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An In Situ Exploration of Practicing Rugby Coaches' Cognitions, Higher Psychological Functions, and Actions Using Think Aloud Protocol

Simon Quick, School of Sport, Rehabilitation and Exercise Sciences, University of Essex

John Lyle, Centre for Sport Coaching, Carnegie School of Sport, Leeds Beckett University

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Abstract

Psychology-based research has been a characteristic of empirical enquiry in sport coaching for over fifty years and cognitive function is widely accepted as a fundamental component of sport coaching expertise. Within the academic literature, much empirical research on coaches' cognitions has tended to adopt retrospective approaches, such as post-session interviews or stimulated recall, thus capturing participant recall after the incident, training session or competition. Methods such as these that rely on participants' retrospective recall are prone to memory decay, reordering of accounts (Lyle, 2003), and confirmation bias. The aim of this research was to collect a different type of data to what is generated with retrospective approaches and, rather, capture coaching cognitions *in situ* using Think Aloud Protocol. The data captured were broken down into meaning units and analysed using a Reflexive Thematic Analysis. Situated in the practice of 6 experienced rugby coaches, findings revealed that Think Aloud Protocol generated rich data. However, engaging Think Aloud Protocol was problematic as the site of enquiry was confounded by multiple social interactions and required coaches to provide frequent instruction and feedback. The interaction between cognition and action is conceptualised by the tentative offering of a conceptual model which includes cognitive triggers and thresholds. The implications of these findings can help academics and coach developers to understand the complexity of capturing coaches' *in situ* thinking within dynamic social environments.

Keywords: coaching, psychology, thinking, methods, pedagogy, interactive

Exploring coach thinking and practice using TAP

What coaches think (cognition) during *in situ* practice has received limited empirical attention. Lyle and Vergeer (2013) list a number of contributory elements to cognition; for example, judgement and decision-making, reasoning, problem solving, mental models and knowledge structures. With a focus on these features of cognition, a great deal of emphasis has been placed on their prevalence and function in performers/athletes, particularly, skill acquisition (Fitts & Posner, 1967; Renshaw et al., 2019). However, the corresponding body of work focusing on coaches is much less extensive. The research described in this paper is intended to be a contribution to this area of study and more specifically, sessional-interactive pedagogy.

Effective sport coaching is cognitively demanding and requires coaches to observe, think and act (Lyle & Cushion, 2017; North, 2017). It is clear, therefore, that cognitive activity is a characteristic of coaching expertise and, therefore, of interest to both researchers and practising coaches. This is evident in fields of enquiry that have focused on, for example: naturalistic decision-making, which seeks to examine coaches' mental operations when practising (Harvey et al., 2015); professional judgement decision-making, which emphasises a blended approach of classical and naturalistic decision-making to inform actions (Collins & Collins, 2021); coaches' knowledge that includes professional, interpersonal and intrapersonal (Gilbert & Côté, 2013; Saury & Durand, 1998); cognitive management strategies during *in situ* practice (Debanne & Fontayne, 2009) and cognitive capacities that enable coaches to regulate and engage strategies to coordinate cognitions and actions in a logical sequential fashion. (Kennedy et al., 2021). This existing literature has contributed towards the development of a partial picture of coaching cognitions. Nevertheless, it has been suggested that there is a need to attend to the real-world practice setting of *in situ* coaching, namely *how* the sessional (e.g., practice structure and type of sport) and

interactive features (e.g., pedagogical approach and face-to-face interaction) can influence, constrain and enable cognitive processes *(*Lyle & Muir, 2020).

In the first instance, it is necessary to clarify what is meant by cognition. As to what constitutes our understanding of cognition in this study, Bayne (2019) offers a detailed and practice-related explanation: *"all the activities and processes concerned with the acquisition, storage, retrieval and processing of information regardless of whether these processes are explicit or conscious"* (p. 609). This definition offers a useful way forward but does not capture the contextual application of cognitive functions (Kennedy et al., 2021). We make the assumption that cognitive activity is impacted by and, in turn, influences the contextual behaviour and practice of coaches. This study, therefore, is an attempt to explore coaches' cognitions in a practice context – embracing, rather than reducing the complexity of the site of enquiry. For the purposes of this research and in simple language, cognition is considered to be the 'thinking' - activities and processes - that occur 'inside the coach's head', while operating in a particular coaching environment and context. This provides a parallel focus on cognition and the social-technical-tactical interactive research setting.

In order to illustrate and categorise the types of cognitions that may arise within such research, we draw upon the concept of higher psychological functions (Vygotsky, 1977). These can be considered types of conscious deliberate thinking into which specific cognitions can be grouped. Mason's (2002) concept of 'noticing' is an example of a higher psychological function; one that has been incorporated by Jones et al. (2013) in their notion of 'orchestration'. Cognitions can be understood as activities and processes that contain 'content' or 'subjects' (i.e., something to think about), whereas higher psychological functions offer a way to group cognitions

74 according to their similar characteristics and allow us to attend to the content of our
75 thinking.

76 Previous research in sport coaching that has sought to understand better the
77 cognitive processes of coaches has typically employed retrospective methods; for
78 example, stimulated recall, pre- and post-game interviews and verbal cues (Cloes et
79 al., 2001; Harvey et al., 2015). Retrospective methods that rely on participants'
80 retrospective recall and are intended to offer a reflective account of 'thinking' and
81 behaviour are associated with an array of potential problems including memory decay,
82 rationalisation of subsequent behaviour, confirmation bias, and attempts to appear 'in
83 control' (image management) (Lyle, 2003). The means of stimulating recall may also
84 be open to selection bias. As an alternative to retrospective approaches, Ericsson and
85 Simon (1993) proposed Think Aloud Protocol to capture the verbalizations of *in situ*
86 cognitive processes within different domains. More recently within the field of sport
87 coaching, Think Aloud Protocol has been used as a knowledge elicitation method
88 with athletes (Whitehead et al., 2016; Whitehead et al., 2018) and as a mechanism to
89 facilitate reflection in-action and on-action (Swettenham & Whitehead, 2021).
90 Neighboring domains including teaching (Cowan, 2019) and nursing (Banning, 2008)
91 have explored the use of Think Aloud Protocol to understand the *in situ* cognitive
92 processes of students and trainees whilst undertaking tasks with fewer peripheral
93 distractions (e.g., time-pressure and need to socially engage). Nevertheless, Think
94 Aloud Protocol has not been trialed to capture the cognitions of practicing coaches
95 operating in complex, timebound and social environment. Within a rugby specific
96 context, Mouchet et al. (2014) explored the in-game communications of rugby
97 coaches and reported the use of coaching routines, interventions and communications
98 as being context dependent and of a personalised nature. Additionally, Hall et al.

(2016) remarked on the complexity of coaching practice, suggesting that activity type and coaching behaviors warrant further investigation. Therefore, this study is intended to 'get closer' to the act of coaching by using Think Aloud Protocol and thus allowing contemporaneous data collection of cognitions which underpin coaching behaviours.

Much of the academic literature employing Think Aloud Protocol within sport coaching has focused on tasks that: 1) take place in environments with limited external or peripheral distractions, and 2) have a defined sequence with a clearly expressed outcome (Whitehead et al., 2018; Whitehead et al., 2016). This has allowed participants 'cognitive space' to exercise some measure of deliberation over decisions. However, this does not adequately represent the cognitive tasks that a dynamic, evolving and interactive situation, such as a team sport training session, requires of the sport coach. Previous attempts to reduce the complexity of the activity may present fewer problems for the researcher but the result is, at best, a partial insight into cognitive expertise. The purpose of this study is therefore twofold. First, to offer a novel insight into coaches' *in situ* cognitions by using Think Aloud Protocol to study sessional behavioural approaches that coaches' employ whilst practising in context-dependent situations with a high cognitive load (Jääskeläinen, 2010). Second, to examine the strengths and weaknesses of Think Aloud Protocol as a method to explore *in situ* cognition in coaching.

Method

The purpose of this study was to use Think Aloud Protocol to capture the *in situ* cognitions of six practising Rugby Union coaches. This study was underpinned by a realist ontology (i.e., reality exists beyond the limits of the researcher's understanding) and post-positivist epistemology (i.e., researcher background and

position impacts on what is observed) (Smith & McGannon, 2018). By engaging Think Aloud Protocol in this context and asking coaches to verbalise 'live' thoughts, the data that were generated would expose the marbling of cognition, feedback and instruction. For clarity, we view cognition as mental activities and processes which cannot easily be seen. We consider feedback to be the coach's selected articulations of what they have perceived to the players. Instruction is deemed to be the coach's speech to players with a view to intentionality and providing player/sessional direction. The dynamic and interwoven nature of cognitions in an 'open', unconstrained practice arena is an inescapable feature of *in situ* coaching and teaching. Therefore, the approach taken in this research was to embrace this complexity and, as a consequence, contribute to our knowledge about cognitions in the moment.

Participants and setting

A purposive sample of six male Rugby Union coaches was selected based on their experience, coaching qualifications, and role within the Rugby Football Union (e.g., Rugby Development Officer, Coach Developer, etc.) or a Premiership Academy. Coaching qualifications within the group ranged from Levels 2-4, with all individuals being employed in full-time professional coaching positions. The range of coaching experience was from 7-25 years.

In total, each of the six coaches was observed on two occasions, i.e., 12 sessions were recorded, with an average length of 50 minutes. The sessions lasted for between 30-90 minutes and were characteristic of what the coaches deemed to be a 'representative' session and part of their overall schedule. This ensured that coaches were able to keep to their routines and therefore, cognitions that were captured could

be considered as 'naturally occurring' as opposed to artificially generated as a result of a coaches' atypical coaching session. Male and female players (aged between 12-18 years of age) took part in the coaching sessions. Their levels of ability ranged from of having been recently introduced to the sport to competing at junior academy level.

Think Aloud Protocol overview

Think Aloud Protocol (TAP) has the capacity to generate different levels of data. Level 1 verbalisation is the vocalisation of inner speech which requires no cognitive effort to provide whilst performing a task; Level 2 verbalisation is the articulation of thoughts that are not originally in a verbal format or code. These thoughts might conceivably be represented in terms of mental models or images. This level of data is concerned with discovering what the subject is focusing on and is not revealed within Level 1 data. Level 3 verbalisation requires subjects to rationalise and explain their thought processes; for example, why they chose to make an intervention in a session (Ericsson & Simon, 1993). For the purposes of this research and in accordance with Ericsson and Simon (1993), Level 1 and 2 verbalisations were collected, as it was considered that the time required to *explain* the ideas, hypotheses and motives at Level 3 would disrupt the flow of coaching processes (Whitehead et al., 2016).

Procedures

Prior to its implementation, all coaches were briefed on how TAP would be conducted, what equipment would be used, and how this might impact the training session. Specifically, coaches were instructed to verbalise, where possible, what they were thinking during the coaching session. It was suggested that this might include aspects such as observations of coaching drills, what was deemed to be 'working or not working' and emotions. The coach and researcher undertook a 30-minute 'run

172 through' prior to the session. During this time, the coaches walked through the set-up,
173 activities and goals of their session, including the layout of equipment. This time
174 allowed coaches to verbalise their thinking (e.g., how they were setting up activities).
175 During the run through, the researcher was present to listen in, but also to provide the
176 coaches with any further information in terms of how much and what level of
177 verbalisation they were offering (Birch & Whitehead, 2020). This presented the
178 opportunity to speak with coaches and emphasize that they did not need to *explain*
179 their thought processes, but instead, simply to verbalise the thought itself. Feedback to
180 coaches regarding the level and quantity of their Think Aloud verbalisations was
181 offered during and after the run through in order for coaches to understand better what
182 was expected as part of the protocol. Coaches were encouraged not to deviate from
183 their typical structure and style of coaching. The recording of the sessions began when
184 the coach formally gathered the players and ended when the coach had delivered his
185 closing messages to the players.

186 ***Apparatus***

187 All 12 coaching sessions were recorded using a video camera attached to a wireless
188 audio receiver. The audio receiver was placed in the coaches' pockets and was
189 attached to a microphone on their collars. The video camera was placed either at the
190 side or end of the pitch to capture all players within the frame. The camera was fixed
191 to a tripod and was rotated by the researcher, as required, to ensure that the coach and
192 players remained in the centre of the screen. The purpose of the video recordings was
193 to assist with analysis and add a vital layer of context to the Think Aloud Protocol
194 audio data. The capturing of both audio and video data allowed actions and coaching
195 behaviours to be observed, thus providing a useful contextualisation.

Ethics

Ethical clearance was sought and subsequently approved by the University ethics committee and written consent was provided by all participant coaches in the study. All data that were generated and captured, including video and audio files, were stored on a password protected laptop and external hard drive in line with the University's ethical procedures. In the presentation of results, pseudonyms have been used where coaches have mentioned players' names.

Data Analysis

The aim of this study was to use Think Aloud Protocol to understand better the *in situ* cognitions of practising coaches. In this fashion, this study is intended to overcome limitations of retrospective methods (Lyle, 2003) and contribute to the coaching literature (Whitehead, 2018; Swettenham & Whitehead, 2021) with a unique focus on coaches' cognitions. The following data analysis, therefore, was designed to analyse the Think Aloud Protocol audio data and make sense of *how* and *what* coaches were thinking during the coaching sessions. The primary researcher was a qualified rugby coach and this knowledge was used as a resource throughout the data analysis phases.

Phase 1: The audio content from the audio/video recordings from each of the coaching sessions was transcribed verbatim. This process facilitated deep researcher immersion in, and intimate familiarisation with, the data (Joy et al., 2023).

Phase 2: The transcripts were read in full to initially generate some ideas that helped in the formulation of themes. Subsequently, the data were broken down into meaning units and coded using researcher familiarity with the data and a reflexive approach drawing on and refining the initial themes (Braun & Clarke, 2019; Joy et al., 2023). In this fashion, coding was both a process and an output. The data were analysed and

themes of higher psychological functions (e.g., noticing, questioning and problem solving) were developed. Once completed, an independent researcher in the field of Sport Coaching was asked to verify the categorisation of the meaning units under the theme headings. Resulting from this this process, there was an 80% agreement rate (Whitehead et al., 2018). The remaining units of disagreement were assembled into groups of according to similar differences a mutual decision taken about their categorisation in order to ensure that all meaning units were categorised. In total, 1337 meaning units were created and coded.

Phase 3: Once the initial framework of higher psychological functions was created, the data were further analysed inductively in order to make sense of and create second order themes (Fereday & Muir-Cochrane, 2006). This provided the specific detail or 'content' of, for example, *what* or *who* coaches were noticing (e.g., technical, tactical aspects). In total, 815 meaning units were coded as cognitions (Table 1). A further 522 meaning units revealed themselves to be instruction or feedback and, consequently, these were coded as 'actions' as seen in Table 2.

Results and Discussion

The developed higher psychological functions are depicted in Table 1. Significantly, noticing and questioning were prevalent in all sessions. Noticing developed primarily through Level 2 verbalisations, as coaches appeared to be more at ease when they were physically distanced from players and with no immediate need to engage verbally with them.

Table 1

Reflexive Thematic analysis of *in situ* higher psychological functions

[TABLE 1 HERE]

The results in Table 1 revealed the range of questioning used within sessions. These questions were directed both at players and as part of the coach's inner thoughts. Significantly, questioning can be considered as both a cognition and an action (L& Jornet, 2013). However, it is assumed that, in this instance, questions were representative of the coach's cognitions prior to such an action and, therefore, were included within the broader theme of diagnostic cognitions.

A significant amount of the data collected (522 meaning units) could be categorised as 'instruction' and 'feedback' (actions), the scale of which reflects their importance and use by coaches. Actions manifested in four different ways: direct instruction to players, collaborative instruction to players, feedback during drills, and feedback during interventions (interventions in this instance are recognised to be occasions when the coach stopped the session to deliver information). Examples of coaching actions are displayed in Table 2 and were consistent across all coaching sessions.

Table 2

Reflexive Thematic analysis of captured *in situ* coaching actions

[TABLE 2 HERE]

The analysis of results below begins with the developed higher psychological functions (noticing, questioning, problem solving and deductive reasoning). These are populated with session content and followed by the resultant actions (instruction and feedback).

Noticing

In total, eight second-order themes were developed under the category of noticing. For the purposes of this discussion, six of these themes are elaborated upon below, which, reflects their significance within the results.

Quality of the session

The perceived quality of the session was something that all coaches frequently considered. As an illustration of noticing the quality, Coach #6 verbalised, "Loads of dropped passes. Loads of imposition. Loads of people not running lines. Loads of people passing the ball badly. Which is not what we want at all, but ok". The use of the word 'badly' signifies an internal judgement that has been made by the coach (McMorris, 2015). The coach finished his thought by acknowledging that it was not ideal, but that it was "ok", suggesting that he was not ready to act immediately. This implies that coaches accept an element of variability in performance and may take a view that the standard of performance at a given time is 'good enough' for the purposes of the goals within the session (c.f. Simon's theory of bounded rationality or 'satisficing' (Simon, 1956)). The incident outlined above was notable because of the resultant action and feedback from the coach (upon further examination of the original transcript) who said "Come in. Couple of things boys just to make the exercise work… I just let you do that because I just wanted to get our hands going" (Coach #6). Coaches afford their players or teams some latitude against expectations, but this is likely to fluctuate as a result of a number of factors, such as the stage in the session or the individual players involved.

Inter-player communication

Coaches took into account the level of verbal inter-player communication, most likely because of the potential contribution to team performance. To begin with, the coaches

commented on the incidence of communication, without passing judgement on its quality. For example, "So, the lads are just starting to talk." (Coach #2). However, as sessions unfolded coaches began to notice more nuanced and performance-related details. For instance, one coach was focused on the source of the inter-player communication: "let's have a look, are we getting the information from out wide?" (Coach #3). The theme of inter-player communication is perhaps unsurprising as the sharing of information between players is more likely to increase the effectiveness of a team. As a result, coaches invested time in diagnosing communication issues - when this was happening and if it was appropriate.

Technical evaluation

Research has suggested that technical concerns are always high on coaches' priority lists (Latinjak et al., 2018). However, safety concerns are also important in the context of the physical contact nature of the game, in which incorrect technique may result in injury to a player (Podlog & Eklund, 2007). Whilst referring to the technique of clearing opposition players from the ruck, one coach explained, "Poor on the clear out, body position's been bobbing really. I know it's cold and everything, but you just look at it and there's a few" [bobbing refers to the height of the player's head and shoulders] (Coach #2). In this example, the coach was noticing the height of his player's head in the contact area. However, the cognition has two aspects. First, the element of safety is an ongoing consideration. Second, correct technique increases the chance of winning the ball and improving performances.

Positioning on field and use of space

The theme of positioning and use of space was mentioned by all coaches. Again, this is unsurprising in an interactive team sport. It was evident that coaches were

consistently noticing where players were in relation to each other, the ball and the opposition, and how space between players could be exploited. For example, Coach #6 verbalised, "They crossed the gain line, but they are now outside the outside post", illustrating that they were aware of how much forward and lateral progress their team needed to make. This implies that the coach had a mental model of *where* players needed to be on the field and *what* they were required to do in order to gain advantage on a particular play. This is an example of coaches operating with a performance model - focusing on the utilisation of space within the session as part of the technical component of the model.

Tactical evaluation

Tactical evaluation, although initially similar to 'positioning and use of space', offers a slightly different set of principles (Gray & Hall, 2015). This theme is based on collective team effectiveness, hence the strong evaluation aspect, suggesting that, in appropriate drills, coaches were constantly assessing the impact of player or team behaviour on tactical effectiveness. For example, one coach mentioned, "Good enterprise from the defence… allowing people to get back and recover" (Coach #3). The coach was making a judgement about the defensive unit, evidenced by his, albeit short, rationale. In this instance, the coach revealed that his attention was on a particular group of players, working together to achieve a particular goal or outcome. The coaches' noticing of tactical issues involved a judgement or diagnosis, as a potential catalyst to determine whether they needed to spend time resolving the problem.

Decision-making (of players)

The findings identify player decision-making as something that is highly person-specific, contextual, and situational. As an example of how a coach's prior knowledge of a player was used when evaluating a player's decision-making skills, Coach #5 stated, "The guy on the ball now is a very capable player, probably just lacks a bit of confidence in himself. But all his passing and decision-making has been spot on". The coach was able to focus on an individual player and take into account a range of factors that could influence the players' decision-making. The reference to the player's personality and mental state implies that the coach was able to recognise individual player resources and how these personal and situational factors have the capacity to impact on the player's performance.

Coaches also noticed players' decision-making in specific drills and how these impacted on tactical outcomes. Whilst observing a drill in action, Coach #6 verbalised, "That's a very early kick option, I understand they don't want it to be the same attack". This suggests that the coach was not expecting the kick to occur and, again, was utilising a simulation model to match the decision against his expectations of how the play would unfold. Shortly afterwards, the coach followed up his statement about the kick with a justification of the decision – "I understand they don't want it to be the same attack". This implies that the coach could take mitigating factors into account when evaluating the need for subsequent action. Although the coach noticed the superficial and surface level errors that the players were making, he was able to problem solve *why* they were making these decisions, note *what* was needed and *how* the problem could be remedied later in the session.

Questioning

The extended mind (Robbins & Aydede, 2009) offers a useful perspective into how questioning, as a higher psychological function, but also as an action, has the ability to extend into the social environment (i.e., the coaching session). In this instance, coaches verbalised their cognitions into their (coaching and players') environment. The players can respond to the extended cognition by amending their actions or justifying them verbally through dialogue or physically through game-based actions. As part of this analysis, questioning is viewed as a cognition, but manifests as both an action and tool which coaches use within sessions. In total, 6 themes evolved under the main category of questioning, of which, 5 are discussed below in accordance with their prevalence.

Questioning player communication

Coaches tended to focus on *how* players were able to pass information from one to the other during activities. For example, when speaking to a player one coach asked, "Ok, and how are you passing that information on to the players? Because you were doing it at times in that game" (Coach #3). Although this evolved as an action, the cognitive antecedents of questioning were significant as the coach wanted to understand *if* the player was aware of how he was communicating. In this instance, the question also serves as a mechanism to prompt or remind the players to communicate during a game or drill.

Questioning what players are seeing

Questions, first as cognitions and then as actions, allowed coaches to understand the players' perspective: first, the player's conscious in-session deliberations; second, what they were recognising in the session and in themselves; and third, what had prompted them to make decisions on the pitch. In the case of one coach, he asked a

relatively simple question to a player, "who is the player in the most space?" (Coach #2). This question implies that the coach was wanting to gain more information about *how* and *what* the player was seeing, and, perhaps, testing the player's understanding.

Similarly, a different coach gave an instruction immediately followed by a string of questions to his players, "fellas let's be feeding it in, what defenders have we got, or might we have? Ok where are they coming from? Do we need to fix? Do we need to straighten up? Do we need to go back at them?" (Coach #1). It is reasonable to suggest that these questions were intended to be rhetorical, as the coach didn't give an opportunity for the players to answer him and they followed an initial basic instruction. The flow of questions to the players is likely to have been a reinforcement mechanism for reminding players about previous advice/information, and inviting them to question themselves about their level of awareness of what was required (Debanne & Fontayne, 2009).

Questioning of game (rules) and tactics (strategies)

A number of coaches questioned players on their understanding of the rules of the game. For instance, one coach asked a player, "ok, so now, if the ball goes to the floor, what are you going to do? Can the ball go on the ground?" (Coach #2). From this, it is possible to infer two possibilities; first that the coach was merely cognitively questioning if the player was aware of the rules or laws of the game; but second, and arguably more likely, the question allows the coach to identify a mistake or irregularity with the player's performance and therefore, address these issues through subsequent coaching actions. We can perhaps assume that the coach's performance model incorporates adherence to the laws of the game, on which his verbalisations were based.

Tactical/strategic knowledge of the game was a prevalent theme in most coaching sessions, evidenced by Coach #3 who asked a player, "and if they spread, what do you do then?". This questioning of players' tactical knowledge is again likely to be a 'check and challenge' mechanism – partly probing for a 'judgement call', but also a simple reinforcement or awareness exercise.

Questioning of session or drill goals

Most coaches did not explicitly state the session goals at the beginning of the session. However, during conversations and by inference from their subsequent verbalisations, it was evident that coaches were working towards a set of goals. The questioning of player knowledge and awareness about session goals demonstrated the accompanying cognitive activities. For example, a coach asked, "What are we trying to promote in this game?" (Coach #1). In this instance, the coach was establishing expectations about the goal context, most likely as part of a broader programme of work, and then using this device to assist players to notice any deviance away from this. Their questions acted as a mechanism to steer the session back on track. In a different example, a coach asked a question and then explained a condition he was going to impose on the drill, and finally repeated his original question - "What challenges have we got in this narrow channel then? Every time you retreat now, I'm going to pull a player out, to start off with. So, you might be, ok, the fourth player holding back with me and Ben, you might be going 3 on 3, you might be going, 3 on 2, what challenges are we getting immediately in this channel?" (Coach #1). The way in which the coach presented the information by a question-condition-question formula helped to provide a frame of reference for the players to reflect upon the coach's questions and the reasons for his 'conditions'. This demonstrates how questions accompanied by

contextual information give the players a narrower degree of focus and information about what they ought, actively, to focus on.

Problem Solving

Problem solving was mostly evidenced through player-coach or coach-coach conversations. As a case in point, one coach explained to his player, “The only time you’d want to roll someone is if you come in at a bad angle and you’re not able to get to a lever, or if you got to the ruck quite late, and there’s a lot of bodies there you just need to take him out” (Coach #2). Although not explicitly stated, the coach was identifying the problem (wrong choice of ruck technique) and offering a solution to the problem. Problem solving requires three things: 1) noticing the issue (in this instance, the angle of approach), 2) use of a schemata-based knowledge framework (Lyle, 1999) to suggest one or more solutions, and 3) the opportunity for the player, through trial and error, to internalise the solution. Coaches often problem solve using simulation and performance models to identify what they notice is ‘out of place’. This function might be better divided into problem identification, problem hypothesis, and identifying solutions. Having recognised the issue, coaches refer to previous examples or developed schemata to ‘place’ the problem in context. This might be a mix of deliberative and less-deliberative cognition, but subsequently the coach communicates the associated solutions in verbalisation.

Deductive reasoning

Deductive reasoning was mostly evident through coach-player conversations and was exemplified by meaning statements that were longer and offered an often extended narrative. For example, one coach mentioned “So now, the thing is, early on I’ve done a lot more intervention than I would have wanted to. So now is the chance to really

get them playing and let them just have a go at doing stuff knowing that there is no whistle, and they are managing this" (Coach #5). In this instance, the coach revealed that he had deviated from his session plan. However, he extrapolated from this that his subsequent 'standing back' from the drill would have a positive effect on the players, as they would be less aware of or reliant on the external cues coming from the coach's whistle.

Instruction

Two types of instruction were developed: direct instruction to players and collaborative instruction. Direct instruction was the prevalent activity within all coaching sessions. However, it seemed that collaborative instruction (seeming to involve the players' acquiescence in the decisions) is a deliberate and supportive strategy, designed to engage and motivate players. In one instance, a coach gave an instruction when setting up a drill, "this game is going to be a tackle game, we're going to take the principle of the stuff that we've done with me around the contact area. We're going to put it into a game, it's going to be an overloaded attack game, so you're going to need to make sure you were defending like you were with Tom and Finlay, ok it's like making a cake, we're putting it altogether now." (Coach #2). This indicates a certain level of prior reasoning that the coach considered pre-verbalisation; for example, taking what was learned earlier on in the session and encouraging the players to apply it in a conditioned game scenario. The instruction, in this case, also contains elements of explanation (rationale), relevance, and quality. This provides an indication of how instructions might act as an end point to multiple prior cognitions.

Feedback

Feedback evolved in two distinctive ways - during drills (contemporaneous with activity) and during the coaches' interventions. These interventions were largely delivered in periods between drills, during which coaches could offer feedback in a more considered and reasoned fashion. Whilst players were engaged in the task, feedback from coaches tended to be short, sharp, and specific about a technical or motivational point. Coaches made several statements such as, "Jonathan, good work" (Coach #1). This type of feedback could be perceived as more motivational than instructional and might be more frequent in micro-management settings during drills, in which there is little time to offer detailed technical/tactical feedback. As an alternative example, another coach offered feedback to a player, "ok, so Charlie, don't worry about lifting him, you're just there then, you're going to come forward and get out of his way so you can track through, alright?" (The lifting in this case refers to raising a person to catch the ball from a line out) (Coach #2). This time-constrained deliberation and action was not an intervention, but a natural pause in the stop-start flow of the session. Most coaching sessions have a characteristic 'flow' and are interwoven with natural pauses and breaks. This results in coaching sessions being different in style and approach, with variations in the type and quantity of feedback that is provided. Nevertheless, it seems that coaches are able to respond, perhaps in a less-deliberative fashion, by combining the noticing of a technical or quality issue, with a judgement of the need or value in vocalising a response. We might speculate that the less-deliberative responses are of a general, often motivational/hustling nature and the interventions reflect a speedy recourse to the coach's mental models.

Interventions and implications

Coaches continually sought to gather information through noticing and questioning. This provided a stream of information for coaches to interpret, question, problem set

and solve, reason and act upon. The gathering of data by the coach was part of their embedded routines and an essential precursor before making any decisions.

Noticing is the first, and arguably most important, of these processes, for without the identification of an issue or prompt to action, there can be no subsequent cognitive routines (Mason, 2002). Noticing developed in three distinctive ways: *how* the session was going, *what* the players were doing and *what* the players appeared to know. These three considerations summarise what coaches were focused on and were embedded within their cognitive routines. The use of questioning suggests that coaches verbalised this cognitive process to act as a tool to verify and challenge what had been noticed. In some cases, the act of questioning served as a deliberate mechanism to engage with players and facilitate the gathering of information. As such, the action of questioning could be viewed as a strategy to shift the decision-making environment from non-deliberative to semi-deliberative, allowing coaches opportunities to problem solve rather than operating in a reactive fashion or depending upon heuristics (Collins & Collins, 2021). In turn, this notion is supported by Mouchet et al. (2014) who reported coaching routines and interventions being highly contextual and of personal nature.

Overall, there were few examples in this study to support the notion of problem solving and deductive reasoning, and these were mostly inferred, rather than naturally emerging from the data. The dynamic, reactive nature of the micro-management of the sessions may prompt problem recognition, with a subsequent reflection and reasoning to follow if immediate solutions prove inadequate. Problem solving and deductive reasoning were revealed through longer composite quotations, often in the form of a 'chain-of-instruction' demonstrating the coaches' logical thinking. This suggests that these higher psychological functions occur, but the

structure and conduct of the sessions and methodological limitations are likely to be responsible for their relative absence in this study.

Although coaching can be viewed as a flow of serial events (Lyle & Cushion, 2017), cognitive processes are different. Rather, they operate in an intermittent style, e.g., notice, question, notice, question, problem solve, question etc., until a threshold is reached, manifesting in a decision about whether to offer feedback or provide instruction – or to do nothing (Harvey et al., 2015). Consequently, any of the contextual conditions (e.g., if the team lost their last match in a particular fashion) might provide a 'weight of importance' given to the cognition, resulting in the breaching of thresholds and activation of triggers, or interventions.

As a consequence of using TAP and the capturing of data including coach-player interactions, the prevalence of instruction and feedback within sessions was highlighted. Although the quality of instruction and feedback was not explored in this study, it is acknowledged that instruction and feedback are essential components of coaching and, when provided in an appropriate fashion, have the capacity to improve team/player performance (McMorris, 2015). Finally, coach instruction and feedback can be viewed as part of emergent cognitive routines, 'checkpoints' intended to influence player understandings and behaviours.

A conceptual model of the relationship between higher psychological functions and actions in a micro-management setting

Sessional-interactive coaching practice has been revealed as an intense and dynamic manifestation of cognitions (including noticing) and action. This finely tuned balance portrayed coaching as a dynamic, yet not chaotic, process, with the coach or teacher

often acting as the conductor (Bowes & Jones, 2006; Jones et al., 2013). Figure 1 demonstrates how the cognitions and actions can be considered situated, interdependent in relation to each another and a vital component of decision-making (Harvey et al., 2015; Mouchet et al., 2014). The data paint a picture of a coaching process that is complex and, yet, had a degree of order. This was, in part, due to the micro-management of the sessions and in the context of sport-specific requirements such as team sport, high level of physicality, need for technical and tactical precision, and invasion game tactics (Lyle, 2010).

Figure 1

A conceptual model of the relationship between higher psychological functions and actions in an interactive micro-management setting

[FIGURE 1 HERE]

In Figure 1, problem solving and deductive reasoning have been grouped together as a result of their perceived similarities within this context. Although these higher psychological functions were evident, it is acknowledged that they were not as frequent as 'noticing' and 'questioning'. This may reflect the narrower focus in the study and the emphasis on what might be termed the micro-management of the session.

This exploratory conceptual model illustrates how the higher psychological functions are interlinked and dependent upon one another. For example, when coaches notice something, it often prompts some form of questioning to gain more information. Whilst problem solving and deductive reasoning could be viewed as a result of the 'noticing – questioning' pattern of thinking, they may prompt further noticing and questioning to gauge whether the solution in the form of feedback was

indeed correct (Lyle & Cushion, 2017; McMorris, 2015). These higher psychological functions operate serially and in concert, each one contributing towards the coach's knowledge and providing coaches with opportunities to test their understanding and make necessary interjections.

These four higher psychological functions influence the type of instruction and feedback that the coach will provide. It is possible to view the move from cognition to action as a result of a threshold being breached (Harvey et al., 2015; Lyle, 2002), which triggers a subsequent coaching intervention. However, the issue of *when* the coach acts provides a layer of complexity as to what constitutes a breach of a threshold. There were several examples in the TAP data in which coaches acknowledged an issue but decided not to take any immediate action. Importantly, only once a trigger has been activated does it lead to a resultant action from the coach.

The conceptual model includes a number of those emergent contextual factors such as goals, player relationships, knowledge of players and performance outcomes. Although these wider contextual factors were not explicitly considered a part of study, they were evident in the coaches' verbalisations, and it is acknowledged that they exist and influence cognitions and action. However, it is unclear based on the findings of this study *how*, or to what extent, they might underpin or influence what happens during the coaching sessions. It might be reasonably speculated that this 'background' knowledge forms part of the coaches' modelling of the coaching process and would be evident in performance (both individual and team), goal and simulation models.

Conclusions and limitations

This study has, to some extent, captured and explored cognitions of *in situ* practising rugby coaches. By drawing on the concept of higher psychological functions, this

601 research has usefully conceptualised the types of thinking in which coaches engage.
602 Specifically, coaches were required to notice a wide range of sessional features,
603 diagnose problems and act under the pressure of time. Those tasks, therefore,
604 demanded the engagement of a range of higher psychological functions including
605 noticing, questioning and reasoning in order for coaches to operate efficiently and
606 effectively. The findings suggest that the specificity of the environment, in this
607 instance, a micro-management setting, impacts on the types and patterns of higher
608 psychological functions that coaches can engage as part of a pedagogical approach.

609 Finally, Think Aloud Protocol has been demonstrated to capture rich *in situ*
610 data in a micro-management coaching setting, yet is limited and fallible because of
611 the social relationships that exist and the consequent need for coaches to filter the
612 appropriateness of their verbalisations. This was retrospectively shared with the
613 researcher by some of the coaches. In addition, sport coaching happens in a time-
614 bound serial fashion, meaning that coaches are often not in control of the speed of
615 what occurs. This means that much cognitive 'material' is therefore unable to be
616 verbalised as the act of coaching requires action and intervention. In addition,
617 cognition can be conscious or subconscious, in turn this illustrates the difficulty and
618 indeed limitations of capturing subconscious cognitive processes. Put simply, there is
619 an inherent need for coaches to provide instruction and feedback as integral parts of
620 the coaching process – each of which constrains the coaches' verbalisations.

621 Whilst the use of Think Aloud Protocol has provided insight into the cognitive
622 processes of coaches practising *in situ*, sessions that demand high levels of coach-
623 player interactions place restrictions on how much data can be collected using this
624 method. For example, at times, it was observed by the researcher that some coaches
625 expressed difficulty with verbalising their thoughts due to the need to deliver

feedback and interact with players. Therefore, some verbalisations were intentionally quiet. This, therefore, was problematic for the researcher to know to what extent coaches were verbalising their cognitions within sessions. However, a greater focus on how coaches are trained using this method is likely to impact both the quantity and quality of data. For example, it may be more beneficial to have coaches practice Think Aloud Protocol in coaching sessions, rather than during session run throughs.

In terms of research quality and rigor, this study presents a reflexive account of the methodological and procedural issues that were faced, such as, the problems that coaches encountered when attempting to verbalise cognition in the act of coaching. This study demonstrates credibility by the explicit sharing of quotations from the coaches and the elaboration of how the data link to aspects of the wider context. In terms of credibility, the extended discussion conveys a level of rich description, which helps to contextualise selected quotations. Moreover, this is important in bridging some of the more abstract concepts (e.g., higher psychological functions) with the real-world verbalisations.

Finally, in conjunction with cognitive processes, coaches are also presented with the issue of if, when, and how to respond. Clearly, the relationship between cognition and action is inherently complex - not all cognitions lead to action as coaches have an internal threshold of acceptability. Consequently, this research has drawn upon the notion of triggers and thresholds to explain how the link between cognition and (delayed) action can be considered.

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