Article Type: Opinion/Review

Title: Key characteristics of decision making in soccer and their implications

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Abstract

This paper puts forward the position that the cognitivist approach adopted in research on decision making in team sports leads to a disconnection from the actual environment of play. The argument is structured as a narrative review of 60 articles that were analyzed to identify the most recent concepts related to the following topics or combinations thereof: tactics and action in the play; decision making and associated cognitive mechanisms and skills; and the teaching–learning–training process. The results of the review led us to characterize decision making in the team sports context as being (a) "prereflected," (b) based on evaluation, (c) frugal, and (d) "generated," as opposed to being a process of choosing from alternatives. In addition to showing clear adjustments to the environment of play, the four characteristics imply that teaching, learning, and training to play should also be designed according to the restrictions imposed by the context and the actual lived experience of the play. We conclude that cognition should not be considered solely responsible for decisions, and thus both theoretical and pedagogical models of player development should take the ecological perspective of decision making into account. As a result, the methodologies employed to develop players from an early age could be elaborated on by taking into account the interaction between cognitive skills and the possibilities emerging in the play.

Keywords: cognitive approach; action; team sports; sports science

Inherent in invasion-based team sports, tactics, or so-called tactical actions, are usually defined in the literature in respect to the movement of the players (Garganta, Guilherme, Barreira, & Rebelo, 2013). As pinpointed by Garganta et al. (2013), two dimensions bound tactical actions in a play: team strategy (predetermined or modeled) and individual (momentary) objectives. This distinction splits the concept of tactics into two time frames: Strategy acts more as a plan that can be reflected on a longer duration, whereas individual tactics are instant solutions that are generated in the moment of the action. In simple terms, "tactics" refers to the management of the space of play through positioning and movement of players (Teoldo, Guilherme, & Garganta, 2017), which makes the short time frame more in line with the idea of solving various situations of play that vary randomly in the absence of predefined strategy (Garganta, 1996). In the absence of formal organization or even in the context of learning, the nature of tactical actions would rather be assimilated to the short time frame.

In practice, all players must continuously accomplish tasks to reach collective objectives in the play, also described as *solving problems* in the play (Mombaerts, 1999). All players must be successful in choosing what to do in the play despite its variability, unpredictability, and many other factors, even when they do not have the ball (Pagnano-Richardson & Henninger, 2008). In fact, players will be successful in the game if they satisfactorily execute *coherent action* (Greco, 2006). We use the term *coherent* as opposed to "right" to acknowledge that many right actions are possible and that the one that is executed has to at least help the team (Raab, 2012). The greater challenge, however, lies in the way players coordinate their actions in opposing situations in an attempt to maintain and

progress with ball possession, as well as create scoring opportunities (Bourbousson, Poizat, Saury, & Seve, 2010; Garganta et al., 2013; Gesbert & Durny, 2017).

Hence, performing bodies (e.g., clubs, academies) in team sports seek players who are efficient, effective, and consistent in executing coherent actions in changing circumstances and use corresponding decisions as example to discuss them with other players in development (Mesquita, 1998). Decision making is the process through which players choose what they will do in a play, mainly to support the tactical component of the game (Barata & Araújo, 2005). Since human beings are constantly exposed to situations requiring decision making, the corresponding process has been the topic of numerous studies in areas from medicine to sports science and with various approaches (Araujo, Davids, & Hristovski, 2006; Gesbert, Durny, & Hauw, 2017; Raab & Gigerenzer, 2015). In the fields that are associated with team sports, efficient decision making has been portrayed as a crucial element of performance, as the efficiency of a player mainly depends on the relevance of the decision (Gréhaigne, 2014). However, there are many models of decision making; those that have usually been used to explain the decision process in team sports have been based on cognition.

Given the importance of intentionality and purpose at the beginning of an action, the perspective that decision making mainly operates through cognition has long guided investigations in sports (Samulski, 2009). Thus, decision making was initially conceptualized as an internal process occurring in each individual, because the individual chooses what to do (da Silva Matias & Greco, 2010). More specifically, models were built on the assumption that information must be processed to make decisions. According to this perspective, players must perceive and process what is happening around them to determine what they have to do

to reach a given objective, through the use of cognitive resources, aptitudes, and mechanisms (Raab, Bar-Eli, Plessner, & Araújo, 2019a). For instance, studies have found that good players are able to direct their attention to relevant information and to anticipate probable events in a play (Aksum, Magnaguagno, Bjørndal, & Jordet, 2020; Vítor de Assis, Costa, Casanova, Cardoso, & Teoldo, 2020). Such abilities allow players to make coherent decisions, a quality known as tactical intelligence (Casanova, Oliveira, Williams, & Garganta, 2009; Mouchet, 2014). For this reason, perception and processing occupy important roles in decision-making models in team sports.

Despite extensive research on the topic throughout the last decade, recent hints of adaptation are only just emerging, suggesting a more important influence on decision making of the play itself (Raab, MacMahon, Avugos, & Bar-Eli, 2019b) compared to traditional models that see the cognitive skills used in the decision process as accountable for the result of the action (see, e.g., Orasanu & Connelly, 1995, for sequential decision process). There seems to be a specific adaptation of cognitive skills to sports-related decision making under pressure. This adaptive function has not been described in detail before now in spite of important work on the weight of the context of play, understood as the situations that emerge in the game (Araujo & Davids, 2009). Such adaptations in a "cognitivist" decision process of solving these situations (also referred to as "problems") could be clarified based on the modified function of mechanisms in response to time pressure and the most important outcome in the play (Raab, 2012).

The aim of this review article is to connect the cognitivist theoretical framework of decision making in team sports with emerging evidence that the decision process does not entirely rely on the individual but also on the context of play. We have reviewed 60 scientific

articles identified in searches in scientific databases with the objective of contrasting the suggestions made from different perspectives on decision making and tactics in soccer. Various searches in the Laval University article database were performed with decision making and tactics as primary keywords, in addition to secondary keywords such as knowledge, learning, and development, in five languages. The manually selected articles were published between 2001 and 2020 and covered all of the following topics or combinations thereof: (i) tactics and action in the play; (ii) decision making and associated cognitive mechanisms and skills; and (iii) the teaching–learning–training process.

One main contrast we have explored in the narrative review points out the ways the decision process is obliged to adapt to the context of play, which has helped highlight the qualitative nature of the collected concepts on the topics. Pursuing our aim to provide experts' intuitive, experiential, and explicit perspectives on the different approaches to decision making in team sports (Ferrari, 2015), we present our conclusions in the form of four key adaptations of the decision process to the specific context of play and their implications for research and player development.

The cognitive decision process and its limits

According to the traditional cognitivist models, perception and processing are fundamental to the decision process, and knowledge is considered an important resource that feeds good decisions. For instance, sequential sampling of information makes processing responsible for the use of knowledge to make decisions (Johnson, 2006). According to this theory, knowledge is stored as “chunks” in working memory and is used when the situation makes the players think about what they know (Klingberg, 2010). However, the use of cognitive mechanisms and knowledge reportedly differs from recalling memories and

comparing them to the situation at hand because of the limited time that players afford to make their decisions in the play. The mechanisms and knowledge that are used by players characterizes the actual decision process when playing. This section explores the nature of knowledge as well as the functioning of decision making in the specific context of play. With the aim of situating the cognitivist perspective of decision making, this section also highlights its limits.

Dodds, Griffin, and Placek (2001) explained that game knowledge, such as the rules of the game, the roles of positions on the field, and to a certain extent the strategies, reflects declarative knowledge. In fact, this type of knowledge is composed of tangible and established facts and cannot be subjectively interpreted. The distinction was first demonstrated by Anderson (1987), who pointed out the difference between procedural knowledge (*the knowledge you do*) and declarative knowledge (*the knowledge you say*).

As often manifested through conversations with players, that knowledge of the game is often made of "if–then" rules and a verbalized representation of situations in a play (McPherson & Kernodle, 2003). The more experienced players are, the more they are able to verbally detail various conditions for suitable solutions, strategies, or probabilities of an event happening (McPherson & Kernodle, 2007). The taxonomy they employ to justify their decision or the richness of details can reflect their level of knowledge and conceptions of the game (Griffin, Dodds, Placek, & Tremino, 2001; Nevett, Rovengo, & Babiarz, 2001). In general, few players are able to verbalize a play in a detailed fashion (González-Víllora, García-López, del Campo, & Contreras-Jordán, 2010).

However, no correlation has been identified between declarative tactical knowledge and performance in actions without a ball for college students, but a difference in declarative

knowledge has been found between novices and experts (Auld, 2006). Williams and Davids (1995) have also shown that declarative knowledge is a by-product of experience that is developed through thinking about the game. Thus, verbal manifestation is no guarantee of actual game performance although it can be used to gauge players' experience and conceptions of the game (Araújo, Travassos, & Vilar, 2010). For these reasons, declarative knowledge as portrayed in the previous paragraphs can be considered a resource in the decision process only when its content fits the situation of play and the task that has to be performed—otherwise it would be practically useless.

The concept of decision making being composed of perception, processing, and use of knowledge is built on the assumption that players can recall the knowledge stored in their memory when they process what they perceive (Bossard & Kermarrec, 2011; Ericsson & Delaney, 1999; Ericsson & Kintsch, 1995; Orasanu & Connolly, 1995). However, the limited time to act constrains the possibility of recalling procedures, making comparisons to the situation at hand, and correspondingly pursuing a rich decision process based on knowledge (Raab, 2012). Thus, the conceptions of knowledge that most apply to the action in a play tend to be more in line with procedural knowledge (*the knowledge you do*): a tacit knowledge or skill that is built through experience without necessarily being verbalized (Raab & Araújo, 2019; Raab et al., 2019b).

Procedural knowledge relies on individuals' consciousness of their own capabilities and abilities. In the context of sports, capabilities are defined as biological allowances, and abilities are associated with skills. Results of a study based on the auto-assessment of the performance of players at different levels of competency show that the best performing players reported more accurate knowledge of their own capabilities and abilities (Kannekens,

Elferink-Gemser, & Visscher, 2009). Players use such knowledge to determine what to do within the span of skills they can use to execute an action efficiently, or else the decision would be incoherent and the action, unsuccessful (Barata & Araújo, 2005). As a result, the knowledge of self will influence a person's actions more than other sets of knowledge will.

Among these other sets of knowledge, knowledge of the game and the environment is associated with a good reading of the game, its events, and its probabilities. This gives players useful guidelines for choosing and executing coherent actions that will contribute to the success of the team according to, for instance, the phases of play (Garganta & Pinto, 1994). Optimally, such *tactical* knowledge should be used to play as a team, since teammates should make decisions that interact with one another. For this reason, the idea of shared knowledge has been explored in studies that have highlighted the use of models of thinking that players can refer to as they perform (Filho, Tenenbaum, & Yang, 2015). Such knowledge essentially works as a shared reference to enhance synchronization between players, although this would require the processing load for each action to be as low as possible to leave more room for a proper reading of the game. Such a capability was observed in players with greater tactical knowledge (Cardoso, González-Víllora, Guilherme, & Teoldo, 2019).

Besides the important functionality of knowledge used in a play, that knowledge is rather a subjective matter since it is built through each person's own experience (Beilock, Wierenga, & Carr, 2003; Gallego, González, Calvo, Del Barco, & Álvarez, 2010; Mouchet, 2013). Similarly, decisions and knowledge should be described not to compare them to somebody else's resources, but rather to understand the reasons a person chooses one solution over another (Bar-Eli, Plessner, & Raab, 2011), considering all situations and solutions are unique (Bossard & Kermarrec, 2011; Gesbert & Durny, 2017; Mouchet, 2012).

Apart from being molded around the interaction of task, environment, and individual, this knowledge is also required to fit the specific functioning of decision making in the context of play. This knowledge serves to direct attention toward relevant stimuli, which is essential for making quick decisions and solving situations of play (Araujo et al., 2006; Iglesias, Moreno, Santos-Rosa, Cervello, & Del Villar, 2005; Orasanu & Connolly, 1995). It also feeds and helps the cognitive mechanisms solicited during the quick decision process (Larkin & O'Connor, 2016). Players first evaluate what they see, for instance, distance and speed, and then interpret that information in time to act (Petiot, Aquino, Cardoso, Santos, & Teoldo, 2017). More specifically, evaluating the perceived information supports a higher level of cognitive functioning; anticipation involves all of the mentioned mechanisms, adapted perceptual-cognitive skills (Roca, Ford, McRobert, & Williams, 2011; Williams, Huys, Cañal-Bruland, & Hagemann, 2009), and knowledge. Such skills help experts look for relevant information in play situations (Vaeyens, Lenoir, Williams, & Philippaerts, 2007; Williams & Ericsson, 2007; Williams, Janelle, & Davids, 2004) by allowing them to scan quickly and more often than their counterparts (Roca, Ford, McRobert, & Williams, 2013). Moreover, high-performing players employ more efficient visual search strategies to perceive not more but better information depending on the task they must perform (Klostermann, 2020; Roca et al., 2011). This supports the "less is more" theory of simple heuristics, in which a smaller set of information to be perceived and processed during the decision process is better than a large set (Raab & Gigerenzer, 2015).

Similarly, recognition, evaluation, and judgment seem to be processing mechanisms that promote better decision making as long as they are light and adapted to the constraints of the context of play and to the changing, uncertain nature of play. For instance, judged and

calculated probabilities can be interpreted as risks. Risk can be experienced by players as an overall interpretation of the cues and patterns they have perceived since it will influence their judgement (Pleskac, Conradt, Leuker, & Hertwig, 2020). Thus, if ever used in the short time frame, knowledge is probably used to process significant cues, patterns, and risks rather than recall memories.

Yet again, less is more remains relevant, as the most important task is to perceive and process what is happening in the moment rather than loading the mind with information on which to make comparisons. Accordingly, the actual nature of solicited knowledge when playing tends to reflect content that evolves over time and through on-field experiences as opposed to accumulated memories that would demand more processing and therefore probably hold back the flow of action (Williams, Ward, Bell-Walker, & Ford, 2012). Moreover, the mechanistic view of decision making practically holds the cognitive capabilities, abilities, and skills responsible for the performance of a decision and consequently for its outcome. In contrast to this view, recent studies in the area continue to highlight clear influence of the fast-paced and changing environment that characterizes team sports games, showing that the play itself practically works against the use of knowledge as a resource, querying, and detailed processing (Runswick, Roca, Williams, McRobert, & North, 2018). Thus, the immediacy of repeated decision making rather fits the ecological perspective of a perception–action link in the course of a play (Gibson, 1979).

On the other hand, it has been acknowledged that players will not perform only deliberate actions. The distinction between intuitive and deliberate decisions has been made for both short and long time frames in decision making. Intuitive decisions have been defined as quick, automatic, effortless, associative, and implicit (Kahneman, 2003). According to this

proposition, the concept of intuition is often associated with an implicit action based on an impalpable experience, as opposed to what Kahneman (2003) called deliberate decisions or slow thinking. It would be reasonable to associate the cognitive mechanisms listed above with deliberate decisions even if it is probable that these mechanisms can run quickly if they stay frugal. Thus, all these mechanisms, whether they are intuitive or deliberate, can help players renew and change their decision in reaction to short time frame events. Such a conception emphasizes how players manage to perform short time frame decision making repeatedly while playing.

In parallel, studies with expert players have shown that the way decisions are made can vary between intuition and processing information (Moxley, Ericsson, Charness, & Krampe, 2012). Even if it is largely used by practitioners, the concept of intuition in soccer has not been defined with a strong consensus in the literature. The few authors who have proposed a definition of intuition have argued that decisions in team sports are primarily the result of the accumulation of extended experience, and more importantly, the duration and quality of training activities leading to fast decisions under time pressure, with the occasional complement of deliberative thinking off the field—without time pressure (Moxley et al., 2012). However, Musculus and her collaborators have shown that option generation and selection in time-pressure situations change over time: Younger players prefer to select a solution they are sure they can execute whereas older players may rely on their first option, that is, the intuitive one (Musculus, Raab, Belling, & Lobinger, 2018; Musculus, Ruggeri, Raab, & Lobinger, 2019). In this case, the option-generation perspective reinforces the relation between the decision and the ability to execute: Skillful players with more abilities

would be able to effectively execute the first option they generate without needing alternatives.

In brief, one interpretation is that regardless of the player's level of expertise, the actual decision process relies on better information as well as adapted and trained cognitive skills: Better players end up knowing better but are apt to engage in a similar decision process overall. Especially during the formative years, decisional schemes will probably resemble between players, as "practical experience" has been shown to be based not on memories (Williams et al., 2012) but rather on the "quantity of quality" of training involving decision making (Roca & Ford, 2020). But experts are better at evaluating more important information and resort to a greater span of skills to solve a situation, whereas learners are expected to resort to solutions that they know are effective, and to information that is significant to them (Mouchet, 2013; Musculus et al., 2019; Vítor de Assis, González-Víllora, Clemente, Cardoso, & Teoldo, 2020). These characteristics result in giving more importance to the context of decisions and development than in earlier decision-making models. This has repercussions for both the conception of decision making and its training in team sports.

Adaptation of the decision process to the context of play

Many studies over the years taking the cognitivist approach have shown how good players are able to direct their attention to relevant information in a play and to anticipate probable events (Williams & Jackson, 2018). Such abilities are thought to be important elements that contribute to the making of sound decisions (Casanova et al., 2009; Mouchet, 2014). However, this quality requires tuning the process to the reality of the game to keep proceeding in an efficient way.

Sternberg (1999) has shown that the simplicity in cognitive tasks helped not holding back creativity even in complex situations of play. This would not be possible if all cognitive processes implied a load or a delay in the execution. The conception of a fast perception, directed to less stimuli, as the central mechanism for creating solutions has been articulated by many other authors (Bacconi & Marella, 1995; Garganta, 1997). Correspondingly, the use of reasoning and deep information processing has been identified as a supplementary task that would make an action meditated or over-thought (Raab, 2014; Ward, 2003). First, this implies that decision making according to the traditional step-by-step process and complete reasoning (Lindsay & Norman, 1980; Orasanu & Connolly, 1995) does not fit with time constraints in the game. It also shows that the cognitive activity solicited throughout the decision process has to be adapted to function in a time-limited and dynamic environment, among other specific characteristics (Gesbert et al., 2017). As of this writing, however, there is a lack of evidence on the way these adjustments are made.

While recognizing patterns implies processing many elements of information simultaneously, a kind of global appreciation that saves time, studies have shown that experts detect and recognize more details in the environment than novices (North, Ward, Ericsson, & Williams, 2011; Williams, Hodges, North, & Barton, 2006). Even if more capable players are able to perceive more information, it is expected that cognitive activity runs quickly (Marasso, Laborde, Bardaglio, & Raab, 2014). Thus, key adjustments in cognition can be seen as shortcuts that do not discard information essential to making sound decisions but still result in a lighter overall cognitive load (Raab & Gigerenzer, 2015). In line with the cognitive mechanisms explored in the previous section, we have identified in the reviewed literature four adjustments that mainly sync cognitive activity to the context of play (Table 1). In

addition to portraying how the decision process works in that context, these four key adjustments characterize the internal experience of the players.

Table 1. The key characteristics of decision making in team sports games

Characteristic	Reference
The first decision made is the one executed ("take the first")	(Johnson & Raab, 2003)
Cognition is simplified ("simple heuristics")	(Raab, 2012)
Evaluation prevails	(Petiot et al., 2017)
Decisions are not completely reflected (e.g., assess pros and cons) ("prereflected")	(Vermersch, 2000)

In brief, the decision process must happen instantaneously and thus the concept of simple heuristics applies well, showing that "less is more". It is characterized by the use of judgment and a purposeful limit to the cognitive load. First, the decision is generated, or as illustrated by Mouchet (2012), the decision emerges from the play, that is, the interaction between the players and the rest of the environment. Therefore, the first decision that is made is the one that will be executed (Johnson & Raab, 2003; Raab et al., 2019b). The take the first heuristic reflects operating with that first solution as opposed to picking among possibilities, and therefore practically eliminates the need to generate other solutions to the same problem unless a new event happens and changes that problem.

Second, as suggested by the term simple heuristics, players utilize simplified cognition in which they deliberately consider only some of the available information to shorten the decision-making process (Gigerenzer & Gaissmaier, 2011; Raab, 2012; Raab & Gigerenzer, 2015). Both adjustments portray the shortcuts cognition has to take to deal with time constraints. In this regard, it can be summarized that players prefer to evaluate rather than simply to monitor what they perceive or even make plans based on that information (Petiot et al., 2017). Processing the information by directly evaluating it matches the theories explored earlier as it leads to judgment as an outcome. It practically is the shortest cognitive intermediary between perception and action that fills a purposeful role between perception and action. This intermediary can first embed the implicit "in-the-act" knowledge, that is, an individual experience that forms the judgment used in one's decisions.

The first three characteristics already contrast with a linear cognitive process as suggested in the first models of the cognitive decision process (Orasanu & Connolly, 1995). As it ties perception to action with fewer steps in between and with more global purpose and influence from the environment, a frugal perception and processing aligns with the ecological model of a direct perception–action link (Gibson, 1979). Adding to the relevancy of such a model for more direct actions as are the case in a game play, Gibson's perception–action theory also presupposes that players will share the possibilities in the play that they would have created with their knowledge of the environment as opposed to a rich repertoire of queried memories (Silva, Garganta, Araújo, Davids, & Aguiar, 2013). Assuming that there is more than knowledge at the source of tactical decisions, a variety of solutions to problems in the play should emerge from the actions of other players. Hence, solutions in the play should rather be seen as the interaction between the repeated decisions/actions of multiple

players as opposed to a singular decision and thus can be read in the behavior of all participating players (Roca & Ford, 2020; Williams & Ericsson, 2007).

Figure 1. Comparison between the components of a sequential model and the key characteristics

Sequential model	**Model based on adapted key characteristics**
Assumption: processing makes decisions	Assumption: decision is part of a lived experience
Perception ⇩ Processing (with knowledge as a resource) ⇩ Planned execution (As a motor action)	Perception ⇩ Evaluation (with recognition and judgment) ⇩ Generated response (As intended and purposeful actions)
Output: action	Output: behavior

As a result, the conception of decision making in the context of team sports such as soccer contrasts with a computational model. The contrast presented in Figure 1 highlights the conceptual differences despite a similar order. Considering the human lived experience as its core assumption, the adapted model presents the mechanisms as a viable shortcut between perception and action. It also presents the execution as a generated response, as suggested in the take-the-first approach. Finally, the output in the form of a behavior reflects the characteristically individual result of decision making in a play and the ownership of the decisional schemes (Mouchet, 2012; Teoldo et al., 2017). Such a conception loops to the idea of lived experience that differs between players and that is affected by factors of performance.

Accordingly, as a fourth adjustment, decisions are prereflected, as players cannot analyze all the details (e.g., pros and cons) of each decision (Vermersch, 2000). In his article, Vermersch portrays prereflected decisions as being like the state of happiness, in which individuals are conscious but have not reflected on why they are happy. Comparably, players are conscious of the information they have perceived but will not be able to make detailed sense of their reaction to these elements of information. Such a state, neither unconsciousness nor thinking, reinforces the implicit and affective nature of the action in the play and makes it difficult for researchers to describe the content decisions are based on. Nevertheless, it reflects the lived experience of decision making and opens alternative approaches to studying decisions, to portray their enacted characteristics and the role of factors in cognition and the decision process, such as emotions (Gesbert et al., 2017) and growth (Gallahue, Ozmun, & Goodway, 2006).

Factors of performance in decision making

Cognitive mechanisms are affected by factors that the individual cannot control. At first, information processing will allow their cognitive mechanisms perform properly if players do not let their emotions dominate them. Emotions are triggered by the results of previous actions or events and by the characteristics of the players, such as the trait of impulsivity (Gonzaga, Albuquerque, Malloy-Diniz, Greco, & Teoldo, 2014; Santos, Padilha Maickel, & Teoldo, 2014). At first, players remember what they have done well and what they have missed because they keep in memory event and their results through emotion, which is the effect of somatic markers (Oliveira, 2004). Cognitive activity is therefore influenced by emotion because emotion is recovered before reasoned thinking, especially under time constraints (Damásio, Vicente, Segurado, & Branco, 1997). Decisions are also

influenced by the players' surroundings, including feedback from the coach and the shouts of the public (Mouchet, 2003, 2012). Reactions in the crowd or even within the family after a performance can influence decisions. Moreover, decisions made in negative environments or in situations that tend to be more emotional than rational can possibly lead to limited perception.

The influence of emotions on performance is important to consider when studying decision making (Laborde, Raab, & Dosseville, 2013; Vorraber, 2010). In the moment, players can experience many psychological states depending on the scenario of the game, which changes many parameters of their motivation and concentration (Cotterill, 2012; Weinberg & Gould, 2014). More broadly, life events can also have an impact on the players' daily performance. However, the influence on decision making is not only negative. It has been shown that positive emotions lead to better perception and performance (Schmitz, De Rosa, & Anderson, 2009). Thus, in addition to relying on cognitive skills, performing players may resort to emotional intelligence to mitigate the effect of emotions on their performance and regulate their behavior in a play (Cowden, 2016; Vaughan & Laborde, 2018).

In the longer term, young players go through a maturation process that has a direct influence on their capabilities. Throughout this growth period and more importantly during adolescence, the body and mind are developing (Gallahue et al., 2006; Haywood & Getchell, 2009). Biological development (e.g., physique), before self-development, has an impact on capabilities in each of the four components of the game, that is technique, physique, psychology and tactics. When training, for instance, even increasing the number of sprint repetitions may not help increase speed because of the body's growth limitations (Gastin, Tangalos, Torres, & Robertson, 2017). The same principle applies to cognitive abilities, such

as memory and perception, both essential to perceiving and processing information during the decision process (Poolton, Masters, & Maxwell, 2006). Thus, biological maturation progressively aids the development of perception and comprehension of several elements of the game (Teoldo & Cardoso, 2013). For this reason, a majority of players will show the necessary cognitive capabilities and skills to perform all tactical movements from the age of 15 (González Víllora, Serra-Olivares, Pastor-Vicedo, & Teoldo Da Costa, 2015). In principle, these capabilities should reach an optimal level in adulthood if the individual puts them to use to complete tasks that will result in the development of useful abilities for a full potential performance (Rezende & Valdés, 2003, 2004; Tenenbaum, Stewart, & Sheath, 1999).

Thus, players go through a lengthy individual development process through which new capabilities emerge, new abilities are trained, and new knowledge is generated. Among the qualities that are important at the competitive level in soccer, tactical intelligence and creativity are sought in both high-performance development and competition (Gréhaigne, 2014; Santos, Memmert, Sampaio, & Leite, 2016). Players can show tactical intelligence through the way they solve problems, and more creativity in the divergent solutions to situations of play, two qualities found in very good soccer players up to 15 years old (Giacomini, Soares, Santos, Matias, & Greco, 2011). In all cases, tactical intelligence should develop in more players if they are offered training programs that fit the task demand and reality of the decision process. For all the reasons mentioned in this section, the long-term development path of players is conceived in the contemporary literature as nonlinear and is recommended to be player centered because of the differences among teammates (Práxedes, Del Villar, Pizarro, & Moreno, 2018).

Implications for research and practice

Actions and decisions are commonly described as unique: Solutions in a play cannot be prepared in advance, and they are unique to every new situation in a play, and to every player. Moreover, more than one solution exists to reach an objective, again, depending on the capabilities and abilities of the player who is performing it (Davids, Button, & Bennett, 2008). It has also been shown that players direct their attention to stimuli that are of interest, familiar, and significant to them in the given situation (Beilock et al., 2003; McPherson, 1999; Orasanu & Connolly, 1995). The combination of the personal aspect of the decision, emotions, growth, and the particular functioning of decision making in the context of play reflects the actual experience of the individual in the play, especially as players have to go through a long development phase.

This new conception of the characteristics of the cognitive aspect of the decision process in this article have implications for both research and practice. At first, models used to portray the decision process reveal connections between their conceptions, whether the initial assumptions are cognitivist or ecological. Considering the cognitivist approach can illustrate the decision process only up to a point; this paper opens further discussions and attempts to integrate the ecological concepts, showing how the environment is responsible for shaping decisions (Gibson, 1979; Raab & Araújo, 2019). More precisely, there is more space for consideration of context in the conception of decision making and the study of the possibilities it offers, even if one assumes individuals are accountable for their decisions. More specifically for team sports, the context of play has a strong influence on the decision process and, as a result, shapes behavior (i.e., the response) as much as the lived experience of the play (i.e., the experience from the individual's point of view). These characteristics

reflect a clear response to constraints and possibilities presented in the context of play and should be embedded in both theoretical and practical models of the development of decision making. As an extension to the first implication, the methodologies applied in long-term player development would benefit from considering these constraints and the lived experience that was created.

In the context of player development, a player's overall ability to choose and execute a coherent action in a play depends on a development process that begins at a young age. Strongly assimilated perception–action associations will come to the surface under time pressure, as time constraints have a stronger influence on the players (Araujo et al., 2006). Coupling elements of information and action remains a powerful way to build one's own repertoire of solutions in a play. Constantly training under time pressure and direct instruction can forge habits (i.e., preferred predispositions) rather than lead players to understand the situation and adapt their response accordingly and coherently. It becomes difficult to modify actions that have been repeated and assimilated because doing so requires new questioning, understanding, assimilation, and, ultimately, a delay (Dodds et al., 2001; Griffin & Placek, 2001). It is therefore important to design development activities that are appropriate for the task demands and the functioning of cognition (Petiot et al., 2017) but also allow decisions to be made intuitively (Moxley et al., 2012).

In addition to training on the field, other development activities can be designed to develop the tactical component of plays, by enhancing understanding, judgment, and knowledge of the environment (i.e., of a play). By describing the actions with guidance from an interviewer, performers can recall their lived experience and bring this information from its prereflected state to consciousness and share it in their narrative of the situation of play.

More specifically, this approach has been shown to contribute significantly to improving judgment, awareness, and other assets and to transferring those assets to plays (Gréhaigne, 2007) and to the construction of knowledge and understanding of the game when repeated (Jones & Thomas, 2015; Light, Harvey, & Mouchet, 2014). The approach can also serve the ability to auto-assess more realistically, with the aim to help players direct their own development (Macnamara & Collins, 2011). Even if verbalization is commonly recognized as practical on the field, not all players can fully benefit from it because players do not learn the same way or use verbalization to assimilate new contents (Nortje, Dicks, Coopoo, & Savelsbergh, 2014). For this reason, models that fit hybrid approaches to *learning how to play*, such as the SMART-ER model, would fit the nonlinear nature of the learning process and adapt to differences between players (Raab, 2014).

Advancements in the phenomenology of experience have researchers helped to access to the information that is processed during decision making by relying on the players' opinion (Gesbert et al., 2017; Kermarrec & Bossard, 2014; Mouchet, Morgan, & Thomas, 2018). By describing their decisions, researchers can study the information that is significant to the player and the subjectivity of the judgement. In this regard, previous studies using the elicitation interview have successfully shown that the lived experience can be used as empirical data to trace the sources of decisions and improve them (Light, Evans, Harvey, Hassanin, & Mouchet, 2015; Mouchet, 2013). This shows that to study decisions and use science to help development, it would be relevant to rely on that lived experience. This could begin with identifying the intentionality of actions (Allen-Collinson, 2009) and linking it to situations of play. Since these situations of play are commonly shaped by constraints (Machado et al., 2019), it is then even easier to tell which constraint is influencing the task,

the environment, the individual, and, as result, the action and decision making (Newell, Van Emmerik, & McDonald, 1989; Nitsch, 1985).

For practical purposes, the composition of a curriculum that offers opportunities for the development off most of the elements important in decision making might include (a) playing under different variants of the game to explore different degrees of freedom (da Silva Matias & Greco, 2010); (b) limiting the number of extra conditioning rules to avoid cognitive overload; (c) and leaving room for mistakes to keep up the flow and speed before eliciting reinvestment (Masters & Maxwell, 2004). In general, theories on learning suggest that learning is most effective when the learner is given an adequate period of quality time with a specific play experience, in addition to key feedback. However, training should also include opportunities to reflect on the game. Among the activities identified in the literature, debating the games went or might go, and discussing about tactical contents are good ways to elaborate on solutions (Gréhaigne, 2007), and reenacting or confronting past experiences is a good way to enhance players' consciousness of their own actions (Gesbert et al., 2017).

Summary and conclusion

We sought to find evidence of adaptations and adjustments in the functioning of cognition to perform in the context of a play in team sports. The four key characteristics that describe the decision process as (a) generated, (b) prereflected, and based on (c) simple heuristics and (d) evaluation were identified as indicators of the way players adapt their decision process to the environment of play. We undertook a detailed review of the traditional cognitive framework to weigh the role of cognition in the decision process in the context of play and show the influence of this context on the lived experience in a play. Our goal was

to suggest a bridge between conceptions of decision making that were developed from two contrasting perspectives.

A key notion of this paper is that together, the four key characteristics portray the fast and frugal functioning of decision making tuned to the context of play and task demands. We believe that such an adaptation to time restrictions and short time frame functioning implies that knowledge could not be used with request-based mechanisms. Thus, it is less probable that conception and representation of the play, as we discussed above, are used as references during the decision process. This is precisely in line with emerging discussions in the literature suggesting that the generation of action in a specific situation of play can be conceptualized from either a cognitivist or noncognitivist perspective (i.e., sequential cognition vs. embodied decision making; (Raab, 2017; Raab & Araújo, 2019).

Given the characteristics of contextually adapted cognition for short time frame decisions in team sports, teaching and training methodologies should be designed to help players develop their ability to respond to the situations that emerge from a play. Currently, as tactics are predominant in team sports games, many methodologies are being used with respect to sports pedagogy beforehand. To have a greater impact on the play, it would instead be helpful to consider the reality of decision making and its nature in the specific context of situations of play, as inferred in the four key characteristics, when intervening through the process of player development.

Acknowledgements

Thanks to professors João Claudio Machado, Marcos Reis, and Davi Silva for the review of the document and advisory; to Marie-Denise Lavoie for the assistance with the

library research systems at Laval University; to PhD Luc Nadeau, for the supervision of the literature review; and to Anita Todd for the review of the English.

Funding

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001 and the Social Sciences and Humanities Research Council of the Government of Canada as a Grant for research at Laval University.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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