

Temporal Aspects of Team Cognition: A Case Study on Concerns Sharing Within Basketball

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This case study investigated team cognition in basketball. The focus was on how concerns in a real match situation were shared among teammates and how the sharedness evolved. The activity of five basketball players (M age = 17.60, SD = 0.89) was studied. The data were collected and processed according to a procedure defined for course-of-action analysis (Theureau, 2003). The results indicated that the instances when all the teammates shared the same typical concern were relatively rare, but temporal analysis revealed two kinds of convergence phenomena (simultaneous and progressive). In conclusion, shared understanding emerged within this team as essentially “local sharing of understanding.”

TEAM COGNITION: ERGONOMICS AND SPORTS SCIENCE

The past several years have seen a number of studies focused on team cognition. The assumption guiding this work has been that a better understanding of team cognition would provide insight into the “expert team” as more than a mere “team of experts” (Eccles & Tenenbaum, 2004) and team performance as more than the sum of individual performances. In sport science, although investigations into team cognition are multiplying, this type of research is conducted within a variety of theoretical frameworks (e.g., Bourbousson, Sève, & McGarry, 2010; Lausic, Tennenbaum, Eccles, Jeong, & Johnson, 2009; LeCouteur & Feo, 2010). Team cognition research has focused on the cognitive processes that underlie team coordination. According to the researchers working on this topic, the cognitive phenomena that allow team members to coordinate are conceived as the sharedness of cognitive contents among teammates.

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Ergonomics research in the fields of civil and military aviation, traffic regulation (air, rail, and road), and military troop organization has been a great source of insight into team cognition, and the heuristic value of research in sport science has recently been pointed out (e.g., Bourbousson, Poizat, Saury, & Sève, 2011). In line with this conviction, several works in the sport science have sought to extend the research of Eccles and collaborators (Eccles, 2010; Eccles & Tenenbaum, 2004) by investigating team cognition within a variety of sport science teams, including tennis (Blickensderfer, Reynolds, Salas, & Cannon-Bowers, 2010; Lausic et al., 2009), table tennis (e.g., Poizat, Bourbousson, Saury, & Sève, 2009), and basketball teams (Bourbousson, Poizat, Saury, & Sève, 2010, 2011). In ergonomics, studies on team cognition have classically conceptualized sharedness as similarity and argued that this is an essential condition for shared understanding (Cannon-Bowers, Salas, & Converse, 1993). To encourage and expand the sharedness of individual understandings, it is mainly assumed that the many cognitive contents need to be shared. This assumption is widespread through a variety of theoretical frameworks, as, for example, in a recent sport science study of LeCouteur and Feo (2010), which used conversational analysis. These authors again noted the need for a mutual orientation of coordinating teammates in order to build a situated shared understanding. To illustrate, the performance of homogeneous sport science teams was also assumed to be directly influenced by (a) a high degree of knowledge sharedness (e.g., Eccles & Tenenbaum, 2004); this ensures shared understanding and shared expectations related to unfolding events; (b) a certain degree of awareness sharedness (e.g., shared perception and co-orientation), even when teammates do not completely share the same perceptions, a certain minimum agreement about what is important is necessary so that all members can count on the others (e.g., LeCouteur & Feo, 2010); and (c) a high degree of concern sharedness¹ among teammates, if this is not the case, the team will be less coordinated because of the differing involvements of individual members (e.g., Reimer, Park, & Hinsz, 2006) leading to a lack of shared understanding.

In light of these assumptions, previous works of Bourbousson and co-workers explored the first two assumptions. First, knowledge sharedness was investigated in the ongoing team cognition of a basketball team (Bourbousson et al., 2011). The authors indicated that the knowledge mobilized was rarely shared by all members of the team. The study pointed out the importance of the local sharing of understanding (between only certain players) and, thus, led the authors to refer to the conceptualizations about distributed situation awareness (Salmon, Stanton, Walker, & Jenkins, 2009) used to describe the transitory shared understanding occurring in socio-technical collaborative systems. Second, awareness sharedness in basketball was examined (Bourbousson, Poizat et al., 2010). The results pointed out that the players rarely took more than one teammate into account to act. The sharedness of awareness was infrequently observed and team coordination was not principally based on this mechanism, suggesting that maintaining high attentional availability was not necessary for every member at every instant. These studies notably invite us to reexamine the assumption that the sharedness of cognitive contents is necessary to achieve viable team coordination. The contribution of concerns sharedness to shared understanding in an action team has not yet been explored and, thus, was the purpose of the present study. Previous exploratory works (Bourbousson, Poizat et al., 2010b, 2011) suggested that the concerns of each individual player do not have to be perfectly shared by all the teammates.

From Sharedness to Sharing

With reference to the need for research on team cognition, several authors (e.g., Cooke, Salas, Kiekel, & Bell, 2004) recently pointed out that the studies on team cognition have

essentially produced a static investigation of the cognitive contents needed to coordinate, for two reasons. First, the studies often employed methodologies for collecting data on actors' relatively generic cognitive contents about their activity and investigated to a lesser degree the actual cognitive contents being dynamically experienced in real situations (Salmon et al., 2009). Second, almost all the studies analyzed the sharedness of understanding as a product at a given moment (e.g., analysis of the contents and structure of cognition) and gave little attention to cognition sharing as a process (Cooke et al., 2004). From this perspective, Endsley and Pearce (2001) indicated that the processes leading to sharedness may be more important than the outcome of sharedness. To describe these processes, the notion of sharing may sometimes be preferable to the notion of sharedness (e.g., Bourbousson et al., 2011). Sharing refers to when and how cognitive contents are shared (i.e., is, descriptions on the modes for constructing and deconstructing sharedness) whereas sharedness has often been used to refer to what is held in common. Our study concerned both the contents of sharedness and the process of sharing.

To illustrate, some of the works conducted in sport science have simultaneously explored the types of cognitive content sharedness that are favorable for effective team coordination, and the temporal evolution of this sharedness. For example, in an initial study in table tennis, Poizat et al. (2009) investigated team coordination by analyzing how contextual information was shared by doubles partners. They demonstrated that information sharedness in an actual match situation was not guaranteed in advance by the shared culture of the two players, but that instead this sharedness was at times asymmetric (i.e., only one partner monitoring the sharedness built within the dyad) and often fragile (constructing and deconstructing at each moment) because of the constant temporal adaptation of the teammates' activities. In the study of Bourbousson, Poizat et al. (2010), the cognitive network that linked the teammates at every instant of the match was analyzed, and the authors suggested that shared understanding was built on the basis of partial sharedness (between only certain members) chaining together and reconfiguring over time. Taken together, these studies first pointed to a less well-defined role of cognitive sharedness than that suggested by most of the research on team cognition, and second emphasized the need for temporal investigation of the various types of cognitive content supposed to contribute to shared understanding. Related to the present study, these works suggested that the concerns sharedness in a team is reconfiguring over time, what contributes to building sufficient shared understanding and dynamically ensuring team effectiveness.

In this light, our study was exploratory because of the weakness of the sport science studies in this scope. The aim was to identify some of the neglected phenomena calling for further investigation, and the study was conducted within the course-of-action framework. It examined how expert basketball players adopted ongoing activities propitious to the construction of shared understanding. To do so, we specifically conducted temporal analysis of the sharedness of concerns that was observed.

Course-of-Action Framework

Some of the recent studies in sport science have investigated team cognition by reconstructing how individual cognitions were articulated during competitive matches and determining how these articulations were adjusted over time. For this, they used the theoretical and methodological framework of the course of action (Theureau, 2003). The course-of-action framework was originally developed in the French language for research in ergonomics (Theureau, 2003) and was used for various recent empirical studies in the field of sport science expertise. This framework includes a methodology that makes use of video recordings in natural settings and

interview techniques of stimulated recall (Calderhead, 1981). It, thus, permits activity to be studied on the basis of the reconstruction of the natural and sport science specific conditions of athletic activity. It provides a means for accessing the dynamics of the cognitive contents constructed by actors in a given situation. One way to study the process of this meaning construction is to focus on the dynamic and circumstantial construction of actors' shared concerns. Within the framework, a concern refers to an actor's interest and/or intention. A given actor may have many concerns and these may be linked. Concerns can be defined and specified at any given instant by what has meaning for the actor in the situation. If we assume that an actor's concerns orient (i.e., circumscribe) his or her situated activity, an investigation of concerns at a given instant and a categorization of them into typical concerns (i.e., grouping them into more general categories of similar types of concern) can somewhat describe the cognitive orientation of each player at any instant. We believe that this is likely to shed further light on the phenomena of shared understanding observed up to now. To describe how the concerns of five basketball players were dynamically articulated during an official match, three aspects were particularly important: the forms of concern sharedness among teammates, the processes underlying these forms of sharedness (i.e., forms of sharing), and the relationships between these forms of sharing and qualitative team effectiveness.

METHOD

Participants

Five French male basketball players and their coach volunteered for this study. The team played at the highest national level in the under-18-years category. Players were given pseudonyms to guarantee some degree of confidentiality: Chris (guard), Théo (forward), Pierre (forward), Luc (center), and Noé (center). The participants were between 16 and 18 years old at the time of the study ($M = 17.60$, $SD = 0.89$) and had been playing competitive basketball for 6 to 10 years ($M = 8.20$, $SD = 1.64$).

Procedure

The players' activities were studied during an official match. The team was playing in the first division of the French Cadets Championship (i.e., the 16 best teams in the under-18 category), and the competition was held in October of 2006. The five players were the starting lineup and they remained together on the court for the first 10 min of the match, the period that was analyzed in our study.

Data Collection

The data were collected according to a procedure defined for course-of-action analysis (Theureau, 2003). Two types of data were gathered: (a) continuous video recordings of the players' behaviors during the match, and (b) verbalizations during post-match interviews.

During the match, recordings were made with the video camera positioned behind and to the side of the court. A wide angle lens continuously filmed all players and their opponents.

The verbalization data were gathered from individual self-confrontation interviews with each of the players (Theureau, 2003). To prevent the players from making inferences or generalizing about their thinking, the methodological precautions recommended by Calderhead (1981) were adopted. The interviews were conducted as soon as possible after the matches, depending on the players' availability (from 24 to 48 hr post-match). During the interview, each

player viewed the videotape of the match together with the researcher. The player was asked to describe and comment on his activity during the match (what he was doing, feeling, thinking, and perceiving during the match). Prompts from the interviewer dealt essentially with actions that were meaningful to the players and were designed to obtain complementary information about these actions (e.g., “There, you’re saying that you’re waiting for Chris to call the play . . . ?” “There, you’re saying that you don’t know what to do . . . ?”). The technique of the self-confrontation interview is designed to account for the level of activity that is meaningful to actors, although it does not reach the non-reportable unconscious processes that guide their activity. The interviews lasted between 31 and 35 min each. The interviews were recorded in their entirety using a camera and a tape recorder. All the interviews were conducted by the same researcher, who was a coach at the national level. He had already conducted self-confrontation interviews of this type in previous studies and was experienced in interviewing techniques.

Data Processing

The videotapes were viewed to create an inventory of the five players’ movements. The verbal exchanges between players and the researcher during the interviews were recorded and fully transcribed. The data were processed in four steps: (a) generating a log of the match, (b) reconstructing individual players’ courses of action, (c) synchronizing the individual courses of action, and (d) analyzing interpersonal coordination at the individual and relational level.

Generating Match Logs

This step consisted of generating a summary table or log for each player containing the data collected for the match. The data were presented by mapping two levels of data together. The first level pertained to the data recorded during the match. It contained the descriptions of a player’s moves and communications. The second level pertained to the data recorded during the post-match interview. It contained the verbatim transcription of the prompted verbalizations (see Table 1).

Reconstructing Players’ Courses of Action

At this stage, players’ courses of action were recomposed into discrete meaningful units of activity in succession. These units have personal meaning and are assumed to be the expression of the articulation of six components described below (Theureau, 2003). The six components were documented step-by-step on the basis of (a) the video recording, (b) the verbalization transcript, and (c) specific questioning. We defined each of the components and illustrate them with Chris’s verbalization data (see Table 1) when Théo passed the ball to him, putting the ball into play from out of bounds.

The first component in each unit of activity corresponds to the player’s concerns at a given moment. In accordance with the course-of-action framework, it is called involvement in the situation (E; Theureau, 2003). We identified the involvement in the situation by asking the following question about the collected and transcribed data: What are the player’s significant concerns in relation to the specific situation? In the example, Chris was involved in looking for the best position to receive the ball.

The second component in each unit of activity corresponds to elements expected by the actor in his dynamic situation at a given moment, and is called potential actuality (A). The situated expectations of the actor (A) are identified taking into account his concerns at this time (E): Expected outcome are delimited by the concerns. We identified the potential actuality by

Table 1
Excerpt from Chris's Match Log

Observed behaviors	Chris's verbalizations
-In putting the ball into play from the sideline, Théo passes it to Chris	... I'm telling myself here that I'm going to have to make a basket... and then here it is, the guard is putting pressure on me, so I have to get ready and it's not always easy... so I have to do this right...
-Chris begins to dribble	... then here I'm going to try to get around the defense... I already see the other player who's trying to come to block me... so I'm not sure, I'm going to try to get through the middle... yeah, try to pass the ball between the two there...
-Chris breaks away from the two defenders	... now I'm going to see what I'm doing, I think I'll wait... I don't really know what I'm going to do...
-Chris passes the ball to Pierre	... there it frees up so I make the pass... I didn't really know what I was going to do... I thought maybe an attack or... but because it closed up in front of me and Pierre was free, well, I made a pass...
-Pierre is in position to shoot	... here I get free again... to get hold of the ball and call a play...
-Pierre passes the ball to Luc who's across from him	... well, I didn't get the ball, and I tell myself that... I'm a little disappointed not to get it, I would have liked to have it to call a play... so here it's going to Luc, maybe they're going to make a play with the three of them... I'm not too involved, I'm watching...
-Luc has the ball	... here, it's on the other side that it's all happening, and depending on what they do... I'll try to be available...
-Luc passes the ball to Noé	... so here I saw that the ball went to Noé... I don't ask any questions, I know that they're going to get a foul called, or Noé is going to score one basket... so I didn't get the ball, and I'm not mad at Pierre about it, after all, he did a good job...

asking the following questions about the collected and transcribed data: What are the player's realistic expectations arising from his concerns and from the situation? What result is he waiting for? In the example, Chris's expectations were related to Théo's pass.

The third component in each unit of activity corresponds to the actor's past knowledge that can be used at a given moment, and is called referential (S). The situated knowledge is identified regarding the two first components: The knowledge that the actor can mobilize at a given moment is delimited by his concerns (E) and expectations (A). We identified the referential by asking the following question about the collected and transcribed data: What prior knowledge is the player using? In the example, Chris used knowledge about the game in general: He knew that Théo was going to pass him the ball and that he had to be positioned to receive it.

The fourth component corresponds to the elements of the situation that are significant to the actor at a given moment, and is called representamen (R). The elements that are taken into account by the actor at a given moment are guided by his situated concerns (E), expectations (A), and knowledge (S). We identified it by asking the following questions about the collected and transcribed data: What is the meaningful element in the situation for the player? What element of the situation is the player considering? In the example, the meaningful elements

for Chris were that his team was in a situation of getting the ball back into play and his direct opponent was exerting pressure on him.

The fifth component corresponds to the fraction of activity that can be shown, told, and commented on by the actor at a given moment, and is called unit of course of action (U). This unit is assumed to emerge from the other components and expresses them into an interpretation, physical action, communicative exchange, or emotion. We identified it by asking the following questions about the collected and transcribed data: What is the player doing? What is he thinking? What is he feeling? In the example, the commented action for Chris was to get into position.

The sixth component corresponds to the component of activity that is modifying elements of knowledge at a given moment, and is called interpretant (I). The interpretant refers to constructing/deconstructing the referential (S): For example, validation and extension of past knowledge, or construction of new knowledge. We identified it by asking the following question about the collected and transcribed data: What knowledge is being constructed, validated, or invalidated by the player? In the example, the data did not allow us to identify the knowledge validated/invalidated by Chris.

All components of the units of activity were documented in order to analyze the players' concerns. This allowed us to conserve the unity and continuity of each player's activity. To identify and document the components of the discrete meaningful units of activity that constituted the course of action for each player, we first identified the chain of U components. Then, with respect for the logical linkages between them, E, A, S, R, and I were identified in this order.

In the period of the game that was studied, 139 discrete units of activity were identified for Chris's course of action, 135 units for Théo's, 96 for Pierre's, 110 for Luc's, and 87 for Noé's.

Identifying the Players' Typical Concerns

An analysis of the players' concerns allowed us to group them into more general categories of similar types of concern (typical concerns). The typical concerns were distinguished on the basis of three criteria: (a) the meaning of each category of typical concern, (b) the same level of generality across the categories, and (c) labeling that was sufficiently discriminating to avoid overlap (Strauss & Corbin, 1990). The categories were defined one by one, with a new category created each time a concern did not correspond to one of the existing categories. Four typical concerns were identified from the courses of action of the five players. They were labeled: (a) carry out a team routine, (b) exploit opportunities offered by the game, (c) personally perform well, and (d) strengthen team spirit (Appendix 1). The typical concern was labeled in such a way that its general meaning was evident. To illustrate, the concerns of find free zones while attacking, stay positioned to receive a pass, and observe the unfolding match were categorized under the same general concern of exploit opportunities offered by the game.

Synchronizing the Players' Courses of Action

In this step, we synchronized the five courses of action by presenting them side by side in chronological order in the same table. To facilitate the synchronization, an objective description of the unfolding match was inserted, which gave the ball-holder's name, the timing of the players' actions, and the players' positions on the court. Once the five courses of action were synchronized, we identified the chain of collective units. Table 2 shows the synchronization of the meaningful units of the individual players' activities at a given moment of the match and illustrates how these units could be grouped into a collective unit. A collective unit specifies the overlaps among all the players' units of activity at each instant in the

Table 2
Illustration of a Collective Unit at a Given Moment of the Match

Extrinsic description	Chris's units of activity	Théo's units of activity	Pierre's units of activity	Luc's units of activity	Noé's units of activity
Chris and Noé are in the backcourt. Chris has the ball and Noé is running behind him. In the frontcourt, Théo is running along the right wing, and Pierre is in the left wing. Léo is running down the center court.	<p><i>E</i> = Advance the ball up-court without losing it</p> <p><i>A</i> = Getting around the defender</p> <p><i>S</i> = When the defender sticks to me while I'm advancing the ball, I try to get around him by dribbling</p> <p><i>R</i> = The defender is sticking to me</p> <p><i>U</i> = Tries to get around the defender by dribbling</p> <p><i>I</i> = Validation of the type: the opponent leader defends by putting pressure on</p>	<p><i>E</i> = Act as wing player</p> <p><i>A</i> = Offensive play called by Chris</p> <p><i>S</i> = When I play the wings, I have to run to my position in the wing</p> <p><i>R</i> = Chris is advancing the ball up-court</p> <p><i>U</i> = Runs in the wing to get into position</p> <p><i>I</i> = NI</p>	<p><i>E</i> = Act as wing player</p> <p><i>A</i> = Offensive play called by Chris</p> <p><i>S</i> = When Chris advances the ball, he usually calls an offensive play</p> <p><i>R</i> = Chris got through the defense</p> <p><i>U</i> = Waits for Chris to call an offensive play</p> <p><i>I</i> = NI</p>	<p><i>E</i> = Carry out his role in the "transition" offensive play</p> <p><i>A</i> = Positioned at high post to make a hand-to-hand pass with Pierre</p> <p><i>S</i> = When the play is fast, it's often the "transition" being played</p> <p><i>R</i> = Situation of a fast game</p> <p><i>U</i> = Tells himself that Chris will surely call the "transition" offensive play</p> <p><i>I</i> = NI</p>	<p><i>E</i> = Carry out his role in the "transition" offensive play</p> <p><i>A</i> = Ball passed by Chris to Luc in the wing</p> <p><i>S</i> = Ball is often passed to a wing player to get it into center court</p> <p><i>R</i> = Playing according to the "transition" offensive play</p> <p><i>U</i> = Runs to get close to center circle</p> <p><i>I</i> = NI</p>

Note. E = involvement in the situation, A = potential actuality, S = referential, R = representamen, U = unit of course of action, I = interpretant, NI = not identified.

course of the game. Once identified, collective units allow the relationships between individual courses of action to be characterized. In the period that was studied, 251 collective units were identified.

Characterizing the Forms of Concern Sharedness and Analyzing the Processes Leading to Moments of Complete Sharedness

Based on the collective units previously identified, this step consisted of characterizing the players' concern sharedness at time t . Three main forms of sharedness were identified. Each of the collective units was, thus, characterized by a form of sharedness, and the recurrence (i.e., percentage) of each individual form was calculated in relation to the total number of collective units identified. To investigate the processes underlying these forms of sharedness, the conditions in which they occurred were analyzed, notably the recurring situations in which they appeared. We also described the ways sharedness evolved (i.e., the sharing), and identified characteristic dynamics of change in the forms of sharedness. We did this by focusing on the dynamics leading to a complete sharedness of typical concerns among the players (convergence) or leading to non-sharedness of typical concerns (divergence).

Team effectiveness during these moments (of sharedness and sharing) was then characterized. From the video and voice recordings, the researcher distinguished (a) satisfactory team effectiveness: favorable shooting position, rebounds, blocks, provoked fouls, interceptions, nice flow in the players' movements; (b) moments of relative dysfunction: unfavorable shooting position, losing the ball, fouls, lack of flow in the players' movements; and (c) moments when the team activity could not be described in terms of team effectiveness. This characterization was made by the first author alone, a national-level basketball coach, because he was the only investigator having sufficient basketball knowledge. The criteria were established in relation to the expected effectiveness in accomplishing the team goal: winning the match. The judgments on team effectiveness were then presented to the coach, who might at any moment confirm, clarify, deny or debate them. He fully confirmed the researcher's assessments.

Trustworthiness of the Data and Analysis

Several measures were taken to enhance the credibility of the data (Lincoln & Guba, 1985). First, the transcripts were given back to the participants so that they could ensure the authenticity of their commentary and make any necessary changes to the text. No comment has been made regarding confrontational responses. Second, the data were coded independently by two trained investigators. These two researchers had already coded protocols of this type in earlier studies, were familiar with course-of-action theory, and one of them had previous experience in basketball while the second had not. The reliability of the coding procedure was assessed using Bellack's agreement rate (Van Someren, Barnard, & Sandleberg, 1994). The initial agreement rate was 83% for the identification of hexadic signs and 87% for the identification of typical concerns. Any of these initial disagreements were resolved by discussion between the researchers, who debated their interpretations until a consensus was reached. They reached consensus on the number of hexadic signs and the labeling of the six components of each sign.

RESULTS

Our results are presented in two parts, which characterize and illustrate the following: (a) the forms of sharedness of the players' typical concerns, and (b) the sharing conditions for the appearance of the phenomena of complete sharedness of concerns.

Characterization of the Forms of Concern Sharedness

The comparison of the players' concerns allowed us to identify three main forms of sharedness: (a) moments of non-sharedness that characterized team activity in which the players had concerns belonging to any one of the typical concerns, (b) moments of partial sharedness that characterized team activity in which the concerns of some players belonged to the same typical concern, whereas the concerns of other players belonged to different typical concerns, and (c) moments of complete sharedness that characterized team activity in which all the players had concerns that belonged to the same category of typical concern.

Non-Sharedness of Typical Concerns within the Team

Moments of non-sharedness of typical concerns occurred when the entire set of typical concerns was represented by the players' activities. We identified two moments of non-sharedness in the game period under study. These moments could not be described according to the criteria of team effectiveness that had been adopted. The first was a situation in which the team had to put the ball back into play. This sequence was, thus, outside of effective play because the clock was stopped. The second occurred at a moment when the team began to play defense and the other team's point guard was slowly bringing the ball back up the court; the perception of any threat from the opponents was very low. These two moments of not sharing typical concerns were both characterized by a temporary weakening in the degree of confrontation between the two teams and a drop in the time pressure weighing on the players' activity (a slowing down or interruption in the flow of events).

Moments of non-sharedness of concerns made up 1% of the total number of collective units of activity between the players.

Partial Sharedness of Typical Concerns within the Team

Partial sharedness occurred at those moments when at least some of the players had similar concerns at the same time, whereas others had other types of concerns. These moments were more frequent and made up most of the game period under study. Eighty-seven percent of the collective units of activity were of this type. These moments were associated with phases of team effectiveness (e.g., making a basket, intercepting the ball, provoking an opponent's foul), as well as with some dysfunction (e.g., spatial imbalance in defense, losing the ball).

Complete Sharedness of Typical Concerns within the Team

Complete sharedness of typical concerns was manifested by moments in the game when the five players had concerns of the same type. We observed this for each of the four main typical concerns.

We counted 15 instances of complete sharedness in the game period under study. Four instances concerned "Carry out a team routine," three concerned "exploit opportunities offered by the game," six were of the type "personally perform well," and two were "strengthen team spirit." Sharedness represented 12% of the total number of collective units of activity between the players and almost all of them were associated with phases of effectiveness (the other instances could not be qualified).

Characterization of the Sharing Conditions for the Appearance of the Phenomena of Complete Sharedness of Concerns

Analysis identified two dynamics of convergence between players that led to an instance of complete sharedness (process of sharing that allows the players to construct similar concerns): (a) simultaneous adoption of concerns belonging to the same category of typical concerns by

all players and (b) progressive adoption of concerns belonging to the same category of typical concerns by all players. These two dynamics reflect two modalities for articulating individual activity.

Simultaneous Adoption of Similar Typical Concerns

In the case of simultaneous adoption of similar typical concerns (e.g., all the teammates adopt and carry out a team routine at a given instant), the players constructed identical judgments of the situation on the basis of different meaningful elements and recognized a situation-type. A situation-type was a game configuration familiar to the players, recognized as such with regard to their past experience. It was identified on the basis of a conjunction of meaningful elements (moment in the match, score, placements and movements of opponents and team members on the court, position of the ball-holder). Recognition of a situation-type was accompanied by expectations about a particular team routine associated by all with this situation-type: The teammates, thus, acted simultaneously within a framework of coordinated collective action, in which each one took on a predefined role to optimize cooperation with the others.

Four instances were identified when all the players had the same concern corresponding to one of the situation-types. For example, one of the situation-types was characterized by the following elements: The team had just made a basket, the strong point of the team was playing fast, and the opposing team was slow to get on the defensive. The associated team routine was a chaining of movements to organize for fast play. The period from 5'03'' to 5'09'' illustrates the dynamics of simultaneously adopting the same typical concern (Appendix 2). In this period the players were playing defense. Four of them were concentrating on their direct opponent. The fifth one, Luc, did not think that his opponent was dangerous and was observing the game (especially the one-on-one between Chris and his opponent). The other team made a basket and the concerns of the players then shifted, with some concerned about reinforcing the unity and solidarity of the team and others being concerned with their own performance. Quickly, the players perceived that the opponents were taking their time going on defense and they recognized that this was a situation for them to use their speed to good advantage by organizing fast play. They all decided it was a good moment to use a team routine to counterattack, termed transition. Simultaneously, the five players acted in relation to the relative expectations for the "transition" team routine: Théo and Pierre ran to get into position in their wing, Luc put the ball into play, Noé ran down the center court to get into his position, and Chris got the ball in play and began to run up-court.

Progressive Adoption of Similar Typical Concerns

In this modality of the converging of concerns, the players successively adopted concerns that belonged to the same category. The dynamics resulted from a diffusion or contagion from one player to a proximal player. A player perceived certain elements in the environment that gave rise to certain interpretations, which in turn influenced and modified his concerns and expectations. He acted in conformity to his expectations, thereby making his intended actions ostensible for his teammates. The perceptive judgment of this behavior by another player led this player to construct an interpretation of the situation that was compatible with that of his teammate and to have concerns belonging to the same category as his teammate's concerns. This player himself acted on the basis of this typical concern. His behavior was in turn perceived by another player who then modified his own interpretation of the situation and adopted a typical concern identical to that of this teammate. Thus, from one to another compatible judgments were progressively built up about the situation and the result was a convergence of the players' concerns.

Eleven instances were identified when all the players had the same concern corresponding to a contagion phenomena. For example the game period from 4'05'' to 4'15'' illustrates the process of progressive adoption of the same typical concern during one of the five occurrences (Appendix 3). At the beginning of this period, Chris, the point guard, was preoccupied by his own performance and was trying to confront his direct opponent. The other players moved toward the other team's basket in an attempt to put into play a fast game (transition). Chris suddenly overwhelmed his opponent and this made him think that the opponents' defense was destabilized and that the new situation would let him take advantage of a weakness in the defense that he had created. His concerns changed: Chris began to look for a way to gain a greater advantage over his opponents. The opening in the defense that Chris had created was then perceived by Théo, who then interpreted the situation in the same way as Chris and let him know that he could pass him the ball. Chris then passed to Pierre, who was unguarded. Unexpectedly finding himself with the ball, Pierre then assumed that this was a good time to look for an opportunity to make good use of the opponents' weakness. He passed the ball to Luc, assuming that he was in a good position to get it. Luc, seeing that the team was not playing according to the worked-out team routine (in that he had received the ball in an unexpected way), changed his concerns and expectations. Last, Noé, who had continued moving up the court according to plan and had noted that he was in a good position to get the ball from Luc (who was looking fixedly at him), changed his concern and began to look for ways to take advantage of the opportunities offered by the unfolding events. At this point, all five players shared the same typical concern: exploit opportunities offered in the game.

Characterization of the Processes Underlying Convergence Phenomena

Generally, the modalities of team coordination corresponding to convergence phenomena were based on the compatibility of the players' expectations. Expectations were compatible when they were not mutually contradictory regarding the outcome of the unfolding situation: Without necessarily being similar, the players' expectations were associated with activities that could be carried out simultaneously. The compatibility of the individual expectations was possible because of a certain degree of sharedness among the players, which occurred according to the process of sharing (e.g., dynamics of convergence).

Specifically, in some cases the players simultaneously adopted the same typical concern when they all recognized the same situation-type. They shared knowledge that led to immediate and simultaneous recognition of an overall game configuration. They also shared knowledge about team behavior that accompanied this configuration (team routines). Also, each player acted with reference to systematized chains of action that had been worked on in training (each player knew the upcoming actions of his teammates and prepared for them). In these cases, sharing was synchronous and based essentially on common knowledge constructed in the past. On the other hand, the progressive adoption of the same typical concern occurred through a succession of interpersonal adjustments, on the basis of the perception of the other players' behaviors and the inferences drawn from them. In these cases, the players' activities coordinated one by one on the basis of perceptions of the unfolding event. Convergence was constructed by dyadic adjustments based on sharing the same situation, and mutual intelligibility was built up locally and step-by-step between the players. Figure 1 models these two modalities of convergence, both of which led to shared concerns.

The phenomena of convergence that we observed seemed to lead to satisfactory team effectiveness in the match, especially because sharedness of the same typical concern facilitated the synchronization of team activities and, thus, gave rise to fluidity in the team activity. For example, when the players simultaneously adopted the same typical concern, it was easy to switch from defensive play to offensive and improve the speed and coherence of their actions.

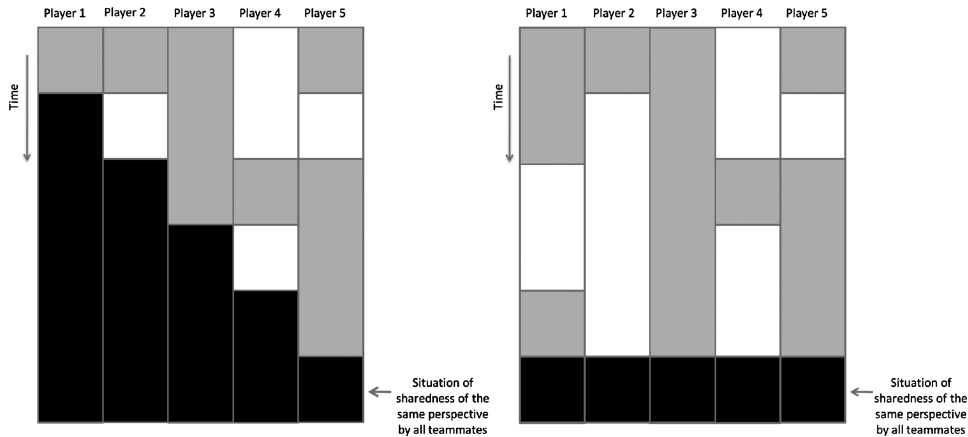


Figure 1. Graphical representation of the two observed convergence modes. On the left, the overall sharedness is achieved by local sharings and mutual adjustments chained together; on the right, sharedness is simultaneously achieved. *Note.* White, gray and black zones represent distinct cognitive contents.

Their commitment to carrying out the same team routines circumscribed their expectations, facilitated the inferences drawn about their teammates' upcoming actions, and let them act quickly while still anticipating the other players' behaviors. When the players progressively adopted similar concerns, team effectiveness was also noted in the search to destabilize the opponent's defense, especially by exploiting a series of opportunities; for example, getting into position to make a basket. The chaining of actions by one player created a new game configuration that was exploited by another player. The successive exploitation of resources offered by the new situation ended with a favorable game configuration for one of the players.

DISCUSSION

To explore the dynamic nature of team cognition in a real situation and to investigate the changes in the sharedness of concerns, our study was qualitative and based on the ability of expert athletes to give a precise account of their thoughts. This allowed us to reconstruct their ongoing cognitions as they played. Although this study could only account for a certain level of cognition of the basketball players (i.e., the concerns reportable by the athletes), it generated original results about how shared concerns changed during the course of a time of activity. The results are discussed in three parts in relation to (a) the sharedness/sharing of concerns and team effectiveness, (b) the notion of shared understanding, and (c) practical implications.

Sharedness/Sharing of Concerns

Our results revealed that the coordination of the players' individual activities, which was based on a sharedness of concerns, or based on a convergence phenomenon, was a source of team effectiveness in this match. Team effectiveness was linked to the compatibility of the players' respective expectations and circumscribed by their concerns in the situation. In some cases, the simultaneous recognition of a familiar situation favored speed and synchronicity in chaining their actions because all were able to anticipate the upcoming actions of their teammates. In other cases, progressive adoption of the same typical concern led them to

destabilize the opponent's defense by a series of exploitations of local imbalances that they had created. This result suggests partial confirmation of the classical hypotheses about the importance of similar concerns between teammates as a key to improving team coordination.

However, the instances when all the teammates shared the same typical concern were relatively rare (12% of the total number of articulations of the meaningful units of activity). The five players did not systematically construct the same judgments on the unfolding game: Uncertainty about the actions of their opponents and teammates led them to individually revise their interpretations and modify their concerns. Thus, the degree of sharedness of concerns fluctuated during the match according to the characteristics of the situation. Most often, three or four players shared the same typical concern, whereas the others had different concerns (87% of the total number of articulations of units of activity). These instances showed no drop in team effectiveness (e.g., getting the ball back in defense, getting into good position to shoot). Also, at the level of activity that is meaningful for the actor, it did not seem necessary for this basketball team to adopt the same typical concern to act with effectiveness. Thus, if a team is classically defined as one or two individuals who work together toward a common goal, our results specified some of the real modalities of sharing a common orientation in a five-member team's activity.

Team effectiveness was not always linked to the adoption of similar typical concerns (i.e., sharedness): It was often found in the dynamics of interaction between certain teammates (i.e., sharing) in association with the creation of successive imbalances in the opposing team's play. The effectiveness in team functioning was not affected when one or more players did not share their concerns with their teammates. By showing the low number of instances of complete sharedness of concerns, our results strengthen two hypotheses. First, Poizat et al. (2009), who studied information-sharing between teammates in a doubles table tennis match, found that effectiveness remained satisfactory despite the low number of times that the two players made similar interpretations. The authors suggested that dynamic discrete points of connection were sufficient to ensure viable interpersonal coordination in dyads (Poizat et al., 2009). Our results reinforce the idea that team activity constructed on the relative fragility of sharedness can be associated with a certain degree of team effectiveness. Second, our study enriches the conceptualization of sharedness by extending it to the functioning of a team of five members. The local sharing of concerns and the phenomena of the contagion of concerns from one teammate to another are empirical data that offer insight into team sports activity according to the notion of local sharing of understanding (Bourbousson, Poizat et al., 2010, 2011). This notion was formulated to nuance the classic approaches to shared understanding and to underline the role of dynamic sharing between only certain teammates. For this basketball team, most points of connection occurred at the local level (between two or three players). These local connecting points were seen in terms of the players' concerns but they may be analyzed in other terms, such as elements of knowledge (e.g., chainings of predetermined actions), perceptions and judgments of the situation (e.g., recognition of situation-types), or expectations (e.g., expectations about team routines). Thus, the points of connection between team members were constantly modified by topology and contents. These results confirm the hypothesis that the shared elements on which team coordination is built are diverse and complex (Salmon et al., 2009).

The Notion of Shared Understanding

Modeling Sharedness

Several works have focused on the processes that underlie collective activity, exploring the notion of shared understanding from several perspectives (e.g., Cooke et al., 2004; Eccles &

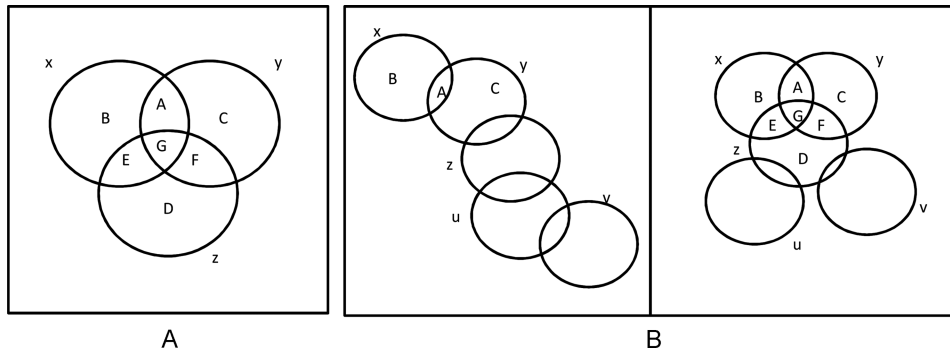


Figure 2. A - Graphical representation (from Eccles & Tenenbaum, 2004) of sharedness in a three-member team. Each circle (x, y, z) represents the understanding of an individual. Labels B, C, and D respectively represent the individual understandings of x, y, and z. A, E, and F represent three local zones of shared understanding. G represents the zone of complete sharedness of understandings; the largest this area is, the more viable team coordination is supposed to be. B - Graphical representation of two cases illustrating another conception of the sharedness of understanding within a five-member team. For example, x and y represent the individuals. B and C represent the individual understandings of x and y. A represents a local zone of shared understanding between x and y.

Tenenbaum, 2004). Shared understanding was principally seen as a phenomenon that points to the similarity in the individual understandings held by group members about unfolding events. This shared understanding allows them to construct shared expectations about the future of the situation: They can, thus, coordinate effectively in that they anticipate and predict future events in the same way. Depending on the study objectives and the analytic framework, the notion of shared understanding has been understood with reference to notions of shared knowledge (Eccles & Tenenbaum, 2004), shared mental models (Cannon-Bowers et al., 1993), shared situation awareness (Salmon et al., 2009), or the common ground (Bourbousson et al., 2011).

Classically, shared understanding has been conceptualized as a zone that covers individual understandings: The bigger the zone is, the more effective the group's functioning is expected to be (Eccles & Tenenbaum, 2004; Reimer et al., 2006; Endsley & Pearce, 2001). This conceptualization corresponds to the flower type of model (see Figure 2a).

Our study focused on the interactions of a team of five and underlined the importance of interpersonal adjustments occurring at the dyadic level, as well as local sharing of understanding. Our results suggest other forms of sharedness between individuals engaged in the same task (see Figure 2b). Figure 2b depicts (a) local coordinations chaining together (i.e., local intersections of teammates' understandings) and (b) the central role that certain players can take in the team organization (Bourbousson et al., 2010b). It reflects the constant construction/deconstruction of the team on the basis of local and temporary sharing.

Describing Shared Understanding on a Basketball Team as Complex and Dynamic

Our results showed that it is possible to specify the meaning of sharedness when it concerns shared understanding on a basketball team. First, sharedness can refer to what is held in common among several teammates. From this perspective, shared understanding refers to that part of individual understanding that is shared by all the players. Second, sharedness can refer to the distribution of a team's resources in such a way that the roles, the stakes and the rewards are shared. In this sense, shared understanding is distributed among the teammates.

Each player has an understanding that is personal but that fits in with the understandings of the other players in such a way that the team is able to be effective. Teams that function in this mode are termed heterogeneous (Salmon et al., 2009), and they generally are characterized by role assignments that are attributed before the collective activity begins. Our results suggest that basketball teams (i.e., homogeneous teams) function using both these modalities of shared understanding. Sharedness as similar judgments of a given situation characterized the local interactions between certain players but rarely concerned all the players at once. A definition of team organization as a dynamic “constellation” of local sharing of understanding (Bourbousson, Poizat et al., 2010b; 2011) takes into account both the local intersection of perspectives (sharedness between certain players only) and the distributed understanding of events throughout the team (several zones of sharedness on the team interacting dynamically as a constellation).

Our results, thus, indicate that shared understanding is the result of dynamic interactions between certain players: Local sharing of understanding is dynamically created and the temporal interaction of these local instances of sharedness (e.g., phenomena of the contagion of concerns) permits the players to regularly revise their understanding of the situation, update the sharing process, and even adopt the concerns of others. The convergence of individual understandings as well as the updating of shared understanding can affect all the team or a part of it and can occur simultaneously or successively. These data point up the internal dynamics of construction/deconstruction of a team’s cognitive phenomena, and suggest some directions for studying the temporal aspects of team cognition.

Practical Applications

To better describe the practical applications suggested by our results, two hypotheses can be formulated. The first hypothesis is that the local sharing of understanding implies a certain cognitive limitation of the coordinating players, in that they are unable to take into account all of their teammates at once. This limitation in the players’ capacities leads them to interact with only a small number of teammates and, thus, favors phenomena like the chaining together of local coordinations (observed in Bourbousson, Poizat et al., 2010) or the progressive adoption of the same concern (observed in the present study). The second hypothesis is that the chaining together of local interactions is a more general and parsimonious form of viable team functioning that can be seen in other systems. This hypothesis draws from phenomena observed in human teams and other natural groups (e.g., schools of fish, flocks of birds) for which the complex, dynamic and distributed and/or fractal properties and the role of local interactions have been documented.

A focus on one or the other of these two hypotheses would give a different orientation to the development of training aids to optimize performance in basketball. The first would orient developers toward methods to train cognitive capacities, in the goal of increasing the exchange of information within the team and improving the sharedness of understanding (in becoming more like the flower model). In this way, recommendations to sport psychologists and coaches fall into offensive and defensive individual awareness training (e.g., Breedon, n.d.) in such a way that mutual awareness will increase within the team. The second hypothesis suggests the possibility of new conceptions of team effectiveness and training methods. Proposals for new interaction configurations to dynamically articulate the local sharing of understanding would provide diverse work groups with options that are favorable for top performance. In basketball, our results suggest the interest of constructing game configurations in which simple, local coordinations can be temporally and dynamically articulated, rather than the adoption of coordination modalities that simultaneously implicate all the players at a given instant.

Although these team members had received substantial training in sharing their understanding of the game, once they were on the court they experienced their own situation and the complete sharedness of awareness became very rare and precious for the team. These observations might well lead some basketball coaches and sport psychologists to make fewer cognitive demands on their players. Yet coaches might optimize training if they were able to distinguish those few events in the game when players need to completely share their understanding (which was called situation-type in the present study). Training for mutual awareness would, thus, be a well-identified special case, and the main focus of training would be the chaining of local coordinations at all other times.

CONCLUSION: A NEED FOR TEMPORAL INVESTIGATION OF SHAREDNESS

The exploratory investigation of team cognition conducted in this study was limited in that it only considered the first 10 min of activity of the five starting players of the team, with priority given to the qualitative description of team cognition and a focus on the activity experienced by the athletes. The main results emphasized that the complete sharedness of cognitive contents should be considered as an exceptional and noteworthy cognitive team configuration, and not as the foundation of team coordination. However, although sharedness was very partial within the team, the temporal analysis of shared understanding allowed us to point out significant convergence phenomena regarding the teammates' cognitions. This step-by-step building of sharedness, thus, suggests that at least a part of the consistency of the team cognition of this basketball team was based on temporal properties. To guide future research, the present study, thus, calls for (a) further investigation of the temporal properties of sharedness with various players and contexts (e.g., over longer time spans: entire match, cumulative number of games, training period of several weeks), (b) a more quantitative description of what is shared, in order to give an accurate account of decreases or increases in sharedness, and (c) further investigation of the assumed linkages between sharedness and team effectiveness: As an illustration, the temporal description of sharedness might address the question of whether team effectiveness follows the sharedness of cognitive contents or whether progressive effectiveness (i.e., emerging over time) fosters a sharedness configuration.

FOOTNOTE

1. The notion of concern has been selected for the present exploratory study. It is assumed to be broad enough to deal with concepts used in various frameworks, such as intention, goal, orientation or involvement.

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