbal response (Bruce, Farrow, Raynor, & Mann, 2012; Macmahon & Mcpherson, 2009). Understanding how the players make their decisions can provide valuable information for the training process. Training is of high importance in the formation of players, especially in terms of decision-making, considering good decisions will elevate their competitive level to new heights, as well as their teams.

Studies on decision-making point out that expert soccer players are capable of making better decisions compared to their less experienced peers (Roca, Ford, McRobert, & Williams, 2011). This occurs because more

experienced players tend to search the information available in the play more effectively; detect and recognize better the structured patterns of play; interpret the meaning of the information more accurately; and make faster, and more appropriate decisions (Williams, Ford, Eccles, & Ward, 2011). Furthermore, in a recent study, Assis et al. (2021) found that players of the same competitive level but with different levels of efficiency in tactical behavior make different decisions. These authors point out that the most tactically efficient players are better at making decisions as they are better at reading the context of the game.

New instruments have been developed to assess their decision-making ability, which provide better data on its input in the game as well as insightful information about the individual profile of decision-making in players. Amongst the instruments identified in the literature that are able to evaluate the decision-making skills in soccer players, Machado and Teoldo (2020) have recently developed and validated the TacticUP[®] video test for soccer. This instrument helps evaluating the ability to “read” the play and the response time in the decision-making of soccer players according to the core tactical principles of soccer (Teoldo et al., 2017). The research mentioned above has assessed players from different expertise levels, and the authors have suggested the need for further investigation in different contexts, such as using players from different age groups. In addition, Andrade et al. (2021) verified the influence of positional role on the decision-making skills of U-13 soccer players and pointed out that midfielders made quicker decisions, when compared to defenders and forwards, in situations near and distant from the ball.

The novelty of the current study is that it is the first in the literature to compare players' game reading and decision-making skills from different age groups, based on the core tactical principles of soccer. This type of study may help coaches and researchers understand better the characteristics of game reading and decision-making skills among players according to their sport development phase. This kind of information may support the development of more specific drills during practice based on players' needs and potentials from different age groups. The aim of this study was thus to compare the quality and the response time in decision-making of Under-14, Under-16, and Under-17 Brazilian soccer players.

Material & Methods

Ethical Procedures

An official demand was accepted by the responsible of the training centre to conduct the study with the selected players. After acknowledging the nature of the study and its objective, each player and their parents and/or legal tutors signed a term of consent. This study was approved by the Research Ethics Committee (number 2.312.402) of Universidade Federal de Viçosa, Brazil and all procedures were in accordance with the standards of the Declaration of Helsinki (2008) and of the Brazilian National Health Board (466/2012).

Participants

The study was descriptive and transversal and was realized on the field. The sample was composed of 37 adolescent male soccer players, all affiliated to a club who compete in the Serie C of the Brazilian Championship. The participants were divided in three age levels: Under-14 (n = 12; 13.75 ± 0.45 years old), Under -16 (n = 10; 16.40 ± 0.51 years old) and under -17 (n = 15; 17.06 ± 0.55 years old). As an inclusion criterion, the players must be registered to the club and not being participating to try-outs.

Instrument for data collection

TacticUp[®] was utilized to evaluate the quality of decisions and the response time. This instrument is composed of video sequences of offensive and defensive phases of play extracted from a formal 11-a-side game. Videos were captured from an elevated point of view. For each scene, the participants had to choose the most adequate solution between four possible alternatives. Before the beginning of the test, the instructions and information about the structure of the test were given and three scenes were presented to familiarize with the task. The final punctuations are presented in 15 items (one for each tactical principle), in addition to points attributed for offensive and defensive phases as well as the game (offensive and defensive phases together) (Machado & Teoldo, 2020).

Instrument for data collection

Data collection was conducted by the coaches and qualified evaluators. The TacticUP[®] video test was presented to the participants with the aim to evaluate decisions associated to core tactical principles of the game of soccer (Teoldo, Garganta, Greco, & Mesquita, 2009; Teoldo et al., 2017) as well as the response time (Machado & Teoldo, 2020).

The core tactical principles are grouped according to the phases of play (Machado & Teoldo, 2020). For the offensive phase: 1) penetration; 2) offensive coverage; 3) width and length with the ball; 4) width and length without the ball; 5) depth mobility; 6) offensive unity. In contrast, for the defensive phase: 7) delay; 8) defensive coverage; 9) recovery balance; 10) defensive balance; 11) concentration; and 12) defensive unity. These principles also allow the players solve situations of play effectively through the management of space, within and outside the centre of play. These principles embed aspects that are central to the educational process of tactical skills and that can be objectively measured through the movements of the players when associated to the management of the space of play.

Statistical Analysis

Data was presented as the average and standard deviation. At first, the Shapiro-Wilk test was performed to verify the distribution of data and subsequently, the ANOVA one-way with post hoc of Tukey was applied to compare the variables between the Under-14, -16 and -17 age levels. The level of significance adopted was $p < .05$. All analysis were conducted utilizing GraphPad Prism 8.1[®].

In addition, the effect size was calculated for each comparison between the age levels (Under-14 vs Under-16; Under-14 vs Under-17; Under-16 vs Under-17). The effect size was measured with Pearson r , which is categorized as: small size ($<0,29$), medium size ($0,30-0,49$) and large size effect ($> 0,50$) according to the calculation realized with, respectively: the formulas for the independent t test (a) and to the Mann-Whitney test (b) (Field, 2009):

$$r = \sqrt{\frac{t^2}{t^2 + df}} \quad (a)$$

$$r = \frac{Z}{\sqrt{n}} \quad (b)$$

Results

The table 1 shows that the quality of decisions was similar in all age levels, as there was no significant difference in the comparison between the variables.

Table 1. Quality of decisions associated to core tactical principles.

Age levels and variables	U-14 (n=12) A.U.	U-16 (n=10) A.U.	U-17 (n=15) A.U.	p	r (U-14 vs U-16)	r (U-14 vs U-17)	r (U-16 vs U-17)
<u>TACTICAL PRINCIPLES</u>							
<u>OFFENSIVE</u>							
Penetration	74,03 ± 15,62	79,40 ± 6,14	74,09 ± 12,00	0,503	0,222	0,002	0,258
Offensive coverage	63,22 ± 14,63	75,76 ± 12,79	67,53 ± 19,68	0,215	0,428	0,125	0,235
Width and length with the ball	87,56 ± 13,39	83,53 ± 17,07	79,29 ± 19,03	0,455	0,137	0,246	0,117
Width and length without the ball	91,03 ± 10,50	95,33 ± 3,22	88,89 ± 14,18	0,366	0,268	0,086	0,280
Depth mobility	61,28 ± 18,47	72,50 ± 15,69	63,96 ± 14,01	0,251	0,321	0,085	0,284
Offensive unity	40,00 ± 20,35	33,33 ± 15,71	47,78 ± 20,76	0,197	0,185	0,191	0,362
<u>DEFENSIVE</u>							
Delay	81,69 ± 17,61	69,60 ± 19,78	77,47 ± 24,33	0,413	0,321	0,100	0,174
Defensive coverage	57,36 ± 12,73	53,50 ± 25,08	57,27 ± 18,11	0,862	0,103	0,003	0,090
Recovery balance	71,36 ± 15,30	61,50 ± 20,25	66,42 ± 17,65	0,436	0,279	0,151	0,133
Defensive balance	86,86 ± 12,36	81,33 ± 16,94	81,09 ± 24,56	0,707	0,013	0,087	0,110
Concentration	80,64 ± 21,56	81,13 ± 16,41	77,25 ± 18,77	0,852	0,193	0,146	0,005
Defensive unity	43,89 ± 19,48	49,87 ± 23,19	45,04 ± 13,79	0,732	0,145	0,036	0,135
<u>GENERAL</u>							
General offensive	69,52 ± 5,07	73,31 ± 4,68	70,26 ± 7,12	0,301	0,374	0,060	0,240
General defensive	70,30 ± 7,86	66,16 ± 6,33	67,42 ± 12,96	0,603	0,287	0,133	0,059
General play	69,91 ± 5,24	69,73 ± 3,94	68,84 ± 9,05	0,909	0,019	0,072	0,060

Note: A.U. – arbitrary units.

Source: Authors

The table 2 shows the response time for each tactical principle. The results show that the Under-16 and -17 players were faster making decisions associated to the tactical principles of “penetration” (medium effect),

“width and length with the ball” (medium effect), “width and length without the ball” (medium effect), “depth mobility” (medium effect), and “offensive unity” (medium effect) in comparison to the Under-14 players. Under-17’s was also faster making decisions associated to “offensive coverage” (medium effect) also compared to the Under-14’s.

Additionally, in the defensive phase, Under-17’s was faster in making decisions associated to “delay” (medium effect) and “defensive balance” (medium effect) compared to the Under-14’s. Only the defensive principle of “concentration” (medium effect) has faster response time between Under-16’s and -17’s compared to the Under-14’s. The time of response has been faster for all general (medium effect), offensive and defensive principles (medium effect) for older players (Under-16 and -17) compared to younger players (Under-14).

Table 2. Time of response in decision-making for each tactical principle

Age levels and variables	U-14 (n=12) S	U-16 (n=10) S	U-17 (n=15) S	<i>p</i>	<i>r</i> (U-14vsU-16)	<i>r</i> (U-14vsU-17)	<i>r</i> (U-16vsU-17)
TACTICAL PRINCIPLES							
<u>OFFENSIVE</u>							
Penetration	20,81 ± 13,21*	9,63 ± 5,72	9,88 ± 7,66	0,008	0,485	0,474	0,017
Offensive coverage	18,82 ± 19,31#	7,26 ± 2,50	7,28 ± 4,89	0,026	0,380	0,370	0,062
Width and length with the ball	20,07 ± 13,93*	9,39 ± 5,44	9,02 ± 6,89	0,010	0,453	0,474	0,029
Width and length without ball	16,58 ± 13,85*	6,09 ± 1,87	6,77 ± 6,11	0,010	0,467	0,442	0,070
Depth mobility	20,05 ± 18,31#	8,00 ± 4,94	8,56 ± 7,49	0,027	0,410	0,377	0,085
Offensive unity	18,36 ± 15,77*	6,19 ± 2,58	6,62 ± 4,98	0,005	0,473	0,478	0,052
<u>DEFENSIVE</u>							
Delay	19,07 ± 18,48#	7,84 ± 3,76	6,30 ± 5,28	0,014	0,387	0,455	0,163
Defensive coverage	18,43 ± 14,84	9,87 ± 6,92	9,03 ± 7,38	0,056	0,350	0,394	0,059
Recovery balance	16,89 ± 12,49	8,73 ± 3,55	11,27 ± 11,62	0,180	0,406	0,234	0,137
Defensive balance	20,69 ± 19,75#	8,92 ± 5,13	7,71 ± 6,69	0,023	0,511	0,599	0,233
Concentration	20,03 ± 13,91*	7,86 ± 4,03	6,17 ± 3,30	<0,001	0,378	0,431	0,100
Defensiva unity	20,15 ± 24,18	8,15 ± 4,33	7,48 ± 6,22	0,065	0,326	0,364	0,061
<u>GENERAL</u>							
General offensive	19,09 ± 13,95*	7,76 ± 3,46	8,24 ± 5,48	0,005	0,487	0,479	0,048
General defensive	19,21 ± 15,35*	8,56 ± 4,07	7,99 ± 6,29	0,012	0,428	0,458	0,052
General play	19,15 ± 14,27*	8,16 ± 3,74	8,12 ± 6,00	0,007	0,466	0,477	0,004

Note: S – seconds; *, difference for the Under-16 and -17’s; #, difference for the Under-17’s.

Source: Authors

Discussion

The aim of this study was to compare the quality and response time in decision-making of Under-14, -16, and -17 Brazilian soccer players. Results showed that there was no difference in the quality of decisions between age levels although there were differences in the response time in decision-making.

According to the results, the Under-16’s and -17’s have shown a faster response time in their decision-making for the principles of “penetration, width and length with and without the ball, depth mobility and offensive unity” in comparison to the Under-14 players. Under-17’s were also faster making decisions associated to the “offensive coverage” compared to the Under-14’s. As suggested in the literature, these principles are executed near and further from the ball, that is within and outside of the centre of play (Teoldo et al., 2017). This

means that older players show a greater ability in reading the various situations of play and can adapt better to these situations since they are able to interpret them faster and consequently make faster decisions.

Additionally, in the defensive phase, older players were also faster at making decisions for concentration, whereas Under-17's were particularly faster in making decisions associated to "delay and defensive balance" compared to the Under-14's. This can be associated to a higher level of tactical performance in Under-17 players compared to Under-14's. According to Silva et al. (2021), Under-15 players with better tactical performance were able to adapt to situations of play in small-sided and conditioned games compared to other players of the same age level with lower levels of tactical performance based on the core tactical principles.

In general, the response time has shown better results in older players than in the younger ones. In addition to the arguments mentioned earlier, these results can also be associated to a greater experience and time of practice in older players (Giacomini, Silva, & Greco, 2011). Such experience allows players to acquire and accumulate tactical knowledge, reinforcing that "knowing" helps "doing", which is manifested in faster decisions (Giacomini et al., 2011). The study conducted by Américo et al. (2017) has shown that Under-15 players had better perceptive-cognitive skills compared to Under-11's and that older players had more practice time in soccer, which gave them more experience in tactical situations in the play. Moreover, Moreira et al. (2014) verified that Under-15's show better decision-making skills in offensive situations compared to Under-14's. The results of our study summed to the studies cited in this section reveal the importance of assessing the decision-making skills in terms of both quality and response time, since both variables are factors of performance in the play. More specifically, the assessment based on the core tactical principles, both offensive and defensive, marks a methodological progress in the assessment of decision-making as it aligns with the learning process of players (Teoldo et al., 2017).

Furthermore, it is recognized that during adolescence there are improvements in abstract thinking, in addition to speculations about hypothetical situations and the acceleration of deductive reasoning and also of imagination, which are elements that directly influence the tactical knowledge (Piaget, 1964) and, consequently, the players' decision-making skills. In fact, the selection of the tactical principle was similar between age levels probably due to the knowledge associated with the tactical principles that are recommended to teach from 12 years old (Teoldo et al., 2017). In addition, the literature points out that players of different ages have similar tactical performance in the confrontation between the categories, despite small differences in team compaction and in the effectiveness of the action (Silva, Resende, Vasconcellos, Praça, & Teoldo, 2020), which can justify this similar performance. However, the response time, conditioned by the speed of information processing, is the most significant difference between expert players and non-experts (Ford & Williams, 2013, Ward & Williams, 2011). Thus, in addition to using content related to tactical principles (offensive and defensive), teachers and coaches must incorporate different conditions in training in terms of difficulty, increased time pressure, space pressure, game complexity and speed of execution of the actions to help players improve their performance.

In practical terms, the players' response time has a direct implication in the training structure. For example, younger players need more time to respond to the demands of the game and thus, as we saw in the results, it is necessary that the activities have the space/time ratio that allows them to have more time to decide compared to players from older age groups. This structuring can be manipulated through small-sided and conditioned games, manipulating constraints such as field size, number of players, touches limitation and time limitation for solving problem situations. Ultimately, in addition to adapting the training context to the characteristics of the age level, it is also necessary to adjust the stimuli according to the individual characteristics of the players to optimize development. One of the possibilities is to organize interactions in activities so that athletes form cooperation or opposition according to the level of performance they present in different types of movements on the field, whether offensive or defensive, close or far from the ball, as suggested in previous research about decision-making development using the same instrument used in our study (Machado, González-Villora, Sarmiento, & Teoldo, 2020).

Our study provides information that allow practitioners who work in soccer to take in consideration the differences about the game reading and decision-making skills in youth soccer players and seek to elaborate the training practices that are adequate to their age levels. Moreover, it is suggested that coaches should adjust training activities and demands, and direct it with a progression in the levels of complexity in agreement with the abilities detected in the group of players. Nevertheless, it is still necessary to mention that a limiting aspect of the study was to collect data in one single club, which has made it difficult to generalize the obtained results. Considering the novelty of the instrument and the evaluation process, the current findings can be considered as valid and useful in the field of study as it reveals key differences that corroborate other studies in the literature. Thus, more studies are necessary to investigate the effects of the age on the game reading and decision-making skills based on the core tactical principles of soccer.

Conclusions

It was concluded that there was no difference in the quality of decision-making between the three ages groups. However, the Under-16 and -17 players needed less time to read the situations of play and to make their

decisions compared to the Under-14 players. Higher-end performance programs would likely feature players who have good game reading and decision-making skills from early stages of talent development, and continuity in such programs would lead to more efficacy in the process of decision-making as players become older and more experimented.

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