A Naturalistic Decision-Making Investigation of Football Defensive Players: an exploratory study

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ABSTRACT

Introduction: The aim of this study was to describe decision-making of football defensive player according to RPD model, and to investigate dynamic relationships between recognition processes and by-products used in naturalistic setting. Yet very few researchers have investigated the dynamic nature of decision-making, in sport real-world settings **Method**: Behavioural data was recorded from four high-level football players supplemented by verbal data collected during self-confrontation interviews. Seven critical defensive stages were studied. The data were analysed using a content analysis in five steps. **Results and Discussion:** Considering the dynamic of decision – making, 112 decisions were classified into three types of processes and 8 typical decisions for defensive stages. These findings are discussed from three perspectives: the RPD model highlighting the recognition processes of expert sport players; decision-making as an anticipatory thinking; the implications of these underlying mechanisms for training.

KEYWORDS

Decision making; recognition processes; anticipatory thinking; defensive stages; football players.

INTRODUCTION

A deep understanding of sport competition is essential for games because the success of coaches and players in such events is dependent on many qualitative and latent factors. Various studies in sport psychology over the past three decades have focused on decision-making in order to elicit "objective factors" of athletes' expertise (for a review, see Williams & Ward, 2007). Different aspects, such as visual search strategies (Williams, Hodges, North & Barton, 2006), memory processes (Zoudji, Thon & Debû, 2010), knowledge bases (McPherson & Kernodle, 2003), and the role of practice in decision-making (Kibele, 2006) have been examined. The decision-making context used in these studies was semi-experimental (schemata, slides, and videos).

The difficulty of setting out the "winning-factors" in games has led researchers to study activity in its complex and dynamical properties, and not only as an information-processing system (Sève, Saury, Ria & Durand, 2003; Lenzen, Theunissen & Cloes, 2009). Those studies have introduced theoretical models for studying the dynamic links between the athletes' cognitive resources and contextual constraints. Methods used were different recall techniques from a previously experienced case in natural competitive settings, verbal report and qualitative analysis. In reference to the theoretical approach of the course of action (Theureau, 1992), many studies concerned with sport have focused on the significant components of athletes' experiences: goals in sailing (Saury *et al*., 1997), knowledge building during tennis tables matches (Sève *et al.*, 2003), and emotions experienced in table tennis (Sève *et al.*, 2007). Inspired from the theory of situated action, Lenzen *et al.* (2009) studied the relationship between planning and action and the perception-action coordination in hand-ball. Mouchet *et al.* (2005) considered both first-person approach and the psycho-phenomenology propositions in order to analyze subjectivity of decision-making in rugby. In these games decision-making constitutes a practical fulfillment, situated in a particular context because circumstances are never identical (score, tiredness, players in presence, personal purposes). The assumption is that experts memorize "typical traces" for unusual, competitive, complex or difficult situations, i.e. situations involving "critical decisions" (Hoffman & Lintern, 2006).

In these psycho-phenomenological approaches of course of action, the researchers studied the situated experiences of expert athletes, but they didn't focus on the decision-making processes.

THE NATURALISTIC DECISION-MAKING FRAMEWORK

The NDM paradigm aims to improve the systems that help people to make choices in military, nuclear power or aviation settings. NDM examines the ways in which experts in real-world contexts, alone or in a team, identify

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and assess situations, make decisions and execute actions with consequences which are meaningful to both the actors and their environment (Lipshitz, Klein, Orasanu, & Salas, 2001). The features of the contexts in which experts' significant decisions are made relate to: ill-structured problems, ill-defined or competing goals, uncertain and dynamic environments, time constraints, high stakes, multiple event-feedback loops, multiple players, and organizational settings (Cannon-Bowers, Salas, & Pruitt, 1996). Parallels have already been drawn between working situations and sport situations (Fiore & Salas, 2006; Ward & Eccles, 2006).

The Recognition-Primed Decision Model

In NDM framework, the RPD model is an alternative way to the information-processing model in explaining experts' decisions under time pressure (Hoffman & Lintern, 2006). Klein (2008) refutes the idea that people in dynamic situations make decisions based on rational deductions or exhaustive analyses of expectancies. For Klein, experts use their experience to make decisions under time pressure. Experts confronted with dynamic situations are able to recognize typical situations and to associate an appropriate course of action (*i.e* pattern matching).

Conversely, the RPD model suggests three levels of experiencing the situation: *simple match*, *diagnosing the situation*, and *evaluating a course of action*. At the first level, the situation is quickly perceived as typical, allowing the expert to react directly by means of an action or sequence of actions. The second level occurs when the situation is perceived to be incongruous. The expert must clarify it by diagnosing it, focusing on its similarities with similar cases and hereby choosing an appropriate action. At the third level, the expert perceives the situation as typical but looks for a new solution and evaluates it through mental simulation before implementing a course of action. This process allows him to imagine how effective his action will be in the current situation.

In NDM perspective, experts use a holistic evaluation of the potential during the course of action. The first and most immediate option considered is therefore a plausible option (Lipshitz *et al*., 2001). For Klein (2008), both the assessment of the situation and decision-making during the action itself are supported by the recognition of spatiotemporal patterns. Ross, Shafer & Klein (2006) mentioned the "instantiation of a prototype" (p. 406). This prototype is a cognitive package that includes: information about the current typical situation (relevant cues), what to expect from this situation (expectancies), suitable goals, and typical action.

NATURALISTIC APPROACH OF DECISION MAKING IN SPORTS

RPD models have been used to study decision-making in various dynamic situations in work settings (for a review, see Ross *et al*., 2006), and are starting to be applied in sport settings (Omodei *et al.*, 1998; Johnson & Raab, 2003; Macquet, 2009 ; Bossard *et al*., 2010, 2011). However, experimental procedure and quantitative analysis used by Omodei *et al.* (1998) and Johnson & Raab (2003) didn't describe accurately typical components or cognitive packages athletes use during course of action.

More recently, some researchers used RPD model for qualitative analysis of empirical data. Macquet (2009) has shown that expert volleyball players predominantly used a simple match (level one) to make decisions in competitive situations. The author explains that time pressure during certain tasks forces athlete to rely on the first level. In order to recognize a situation as typical and to react instantaneously (simple match), experts recognize typical components (opponents actions, trajectory of the ball, rules) in the course of action. This process allows them to retain meaningful and efficient actions. In the same perspective, Bossard *et al.* (2010) adapted RPD model to describe cognitive packages supporting decision-making during the counter-attack phase in ice-hockey. They identified ten "typical schemata" used by expert ice hockey players during successive stages of course of action. These schemata represent the underlying structures which link perceptive and cognitive elements and facilitate the recognition under time pressure. In this perspective, Bossard *et al.* (2011) used RPD model and schema theory in order to obtain a dynamic representation of experts' courses of action during a counter-attack training setting in football. These results are used to support participative simulation design for decision-making training.

These studies were based on the assumption of relatively stable cognitive structures are used to recognize situations. They didn't consider the dynamic aspect of decision-making, the refined assessment process, and the role of by-product in this process. Yet very few researchers have investigated the dynamic nature of decision-making, in sport real-world settings.

Purpose of the study

The purpose of this exploratory naturalistic case study was to elicit decision-making components and processes in a competitive football setting. Decision-making in football is a complex mechanism; particularly in defensive plays defenders must make their team-mates continually aware of potential problems regarding their own and the other team's locations and activities. This study focused on temporal analyses to describe course of action as successive decisions athletes have to make under time pressure and tried to propose a refined description of assessment mechanism and sub-products role in these process.

This qualitative exploratory study focuses on examining how defensive players contribute to the joint production of successful defense, and on identifying recurrent practices in the data, i.e. typical decision. In so doing, we will

contribute to scant existing knowledge of the ways in which decision is typically achieved: which are the assessment processes, and the refined by-products / components experts used for decision making in critical situation.

METHOD

Participants and setting

Four international level football players from a professional football team in the French first League participated voluntarily in this study. The overall age was 25.5 (SD = 3,8 years) and they had played in this team for several months. Although the players did not ask to remain anonymous, they were given the following pseudonyms to guarantee some degree of confidentiality: Louis was left back, Robert was right back, Carl and Steeve were the central defenders. The players' decision-making was studied during a first league football match. Training, previous matches, feedback between players and coaches had developed team expertise for defensive stages, so that they were considered as one of the best defenders in the first league.
The team used zone defense or zonal marking. It is a tactic which is used in sports such as football where the players are made to guard a specific area of the field. In zone defense, if a defender is under pressure or in a critical situation their teammates must assist him, so that zone defense promotes or needs lots of interactions between defensive players.

Data collection

Two types of data were gathered: (a) observational data from continuous video recordings of the defenders actions from the beginning to the end of the defensive stage (from the loss of the ball till its recovering) and (b) elicited data from self-confrontation interviews.
The observational data were obtained by video recordings of the players' actions during the match. A digital camera was positioned high in the stand and was set for a fixed, wide-angle view, framing both the field and the players (see Figure 1).
Elicited data were obtained during self-confrontation interviews conducted after the match had been played. The interview techniques were derived from video recordings of players as they played; as the players viewed the video footage, they were asked to comment on the decisions made. The methodology of this interview is closed to the Critical Decision Method (CDM) developed to investigate experts' decisions in naturalistic settings. Self-confrontation interviews have been used by others researchers in natural sport settings (Lenzen *et al*., 2009; Macquet, 2009; Sève, Ria, Poizat, Saury & Durand, 2007).
The interviewer's prompts were related to description of the actions, thoughts, feelings and events as experienced by the player before, during and after each critical decision. According to RPD model, decision – making is a recognition process, and the recall process was facilitated by using some non-direct questions about feelings (how do you feel at this time?), perceptions (what are you looking for?) or focus (what is drawing your attention?), intentions (what do you want to do?), and thoughts (what are you thinking about?) associated with each decision. The researcher stopped the tape before each decision was made and asked the player to comment on his actions and the events leading up to the decision. Players could stop the video at any time to explain something that they deemed relevant.
The present self-confrontation interviews (duration, M = 45 min, SD = 5 min) were conducted the day after the game for each of the four players. To avoid potential bias, the coach agreed not to analyze the match on with the players until the interviews were over. The interviews were recorded in their entirety using a digital video camera and a tape recorder. This type of interview was supported by a formal contract of cooperation between the coach, the players and the researcher. All of the players and the coach had expressed a great deal of interest in the study. The players gave their permission for all recordings to be made available.

Data processing

The video of the match was viewed in order to choose critical stages for the study. Stages were identified as critical situations by the first researcher, another sport psychologist researcher and a football professional trainer. These stages were chosen because a) only the four defenders were between the player in possession of the ball and the goal; b) the player in possession of the ball drove it quickly to the defense area; or c) a long pass could put defenders under time pressure; d) finally, defenders had to stop opposite team attempt. Each defensive stage we chose was between ten and twenty seconds long, and achieved in production of successful defenses (i.e. the ball was intercepted). Finally, each four-defender team participated in seven critical defensive stages; they were characterized by the locus of the end of the adverse attack/the begin of the defensive stage.
Observable behaviors were systematically coded and organized into categories relating to the technical language of football, without making inferences about their intentions. The verbal exchanges between the players and the researcher during the interview were recorded and fully transcribed. These verbal data were processed in five steps: (a) generating defensive stages logs, (b) selecting and identifying decision making by-products, (c) analyzing decision making process thanks to previous coding (i.e. by-products), (e) identifying typical decisions, and (f) ensuring validity.

Generating defensive stages logs

This first step consisted of generating a summary table or log of the sectioned data for each seven defensive stages (Table 1). The main objective was to prepare the data for subsequent content analysis. For each participant, descriptions of the player's actions and comments were placed side-by-side in a three column table in chronological order for each situation studied. The first column references the situation in question, giving the participant's name and the reference number for the defensive stage, as well as the time at which the stage occurred in relation to the beginning of match. The second column lists the player's actions. A transcription of the player's verbalizations produced during the self-confrontation interviews can be found in the third column.

Table 1. *Example of Defensive Stage Log and Short Accounts*

Game highlights	Players' actions and behaviours	Verbal reports from self-confrontation interviews
First defensive stage		Robert – Right defender
	The ball was lost on the left side, about 40 meters away from the goal.	I see him losing the ball on the opposite side (I). Carl is guarding his opponent (I) I'm aligning on Steeve (A). (Level 1)
	The right winger passes to a midfield player (flick pass) and goes through the central defense.	We all guard (I), there is nobody behind me (I), I'm set in case of Steeve would be out of position (E), I check the alignement (I), I'm set to assist him (A). (Level 2)
	Carl intercepts the ball.	

Selecting and identifying decision making by-products

The second phase consisted of selecting data relating to players' decision-making. We used a category system derived from the RPD model (Klein, 2008) to code the salient features of decision-making. Defenders discourse, along with salient information, their own goals, the actions they have chosen and what they could expect, should enable us to identify the active cognitive packages (plausible goals, expectancies, typical action and relevant cues). We attributed a code for each of the salient features: *goals* (G), *action* (A), *information* (I), and *expectancies* (E).

Identifying recognition processes

Because we consider that the sports context could generate specific constraints, we decided to conduct empirical an inductive analysis of courses of action before comparing our results to the RPD model (simple match, diagnose and simulate). So, thanks to previous coding (i.e. decision making by-products), we looked for processes within the specific mechanisms the defenders used to assess successive situations and to make decision. We analyzed the verbal reports about each decision separately. In each short account, to clarify their decision, players established implicit relationships between by-products. They verbalized successively many components of a cognitive package, so that the chronology inside each short account could be considered as an indicator for identifying recognition process. For example a defender said: "I could see that the ball was on the right side (I), the attacker kicks a long pass (I) ; I run back (A)". In this example, relevant cues ("the ball on the right side" and "the attackers is …") are taken in account to assess the situation: so the defender decided to "run back". This approach aimed to elicit the dynamic of decision – making processes to be taken into account during the course of action. We noted/coded this recognition process: I(+I)---A. This kind of process, which included information perception led to action, was identified in 68 short accounts of decision-making. After each short account was analyzed in this perspective, we classified them into "typical processes" and compared the generated categories to those of the RPD model.

Identifying typical decisions

In this step, we conducted an empirical categorization of the data (Strauss & Corbin, 1998) on the different decisions made by the four defenders. We gathered together decisions made in the same way by different players during the seven critical defensive stages. The typical decisions were defined and named at the end of the analysis.

Ensuring validity of generated categories (i.e. types of processes and typical decisions)

The theoretical and empirical categorizations were validated by three researchers who had already coded protocols of this type in previous studies, had prior experience in team sport, and were familiar with the NDM framework. The reliability of the coding procedure was assessed using Bellack's agreement rate; the initial agreement rate was 80% for by-products coding, 90% for typical decisions and 90 % for types of recognition process.

RESULTS

The results will be presented in two stages: (a) the decision processes experienced by defenders; (b) typical decision of expert football defenders.

Processes and content of decisions experienced by expert football defenders

The analysis of the seven critical defensive stages suggested that players make tactical decisions based on combinations of significant information. By adopting a first person approach to dividing up the course of action, 112 successive decision-making situations were identified for the four players. We tried to elicit relationship between the significant by-products of the cognitive packages by considering the dynamic of the activity threw the chronology of self-confrontation interview. Considering the dynamic of decision – making, the 112 decision were classified into three types of processes. And, considering the content of each decision-making, we classified the 112 decisions into 8 typical decisions. The distribution of the processes related to what kind of decision was made is presented in table 2.

The first type of processes consisted in relevant cues invocation immediately conducted to action. In this case, critical information was perceived and the situation was assessed familiar to him, so that the player could rapidly choose an action. For example a defender (Paul) said: "I could see that Mark is following his opponent on the right side (I), I should cover back the central area (A)". Sometimes the process conducted the defender to explicit knowledge (" I have to protect central area; it's the most important to protect this zone; it's the best way to the goal"), so that it looks like a justification about decision-making. This process consisting in some kind of perception – action association, could led defenders to expected outcomes: "I could see that the ball was on the right side (I), the attacker could kick it for a long pass (I), I have to run back (A); my teammates should run back too, so that we'll stand on the same line to prevent a long pass (E)". In this example, it is remarkable that there is not only one relevant cue to be mentioned; the recognition process combined two relevant cues to active a course of action. These kinds of recognition process were coded: I---A; I+I--- A (table 2). This type of process, which included information perception associated to action, was identified in 68 short accounts of decision-making. According to the RPD model, if the player quickly assessed the situation to react immediately, the recognition process should be a simple match (level 1). Results in table 2 shows that this first type of process is the only process defenders used when the ball was the main relevant cue. Close to the ball and their opponent, they had to match immediately perception and action.

In the second type of process, the defender perceived one (or more) relevant cues that conducted him to attempt an evolution for the course of action (expectancies). In this case, information perceived was associated to expectancies, and then, the defender could see another relevant cue that conducted him to choose an action. For example a defender (Mark) said: "I could see that my opponent run behind me (I), I'm ready, I can run back to cut his way (E)". In this example, Mark's expectancy was a preparation to action. The players assess the situation in one way (but he wasn't sure it was the good option) and wait for significant information to confirm plausible options or goals. In some case, this first option could be invalided: "we've just lost the ball on the left side (I), far away from the goal (I), I should stand in my area because the attackers in possession of the ball couldn't become dangerous (E), "but, now, he's passing on the other side (I), so I have to run and to assist the central backs (A)". In these course of action the decision making process began when the defender performed an usual action ("I go back to my place" ; "I'm looking at my opponents" ; "I continue to be aligned") ; the defender pays attention for relevant cues ("I saw him in my back") which generated expectancies ("I feel he can run to the goal"). This type of process was identified in 18 short accounts of decision-making; it was coded I(+I)---E---A or I(+I)---G---A, and it could be considered as a diagnose process. According to the RPD model, we could consider that if the player can't assess the situation immediately, he has to diagnose, i.e. estimate the situation, and attempt for relevant cues before decide what to do (level 2).

The third type of processes consisted in identifying significant information which permitted to imagine the future of the ongoing situation. In this case, the defenders weren't directly concern with the ball; player perceived critical information, and the situation was assessed familiar so that the player could anticipate the future course of action. Knowledge led them to verbalize global assessment or anticipate the consequences of course of action so as they were more in observation rather than in action. For example a defender (Robert) said: "Long pass far forward (I); I know that Carl run really fast (K), he'll trap the winger in possession of the ball (E); so if I just assist the central backs, it's a good option for us (C)". It was coded I---K---E---C.

Sometimes the process conducted the defender to imagine a course of action, to get ready without any action to do: "I see the attacker alone in possession of the ball (I), we (the defenders) are aligned (I). If he (the attackers) challenges Carl (E), I'll have to help him, it's my role (K)! But on the other hand, he (the attacker) used to reverse the game I'll have to protect the goal (K); it's a critical moment for us (C)". This type of process, which included information perception associated to knowledge to generate expectancies, was identified in 26 short accounts of decision-making. According to the RPD model, if the player recognizes the situation and take time to verify it's a good option, he could simulate action (level 3).

Table 2. *Decision and types of decision-making process during defensive stages*

		Types of process			Total
Main relevant cues	**Types of processes**	**T1 I---A**	**T2** I---E---A or I---G---A	**T3 I---K---E---C**	
The ball, the attacker in possession of the ball	1. To track and intercept the ball (a pass or a cross)	8	-	-	**8**
	2. To block or track one attackers driving the ball	15	-	-	**19**
One or more attackers	3. To control and move quickly behind his attackers	7	7	-	**14**
	4. To move backward together and control a plausible long pass	8	6	-	**14**
	5. To look after his attacker and to stay quite close from his area	-	5	8	**13**
One or more team-mates	6. To assist a teammate (who had to challenge an attacker)	7	-	8	**15**
	7. To line up or get organised	15	-	6	**21**
	8. To move to the central defence and to protect the goal	8	-	4	**8**
	Total	68	18	26	**112**

DISCUSSION

This study aimed to extend current research by systematically examining relationships between underlying by-products and recognition processes used by expert when making decision; especially, it was expected that the dynamic of relevant features taken into account during the course of action could led us to decision-making processes. The results showed that elite football players' decision-making was based on three types of processes. These processes could be related to the RPD model recognition processes. If the situation were perceived as typical, the defenders used simple match when they had to a ball trajectory or to attackers 'movement. Sometimes (i.e. when the defenders were far away from the ball), typical situations were simulated in order to anticipate the consequences of course of action. If situations weren't perceived as typical, they were diagnosed and defenders paid attention for more information to generate expectancies. Complementarily, the results showed that elite football defenders' decision-making was based on eight typical decisions. The findings will be discussed from two perspectives: the recognition processes of expert sport players' decision-making and their consequences for training.

Consistency of findings to the three levels of the RPD model

The findings of the present study suggest that the players' decision-making was based on relationships between by-products and recognition processes of a typical situation. In previous study Macquet (2009) had compared the frequencies of the salient features considered for each level of the RPD model. In this study, association between salient features could be considered as criterions to help the identification of decision making processes. If the situations were perceived at first as typical they were simple matched (I---A), if not they were diagnosed (I---E---A or I---G---A). In level 3, the players recognized the course of action, but they used information and knowledge to generate expectations and to anticipate the consequences of action (I---K---E---C).

In previous works on expert decision-making in sport games (Macquet, 2009), recognition processes in these dynamical context are more often a simple matching process than a diagnosing or simulating process. Our results are in line with these findings. Therefore, our results are inconsistent with previous research considering the frequencies of each level of the RPD model. Previous studies in sport games have focused on attackers' decision-making in ice-hockey or football (Bossard *et al.*, 2010, 2011) or on decision-making in volleyball, which is a specific sport game because the players had to defend their playground in the same time (the same action) they have to attack their opponents' playground. In defensive stages in football, defenders have to quickly react to attackers' movement or to the ball trajectories; if they are in urgency, they used simple matching (level 1). But if defenders are far away from the ball, they have more time to assess the situation and to simulate the future of the course of action (level 3). In our findings, they evaluated the situation becoming dangerous for their teammates ("if he is overtaken, I should have to help him") or for themselves ("if he can kick a long pass in my back, I'll have to run back"). In sport game, the aim for the opponents is to be creative, to challenge defenders with low-probability events. While attackers have to initiate actions, defenders sometimes have to resist to typical decision and managing or handling higher levels of uncertainty (level 2).

Future research should aim to explore in more detail how defenders estimate how dangerous is a situation. In our findings, distances between defender and his opponent, distances from the line, from the goals, attackers speed, are precious relevant cues. The situation became particularly difficult for defenders when those spatiotemporal features weren't perceptible: "I can't see the ball, it's dangerous, I'm looking for my opponent and I'm late". In

these sequence the ball is a temporal marker and the line a spatial marker; they led defenders to "the feeling of urgency" for the situation assessment. In other words, the assessment of the situation and decision-making during the action itself seems to be supported by the recognition of spatiotemporal patterns (Klein, 2008).
Most of defenders recognition processes in this study are congruent with RPD model. According to Klein *et al.* (2007), these processes could be discussed toward "anticipatory thinking" and "sensemaking".

Decision-making as anticipatory thinking.

Anticipatory thinking is the process of recognizing and preparing for difficult challenges, many of which may not be clearly understood until they are encountered. Sensemaking often takes the form of explaining events and diagnosing problems, a retrospective process, and it can also take the form of formulating expectancies about future event. It is this future-oriented aspect of sensemaking that interests us here as an anticipatory thinking.
In previous studies about sport games, simple match was the main form of recognition process. Our results suggest that this first level of decision making process deals with two forms of anticipatory thinking: pattern matching and trajectory tracking. With pattern matching, the circumstances of the present situation bring out similar events and clusters of cues in the past: typical decisions could be "to move backward together", "to assist a teammate", "to line up", "to move to the central area and to protect the goal". In our studies, two types of trajectories can be seen as relevant cues. Pattern matching and trajectories tracking are used for the next immediate action they have to do: these processes could be related to "prediction" in Ward's proponents for underlying mechanisms of anticipation in soccer (McRobert *et al.*, 2009; Ward, 2003).
Moreover, we make distinction between tracking a ball trajectory and tracking an attacker, because of the additional complexity needed to track the possible trajectories of other actors in the decision space (Klein *et al.*, 2007). An attacker can change his own intention or/and his course of action. Defenders decisions are often building directly through typical experiences, and sometimes indirectly through patterns of meaning and response which can be used or blended to deal with an as yet unknown and unknowable future. In that way anticipatory thinking is aimed at potential events including low-probability high threat events, not simply the most predictable events. In this study, this diagnose process is used when defenders had "to look after an attacker and to stay quite close", "to control and move quickly", and "to move backward together" in order to get time to assess the course of action. This process could also be related to deep planning (i.e. considering potential alternative occurrences beyond the next immediate move; McRobert *et al.*, 2009; North *et al.,* 2011).
Then, anticipatory thinking relates to the "simulating process". This type of anticipatory thinking requires seeing the connections between events. It could be called conditional (Klein *et al.*, 2007) and is supported by knowledge to generate pertinent expectancies. This is particularly consistent with some finding from the present study. Defenders used this kind of anticipatory thinking when they have to pay attention on the evolution of the course of action; they had "to look after his attacker and to stay quite close", "to assist his teammate", "to line up and stay organized", or "move to the central area and protect the goal". Instead of responding to a cue or to a ball trajectory, as in situational pattern matching, sometimes defenders need to appreciate the implications of different events and the consequences of course of action before choosing the most appropriate typical action. Thus the simulation process allows a positive, negative, or neutral assessment of the situation (Evaluation mechanism according to Ward, 2003).
Because experts in sport games have to be reactive and creative, and have to deal with both of high and low-probability events, expert performers in sport do not necessarily just recognize one option (Ward, Williams, & Ericsson, 2003). Thus, expertise is based upon the ability to predict and simple match, but also upon the ability to plan, to diagnose, to simulate and to evaluate, so that sport games should be a particularly interesting domain for studying underlying mechanism of anticipation and decision-making.

From experts' underlying mechanisms to training in decision-making

This study highlights the relationship between sub-products and types of processes in decision-making. According to the situated action paradigm and its related methods, these findings cannot be generalized to other populations and contexts in the form of a general model of decision making in game play. On the other hand, they reflect some of the underlying mechanism of expertise to be acquired for becoming a professional football player.
The results suggested that players' experiences led them to memorize typical decisions. The recurrence of units of meaning extracted from the experts experiences could be explain thanks to schema theory. Researchers in the field of NDM generally conclude that situation assessment is based on schema- or script-driven (Rentsch & Davenport, 2006). Our results showed that elite football defenders' decision-making was based on eight typical schemas. The implication is that training could be based upon these empirical evidences of expert performance Analysing the literature about decision-making training, Ward & al. (2008) regretted that researchers have used logical and tactical principles of action, rather than base training on expert data from the specific task and skill on which participants are to be trained (Ward & al, 2008). In this way, using defenders' schema and sub-products in order to implement a training regimen for defenders in soccer could be the first application of the expert performance approach to training in sport. In that way, findings about expertise or sport are used in a product-oriented approach of training (i.e. enhancing the content of training pratice, feedback, video simulation,

temporal occlusion training, with empirically derived data about expert performance). Training based on experts' performances provides large improvements in response time, and small benefits for decision accuracy (Ward & al, 2008).

Considering our findings, this products-oriented approach could be complemented thanks to a processes-oriented approach of training, including speed-processing (i.e. simple matching, predicting), but also in the aim to develop resistance in prior plausible options (diagnosing, deep-planning, simulations, evaluating).

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