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Visual search strategies of young soccer players according to positional role

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ABSTRACT

We aimed to compare the visual search strategies of young soccer players with different positional roles. Data was collected with the Mobile Eye Tracking — XG to verify gaze behaviour through visual focus. At the laboratory, an 11-a-side match play video-based soccer simulation from a third-person perspective was presented to the participants. Players were grouped according to their positional roles: defenders (n= 6), midfielders (n= 6) and forwards (n= 5). Visual search strategies were classified according to five fixation locations: "player in possession", "ball", "teammates", "opponents" and "space". The number of fixations and the fixation duration in each location was assessed. One-way ANOVA was performed to compare mean values. Midfielders and forwards showed significant differences in the number of fixations (15.50± 5.85 vs. 27.80± 7.36; p= 0.023) and fixation duration (8.00± 3.11 secs vs. 20.10± 8.47 secs; p= 0.016) for the category "ball", as well as in the number of fixations (22.00± 5.62 vs. 34.60± 1.81; p= 0.044) for "teammates". No other differences were observed. We concluded that the positional role was not relevant to the visual search strategy adopted by young soccer players. This finding is important for coaches and researchers to understand the cognitive and perceptual skills of young soccer players. It can also help coaches design specific training with appropriate stimuli for the players' development.

KEYWORDS: football; cognition; youth; decision-making; sports performance.

INTRODUCTION

The unpredictability of soccer demands that the players perceive, interpret and select various stimuli and signals from the game quickly and assertively (Assis, Costa, Casanova, Cardoso, & Teoldo, 2021; Cardoso, Afonso, Roca, & Teoldo, 2021). Greater skill in identifying postural cues, detecting relevant information, recognizing patterns of play and assessing situational probabilities enables players to make better decisions (Machado, González-Víllora, Sarmento, & Teoldo, 2020; Gonçalves, Noce, Barbosa, Figueiredo, & Teoldo, 2021). In this context, vision plays an important role in providing decision-making information (Klostermann, Vater, Kredel, & Hossner, 2020). Following this, research has explored how soccer players employ visual search strategies to extract information from the game, e.g., movements of teammates and opponents, ball and playing space (Roca, Ford, McRobert, & Williams, 2011; Assis et al., 2021). It has been shown that players with superior performance (Roca et al., 2011) and tactical behaviour (Assis et al., 2021) obtain information from the environment in less time and using fewer fixations.

In soccer, during a game, the functions of soccer players are determined by the positional roles (e.g., defender, midfielder and forward) requiring specific characteristics of players' (Machado, Padilha, González-Víllora, Clemente, & Teoldo, 2019; Hands & Jonge, 2020). Thus, some studies have assessed the relationship between playing position/positional role and visual search strategies (Williams, Janelle, & Davids, 2004; Vaeyens, Lenoir, Williams, & Philippaerts, 2007a). These researches showed that forwards employed more selective visual search strategies while defenders performed

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more exhaustive searches through the environment. In another study, Williams, Ward, Ward, and Smeeton (2008) showed that defenders displayed superior anticipation skills compared to offensive players. However, the studies on these topics have commonly used groups of experts (Williams et al., 2008) or older age categories (Vaeyens, Lenoir, Williams, Mazyn, & Philippaerts, 2007b).

It has also been demonstrated that the developmental stage of a soccer player influences his perceptual and cognitive skills. For example, U-13 players performed more fixations on the "space" than U-15 and U-17 players (Machado, Cardoso, & Teoldo, 2017). In turn, the development stage and soccer-specific knowledge influence visual search behaviours (Roca, Williams, & Ford, 2012; Américo et al., 2017). At the age of 13, the players are in the mature stage of attention (Sternberg, 2010), producing abstract thoughts and testing hypotheses to make decisions even in scenarios with various alternatives (Teoldo, Guilherme, & Garganta, 2017). This development requires an appropriate stimulus for the age during the learning stage and to progress the player's specialization over time (Côté, Baker, & Abernethy, 2007; Ford, Ward, Hodges, & Williams, 2009).

Schumacher, Schmidt, Wellmann, and Braumann (2018) observed that perceptual-cognitive skills are dependent on soccer player age category and positional role. However, the authors did not consider the perceptual-cognitive skills according to positional role separate by age category as criteria for comparison. Therefore, considering that initial category soccer players are separated by positional role, it might be interesting to compare their perceptual-cognitive skills according to the positional role. Following the evolution of this research topic in soccer, Andrade, Machado, Gonçalves and Teoldo (2021) observed that U-13 soccer players' midfielders displayed a greater ability to read the game and make quicker decisions than defenders and forwards. Thus, it might be plausible to assume that underlying mechanisms that support decision-making, such as visual search strategies, could differ between young soccer players according to their positional role.

Thus, the present study aims to compare the visual search strategies of young soccer players based on positional roles. The assessment of players at young ages will provide a better understanding of their developmental stage. Research on this topic may also contribute to endorsing the visual search strategies as important variables in the assessment process in soccer, besides helping to qualify the soccer teaching process. We hypothesized that visual search strategies of young soccer players vary according to the positional role due to earlier findings that indicate that expert soccer players from different positional roles differ in cognitive performance (Slimani et al., 2016; Schumacher et al., 2018).

METHODS

Sample

The sample comprised seventeen U-13 (12.72± 0.46 years) soccer players from a club in the Serie A of the Brazilian National Soccer League, grouped according to their positional roles: defenders (n= 6); midfielders (n= 6); and forwards (n= 5). The G*Power 3.1.9.4® software was used to estimate the minimum sample size following the procedures described by Faul, Erdfelder, Lang and Buchner (2007). A priori power analysis deemed a sufficient sample size of 15 players in total, based on= 95% power (1 – β), an alpha (α) of 0.05, and large effect size (ES) (f= 1.20) (Faul et al., 2007). As inclusion criteria, players had to be engaged in at least three 90-minute weekly training sessions and play in national or international level competitions. The team was composed of 17 players, all of which were recruited and completed this study.

Participants received a term of agreement containing information on the study's purpose and characteristics. Players' legal guardians signed an informed consent, confirming they were aware of the players' participation in the study. All research procedures were conducted according to the norms established by the National Health Council (Resolution 466/2012) and by the Declaration of Helsinki (1996) for research with human beings. The project was approved by the Human Research Ethics Committee (nº 412.816/2013).

Instrument

Data collection was performed using the Mobile Eye Tracking-XG® (*Applied Science Laboratories*, Bedford, MA, EUA). The device tracks the participants' central vision through a system of cameras mounted on a pair of glasses. It detects the reflection of the pupil and the cornea, determined by the reflection of an infrared light source on the surface of the cornea, displayed on a video image of the eye. The Mobile Eye Tracking® performs periodic measurements (every 40 ms), providing the values of the location of the central vision in each measurement. The device was used during the application of the test proposed and validated by Mangas (1999). This test consists of a sequence of 11 video scenes of offensive soccer actions, recorded and watched through a third-person perspective. The edited scenes were obtained from professional matches of European national tournaments and utilized in previous research with young soccer players (Machado et al., 2017; Cardoso, González-Víllora, Guilherme, & Teoldo, 2019; Cardoso et al., 2021).

Data collection procedures

The tests were conducted in a closed environment without external interference and controlled luminosity (maximum variation of 10 lux). The Mobile Eye Tracking — XG® was adjusted and calibrated for each participant. Eye movements were corrected by the ASL RESULTS® software (Applied Science Laboratories, Bedford, MA, USA). The video scenes of the test were presented via projection on a retractable projection screen (TES — TRM 150 V with "Matte White" projection surface) with the dimensions of 3.04 × 2.28 m. The scenes were projected using an HD projector (Toshiba® TDP-s20 DLP A, Texas), mounted onto the ceiling with an XGA resolution of 2 × 2 m. Participants were standing 2.5 m from the screen. The 12-dot calibration method was employed, superior to the 9-dot calibration recommended by the manufacturer. Before the experimental task, test procedures were explained, and participants performed familiarization trials, in which two test scenes were presented.

An 11-video sequence was presented to the players during the experiment, with each video lasting between 7 and 9 seconds. The videos were paused prior to the end of the action (e.g., when a player in possession was about to perform a pass to a teammate or a forward dribble), and the participants were asked to respond as quickly as possible "what the player in possession should do". The calibration of the Mobile Eye Tracking – XG® was periodically checked to ensure precision. The procedure lasted approximately 30 minutes per player (Figure 1).

Visual search strategies

The visual search rate analysis was performed according to previous research procedures (Williams & Davids, 1998; Roca et al., 2011; Assis et al., 2021). The following dependent variables were assessed: Number and mean fixations per location. The preferred fixation location refers to the number and duration of fixations employed by the individual in predefined locations on the scenes. Fixation was defined as the eye remaining stationary by approximately 1.5 degrees of variation tolerance for a period equal to or greater than 120 ms (Williams & Davids, 1998). Five locations were defined for analysis based on previous studies (Roca et al., 2011; Machado et al., 2017): i) player in possession; ii) ball (ball flight); iii) teammates (forwards); iv) opponents; and v) space (areas of free space in the field, in which none of the players is located).

Statistical analysis

Data distribution was analyzed through the Shapiro-Wilk's test. One-way ANOVA was performed to compare the means and standard deviation of the number and duration of fixations between the three positional roles. Tukey's post-hoc was performed to verify significant differences between pairs of positional roles. In addition, the reliability of the observation was calculated with the Cohen's kappa test. Three trained observers performed this procedure after a 21-day interval to avoid task familiarity issues (Robinson & O'Donoghue, 2007). A total of 10% of the data from the first observation was re-analyzed, as suggested by Tabachnick & Fidell, 2007). The inter-observers' reliability revealed an agreement coefficient of 86%, and the agreement coefficient for intra-observers was 92%. These values are classified by literature as 'almost perfect' (Landis & Koch, 1977).

Statistical procedures were performed using IBM SPSS Statistics for Windows, version 24.0 for Windows® (Armonk, NY: IBM Corp.), and for all analyses, the significance level was set to $p < 0.05$.

RESULTS

Number of fixations per location: forwards (27.80± 7.36) focused more frequently on the category "ball" when compared

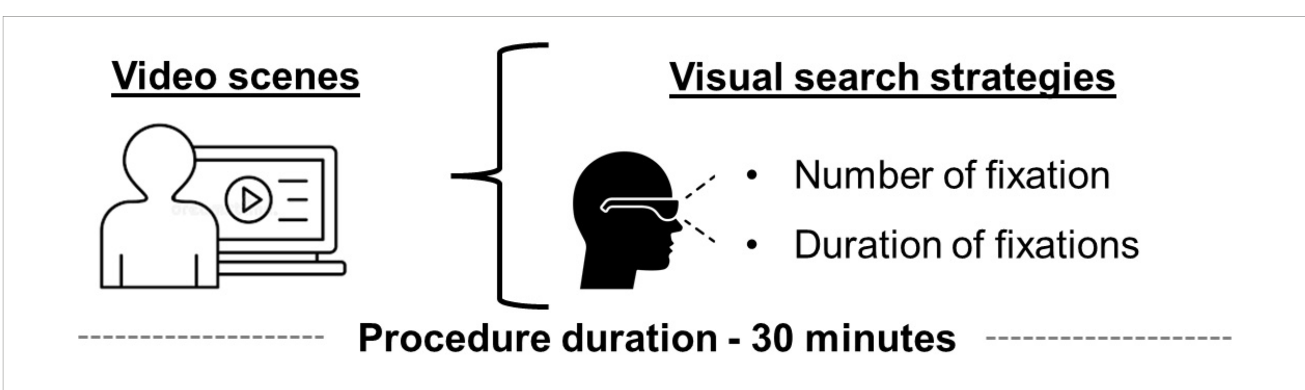


Figure 1. Experimental design.

to midfielders (15.50± 5.85) ($F_{(2)}$= 4.63; p= 0.023; η^2= 0.39), and had a higher number of fixations on the category "teammates" (34.60± 1.81 versus 22.00± 5.62, respectively) ($F_{(2)}$= 3.71; p= 0.044; η2= 0.35). No further differences were found with respect to the fixations per location (Figure 2).

Fixation duration per location: In relation to the fixation duration on the predefined locations, a difference ($F_{(2)}$= 5.69; p= 0.016; η2= 0.45) was observed between midfielders (8.00± 3.11 secs) and forwards (20.10± 8.47 secs) regarding the category "ball", with forwards focusing for longer periods on the ball. No further differences were found with respect to the fixation locations (Figure 2).

DISCUSSION

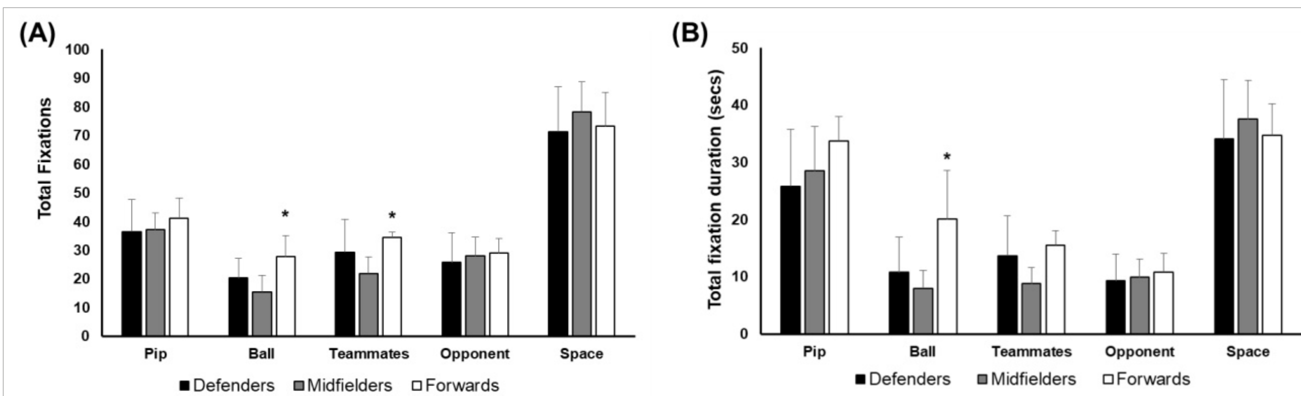
Our purpose was to compare the visual search strategies of young soccer players with different positional roles. Significant differences were found in total fixations in two locations: ball and teammates. Forwards focused more frequently on the ball and teammates when compared to midfielders. Forwards also fixated for longer periods on the ball when compared to midfielders. No further differences were observed. Therefore, the initial hypothesis that visual search strategies of young soccer players vary according to the positional role was partial accepted.

Forwards have been reported to employ a more selective visual search behaviour (Vaeyens et al., 2007a), but our results failed to confirm this for young forward players. Perhaps our sample had insufficient specialization in a single position. Nevertheless, forwards attempted to extract information from locations in which the action took place or where the ensuing action was likely to occur (i.e., ball and teammate). The visual search strategies employed by the forwards at this age may be related to their need to search for, and to generate, passing lines, aiming to unbalance the opponents' defensive organization (González-Víllora, García-López, & Contreras-Jordán, 2015).

Midfielders are primarily positioned in the pre-defensive and pre-offensive sectors, as well as in the central corridor (Taylor, Mellalieu, & James, 2005), areas that include a greater number of players and provide reduced space and time for playing actions (Vaz, Gama, Santos, Figueiredo, & Dias, 2014). This requires well developed perceptual and cognitive skills, facilitating anticipation and reducing the response time (Andrade et al., 2021). These behaviours are acquired during the development process through training and matches (Machado et al., 2020). Looking through our results, they suggest that our sample had insufficiently developed perceptual-cognitive skills to characterize a typical visual search pattern influenced by the positional role.

No difference was found between the fixation locations of defenders and the other positional roles, perhaps because the test consisted of offensive scenes (Mann, Farrow, Shuttleworth, & Hopwood, 2009). The test did not display scenarios typically experienced by defenders during the matches, impairing recall and recognition of patterns. Future interventions of the protocol should consider greater representativeness between experimental and game tasks, especially for defenders.

Overall, defenders, midfielders and forwards displayed similar visual search behaviours, focusing more frequently and for longer periods on the player in possession and in spaces. Being at the end of their egocentric phase, players still focus their attention on the locations where the main actions are taking place, including the player in possession (González-Víllora et al., 2015; Teoldo et al., 2017). The players will



*Significant difference (p< 0.05) between midfielders and forwards; Pip: player in possession of the ball.

Figure 2. Visual search strategies of young soccer players according to positional role (A) number of fixations made by each group in predefined locations in the video sequences, and (B) time of fixations made by each group in predefined locations in the video sequences.

probably have difficulties in extracting relevant information from the environment, as they will not perceive other stimuli, potentially compromising their decision making (Vaeyens et al., 2007a; Roca et al., 2011).

The findings presented here should be considered with caution due to the study limitations. Analyses performed with a higher number of players could have contributed to reducing the chances of the type II error occurring due to the low sample size. In addition to that, the video-based scenarios only assessed offensive actions. Video-based scenarios should also incorporate defensive actions to avoid biasing the results in favour of midfielders and forwards. Additionally, evaluating defensive actions can lead to differences in the visual search strategies, especially in young soccer players.

To the best of our knowledge, this was the first study that assessed the visual search strategies of young soccer players according to the different positional roles. We recommend expanding the analysis by including other age groups for future studies. Also, it would be interesting to evaluate the players' experience in assessing visual search strategies according to positional roles across different stages of sports development. This suggestion relies on the fact that players' practice time and knowledge are likely to influence their perceptual and cognitive skills (Assis et al., 2021; Machado et al., 2020). At last, future studies should also investigate the tactical and physical performance of young soccer players according to the positional role and their relationship with perceptual-cognitive skills.

From a practical point of view, this study provides important information for coaches and teachers. We recommend that coaches design activities that encourage players to focus more frequently on teammates and free spaces. For example, adjust the training by progressing the level of complexity according to the abilities detected in the group of team players (Côté et al., 2007). Deliberate practice, collective tactics in team practice activities and design of training drills "high decision-making opportunities" in team practice activities may be adopted (O'Connor, Larkin, & Williams, 2017; Machado et al., 2020). These strategies facilitate young soccer players' teaching and learning processes through the development of cognitive and perceptual skills, gradually including specialization to help players reach their top performance (Larkin, Mesagno, Berry, & Spittle, 2018).

CONCLUSIONS

It is concluded that young soccer players with different positional roles displayed overall similar visual search behaviours. Despite the sample being compromised of U-13 soccer players at a highly competitive level and involved in systematic training, the visual search pattern differences between the positional role were observed only in a few variables. This information indicates that the positional role is not a factor that differentiates the perceptual-cognitive skills of the U-13 soccer players. The specialization of the group is a continuing process that occurs gradually through the qualifying soccer teaching process.

PRACTICAL IMPLICATIONS

1. Based on the findings of the present study, coaches will expand their understanding of how young soccer players from different positional roles search information from the ambient, an important skill for the soccer context.
2. Coaches will also be able to design activities according to young soccer players' limitations and potentialities, aiming to enhance their development.
3. This information can be useful for helping coaches to design training situations with specific visual stimuli that require the players' faster decision-making.

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REFERENCES

Américo, H. B., Kowalski, M., Cardoso, F., Kunrath, C. A., González-Víllora, S., & Teoldo, I. (2017). Difference in declarativa tactical knowledge between U-11 and U-15 soccer players. *Human Movement, 18*(25), 25-30.

Andrade, L., Machado, G., Gonçalves, E., & Teoldo, I. (2021). Decision making in soccer: Effect of positional role of u-13 soccer players. *Journal of Physical Education and Sport, 21*(3), 1413-1420. https://doi.org/10.7752/jpes.2021.03180

Assis, J. V., Costa, V., Casanova, F., Cardoso, F., & Teoldo, I. (2021). Visual search strategy and anticipation in tactical behavior of young soccer players. *Science and Medicine in Football, 5*(2), 158-164. https://doi.org/10.1080/24733938.2020.1823462

Cardoso, F. S. L., Afonso, J., Roca, A., & Teoldo, I. (2021). The association between perceptual-cognitive processes and response time in decision making in young soccer players. *Journal of Sports Sciences, 39*(8), 926-935. https://doi.org/10.1080/02640414.2020.1851901

Cardoso, F. S. L., González-Víllora, S., Guilherme, J., & Teoldo, I. (2019). Young soccer players with higher tactical knowledge display lower cognitive effort. *Perceptual and Motor Skills, 126*(3), 499-514. https://doi.org/10.1177/0031512519826437

Côté, J., Baker, J., & Abernethy, B. (2007). Practice and play in the development os sport expertise. In R. Eklund & G. Tenenbaum (Eds.), *Handbook of sport psychology* (3rd ed., pp. 184-202). Hoboken.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program fro the social, behavioral, and biomedical sciences. *Journal of Materials and Environmental Science, 39*(2), 175-191. https://doi.org/10.3758/bf03193146

Ford, P. R., Ward, P., Hodges, N. J., & Williams, A. M. (2009). The role of deliberate practice and play in career progression in sport: the early engagement hypothesis. *High Ability Studies, 20*(1), 65-75. https://doi.org/10.1080/13598130902860721

Gonçalves, E., Noce, F., Barbosa, M. A. M., Figueiredo, A. J., & Teoldo, I. (2021). Maturation, signal detection, and tactical behavior of young soccer players in the game context. *Science and Medicine in Football, 5*(4), 272-279. https://doi.org/10.1080/24733938.2020.1851043

González-Víllora, S., García-López, L. M., & Contreras-Jordán, O. R. (2015). Decision making and skill development in youth football players. *Revista Internacional de Medicina y Ciencias de La Actividad Fisica y Del Deporte, 15*(59), 467-487. https://doi.org/10.15366/rimcafd2015.59.005

Hands, D. E., & Jonge, X. J. (2020). Current time-motion analyses of professional football matches in top-level domestic leagues: a systematic review. *International Journal of Performance Analysis in Sport, 20*(5), 747-765. https://doi.org/10.1080/24748668.2020.1780872

Klostermann, A., Vater, C., Kredel, R., & Hossner, E.-J. (2020). Perception and action in sports. On the functionality of foveal and peripheral vision. *Frontiers in Sports and Active Living, 1*, 66. https://doi.org/10.3389/fspor.2019.00066

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159-174. https://doi.org/10.2307/2529310

Larkin, P., Mesagno, C., Berry, J., & Spittle, M. (2018). Exploration of the perceptual-cognitive processes that contribute to in-game decision-making of Australian football umpires. *International Journal of Sport and Exercise Psychology, 16*(2), 112-124. https://doi.org/10.1080/1612197X.2016.1167760

Machado, G., Cardoso, F., & Teoldo, I. (2017). Visual search strategy of soccer players according to different age groups. *Motriz, 23*(3), 14-19. https://doi.org/10.1590/s1980-6574201700030022

Machado, G., González-Víllora, S., Sarmento, H., & Teoldo, I. (2020). Development of tactical decision-making skills in youth soccer players: Macro- and microstructure of soccer developmental activities as a discriminant of different skill levels. *International Journal of Performance Analysis in Sport, 20*(6), 1072-1091. https://doi.org/10.1080/24748668.2020.1829368

Machado, G., Padilha, M. B., González-Víllora, S., Clemente, F. M., & Teoldo, I. (2019). The effects of positional role on tactical behaviour in a four-a-side small-sided and conditioned soccer game. *Kinesiology, 51*(2), 261-270. https://doi.org/10.26582/k.51.2.15

Mangas, C. J. (1999). *Conhecimento declarativo no futebol: Estudo comparativo em praticantes federados e não-federados, do escalão de sub-14 (Declarative knowledge in soccer: comparative study in federated and non-federated practitioners, from the u- 14 level).* Universidade do Porto.

Mann, D. L., Farrow, D., Shuttleworth, R., & Hopwood, M. (2009). The influence of viewing perspective on decision-making and visual search behaviour in an invasive sport. *International Journal of Sport Psychology, 40*(4), 546-564.

O'Connor, D., Larkin, P., & Williams, A. M. (2017). What learning environments help improve decision-making? *Physical Education and Sport Pedagogy, 22*(6), 647-660. https://doi.org/10.1080/17408989.2017.1294678

Robinson, G., & O'Donoghue, P. (2007). A weighted kappa statistic for reliability testing in performance analysis of sport. *International Journal of Performance Analysis in Sport, 7*(1), 12-19. https://doi.org/10.1080/24748668.2007.11868383

Roca, A., Ford, P. R., McRobert, A. P., & Williams, A. M. (2011). Identifying the processes underpinning anticipation and decision-making in a dynamic time-constrained task. *Cognitive Processing, 12*(3), 301-310. https://doi.org/10.1007/s10339-011-0392-1

Roca, A., Williams, A. M., & Ford, P. R. (2012). Developmental activities and the acquisition of superior anticipation and decision making in soccer players. *Journal of Sports Sciences, 30*(15), 1643-1652. https://doi.org/10.1080/02640414.2012.701761

Schumacher, N., Schmidt, M., Wellmann, K., & Braumann, K. M. (2018). General perceptual-cognitive abilities: Age and position in soccer. *PLoS One, 13*(8), e202627. https://doi.org/10.1371/journal.pone.0202627

Slimani, M., Bragazzi, N. L., Tod, D., Dellal, A., Hue, O., Cheour, F., Taylor, L., & Chamari, K. (2016). Do cognitive training strategies improve motor and positive psychological skills development in soccer players? Insights from a systematic review. *Journal of Sports Sciences, 34*(24), 2338-2349. https://doi.org/10.1080/02640414.2016.1254809

Sternberg, R. J. (2010). *Psicologia cognitiva*. Cengage Learning.

Tabachnick, B., & Fidell, L. (2007). *Using multivariate statistics* (5th ed.). Harper and Row.

Taylor, B. J., Mellalieu, D. S., & James, N. (2005). A comparison of individual and unit tactical behaviour and team strategy in professional soccer. *International Journal of Performance Analysis in Sport, 5*(2), 87-101. https://doi.org/10.1080/24748668.2005.11868329

Teoldo, I., Guilherme, J., & Garganta, J. (2017). *Training football for smart playing: on tactical performance of teams and players.* Appris.

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2007a). Mechanisms underpinning successful decision making in skilled youth soccer players: An analysis of visual search behaviors. *Journal of Motor Behavior, 39*(5), 395-408. https://doi.org/10.3200/JMBR.39.5.395-408

Vaeyens, R., Lenoir, M., Williams, A. M., Mazyn, L., & Philippaerts, R. M. (2007b). The effects of task constraints on visual search behavior and decision-making skill in youth soccer players. *Journal of Sport and Exercise Psychology, 29*(2), 147-169. https://doi.org/10.1123/jsep.29.2.147

Vaz, P. S. V., Gama, J. V., Santos, J. V., Figueiredo, A. J., & Dias, F. G. (2014). Network-Análise da interacção e dinâmica. *Revista Portuguesa de Ciências Do Desporto, 14*(1), 12-25. https://doi.org/10.5628/rpcd.14.01.12

Williams, A. M., & Davids, K. (1998). Visual search strategy, selective attention, and expertise in soccer. *Research Quarterly for Exercise and Sport, 69*(2), 111-128. https://doi.org/10.1080/02701367.1998.10607677

Williams, A. M., Janelle, C. M., & Davids, K. (2004). Constraints on the search for visual information in sport. *International Journal of Sport and Exercise Psychology, 2*(3), 301-318. https://doi.org/10.1080/1612197x.2004.9671747

Williams, M. A., Ward, J. D., Ward, P., & Smeeton, N. J. (2008). Domain specificity, task specificity, and expert performance. *Research Quarterly for Exercise and Sport, 79*(3), 428-433. https://doi.org/10.1080/02701367.2008.10599509