

**THE ECOLOGICAL AND COGNITIVE APPROACHES IN FOOTBALL/FUTSAL DECISION-MAKING**Henrique Lamberty Porto<sup>1</sup>, Fernando Copetti<sup>2</sup>, Fábio Saraiva Flôres<sup>3</sup>**ABSTRACT**

Football is a team ball sport in which competitive performance has been analyzed from different theoretical perspectives to be understood. In this investigation, we sought to perform a narrative review of the literature concerning decision-making in football and futsal. Our investigative narrative revealed that there are two different perspectives to describe and explain decision making in football/futsal: an ecological approach and a cognitive approach. The first supports that players' decision-making is underpinned by the perception-action couplings where decisions are sustained on continuous interactions between the player and the context. Thus, players need to actively explore opponent's and teammate's contextual information from the environment, such as postural orientation, interpersonal distances, relative positions, running line direction, and velocity which specifies the affordances that the environment offers to act. On the other hand, studies on the cognitive approach support that players' decision-making process is sustained by the information processing with emphasis on previous knowledge stored in memory. Hence, there is a control center (brain) that commands actions, that is, decisions are centered on the players' and what they store in his memory. Thus, the players' decisions are sequential, hierarchical, and related to visual perception, which is associated with the brain's ability to process and analyze information in different scenarios. Our investigation reveals that the present study is the first narrative review design to assess the decision-making process in football, regarding its theoretical approaches. To sum, we believe that new studies on the decision-making process in football should seek to incorporate both perspectives to try to better understand how these processes influence performance.

**Key words:** Review. Affordances. Visual perception. Information Processing.

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**RESUMO**

Perspectivas ecológica e cognitiva na tomada de decisão no futebol/futsal

O futebol é um esporte coletivo em que o desempenho competitivo foi analisado a partir de diferentes perspectivas teóricas para ser compreendido. Nesta investigação, buscou-se realizar uma revisão narrativa da literatura sobre a tomada de decisão no futebol e no futsal. Nossa narrativa investigativa revelou que existem duas perspectivas diferentes para descrever e explicar a tomada de decisão no futebol / futsal: uma abordagem ecológica e uma abordagem cognitiva. O primeiro sustenta que a tomada de decisão dos jogadores é sustentada pelos acoplamentos de percepção-ação, onde as decisões são sustentadas em interações contínuas entre o jogador e o contexto. Assim, os jogadores precisam explorar ativamente as informações contextuais do adversário e do colega de equipe do ambiente, como orientação postural, distâncias interpessoais, posições relativas, direção da linha de corrida e velocidade que especifica as possibilidades que o ambiente oferece para agir. Por outro lado, estudos sobre a abordagem cognitiva sustentam que o processo de tomada de decisão dos jogadores é sustentado pelo processamento da informação com ênfase no conhecimento prévio armazenado na memória. Assim, existe um centro de controle (cérebro) que comanda as ações, ou seja, as decisões são centradas nos jogadores e no que eles armazenam em sua memória. Assim, as decisões dos jogadores são sequenciais, hierárquicas e relacionadas à percepção visual, que está associada à capacidade do cérebro de processar e analisar informações em diferentes cenários. Nossa investigação revela que o presente estudo é o primeiro desenho de revisão narrativa a avaliar o processo de tomada de decisão no futebol, quanto às suas abordagens teóricas.

**Palavras-chave:** Revisão. Recursos. Percepção visual. Processando informação.

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**INTRODUCTION**

Decision-making is a process that influences performance. In football/futsal, or other team sports, the success is related to players actions regarding teammates and opponents (Araújo et al., 2019), thus the constant cooperation and opposition shape players' behaviors (McGarry et al., 2002).

Decision-making can be understood according to different theoretical perspectives. The Ecological approach explains the decision-making through perception and action couplings and how they influence the performer-environment interaction in the course of problem-solving tasks (Araújo et al., 2017), while the Cognitive approach understands the decision-making as the response selection inside an environment with multiple responses, in which players need to choose the best option to succeed (Raab, 2007; Sanfey, 2007).

The literature has shown that the decision-making is an important variable to understand individual and team sports (Carvalho et al., 2014; Fadde, 2006; Macquet, 2009; Pastor-Vicedo et al., 2020).

However, as far as we know the literature lacks to overview the decision-making process in football/futsal. Thus, our aim was performing a narrative review of the literature trying to show the state of the art regarding decision-making in football/futsal, differentiating the studies according to their theoretical aims and approaches.

**MATERIALS AND METHODS**

An online search was performed in four databases: (a) Google Scholar, (b) PubMed, (c) SportDiscus, and (d) Scientific Electronic Library Online (SciELO). It was used the following expressions to find the published studies: "Decision-Making", "Affordances", "Cognition", "Soccer OR Football", "Futsal OR Soccer indoor", and "Players". Besides, the Boolean connector AND, and OR were used. No year limitation was used.

As inclusion criteria, only articles from peer-reviewed journals and written in English were used. Articles concerning referees and the coach's decision-making were excluded from the study. Research not involving decision-making in sports, or studies of decision-making in individual sports were excluded.

**RESULTS****The ecological approach in football studies**

To the Ecological approach, players' decision-making lies in the action adaptations regarding the changes in the pitch (Araújo et al., 2009).

In football/futsal as in other team sports, players need to pick up a wide range of environmental information. These information's are based on the opponent's behavior and their teammate's patterns concerning their postural orientation, positions, distances, and velocities.

Thus, the player, no matter the position, must perceive the pitch, the ball, and all teammates' and opponents' actions. Thus, all these properties combined provide different affordances (Gibson, 1966, 1979).

The player's ability to perceive and act upon the affordances is understood as determinant for successful performance (Fajen, Riley, Turvey, 2009).

Investigations have been trying to perceive what variables can influence the decision-making process among players and teams. The spatial positioning showed to constrain the opponent's decision-making during passing and shooting (Richardson, Marsh, Baron, 2007).

Travassos, et al., (2011), highlight how the connection between two players (interpersonal interaction) can influence performance during futsal matches. The coordinated behavior patterns emerge as a result of self-organizing processes, being generated within functional constraints, with players and teams exerting mutual influence on each other, so every decision-making has the power to influence the player and the team.

Corrêa, et al., (2014) analyze the angle variation between players during passing. As expected, the pass emerges from different angles regarding the ball carrier and the ball receiver.

The findings also showed that the passing direction was constrained by temporal information provided by the attacker-defender dyads.

This result shows that any variation in movement and displacement of the ball receiver will change the relationship between the attackers and the defenders. More than that, it will influence the decision-making of the ball carrier and, also, of the other players involved in the play.

Basevitch et al., (2020) found that highly skilled players anticipate the outcomes more accurately comparing to low-skill players. These results showed that the affordances provided on the pitch are important to player decision-making. To the authors' the results indicate that processing environmental information depends on temporal and contextual conditions.

The Ecological studies show that the behavioral variability that occurs in football and futsal demands that players perceive the task constraints to solve the problems during the game (Araújo, Davids, Hristovski, 2006; Newell, 1986).

An example is the results found by Vilar, et al., (2013), the authors found that the positioning of the defender and their movement velocity constraints the decision-making of the attacker during shooting performance.

Thus, the attacker's decisions must account for defender behavior. Also, this approach shows that the decision-making is influenced by the relative positions of the teammates and opponents, the displacements of the ball, and the distance to the sidelines and the goalpost. All these constraints provide affordances that change constantly due to match dynamics (Araújo, Davids, Hristovski, 2006; Vilar et al., 2013).

Football and futsal tasks, such as dribbling, shooting, or penalty kicks are present in all matches. To overcome their opponents, players need to adapt their actions according to variations of the opponents. To perform a lateral dive, for example, the goalkeeper needs to perceive the player performing the kick and their potential ability during shooting, the ball trajectory and velocity.

Also, the goalkeeper needs to perceive other pitch constraints, such as the players in front of the ball, and pitch conditions. The literature also shows that the ball carrier needs to perceive the affordances that the others (i.e., teammates and opponents) offer to perform a pass (Oppici et al., 2017; Pepping, Heijmerikx; De Poel, 2011), for example.

The perception constraints the decision-making during passing, being coupled and the information that supports that coupling emerges from the interaction among the players, the environment, and the task characteristics (Craig, 2011; Oppici et al., 2018).

So, the ability to perceive other players' affordances (what the others could do and what the others afford us to do) is

important for the successful decision-making during football and futsal games.

Levi and Jackson (2018) also found that highly skilled players need to evaluate the whole environment to make better decisions.

The perception of individual performance, teammates and opponents, and the scoring status appears to have a significant influence on players' actions and ability to make decisions. These results show that player-environment coupling plays a fundamental role during decision-making behavior in football.

The Ecological approach has shown that the decision-making process is influenced by a wide range of factors, such as pitch conditions, player skills, perception of the affordances, and opponents and teammates' constraints.

Thus, using an ecological approach to study decision-making requires to consider more than a single player, but all the constraints and physical characteristics of the environment that can affect performance and the decision-making process (Davids et al., 2003; Navarro et al., 2013).

### **The cognitive approach to decision making in football studies**

The Cognitive approach shows that the decision-making in football can be influenced by players' perceptual and cognitive skills (Belling, Suss, Ward, 2015; Ward, Ericsson, Williams, 2013; Williams et al., 2011).

This approach understands that players analyze game situations and defines the possible solutions before choosing the best motor skill to solve the problem, so-called, information processing (Fairbrother, 2010; Magill, Costa, 2000; Schmidt, Lee, 1988).

This process implies that decision-making is a sequential and hierarchical process that relates to the visual perception, the focus of attention, the anticipation, and is based on the memory (Afonso, Garganta, Mesquita, 2012).

The ability to make a correct decision, frequently under pressure (time or opponents) may represent the distinction between success and failure (Horrocks et al., 2016).

The cognitive approach has been studied in football and futsal situations. Several researchers investigated the perceptual abilities of players at different levels of expertise while playing (Casanova, et al.,

2009; Nimmerichter et al., 2015; Roca, Memmert, 2018).

Helsen, Pauwels (1993) studied the effects of the visual search strategy in decision-making during football attacks. Results showed that expert players looked longer at the position of defenders, whereas novices tended to search information from different sources such as other attackers, the goalpost, and ball position.

Football and futsal games are characterized by high demanding behavioral uncertainty, which requires a huge use of the cognitive skills to provide appropriate responses in the pitch (Ripoll et al., 1995).

Pastor-Vicedo et al., (2020) analyzed the number and duration of the decision-making units of under 10, 12, and 14 levels. The results showed that older groups present high levels of effectiveness in their decision-making.

Thus, during development, young players learn to use the information processing more effectively, presenting better conditions to decide wisely.

Casanova et al., (2009) highlight that expert players have high potential to perceive relevant key characteristics, knowledge of specific sport situations, recognition of movement patterns, and visual search strategy when compared to novices, improving their decision-making process.

In sum, comparing less skilled players to their counterparts, the experts can recognize faster and more accurate the patterns of play, are superior in picking up cues based on an opponent's postural orientation, have a greater knowledge of situational probabilities, and show efficient and effective visual search strategies (Vaeyens et al., 2007).

Cognitive research has also shown that the player skill to anticipate future actions and their decisions can influence performance (Bishop et al., 2013; Roca, Williams, Ford, 2012; Vaeyens et al., 2007).

General findings highlight that, while aging, players go through different levels of cognitive activity. This development enables the ability to perform better and accurate decisions. Besides, decision-making quality depends on physical skills, movement coordination, and how information is processed in the brain (Vestberg et al., 2012).

Creativity was also studied Roca et al., (2018), showed that high- and less-creative players have different visual search behaviors which can affect decision-making. Results

point out that creative players detected teammates in troubling situations faster during the attack, providing better conditions to choose the best option to act. These perceptual and cognitive skills are also called "game intelligence" (Roca, Ford, Williams, 2013).

To the authors, game intelligence is associated with creative results during the match. They point out that high-level players showed high levels of game intelligence compared to novices. So, the decision-making depends on the ability of the player to process information that is captured by the perceptual systems during the match (Memmert, 2011).

Accurate decisions are the results of the continued focus of attention and integrate task-relevant information, previously stored in memory, which inhibits inappropriate solutions (Fink et al., 2018).

Thus, the correct analysis of the ongoing situations on the pitch is an important aspect of the decision-making process (e.g., changes in the positioning of a teammate, proximity to the goal) which consequently led to changes in each player movement patterns (Johnson, 2006).

The literature suggests that an accurate evaluation of the environment is needed to process information during tactical situations (Pastor-Vicedo et al., 2020; Petiot et al., 2017). Thus, the player's performance depends on players' technical and tactical abilities, and their skills to perceive patterns within the game-pitch.

Additionally, previous knowledge regarding teammates' technical and tactical abilities as well as the potential interactive behavior between them is also a point to be highlighted which can influence players' perception. Thus, the ability to make decisions is an essential cognitive skill possessed by football players.

## **DISCUSSION AND CONCLUSIONS**

Our investigation presents a review of the current literature regarding two theoretical perspectives on the study of decision-making in football and futsal. The Ecological and Cognitive approaches.

The literature shows that players' decision-making can be explained by the player-environment couplings. The Ecological approach shows that the perception of the environment, in this case, the pitch and all

constraints available, are the key to understand players' decision-making process.

Controversially, the Cognitive approach shows that the decision-making process is the result of information processing, with emphasis on previous knowledge stored in memory.

Notwithstanding there are authors who suggested an integrative approach to decision making in team sports. In a simulated scenario study,

Steiner (2018) shows how the effects of two sources of information contribute to decision-making in football.

The author suggested that perceptual information regarding ongoing team positioning and player's knowledge about their teammates on passing decisions can be estimated. The findings support the hypothesis of the coexisting effects of both informational sources (i.e., perceptual and knowledge-based information).

The literature fails to provide studies concerning time constraints, body responses, and extra environmental information (such as different sounds and fans, for example). Simulating these variables should provide results closer to game-real situations.

Thus, our findings showed that the Ecological approach has been used to evaluate how players use the available information provided by the environment, such as in the pitch or by other players.

On the other hand, the Cognitive approach has been used to study brain-behavior during football situations and their influence on performance.

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