

Shared Mental Models: National Representative Coaches' Thinking on Importance, Characteristics, and Development

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Abstract

The aims of the study were to explore how national representative handball coaches reflect on the cognitive properties of the team and how these attributes are developed through team practice. A theoretical (shared mental models) thematic analysis was conducted, and five coaches with extensive experience from the national team and elite clubs participated. The data were analyzed with regard to three overarching topics: *importance*, *characteristics*, and *development* of shared mental models. The interviews revealed that measures intended to influence a shared mental model permeate team practice and underpin the assumption of opponent-specific shared mental models. Alignment between briefings and debriefings as well as field practice were emphasized and used to enhance a shared mental model and understood as measures that facilitate pattern recognition and primed decisions. Single-loop as well as double-loop learning were identified as coaching initiatives to promote the development of shared mental models. Systematic practice with the goal of promoting coordination through repetition of the coordinative patterns in critical game situations was emphasized. Implicit communication is a characteristic of teams sharing a mental model, and distinct proactive bodily movements were emphasized as a crucial requirement for coordination. A model was elaborated to show how the categories can be understood in the cyclic relation between matches and the development of shared mental models.

Keywords

Team coordination, situational awareness, training, briefing, debriefing

Introduction

Elite teams in handball can be described as action teams where performance is characterized by rapid, complex, and coordinated task behavior. The teams respond to and influence the environments within which they operate, and the ability to dynamically adapt to the shifting demands of the situation is critical for effectiveness (Marks et al., 2000). Performing in elite team ball games requires coordination or successful interaction between

playing members. According to Cannon-Bowers et al. (1993), approximately 80 years ago Mead (1934) postulated that faceted cooperative activity is achievable only if each team member can direct their behavior according to the shared notions of task processes and activities. These shared notions can be considered as mental models, which are working models of the world that humans create to achieve an understanding of their environment. In sport science, different

theoretical approaches have been used to explore our understanding of decision-making, and the significance of knowledge in perception action cycles in particular has been debated (Araújo & Davids, 2016). In this discussion, Richards et al. (2017) argue that the improvement of expert-quality team decision makers exceeds a perceptual recognition or problem-solving approach in training environments. Team adaptation in a highly competitive environment is complex and can be understood as interaction between the off-field reflective environment and the on-field action training and competitive environments (Richards et al., 2017).

Cannon-Bowers et al. (1993) used the term shared mental model (SMM), describing it as a knowledge structure held by members of a team that enables them to form accurate explanations and expectations for the task, and in turn to coordinate their actions and adapt their behavior to the demands of the task and other team members. In basketball, Phil Jackson, the legendary coach of the Chicago Bulls and Los Angeles Lakers, has an offensive system named “the triangle” which can be considered a SMM, because it is a knowledge structure involving all the players moving together in response to the way the defense positions itself (Jackson & Delehanty, 2013).

SMMs explain how teams are able to cope with difficult and changing task conditions in order to adapt or pursue team excellence (Cannon-Bowers et al., 1995). Moreover, Salas et al. (1994) suggest that there is a relationship between shared knowledge and team situational awareness. They proposed that information that is shared in strategic models allows members to have common explanations of the meaning of task cues, make compatible assessments of the situation, and form common expectations. Endsley (1995) claims that repeated experience in an environment allows one to develop expectations about future events and introduces immediate pattern-matching mechanisms that are fundamental for developing situational awareness. Salas et al. (1994) argue that SMMs allow team members to make compatible assessments of the situation and require a

common understanding of cues, action sequences, cue patterns, team resources, and appropriate task strategies. In a team setting, common interpretation of cues or overlap of each member’s individual level of situational awareness allow for action that is both accurate and expected by teammates (Endsley, 1995; Salas et al., 1994).

Stout et al. (1996) argue that task demands are related to the way SMMs operate and suggest that SMMs are less important when team members freely communicate and discuss the next moves. However, during elite games, verbal communication becomes difficult because of the opponent, time pressure, and excessive physical and mental workload; in this case SMMs become crucial to team functions (Mathieu et al., 2000). Research on expert teams revealed that team members could often coordinate their behavior without the need for explicit communication, and it is suggested that coordination between members seems to be passed on implicitly under high workload conditions, which implies SMMs (Cannon-Bowers et al., 1993).

Empirically based prescriptions and guidelines are almost nonexistent for team training (Salas et al., 2015). As an overriding consideration, Cannon-Bowers et al. (1993) propose that it would be impossible to train teams in specific performance expectations for a variety of situations, and the goal of training should therefore be to provide players with competencies that enable them to extrapolate their knowledge of the system, which in turn will allow them to form task and team expectations quickly and precisely. The first practical suggestions about effective team training were provided by Salas and Cannon-Bowers (1997). They recommend measures such as information-based lectures, video-based demonstrations, and practice. Salas et al. (2007), comparing three training strategies with sufficient empirical support, concluded that team coordination and adaptation training were more potent than guided team self-correction training or cross-training. Team coordination and adaptation training is a strategy in which members are trained to adjust their coordination

and to reduce the amount of communication (Salas et al., 2007). A major component of on-field practice in team ball games consists of exercises with opponents and teammates where co-acting is emphasized (Giske, 2001); therefore, the team coordination and adaptation training category is well incorporated into ordinary team sport training. We have less specific team sport knowledge about the extent of *cross-training* (where team members rotate positions during training) and *guided team self-correction* (where team members learn to identify difficulties or challenges in the team and find efficient solutions).

Leaders who communicate plans and strategies along with team members' role responsibilities seem to refine performance expectations, and Orasanu's (1990) findings indicate that leader behavior has an impact on the quality of shared problem models developed by teams. Marks et al. (2000) also emphasize leadership and suggest that leader briefings are a critical factor in the formation of team members' mental models, which in turn positively influence team communication and team performance. According to Cannon-Bowers and Bowers (2006), such practice will reduce the need to explicitly coordinate actions during the performance because it enables team members to adjust their individual performances and facilitate anticipation of teammates' responses. Post-performance reviews and team debriefing enable members to collectively make sense of their performance and acquire a shared vision of how to proceed in the future.

Interestingly, Ellis and Davidi's (2005) findings show that discussions of successful and failed performance events enable trainees to develop richer mental models and more effective practice than debriefings that focus only on failed performance. In elite sport, briefings and debriefings are commonly used (Middlemas et al., 2018) and McArdle et al. (2010) showed that coaches and athletes emphasize the utility of debriefings for performance evaluations and learning purposes. However, critical objections have emerged in the literature, and Smith-Jentsch et al. (2008) claim that briefing and debriefing may be

ineffective in improving performance because teammates may develop mental models that are inaccurate, dissimilar, or highly scenario-specific when they are unaided. Previous research in sport has, to a limited extent, been concerned with how teams acquire and maintain team cognitive properties. Eccles and Tenenbaum (2004) suggest that the first step in investigating how a team achieves coordination is to study its preparatory and practice behaviors, and several authors argue that descriptive and empirical studies are needed to improve our understanding of how sports teams function (Bourbousson et al., 2010). In the context of nationally representative teams, we have only anecdotal data on how coaches work to control performance-influencing team variables. National representative team coaches spend fewer total hours together with the players than elite coaches in professional clubs, and they have a primary focus on the tactical and psychological preparation (Lyle & Cushion, 2017).

Because a SMM is a major performance variable, and there is limited time available to create and refine it, coaches of national representative teams should be especially experienced in how co-acting and synchronized team behavior are facilitated. The purpose of this study is therefore to explore how nationally representative handball coaches think about team cognitive properties and how these attributes are developed through team practice.

Method

Research Design

Performance coaching is about intensive preparation and obvious attempts to influence performance variables (Lyle & Cushion, 2017). We consider national representatives as extreme cases, and we therefore follow an ideographic methodology. Qualitative approaches are incredibly diverse, complex, and nuanced (Holloway & Todres, 2003), and according to Braun and Clarke (2006), themes or patterns within data can be identified as inductive or "bottom up," or theoretical or "top down." A more theory-based approach was considered most appropriate in the present study, and the

data are interpreted beyond their semantic content, with an examination of underlying ideas, practices, and assumptions about team cognition and measures to improve it. The analytical interest is SMM, and the data set comprises all instances in the data corpus that are relevant to this topic.

Participants

In view of the research theme, purposive sampling was used, and five national handball head coaches volunteered to participate. Because of the challenges of keeping the respondents anonymous, years of experience and age are presented as overall values. When the interview was conducted, these five respondents (with an average age of 54) had accumulated, in total, more than 27 years of experience as coaches of national representative handball teams. All the respondents had extensive experience as coaches of elite clubs in a national league, and all were employed as national coaches or elite coaches in 2020. All respondents were male, and, as head coaches during the past decade, they had been awarded, in total, 13 medals in grand championships (World, European Championships, and the Olympic Games).

Procedure

Ethical approval for this study was obtained from the Norwegian Social Sciences Data Service (722257), and procedures were in accordance with the ethical standards of the first author's university. Following initial contact with the participants, during which the objectives of the study were explained, each participant was interviewed separately in a different, convenient location. Each interview started with a presentation of the study, in which the participants were informed that this was an investigation into the nature of SMMs in elite team sports. Permission to record and transcribe the interviews was obtained from all participants, and they were also informed that the interview protocols could be reviewed and commented on by the participants at any time. General probing and elaborating questions were

used to explore all (newly) mentioned sources of information on SMMs (Patton, 2014).

Instrumentation

The interview guides were anchored in previous research literature examining SMMs in elite performance (Cannon-Bowers et al., 1993; Cannon-Bowers & Bowers, 2006; Eccles & Tenenbaum, 2004; Giske et al., 2015; Reimer et al., 2006; Ward & Eccles, 2006) and consisted of five basic themes: (1) The importance of SMMs, (2) SMMs in practice sessions, (3) SMMs during matches, (4) Role implementation, understanding and execution, (5) Video meetings and analyses. Based on the interview guide, the coaches were exposed to general probing or assessment questions such as "Why is the quality of SMMs so necessary for a handball player in the national team?" To ensure that the responses were sufficiently in depth, the guidelines set out by Rubin and Rubin (1995) were followed, and questions calling for elaboration, such as "Can you tell me more about the importance of this quality of SMMs among handball players in the national team?", were used to identify and describe the different dimensions and components of SMMs put forward by the participants.

Analysis

All interviews were recorded on tape and lasted between 55 and 100 minutes. To ensure the validity and reliability of the data analysis process, the basic steps for reading verbatim transcripts put forward by Braun and Clarke (2006) were followed and included the following:

- *Familiarization with the data:* The data were transcribed, read, and reread, and initial ideas were recorded;
- *Generating initial codes:* Interesting features of the data were coded in a systematic fashion across the entire data set, and then the data were collated for their relevance to each code. In this process, the researcher always plays an active role in identifying patterns/themes, selecting those

of interest, and reporting them to the reader;

- *Searching for themes:* Codes were collated into potential themes, and all data relevant to each potential theme were collated;
- *Reviewing themes:* The themes were checked to determine whether they worked in relation to the coded extracts (Level 1) and the entire data set (Level 2), and a thematic “map” of the analysis was developed;
- *Defining and naming themes:* Ongoing analysis was used to refine the specifics of each theme, and the overall story found in the analysis generated clear definitions and names;
- *Producing the report:* This provided the final opportunity for analysis and included the selection of vivid, compelling extract

examples, final analysis of the selected extracts, relating the analysis back to the research question and literature, and producing a scholarly report of the analysis.

The raw data, consisting of single phrases or statements, were categorized into subthemes related to the three main themes, using NVIVO as the qualitative analysis software (Figure 1). The analysis was presented to the research team, and the members reached a consensus on the main themes, subthemes, and data extracts. This process was repeated to gain a better overview, to ensure data saturation (Braun & Clarke, 2019), and to ensure that the most accurate meaning units and categories of descriptions were found (Malterud, 2012).

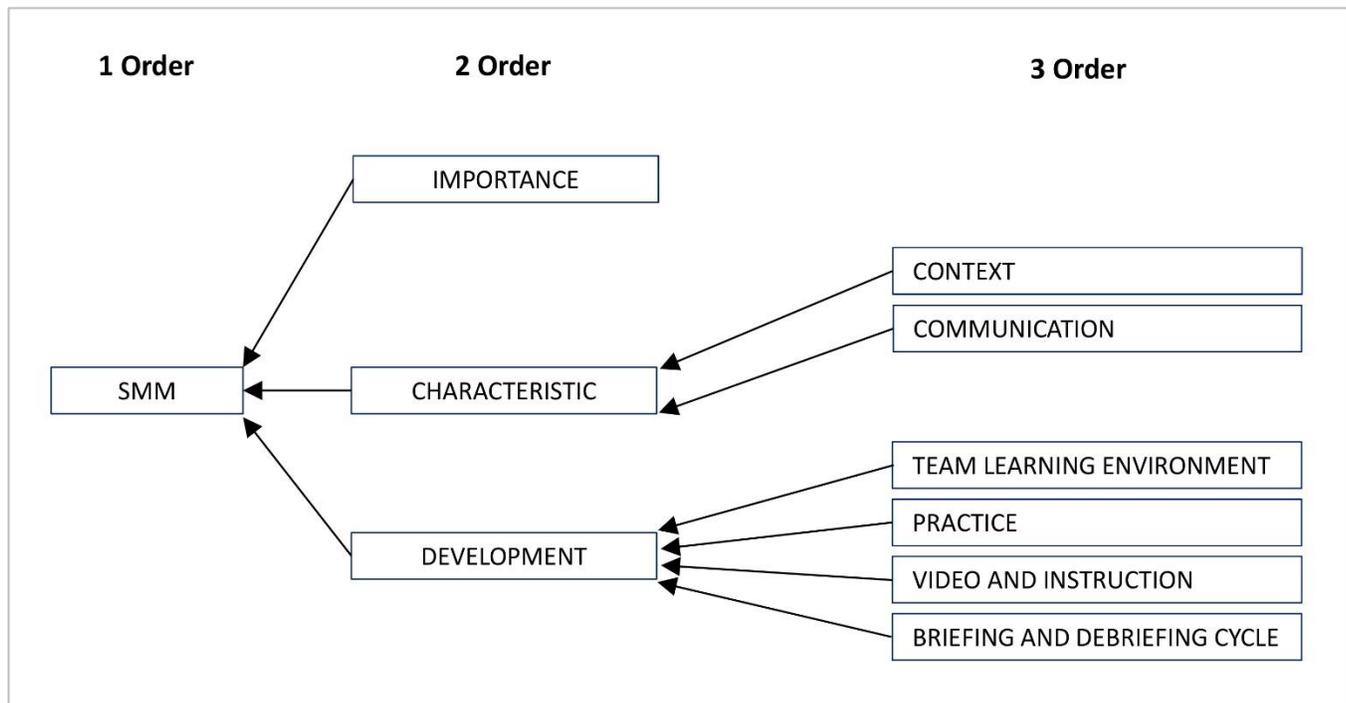


Figure 1. Thematic Structure

Results and Discussion

The aims of the present study were to explore how coaches of national representative handball teams reflect on team cognitive properties and the development of these attributes. The interviews started with a short description about co-acting in elite handball and what enables players to form accurate expectations of each other in defensive and offensive tasks so that they may behave as a collective unit in the game. The coaches used different labels during the interview, including “concept,” “philosophy,” “collective guidelines,” and “shared understanding” about this phenomenon, but the interviews revealed that the content of each was in line with Cannon-Bowers et al.’s (1993) operational definition of SMMs. Following Braun and Clarke’s (2019) methodological guidelines, we found three main themes reflecting the data corpus: *Importance*, *characteristics*, and *development* of SMMs. Figure 1 shows that the development theme includes four sub-themes (team learning environment, practice, video and instructions, briefing and debriefing cycle) while the themes of the characteristics contain two sub themes (context, communication) while the importance theme is without sub themes.

Importance

All the interviews with coaches revealed that efforts to improve team coordination permeated the coaches’ pedagogical activity. One coach expressed it as follows: “When we practice in the national team, then it’s all about co-acting—constantly” (R4). This finding is unsurprising as previous research among elite hockey and handball players shows that team practice is mainly about establishing coordinating patterns (Giske et al., 2015).

Salas et al. (2015) claim that team training should prioritize only those team competencies that yield the greatest impact on performance, and team coordination seems to be the most fundamental team performance variable that the coach has the opportunity to influence at a national team level. One of the coaches clarified the rationale behind the team focus: “I have little impact on the individual development of the player because that happens in the club” (R4).

Furthermore, the following quote illustrates how one coach experienced the importance of the relationship between the SMM and team performance: “In our first championship, I found that the players had no common understanding of the concept [SMM], and the performance was poor. It was a kind of free fall where you never hit the ground” (R3). This finding seems to be in accordance with what Apitzsch (2019) denotes as a collective collapse where a deficient SMM might be some of the explanation.

Characteristics of SMMs

This dimension encompasses coaches’ and players’ descriptions of the qualities of SMMs and includes two themes: Context and Communication.

Context

The handball coaches claimed that there is a difference between coaching a national team and elite club teams with regard to team coordination, as illustrated by the following quote:

As a national coach, you have fewer opportunities to split and part practice coordination, but you can pick players who are able to play the defense roles you want to play. The ability to select players compensates for the lack of time to practice. (R1)

This quote explicitly explains that limited team practice diminishes the opportunity to establish a SMM, but on the other hand the ability to select players increases that opportunity.

One of the coaches said, “In the national team, we choose to play a defense system that most players are accustomed to from the clubs” (R1), indicating that different contextual conditions (national team versus elite league) influence team coaching (Lyle & Cushion, 2017). Moreover, the quotes indicate that coaches have a basic idea of how the team should appear during the game, or what Collins and Collins (2011) refer to as a master plan that guides team selection.

Communication

In elite handball, players have limited opportunities to plan explicitly coordinated behavior during the game. One characteristic of efficient teams is that implicit coordination controls behavior under stressful conditions and allows the team to maintain its performance level (Cannon-Bowers et al., 1993). One coach described the development of implicit communication or an imperative signal in an efficient relationship in a dyadic game in the following way: “They had also developed signs that gave the other players information on what they should do. When player B tilted his wrist behind his back, player A knew that he should move behind player B for a cross” (R2). Previous research on expert teams has reported that coordination between members seems to be passed on implicitly (Kleinman & Serfaty, 1989) and without the need for explicit communication (Cannon-Bowers et al., 1993).

The quote above indicates that the players contribute by developing nonverbal signs or explicit action imperatives that put them in a position to process information in a rapid and flexible manner (Rumelhart & Ortony, 1977). These nonverbal signals, which are difficult for the opponent to decode, are fundamental in games such as handball and volleyball (Reimer et al., 2006). Such signs are proactive and show an intention to create a specific game situation within the game environment that enables the player to direct the action. Previous research in team ball games has primarily been related to decisions regarding the ball, but the main task for handball players when the team is in possession of the ball is to make decisions that create appropriate conditions or alternatives for the player with the ball. SMMs and role perspectives are perhaps more adequate theoretical perspectives for understanding proactive game behavior, signs, or implicit communication and coordination than is an information-processing approach.

When it comes to task-related communication, one of the coaches illustrates the significance of nonverbal communication and clarifies which elements are crucial: “I think it is a combination of verbal communication and

body language, which means clear actions, movement, bodily positions, and eye contact” (R1). Another coach emphasizes the importance of proactive communication (ahead of the situation), and why it is crucial:

You are not able to talk during the actual situation; you have to be ahead of the situation. It has to be a reminder of what your task is, which is communicated before the situation arises. I think that this will give the players some kind of trust or clarity of what your task in the forthcoming situation is. (R2)

Research related to nonverbal language in elite sports teams is relatively scarce and has primarily been concerned with emotions linked to post-goal behavior (Moesch et al., 2015). Few researchers have directed their attention towards nonverbal, task-oriented communication. The quotes show that the coaches consider it to be an important element in coordinating elite teams. The movements and bodily positions of teammates will be elements that create the context and the reason that alternative actions arise and disappear continuously during a game (Giske, 2001). Providing teammates with unambiguous communication cues in the decision-making process or creating playing situations in which pattern recognition is possible seems to be imperative to facilitate team performance. According to Morgan and Bowers (1995), the development of a SMM relies on the team members' ability to understand the decision-making situation and to communicate this understanding to other team members.

Developing SMMs in National Handball Teams

All coaches emphasized the importance of team coordination and supported it with descriptions of the off- and on-field pedagogical activity they used to develop SMMs in the national team. Four sub themes emerged: (1) Team Learning Environment; (2) Practice; (3) Video and Instructions; (4) Briefing and Debriefing Cycles. Together, the findings reveal that the coaches used a variety of options to stimulate a SMM in practice, including video exposure, instruction,

feedback, and practice content. Moreover, facilitating a SMM seems to infuse the coaches' pedagogical activity in these teams. In briefings and debriefings, video in combination with instruction and feedback was used to facilitate team learning. Zaccaro et al. (2001) argue that we know surprisingly little about how leaders create and manage effective teams and about how coaches foster the integration of players' actions. The results of the present study indicate

that a major responsibility of the national coaches is to facilitate a shared understanding of the operating environment and clarify how players need to respond as a team. Figure 2 synthesizes the findings in a heuristic cyclic model which clarifies connections and awareness about key on- and off-field elements the coach might consider when developing SMM. This model is explored and explained in depth in the following discussion.

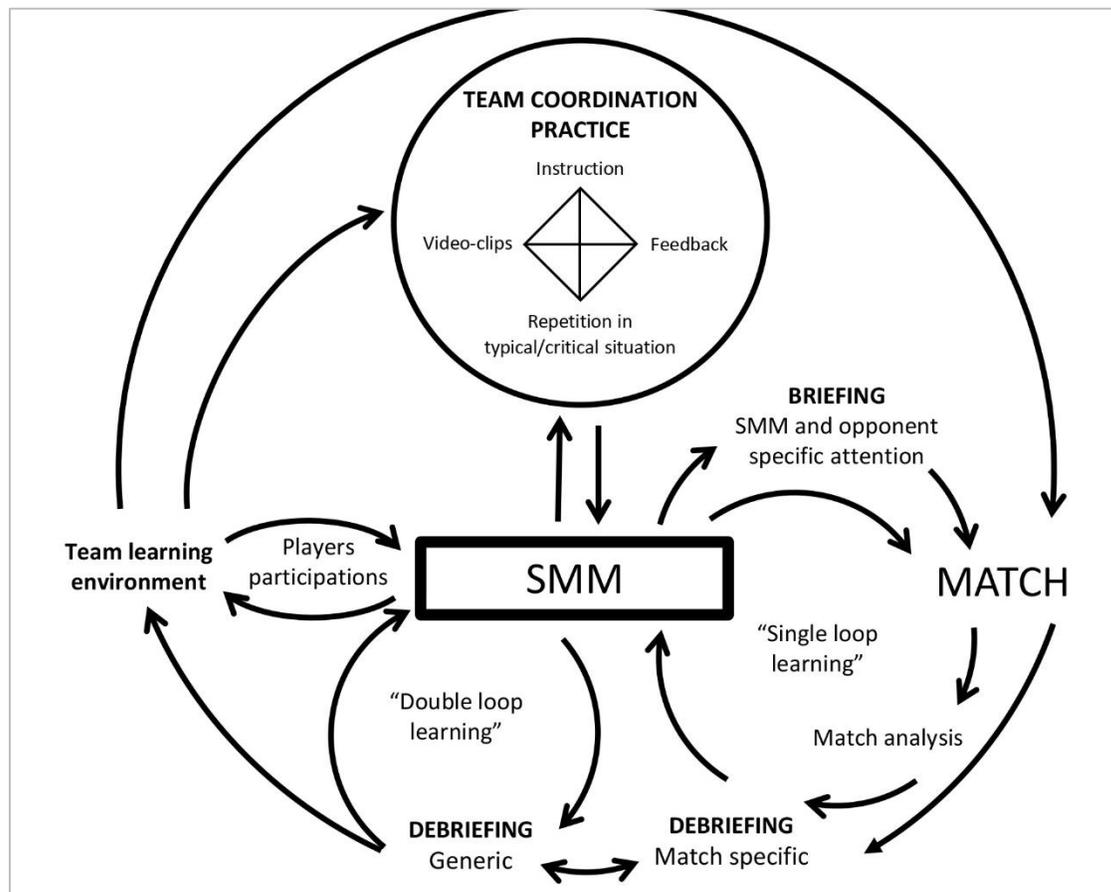


Figure 2. A Heuristic Cyclic Model for Developing a SMM in National Handball Teams

Team Learning Environment

Based on the importance of a shared understanding in high-performance national teams, the learning environment includes team task support to facilitate the players' learning outcomes. The learning environment is considered as an overarching category, which includes both on-field practice and off-field practice such as briefings and debriefings. The following statement from one of the coaches clearly expresses the importance of performance analysis as a basis for didactical considerations:

“After the video review, we go through main ideas in training and try to create part practices to improve performance. We have less time to do this in the national team compared with the club level” (R1). The performance analysis seems to be the primary knowledge base that determines pedagogical measurements in terms of developing a SMM.

The statement above shows the feedback loop from competition to training when there is a difference between anticipated and actual

achievement. This quote also shows that the coach invests effort in creating new team exercises based on the video review, which may be considered a pedagogical innovation. It is interesting to note that the coach claims that the time available to create novelty in game practice is less apparent in the national coach role than in the elite club coach role. The interchange between video review and the creation of training content expressed in this quote may also lead us toward the understanding that adaptive team performance in interactional ball games has more of a cyclical nature (Burke et al., 2006), which gives it rich opportunities for team learning. Lyle and Cushion (2017) argue that we generally have limited scientific knowledge about team coaches' pedagogical considerations, especially in elite team coaching literature, where knowledge about pedagogy is scant. The present study reveals that pedagogical team considerations in the national team infuse the coaching role, but they appear as more implicit processes with uncertain analytical categories. This makes such knowledge difficult to access. We have only some anecdotal considerations to compare SMMs and team learning. The former basketball coach, Phil Jackson, for example, proposed that the beauty of the system (the triangle) was that it conveyed the whole team into a learning organization (Jackson & Delehanty, 2013).

A basic premise for establishing a positive learning environment is to provide the players' with the opportunity to contribute to the development and refinement of the SMM. One statement is especially interesting and sheds lights on fundamental pedagogical leadership:

I have used the players a great deal to create the game we are playing by retrieving suggestions from the players' experiences in their clubs. I also video-analyze all their club matches and collect the best solutions and try to bring them to our national team. By doing this, the players develop ownership in terms of the way we play the game, and I believe that we develop a good, shared understanding and cohesion through this approach. (R4)

The quote illustrates the importance of players' contributions for improving the model and the fact that the coach perceives this involvement as facilitating ownership, cohesion, and the players' understanding of team coordination. Another coach stated that he occasionally handed over the responsibility to create an opponent-specific SMM to players: "The players collect the video sequences and have the responsibility for producing the match plan (not the decisions regarding starters). We do it occasionally to try to create a variation on briefings that can be implemented" (R1).

In general, the quotes support the notion of a SMM as a continuous process where the established team learning environment becomes fundamental for understanding how they adapt. The players' opportunity to contribute to the development and refinement of a SMM is explicitly mentioned by the coaches, indicating that it is an integrated part of their practice, and that participation is considered an important prerequisite in establishing a positive learning environment to facilitate the SMM. This finding seems to be in line with Zaccaro et al.'s (2001) propositions that teams with leaders who encourage participation in team problem-solving will engage in more collective information processing than leaders who use a more direct authoritarian style. Research has shown that team information processing becomes more centralized when teams are under stress. Based on the assumption that stress is clearly present in national teams at this performance level, the findings indicate participant leadership where coaches draw heavily on the players' team knowledge and information resources.

Practice

It is well documented that practice is a necessary condition for skill acquisition (Salas and Cannon-Bowers, 2001). However, the relationship with team learning outcomes has been largely ignored and it is therefore interesting that all coaches emphasized that the main goal of practice is to strengthen the clarity of a SMM. In describing the last practice session before a national team match, one of the coaches was especially supportive of the

pedagogical features that characterized the training session.

I could use different approaches [adjust the number of players in different part practices] to make the movements and repeat co-acting patterns. They should know it so well that they can do it in their sleep. Every player will understand how it should be done, and I often stop [the game activity] and give feedback when the timing between the players is wrong so that the players know exactly how I want it. (R2)

This quote shows that a major goal is for every player to know the movement patterns, and that coaching feedback is used to ensure the accuracy of the SMM. Furthermore, it shows that repetition of co-acting movements with feedback is used, and timing is emphasized. Team practice must be guided, and an obvious way to achieve this is by giving feedback (Cannon-Bowers et al., 1993).

Reimer et al. (2006) argue that it is important for team members to be able to predict their teammates' preferences and behaviors, and this is why the primary goal of team training is often to encourage a shared understanding of role tasks, timing, and communication (Marks et al., 2002). Repetition of co-acting patterns in selected game situations as a prominent feature of practices was mentioned by the other coaches, and in addition to priming the players' decisions, one coach stated that it is fundamental for players to become confident in the co-action pattern: "We are concerned with splitting the game into parts and increasing the number of repetitions for typical situations where the players can find collective solutions for how they want to solve the problem" (R1).

This illustrates the significance of team training and provides details on how a shared understanding is established or refined in elite ball game teams. Additionally, there seem to be at least two pedagogical elements that should be explored. First, the coach argues that an increased number of repetitions are needed for typical situations, which presupposes that the coach is capable of choosing relevant and

critical game situations. The coach adds that practice conditions should be organized in such a manner that players complete as many repetitions as possible in the coordinated pattern. From a learning perspective, it can be claimed that the intention of this type of practice is to automatize coordination between the players or facilitate pattern recognition and primed decisions (Klein, 2009). Second, the coach seems, at least partly, to have a problem-based pedagogical approach, where the players are invited to find collective solutions for how they want to solve problems (Metzler, 2017). Such an approach may facilitate the players' responsibility for, and participation in, developing a SMM instead of unilaterally following the coach's instructions. A problem-based pedagogical approach seems to be in line with Zaccaro et al.'s (2001) advocacy of team problem-solving.

Selecting typical game situations followed by rehearsals to practice co-action with a sufficient number of repetitions seems to be an appropriate approach and is in line with what Salas et al. (2007) refer to as the most effective teaching strategy, namely team coordination and adaptation training. The following quote illustrates how one of the coaches develops the pedagogical objectives of coordination and adaptation training: "We drill during practice in such a manner that the players perceive the situation uniformly and establish an understanding of what their teammate wants based on his or her movements" (R2).

The term "situational awareness" describes people's knowledge of the importance of what is happening in their immediate surroundings, and it includes cognitive components such as selective attention, pattern recognition, comprehension, and anticipation (Endsley, 1995). The previous quote shows that a major goal of this team game practice is to develop expectations regarding teammates' behavior in specific game contexts, which presupposes cognitive processing skills such as attention allocation, perception, comprehension, and projection. Team performance depends on coordination activities, and these drills seem to be an adequate measure for improving shared

assessment of the situation. An assumption in the quote is that repetition of co-acting patterns is a prerequisite for establishing shared situational awareness in a team, and that this enables team members to perform functions from a common frame of reference.

Furthermore, it explains why drills are important and shows that the purpose is to make players perceive the situation uniformly. Durso and Gronlund (1999) argue that extensive experience in the environment is a prerequisite for developing knowledge structures, but that once that is achieved, training should focus on evaluating situation assessment and handling conflicting data. The following quote clearly illustrates that automatized shared situational assessment is the goal of practice:

I think it is important to recreate the most critical game situations as often as possible during practice because the players recognize these situations during the game. Sort of like, when the traffic light turns green [at a crossroads], you know you have to drive. (R3)

One underlying assumption in this quote appears to be consistent with context-driven training enhancing the situational awareness necessary for effective recognition-primed decision-making (Endsley, 1995). Reflecting about practice, the coach's statement seems to be in line with Salas et al. (2015) in terms of considerations about the quality of the training environment. Practice contains all relevant features of performance environment-embedded training because it provides the necessary realism of the problems where the situational cues may be controlled, and feedback provided. The traffic metaphor that the coach uses sounds plausible, but may appear simplistic and mechanical, building experiential repertoires and situational schemata, because game situations are seldom identical (Giske, 2001).

Video and Instructions

As previously stated, repetition of coordination patterns during practice is fundamental in building a SMM. One coach mentioned a playbook as a way to facilitate a SMM: "We

had a playbook where we had drawn out all the attack plays, and which every player received before each national team gathering, and it was approximately 200 pages long" (R3). This kind of instruction shows the extent of the focus on synchronized actions and affords the players an opportunity to practice outside team gatherings, thus saving time.

Video exposure in combination with instruction seems to be used as a teaching strategy facilitating a SMM during on-field practice:

Then we record it sometimes in training and in small refreshments breaks, we can watch the games' sequences that we have problems with and instruct e.g., the defenders to move more forward or ask the players openly about what they should adjust in these situations. (R1)

Salas and Cannon-Bowers (1997) recommended videos as a tool for facilitating SMMs. It is interesting to note that tablets are now used as a tool to facilitate a SMM in on-field practice, indicating a new pedagogical avenue to improve the coach's instructional practice.

Salas et al. (1995) suggest that indicators of team situational awareness are confirming, cross-checking, and sharing information, and that these are fundamental factors in fostering a SMM. Although we have limited knowledge about shared situational awareness in elite team sport, previous interview studies exposing players to video images from a previous match reveal only partial sharedness (Bourbousson et al., 2012; Schei & Giske, 2020), which is probably not a sufficient coaching objective at this performance level. The following statement indicates that showing players and coaches video clips of team behavior is considered a useful measure for establishing a compatible assessment of the situation: "We frequently observe that individual players and coaches have different perceptions of situations after the event, and the video is often useful for clarifying what really happened" (R1). This practice also has the potential to improve each player's individual situational awareness, but the main reason was to check whether the

players perceived the situation in the same way as the coaches and to nurture a shared situational awareness through dialogue based on the video clips shown.

Briefing and Debriefing Cycle

The concept of team pre-briefing and debriefing as methods for promoting reflexivity at the team level was first introduced by Tannenbaum et al. (1998). All the interviews revealed briefing and debriefing to be an essential off-field practice. One of the coaches was especially explicit about the content and the alignment between the match analysis, debriefing on the practice content, and briefing:

In a championship, if we have two days until the next match, we [the whole team] will always watch our game on video the day after the match, paying attention to what went well and what we could have improved. After this meeting, we practice with a focus on areas for improvement for the next match. On match day, the players are shown a short video reminder of the opponent. This makes up 30% of the session, while the remaining 70% focuses on our own good actions, representing how we want to play the game. (R3)

The briefing refers to a scheduled team meeting prior to the match in which players establish and confirm strategies, role expectations, and vital performance issues, while debriefing refers to the systematic process of sharing observations and interpretations of the match and team processes. In national teams, briefing and debriefing seem to be the key components in the team learning cycle, and a meta-analysis revealed that organizations (outside sport) can improve team performance by approximately 20% to 25% by using properly conducted debriefings (Tannenbaum & Cerasoli, 2013).

According to McEwan and Beauchamp (2014), regulation of team performance comprises four recurring phases—preparation, execution, evaluation, and adjustments. Our findings are consistent with the basic cyclical

movement between past and forthcoming performance. Team-based learning is a process in which teams acquire and reflect upon the feedback generated by their actions, and research on this topic is predominantly based on the notion of collective reflexivity (Swift & West, 1998).

The quote above is also in line with previous research indicating that, in the briefing, the coach devotes time to emphasizing team- and opponent-specific tactical instructions (Reimer et al., 2006). It is interesting to note that a video reminder of the opponent takes up 30% of the briefing time while the remainder is directed towards previous good-quality team actions and how they want to play the game. This procedure may strengthen a SMM because it improves interactional patterns that are considered desirable in forthcoming matches, and it may have an additional positive effect on collective efficacy and team identity. Another coach advocated an almost identical briefing practice:

We expose the players to defense and attack video sequences. These sequences could be of the opponent or ourselves. When I present our own team performance, I am committed to showing arrangements with team flow and what we should continue to do. [In other words, you use positive images of how the team as a collective unit has operated, with the intention of reinforcing it?]. Yes. (R.4)

The quotes related to briefing and debriefing reveal that the coaches consider these off-field practices as critical to the formation of the team members' mental model. To facilitate pedagogical alignment between briefing, match analysis, debriefing, and practice therefore becomes an essential leadership task. Furthermore, the use of briefing and debriefing may be best understood as an attempt to improve assessment and retrieval of information on what to do, thereby facilitating recognition-primed decisions (Klein, 2009). The findings about debriefings indicate that successful as well as failed performance events are discussed. This enables trainees to develop richer mental

models more effectively than debriefings that focus only on failed performances (Ellis & Davidi, 2005).

Argyris and Schon (1978) differentiate between single-loop and double-loop learning in organizations. Single-loop learning takes place when lessons learned from a match are framed within an existing SMM. The previous two quotes might be examples of this phenomenon in an elite sport team. Double-loop learning occurs when failure is experienced, and the existing SMM is questioned. The following statement from one of the coaches illustrates a justification for a change of a coordinative defensive team pattern and for double-loop learning: "Our basic defense system is 5:1, but unfortunately our best player was injured. We tried to continue to play in that formation, but it did not work, and that's why we are playing 6:0 today." (R.5)

Double-loop learning requires an examination of underlying assumptions and beliefs to discover more efficient solutions or to correct errors. Debriefings based on objective data (video analysis) combined with subjective data (player experiences) give the coaches rich opportunities to reflect on the pedagogical strategies enhancing team performance. The ability to discover new ideas, detect and correct errors, and critically examine the transfer from practice to competition are typical double-loop learning skills. Debriefings have the potential to form a double-loop learning pathway through reflection, reframing, and redesign, and might help coaches to alter their spontaneous understanding of a particular situation and further develop the SMM.

Richards et al. (2017) claim that the development of individual and team decision-making skills in elite sport cannot be developed effectively without the use of a slow off-field reflective environment and the application of this slow deliberate thinking into the applied tactical knowledge environment. The findings show the national representative handball coaches' immense effort to exploit the off-field reflective environment.

Conclusion

The purpose of the present study was to explore how coaches of nationally representative handball teams think about team cognitive properties and how these attributes are developed through team practice. Establishing and refining SMMs is an important coaching assignment because players have limited opportunities to explicitly plan coordinated behavior during the game. The coaches therefore emphasize implicit proactive communication where the players communicate using nonverbal signs and movements, enabling teammates to stay ahead of the situation.

All interviews revealed that facilitation of SMMs permeates the coaches' off- and on-field pedagogical activity and that giving the players the opportunity to contribute to the development and refinement of a SMM is a basic premise for establishing a positive learning environment. Furthermore, alignment between the performance analysis, debriefing, practice, and briefing is fundamental in facilitating SMMs. Instruction, video exposure, and feedback are didactic tools that coaches use to establish SMMs. Both single-loop and double-loop learning are pedagogical avenues to develop the SMM further and to enhance team performance. Key elements of practice are repetition of co-active patterns and the recreation of the most critical game situations. The coaches made use of videos, not only of their own teams, but also of their opponents. Figure 2 synthesizes the findings in a heuristic cyclic model which clarifies connections and awareness about key elements the coach must consider developing SMM. Some of the coaches invited players to find collective coordinative answers, which may be an expression of a problem-based pedagogical approach, indicating that there are several instructional models that stimulate SMMs. Coaching national handball teams therefore seems to be defined as continuously engaging in problem-solving activities in order to generate solutions that advance team goal attainment. This approach appears to be primarily guided by what needs to be done for effective performance.

Application

Coaches and sport psychology consultants working with individual players and elite teams should be aware of the significance of SMMs in their work to improve performance. Coaches should reflect how their on- and off-field practice strengthens the accuracy of the players' SMM. Furthermore, they should consider how the players are invited to contribute to developing the team SMM and encourage clarity in the SMM. The pedagogical alignment between the performance analysis, debriefing, briefing, and practice can provide a useful base for team learning. Because these categories are interconnected and cyclic, they give the coaches rich opportunities to become experts in team coaching. However, if this knowledge remains tacit, the content of this expertise is inaccessible. The analytical concepts and the model in figure 2 might give us a base for reflection and more explicit knowledge production, which, in the next step, can improve practice.

Limitations and Future Research

This study is not without its limitations, and these should be considered when the findings are interpreted. Elite handball players' perceptions and decisions are understood in a completely different way in an ecological dynamics approach where there is a direct link between perception and action (see Araújo et al., 2006). This paper, however, is based on literature where knowledge or cognition is considered essential to guiding players' actions. The small number of participants in this study means that care is required in the interpretation process, but the style of analysis chosen was employed to establish the validity and consistency of the data (Braun & Clarke, 2006). In our opinion, the empirical material "saturates" the phenomenon, meaning that it is sufficient to reveal the main aspects of SMMs in national team handball. It may be argued that the exclusive and homogeneous population itself is a strength. More interviews will probably not uncover anything decisively new or different, and the strategic variation in the data generated from the five informants should be adequate. Denzin and Lincoln (2011) argued

that a "thick" description and prolonged engagement are preconditions for establishing trustworthiness in a qualitative study. Both these conditions have been considered and, in our opinion, strengthen the trustworthiness of the present study. All quotations used were translated from Norwegian to English. To avoid possible limitations in the analysis due to language differences, the whole analysis process was completed in the original language (Van Nes et al., 2010).

Case study design is especially appropriate in a real-life context gaining in-depth knowledge and by analytical generalization instead of statistical generalizations this knowledge can be transferred to similar cases (Yin, 2018). Future sport-specific research should therefore seek to explore teams' cognitive characteristics and the development of SMMs in different team sports, in different cultures and on different performance levels to refine and eventually develop new analytical categories. Moreover, how the players integrate SMM in their decision making should be further elaborated.

Authors' Declarations

The authors declare that there are no personal or financial conflicts of interest regarding the research in this article.

The authors declare that they conducted the research reported in this article in accordance with the [Ethical Principles](#) of the Journal of Expertise.

The authors declare that they are not able to make the dataset publicly available but are able to provide it upon request.

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