Internal Processes and Cognitive Approaches to Coach Learning and Development

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Abstract

Sport coaching has often been considered a cognitive activity, aligning to a dominant psychological discourse within a process-product paradigm (Lyle & Cushion, 2017). It is a logical extension of this line of thought to turn to cognitively informed perspectives to help us understand how coaches learn, and in turn how to develop coaches and their coaching. This chapter aims to explain internal processes of learning and development, with examples from sport coaching and coach development situations. It foregrounds *what* is involved with respect to learning from this perspective, then considers *who* the coach learner is, and finally explores *how* cognitive approaches can help us in supporting coaches' learning and development. While acknowledging limitations to the available evidence from sport coaching, understanding internal processes such as perception, attention, memory, and the integration of different types of knowledge into changing mental models can offer much-needed focus for coach development and coach developers, for the benefit of sport coaching as a profession and a discipline.

Introduction

The past fifteen years or so has seen increased interest and academic attention into understanding sport coaches' learning, linked to attempts to enhance coach development opportunities and build a profession with an appropriately skilled and qualified workforce. Most would agree that learning is important to coaching, yet when it comes to the development of sport coaches, 'common sense' beliefs and practices prevail with potentially detrimental consequences. Alongside a lack of direct empirical evidence for coaches' learning, taken-for-granted development practices are based on implicit assumptions or theories of learning (Cushion et al. 2010; Cassidy, Jones & Potrac, 2016). When the goal is to foster learning, it is helpful to understand how learning works (Mayer, 2010). Scholarship in coach learning and development is based on the idea that if we can better understand how coaches learn, we can employ this more explicit understanding to help coaches to 'learn better', and ultimately 'coach better'. Yet as the conceptual development of sport coaching is not straightforward (Lyle & Cushion, 2017), 'coaching better', and facilitating practitioners to do so means a multitude of different things to different people working across different coaching contexts or domains. In line with conceptualisations of coaching as a complex, dynamic, socio-pedagogical process (e.g., Cushion, 2007; Jones, 2007), addressing the oversimplified, idealistic aim of 'learning to coach better' is problematic. Equally, as a central aspect of sport coaching, learning itself is a widely contested concept with no agreed definition. This is largely because understanding learning depends on often implicit philosophical perspectives relating to what constitutes knowledge and 'truth' (Cushion et al., 2010). Different learning theories rely on different epistemological platforms, with a host of related assumptions about knowledge, knowing, the role of the learner, and the role of the environment (Quennerstedt,

Öhman & Armour, 2014). Understanding the characteristics of these perspectives provides both a vocabulary for interpreting learning and direction towards variables that bring about learning, enabling more informed decisions to be made in negotiating the landscape of coach development (Cassidy, Jones & Potrac, 2016). It is here we suggest that coach education and development practices would benefit from focusing efforts.

While other chapters explore behaviourist and social constructivist-informed perspectives with likely overlapping ideas, this chapter focuses on coach development and learning as internal processes, namely, a cognitive approach. There is a tradition of adopting cognitive approaches to conceiving of and understanding sport coaching based on disciplinary roots in psychology and influenced by expertise approaches (Lyle & Cushion, 2017; Lyle & Muir, 2020). Although the contested nature of learning means it can be difficult to neatly categorise perspectives, cognitive psychology is the study of the mind, including processes such as perception, attention and memory (Weinstein, Sumeracki & Caviglioli, 2019), knowledge, decision making (Abraham & Collins, 2011) and sensemaking (Klein, Moon & Hoffman, 2006). Cognitvism assumes that certain internal processes and structures are universal amongst humans, shaping our experience of reality – which is thought of as external to the individual – and learning across contexts. Sport coaching can be thought of as a cognitive activity relying on various types of knowledge, reasoning, and decision making (Abraham & Collins, 1998; Lyle & Cushion, 2010). The 'art' of coaching, using intuition to perform detailed technical analyses, recognise patterns of play, plan and orchestrate 'structured improvisation' in various unique contexts and take multiple pressurised decisions, appears instinctive yet suggests the use of both tacit knowledge and explicit cognitive expertise (Nash & Collins, 2006). Coach development then can be positioned to explicitly define and develop skills and

knowledge structures for the individual coach to produce in practice. The aim of this chapter is to use cognitivism, and research under the cognitive tradition, as a lens to help us understand aspects of coaches' learning and development. Specifically, we address three areas: 'what' is involved with respect to learning from this perspective, 'who' the coach learner is, and 'how' cognitive approaches can help us in supporting coaches' learning and development.

What is involved with respect to learning from a cognitive perspective?

The central role of cognition in learning and the brain's role in processing and storing information arguably places cognitive science at the heart of learning, with cognitive theories and influential publications informing educational practice and policy (Perry et al. 2021). Learning from this perspective is seen as individual internal concept development, reorganisation of mental structures or changes in thinking (Quennerstedt et al. 2014). Increased knowledge in a certain domain leads to more sophisticated and efficient mental structures, also referred to as cognitive representations, mental models or schemata (Mason, 2007). Knowledge constructs can be 'acquired' to become one's own (Sfard, 1998), integrated into mental structures and generally applied or transferred to other situations (Mason, 2007). Learning can be understood then as knowledge development from practice and experience that results in enduring changes in behavioural capacity (Schunk, 2019). In this first section we describe how learning happens internally by introducing three important foundational processes: perception, attention, and memory. These processes provide a useful platform for understanding the development of sport coaches' professional knowledge and skills, which has tended to inform the focus of coach development research under the cognitive tradition.

Accordingly, this section underpins subsequent consideration of developing mental models, declarative, procedural, and tacit knowledge in coach learning.

Perception

Any discussion about learning needs to consider perception, the subjective interpretation of signals received through our senses (vision, hearing, touch, taste and smell). Perception determines how we understand the world, as information is interpreted differently depending on the person and the context (Weinstein et al. 2019). Knowledge influences how we perceive and interpret situations through 'top-down' processing of the signals we receive, with different individuals bringing different types and levels of knowledge to learning situations. When learning, coaches need to engage in active cognitive processes of noticing, filtering, selecting and organising information such as words and images and integrating them into prior knowledge before being able to apply what is taught to new situations (Berntsen & Kristiansen, 2019; Mayer, 2009; Stodter & Cushion, 2017). To give an example of a commonly encountered scenario in formal and informal coach development situations (Ste-Marie & Hancock, 2015), two coaches may view video footage of another's coaching session aimed to showcase a particular approach or idea such as the use of questioning in practice. Based on their background and prior knowledge, evidence suggests one coach may interpret the questioning used as a way to challenge athletes and extend learning, while another with a different educational background might see the approach used as a way to check athletes' understanding and maintain informational power (Stonebridge & Cushion, 2018). These differing interpretations of the same scenario, in combination with individual coaches' knowledge of how to coach within their context, would determine how each coach implements questioning in their own practice as well as their subsequent judgements of the

strategy's success. In addition, the types of questions each coach might themselves ask of the showcased approach would also depend on their prior knowledge. Thus, perception is an important consideration in explaining why individuals do not experience learning situations and the world of coach development in the same ways as each other.

Level of expertise influences perception as coaches develop. Research shows that 'expert' coaches see things differently than less expert coaches, with the ability to interpret perceptual cues growing significantly through experience and reflection (Schempp & McCullick, 2010). Anderson (1982) refers to experts being able to attach second order cues to visual cues. That is, being able to take perceptual information and attach further meaning through mental simulation or storytelling based on superior knowledge (Rutt-Leas & Chi, 1993). It seems that expert coaches learn how to make sense of the atypical rather than wasting energy on ordinary events unfolding as anticipated (Schempp & McCullick, 2010). These perceptual differences are based on many years of experience, honing 'expert' coaches' ability to pay attention to critical cues over less relevant information, which has implications for further learning.

Attention

Focus, or ability to focus on specific stimuli, is a crucial cognitive process that influences what coaches will learn from a given situation. Notoriously difficult to define but essential for learning to occur, attention is a limited-capacity resource. Simply knowing where to look matters for coaches' learning. For example, ball sports fans are typically attracted to watching the ball, whereas effective coaches are interested in what is affecting the ball and getting it to where it needs to be, necessitating a shift in focus. People cannot learn what they do not

pay attention to or notice, so coach learners need to be encouraged to be discriminatory in where they place their attentional focus (Cassidy, Jones & Potrac, 2009; Weinstein et al., 2019). In directing attention towards learning, the saliency of material is important. The extent to which a coach has a personal interest or goal related to the topic to be learned is referred to as individual interest, while situational interest is how engaging the learning situation is. Coaches' individual interest might relate to 'critical incidents' or issues of practice they are currently experiencing (Gilbert & Trudel, 2001), forming a guiding influence on what they deem 'relevant' (Nelson, Cushion & Potrac, 2013) and thus pay attention to for learning. While those developing the coaches have no bearing on individual interest or issues of practice, in formal coach education settings situational interest is under the control of coach developers. There is potential then to increase learners' attention levels through varying delivery strategies, which can help strengthen inherent interest (Weinstein et al. 2019). While evidence from coach development settings is sparse, coaches have described effective coach developers as those who captivate attention as 'effective presenters' and able to provide 'good demonstrations' (Nelson et al., 2013, p.213), highlighting an interesting area for further application of learning theory on attention.

Relevant to providing demonstrations, Bandura's social cognitive learning theory emphasises the importance of attention as a key component of observational learning (Thomas, Morgan & Harris, 2016). Learning from observing 'model' coaches or coach developers is a delivery format often adopted in formal coach education and Continuing Professional Development (CPD) workshops and is valued informally through watching more experienced coaches (Cushion, Armour & Jones, 2003; Ste-Marie & Hancock, 2015). Through observation, coaches form rules of how to behave, guiding future actions and bypassing the need for lengthy trial

and error (Thomas et al. 2016). Individuals must attend to the model and recognise distinctive features of the modelled behaviour and related responses for observational learning to occur. What needs attention also must account for individual differences in capability to process the information attended to. Together with coaches' past experiences and situational needs this will shape what is gained from observations. Coaches' backgrounds will also influence how effective the 'expert' model is, as observing a model with perceived similarity to the self is thought to be more helpful than observing a dissimilar model (Thomas et al., 2016). This points to a need to seek several different coaches or coach developers for observation to increase the likelihood of finding similarity across individual learners while enabling attention to diverse approaches. Live and video models of desired practice can be of equal benefit (Eggen & Kauchak, 2014), and evidence suggests context-specific video combined with text-based content is a valued medium that captures coaches' attention and promotes remembering (Berntsen & Kristiansen, 2019). It is also worth noting that the learning taking place could involve things that are intentionally or unintentionally *not* present in observed coaching (Cushion et al. 2003) - that is, if their absence is attended to by learners.

Most important for commanding learners' attention seems to be the perceived effectiveness, competence and status of the model, who could be a coach developer. Skilled coach developers are required to effectively direct attention to coherent messages with relevance to each learner. Little empirical evidence exists to support coach developers in understanding where, how, and why coaches direct their attention in professional development situations (Ste-Marie & Hancock, 2015). Yet the idea of cognitive apprenticeship (Collins et al., 1991) highlights the importance of making thinking 'visible' between both coach developer and learner within the tasks that are to be learned. In short, effective learning goes beyond

observation to deliberately directing attention to the interaction between key cues, thinking, and judgements.

Memory

Cognitive views on learning state that once learners have attended to a stimulus, they must construct and remember mental representations of what they saw or heard, subsequently retrieve these representations and use them to guide behaviour (Cassidy et al. 2006). Memory, or the processes by which humans store, manipulate and retrieve information, is essential for learning and can be separated out into short and long-term stores. Short-term working memory encompasses the cognitive mechanisms involved in actively processing small amounts of task-relevant information to create mental constructs or schema. Consider the team sport coach who, from the sideline, must quickly and accurately coordinate sensory information about athletes' movements and game play, while forming potential future strategies keeping in mind the rules and ignoring irrelevant distractions. Once the game is over, much information from each moment of play will be lost, but if it has been encoded in a meaningful way and with enough continual thinking, review or rehearsal, certain aspects of that information can move into long-term memory – with potential for future reflection on practice (Furley & Wood, 2016). Long-term memory is a durable repository of all things learned which allows subsequent recognition and recall, playing a vital role in learning that lasts – as opposed to more temporary, transient changes in performance.

Working memory is a fundamental concept for understanding how information is accessed, used, stored, or lost. Working memory has limited capacity for processing a few elements of information at any one time - on average seven plus or minus two simple items (Rudman,

2018) - and this, alongside cognitive load theory (e.g., Chandler & Sweller, 1991), has implications for instructional design to support coaches' learning. Research highlights a misalignment between the architecture of memory and learning strategies that apparently create desirable learning environments meaningful to the learner (Kirschener, Sweller & Clark, 2006). Approaches in coach development that have been critiqued include inquiry based or problem-based learning (PBL) and discovery learning (DL). Both approaches seem to fit in that they apparently encourage ownership and developing 'real' and meaningful problems. Indeed, both of these ideas would fit for those coaches with well developed mental models of coaching who are able to experiment with different ideas. However, the limitations of working memory mean that for relative novices, applying a PBL approach can take up too much capacity with applying problem solving methods, meaning that mental model development is neglected. Conversely, discovery learning can be so open that the task becomes directionless with no mental representation of how to solve tasks. Kirschener et al., (2006, pp. 83-84) summarise that the evidence:

> …almost uniformly supports direct, strong instructional guidance rather than constructivist-based minimal guidance during the instruction of novice to intermediate learners… Not only is unguided instruction normally less effective; there is also evidence that it may have negative results when students acquire misconceptions or incomplete or disorganized knowledge.

In short, the approach taken is dependent on the readiness of the learner and the content of what is to be learned.

The important role of meaning in connecting information from working memory to long-term memory may offer some solutions (Berntsen & Kristiansen, 2019; Christina and Bjork, 1991). With novice coaches, qualitative explanations can help learners connect to-be-learned content more effectively to the task and/or to what they already know. While most studies have been laboratory based, changing contexts in meaningful ways to the learner can help learning, leading Bjork and Bjork (2020) to suggest the need for 'desirable difficulties'. Muir (2018) details the importance of creating cognitive dissonance or uncertainty about practice to high skilled coaches' development. However, if initial skill is at a relatively low level, the learner may struggle to find meaning in what they are attempting to learn. This situation highlights the requirement for organised explanation that helps learners forward reason as to why a new idea or approach is useful and how it might connect to other knowledge in long-term memory, without overloading short-term working memory through extraneous cognitive processing (Mayer, 2010). In other words, while a learning activity may feel overwhelming or not immediately meaningful to novice learners, an explanation from a coach developer (c.f., directing attention and cognitive apprenticeship) about what is happening and why can facilitate selection of relevant information. Further, connecting this information to experience supports its integration into long-term memory, and transfer across contexts.

Once new information is in long-term memory, it needs to be organised and integrated into existing knowledge before it can be retrieved and applied in practice or to new contexts. Meaningful learning needs both experience and reflection – also an internal process – to create a 'thinking bridge' that connects a personal understanding of what theoretical constructs mean with how to use them in practice (Berntsen & Kristiansen, 2019; Moon, 2004). Long-term memory is arguably required for everything humans do and is undoubtedly

involved in coaches' identification and recall of experiences for learning after the event through reflection (Collins & Collins, 2012). Indeed, reflection plays a key role in coaches' learning through transforming experience into knowledge-in-action and is pervasively promoted as beneficial in coach development settings (Cushion, 2016). Yet long-term memory is not structured like a library for recalling facts; it is more 'organic', reconstructive, and highly subjective. We see the world through our own unique biographical filter, remembering things in a way that fits our cognitive architecture (Weinstein et al., 2019). Each time information is retrieved from long-term memory, it is altered. Cognitive principles help us consider such limitations to reflection that may simply reproduce rather than create new knowledge. Meaningful learning occurs when learners engage in active cognitive processes including attending to relevant material, mentally organising it into coherent cognitive representations, and integrating it with prior knowledge activated from long-term memory (Berntsen & Kristiansen, 2019; Mayer, 2010). Indeed, as personalised knowledge and representations build into LTM the role of PBL and/or work-based learning, that encourages experimentation in planning, delivery and reflection, becomes more relevant and important. Although these interacting internal processes are consistent across learners, they have implications for what individual coaches will learn and how knowledge develops along diverse avenues.

Developing Mental Models, Declarative, Procedural and Tacit Knowledge

In the previous section, we highlighted the implications of cognitive theories for supporting learning processes, pertinent to some strategies used in coach development settings, particularly PBL (Callary, Culver, Werthner & Bales, 2014). Understanding the internal processes that lead to problem solving abilities and advanced mental models facilitates

informed selection of coach development practices. PBL is partly built on the processes that experts use to solve problems, using schemata (mental models) to facilitate both a recognition of relevant problem information *and* selection of appropriate problem solving rules (Kirschner et al. 2006). In the absence of a guiding cognitive architecture, a crucial characteristic of effective problem solving is missed. Thus the problem is not so much the intention of creating meaningful learning, rather the use of a problem solving rule without connection to a bigger picture. For coaches, this is akin to the difference between using a 'Part' versus a 'Whole-Part-Whole' practice structure to enable linkage to prior knowledge. Several terms exist in cognitive psychology, education and coaching literature that reflect the importance of cognitive architecture in human functioning and development. Schemata, mental models, or knowledge objects are internal representations of how things work, integrating a breadth and depth of knowledge across multiple related concepts and conceptions (Abraham, Collins and Martindale, 2006). These structures allow (coach) learners to:

> …meaningfully and efficiently interpret information and identify the problem structure. Schemata accomplish this by guiding the selection of relevant information and the screening out of irrelevant information (Kirshner et al. 2006, p83).

In short, more advanced mental models appear to be a crucial end goal for coach learning given their centrality to both engaging in practice *and* guiding and shaping the learning of new ideas (Entwistle & Peterson, 2004). Given the breadth of the task facing coach developers with responsibility for developing coaches varying in experience, it is helpful to consider knowledge and problem solving as a gateway to the creation of mental models.

Coaches initially encounter knowledge as concepts, for example ideas or 'bits and pieces' picked up through formal education. These have a shared rather than personal meaning (Entwistle & Peterson, 2004). However, knowledge concepts only become internalised conceptions as coaches apply them to a meaningful context (Stodter & Cushion, 2017). But what is meaningful? An emerging view is that of 'just in time' knowledge (Brandenburg & Ellinger, 2003). This approach assumes that adult learners often learn 'on the job'. Therefore, knowledge that is meaningful and worthy of learning, is knowledge that comes along at the right time. This approach makes sense for coach developers who work with coaches in the field. It also explains why novice coaches typically search for 'right' answers, such as drill and game designs, since it seems most pertinent (Stoszkowski & Collins, 2015). While acknowledging that what coaches want is important, for novices this may encourage 'copycat coaching'. This approach has limitations as elements of different approaches are 'cherry picked', abstracted and applied without a conceptual or practical understanding of their pedagogical foundations and implications (Abraham et al., 2009; Stodter & Cushion, 2017; Stoszkowski & Collins, 2015). Understanding knowledge and its connection to mental models can help us make better informed decisions about how knowledge is presented to challenge and bring about more meaningful change.

The coaching and education literature often distinguishes between declarative and procedural knowledge (Anderson, 1982; Côté & Gilbert, 2009). Simplistically, declarative knowledge is the *why* (theory or rationale) knowledge, whereas procedural knowledge is the *doing* (both *what* and *how*) knowledge (Abraham & Collins 1998). Anderson (1982) split procedural knowledge into very specific (specific procedural knowledge) or general problem solving procedures (broad procedural knowledge). Examples of declarative knowledge

include our personal theories for understanding and predicting the world, while specific procedural knowledge would encompass drills or practice designs. Examples of broad procedural knowledge would be the rules, concepts and explicit beliefs coaches use to address questions or problems, such as using small-sided games for engagement, using principles of play to structure coaching goals, or asking questions to encourage exploration. A well-established mental model integrates all three forms of knowledge, structured around broad procedural rules. These provide a scaffolding within which declarative understanding of the connection and application of these rules to the world sit. Furthermore, the specific procedural knowledge connects to these rules and are embedded like a library of craft knowledge, context specific 'solutions or recipes'.

To be effective, coaches need to develop the ability to draw on a blend of layered declarative and procedural knowledge across three areas identified by Côté and Gilbert's (2009) review. These include professional knowledge of their subject (e.g. their sport), procedures and pedagogy that should be accompanied by interpersonal knowledge of athletes, relationships and communities; and an intrapersonal understanding of oneself, reflection, and ethics. Although this alongside other studies (e.g., Abraham et al. 2006) gives us an idea of the types of knowledge coaches need to develop, there is added value in understanding the processes that drive development and what learning environments facilitate it – ideas which have been hypothesised but are not well evidenced in coaching.

One such hypothesis comes from the work of Biggs and Collis (1982). Their view is that as knowledge becomes more coherently developed with greater depth and breadth of connections it is possible to see how mental models emerge. It is also possible to consider

how approaches to problem solving influence the process of developing mental models. Biggs and Collis (1982) propose four structural shifts in problem solving (see Figure 1):

- Uni-structural level: Being able to work with single concepts or ideas in relatively simple and certain ways (e.g., this drill will give you this technical outcome).

- Multi-structural level: Being able to work with more than one concept or idea in limited ways (e.g., using the Space, Time, Equipment, People concept to adapt a drill to learners).

- Relational level: This represents a significant jump from the previous level as it reflects how a learner sees connections across multiple previous multi-structural understandings (e.g., understanding how adapting Space, Time, Equipment, and People involved in a drill, impacts on various outcomes over different time frames).

- Abstract level: Again representing a significant shift from the previous level, reflecting how the learner starts to recognise that problem solving is relative to the context and can rarely consider the whole context. There is recognition of the learner's own impact on problem solving. Metacognition, a consideration of how one's own thinking impacts on learning and practice, contributes to the overall problem solving process. There is rarely one problem but an interconnected web of seen and unseen problems that may be impossible to address.

The final abstract stage reflects a recognition of uncertain, 'wicked' problems (Entwistle & Peterson, 2004; Horn & Weber, 2007). From this point of view, a mental model grows from initial simplistic understanding to something more integrative. Learning has a spiral nature, growing and building on itself, meaning that what was abstract at one point may become

rudimentary in future (Cohelho & Moles, 2016). For example, in beginning coaching, planning a coherent session may seem an abstract endeavour, yet for those more 'expert', using abstract thinking could involve planning several sessions as part of a season or nested four year Olympic / Paralympic cycle. In this way, mental models grow and develop with increases in procedural concepts and answers along with declarative knowledge and the level of complexity a learner is able to recognise and cope with through that knowledge. For coach developers, awareness of how and why this growth occurs has implications for learning design and personal professional development. Firstly, it reflects the large volumes of time and effort required to grow expertise to this level and supported professional development should reflect this. Secondly, it indicates that programme curriculum grows in a spiral manner reflecting the needs and development of the learner (Takaya, 2008). Finally, creating a spiral curriculum places an emphasis on coach developers having their own clear mental model of the subject(s) and practices they aim to support others with. Conversely, those with poorly organised tacit knowledge may be limited in their capacity to effectively support learning (Krauss et al 2008).

A major limitation of some cognitive and expertise-related perspectives is the impersonal assumption of learning as decontextualised, easily transferable and linear knowledge acquisition, along with a rather narrow individual focus (Perry et al., 2021). Cognitive approaches to learning tend to have a rather mechanistic focus, overlooking more social and situated forms of learning, as well as the importance of motivation and context in learning and resulting practices. What is clear from the preceding discussion, however, is that who coaches are - their unique and ever-changing knowledge structures, mental models and biography - greatly influences learning and its outcomes.

Who is the coach (learner)?

Individual differences have been demonstrated in coaches' motivation to develop and openness to innovation, in turn directing their engagement with learning (Griffiths & Armour, 2013). The sum of a coach's unique past experiences, knowledge and practice – their biography – exerts a guiding influence on approaches to learning opportunities and what is learned (Stodter & Cushion, 2017; Trudel, Milestetd & Culver, 2020). In some cases where attempts to understand individual learners have been deployed in practice, it has led to a tendency to make highly problematic oversimplified, categorical judgments on coaches' learning styles. For example, cognitively influenced 'learning styles theories' have been adopted in formal coach education to describe, compartmentalise and structure activities around coaches' learning preferences (e.g., Mulvenna, Moran & Lesie-Walker, 2019). This is despite learning styles' problematic origins, equivocal evidence base and inability to explain the processes underlying developing coaching practice (Stodter, 2021). Learners may be put through a battery of questionnaires aiming to capture their learning dispositions, leaving coach developers to make judgments based on partial, static snapshots of each 'type' of learner. To move beyond oversimplistic categorisation, an individual difference-orientated approach offers a more nuanced understanding of learners' predispositions, needs and motivations as they develop, requiring additional skill, effort and expertise in learning from coach developers (An & Carr, 2017).

One theoretical perspective that could clarify elements of individual difference with coaches' development over time is outlined across three layers by McAdams (2015). The first layer expresses the dispositional traits of the learner which are stable differences in behaviour usually assessed by questionnaires. Dispositional traits do not locate individuals within their

context and situation, mirroring drawbacks of cognitive approaches to development and criticisms of formal coach education. The second layer, characteristic adaptations, begins to consider the role of the learner's context by viewing them as an active, motivated agent. Learning behaviours are understood through goals, values and beliefs, including approaches to learning (Griffiths & Armour, 2013) and filters through which knowledge is perceived (Stodter & Cushion, 2017). It is here where coach developers might be able to observe change in individual learners over time, and generate individualised strategies to help initiate positive shifts in approaches to and self-regulation of learning. The final of McAdams' layers is life stories. If dispositional traits draw an outline, and characteristic adaptations fill in the details of individuality, narrative identity and life stories give learners' lives unique and culturally anchored meanings (McAdams & Olson, 2010). Through personal stories, educators can access the cultural narratives concerning the serendipitous events occurring in a learner's 'journey' (McLean et al., 2018), allowing insight into how the individual makes sense of their learning as a whole (McAdams & Pals, 2006). These three layers of individual differences can structure thinking about coach development practice beyond initial 'snapshot' or category-based impressions of coach learners. Understanding a coach's biography and how their motivations are situated within their working contexts are crucial starting points for 'what works' in coach learning (Stodter & Cushion, 2017; Trudel et al., 2020). In short, rather than taking a glib view of knowing coach learners, McAdams offers a structure to consider what is meaningful to a coach, where they are in developing different ways of thinking and problem solving, how their experiences have influenced their view of learning, and how able they are to engage in learning processes as a motivated, autonomous person.

How can cognitive approaches help us to support coaches' learning?

Throughout this chapter we have linked and explained some of the key internal processes relevant to learning with illustrative examples from coach development situations. Principles of learning from cognitive science can have a demonstrable impact on learning (Perry et al. 2021), suggesting there is value in coaches and coach developers having a working knowledge of them. There are a few specific strategies for effective learning supported by processes and robust evidence from cognitive psychology (Weinstein et al., 2019). These include spaced practice, retrieval practice, elaboration, interleaving, concrete examples, and dual coding (see table 1 for examples of how they might be used in coach development situations). Despite the possibilities and wider evidence base informing these ideas, it is very possible to implement cognitively-informed learning strategies poorly. The available evidence is largely from educational settings or focused on athletes, meaning it should be interpreted with caution regarding applicability across subjects and learner stages or experience levels (Perry et al. 2021). There is a lack of research directly testing the applicability of cognitive strategies in promoting coaches' learning and developing their knowledge and skills. Particularly, studies that assess actual behavioural change alongside the cognitive alterations to knowledge and mental models that may afford such changes are conspicuous in their absence from the coach development literature. Implementing any approach to coach learning requires sound knowledge of its principles (Cushion et al. 2010), yet theoretical frameworks and techniques that applied effectively have the potential to influence coach learning and change coach behaviours are not often or consistently used in the design and delivery of coach development programmes (Allan, Vierimaa, Gainforth & Côté, 2018).

[Insert Table 1 here]

A focus on coaching as a (professional) judgement and decision making (PJDM) process is one potentially useful approach that can offer a clear cognitively-informed view on the subject matter and learning processes to support coach development (Abraham & Collins, 2011). PJDM focuses on the judgements and decisions that lead to the behaviours used to overcome necessary tasks. It draws on research (e.g., Kahneman & Klein, 2009) identifying that some judgements and decisions are slow and thoughtful while others are fast and responsive. Applied to the popular simplified and rationalist plan, deliver (do) and review view of coaching, planning and reviewing require slow and thoughtful decisions, whereas delivery involves fast and responsive decisions. When coaching is well planned and considered, slow, thoughtful decisions prepare coaches for decisions to be made in faster and more responsive situations. Yet planned decisions do not always match up with observed delivery decisions. However, if captured accurately, this disconnect serves as a point of slower debriefs during the review process. This view of a PJDM process has implications for the development of underpinning cognitive mechanisms that in turn support the development of PJDM. PJDM research (e.g., Nash, Martindale, Collins & Martindale, 2012) reinforces the importance of previously discussed cognitive processes that support good judgement and lead to consistently good results, such as situational awareness through the capacity to attach abstract meaning to perceptual cues, and perceptual skills relating to where, when, and what to pay attention to. We propose that the application of cognitive learning theories to coach development should support the development of such key cognitive processes relevant to effective sport coaching.

Recently, the cognitive constructivist ideas of ‘learning how to learn’ by imparting strategies that allow the practice of concept learning, problem solving and self-regulation (Schunk,

2019) have gained traction in sport coaching (Pacquette & Trudel, 2018). Most work in this area relates to how coaches use self-regulation to prevent stress and burnout, thus leaving room to extend links with learning, particularly in enabling coaches' effective PJDM through metacognition (Collins, Carson & Collins, 2016). Metacognition refers to having active control over cognitive processes (Collins et al. 2016) and selecting the right strategies to learn new ideas successfully (Schunk, 2019). It enables the active cognitive processing necessary for deep learning and constructing, contextualising, and refining useable knowledge (Collins et al, 2016). In contrast to more proceduralised, competency-based notions of coach education, developing metacognition alongside declarative knowledge and skill constitutes a promising avenue. Metacognitive skills are also important for coach developers to articulate their own metacognition in practice (Collins et al. 2016). Alongside encouraging an attitude of responsibility for one's own learning, in focusing on developing expertise in judgement and decision making Phillips, Klein and Sieck (2004) identify four strategies that coaches could use to promote the achievement of outcomes related to enhanced perceptual skills and enriched mental models. They are:

1. Engaging in deliberate practice and setting specific goals and evaluation criteria
2. Compiling extensive experience banks
3. Obtaining feedback that is accurate, diagnostic, and reasonably timely
4. Enriching experiences by reviewing prior experiences to derive new insights and lessons from mistakes.

Indeed, if coaches were to implement such strategies, it would involve exercising their attention and controlling their emotions to learn - in other words, using self-regulation. To summarise, in table 2 we highlight some examples of strategies that are used in coach

development situations with explanations of how, drawing on the ideas presented throughout this chapter, they might support the development of the professional knowledge and decision making of coaches at different levels of experience.

[Insert Table 2 here]

Conclusion

In this chapter we have introduced key internal processes central to learning and applied them to examples from coach learning and development situations, while providing some implications for coach development strategies. We discussed what learning is from this perspective by considering the assumptions of cognitive approaches. In explaining how learning happens, perception, attention and memory were outlined alongside mental models as underpinning the cognitive architecture that allows the development of coaches' knowledge and professional judgement and decision making (PJDM). We acknowledged 'who' the coach learner is, namely their biography and working contexts throughout. In applying these principles, structured reflective practice, imparting approaches for problem solving, and fostering metacognition were identified alongside other strategies as useful ways to support the internal processes of coaches' learning.

For clarity, we presented cognitivist ideas about the internal processes of learning as conceptually distinct from other 'camps' of theoretical approaches, yet the delineation of cognitively-informed ideas from other perspectives is not clear-cut (Perry et al. 2021). Models from cognitive science have largely relied on a neat, individualistic, 'information processing' perspective rather than reflecting the accepted complexity of everyday learning connected to coaching practice. It would be misleading then to see coaches' learning only as an individual

cognitive phenomenon (Cushion et al. 2010). In presenting the key internal processes we risk evidence becoming understood in isolation from the overall picture and overlooking the powerful wider cultural contexts of coaches' learning and development. For example, there is a challenge in ensuring that issues of power relations and inequalities within and beyond particular learning sites are acknowledged in cognitive approaches to learning (Quennerstedt et al. 2014). Clearly, there are factors linked to the social context as well as within the individual that affect coaches' learning. Coaches' experiences, biographies, and cognitive structures interact with the specific learning situation in bringing about learning, making the learner's contexts, purposes and practices the most important factors in the process (Cushion et al. 2010).

Alongside decontextualisation and aligning to cognitivism as only one perspective, there is a risk of oversimplification or misinterpretation linked to intuitive yet prevalent 'neuromyths' like learning styles. At the same time, given that blending is central to coaches' overall development, it is important to remember that all genuine theories of learning may have potential relevance to any development situation (Colley et al., 2003). What is clear though from much of the preceding discussion is that more evidence is needed to support the application, value and outcomes of cognitive ideas in coach development contexts. We challenge scholars to conduct 'research that has the power to close the knowing-doing gap' on the internal processes of coach learning and development (Ball, 2012, p.283, in Quennerstedt et al., 2014). Doing so alongside other approaches to learning will allow the growth of coach learning based on evidence and a clear understanding of theory (Cushion et al. 2010) for the benefit of sport coaching as a profession and a discipline.

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Table 1. Evidence-based cognitive strategies for learning applied to coach development (see Weinstein et al. 2019 for further detail)

Strategy	Summary	Coach Development Application Example
Spaced practice	Revisiting material regularly with distributed timing to secure remembering.	Mentoring a coach in blocks or through club visits spread out over time, revisiting the same key concepts each time.
Retrieval practice	Reconstructing something previously learned by bringing it to mind from memory. This identifies gaps in knowledge and strengthens memory for further retrieval. Can be promoted by generating responses to questions, writing, drawing or organising to recall previously learned information.	Coach developer checks understanding by asking coaches to design a coaching session and create a session plan using a practice structure that they have not used or come across for some time.
Interleaving	Mixing up or switching between topics or types of problems while learning. Noting what new connections can be made between them.	Designing a formal coach education programme that covers topics in a certain order, then again in a different order.
Elaboration	Adding features to long-term memory by connecting new information to pre-existing knowledge, integrating ideas. Understanding can be promoted by asking and answering 'how' and 'why' questions, using concrete examples and 'dual coding' of verbal and visual materials (see below).	Asking coaches to discuss how and why a new approach could work in their context and outlining how they would judge its success using examples from practice.
Concrete examples	Illustrating abstract concepts with specific examples, which can be very helpful for understanding and remembering information.	Coach developer provides several example practices to showcase a games-based approach. Helping coaches to apply examples by making links between salient surface details of the example and the underlying structure (the abstract idea or solution).
Dual coding	Combining words with visuals and encouraging learners to integrate the two, giving two pathways by which to retrieve information later.	Presenting new research findings to coaches using an infographic with written labels, while avoiding cognitive overload caused by too many words and visuals.

Table 2. Examples of coach development strategies and how they could support the development of coaches' PJDM.

Strategy	Overview	Relevance to Novice Coaches	Relevance to More Experienced Coaches	Relevance to Advanced Coaches
Course and assessment design	Programmes of learning delivered over a period of time to support achievement of stated outcomes.	Courses encourage connection with each learner to develop learning outcomes relevant to their needs. Outcomes are aligned with quality assessments, well-developed professional knowledge and relevant theory delivered through a spiral curriculum where core concepts are introduced, built on, returned to, explored, deepened, and connected over time. This approach draws on a range of delivery methods, e.g., from the rest of this table and beyond.		
Classroom Presentation / Lecture	Delivery of information in relatively didactic fashion from coach developer to learner.	Good for facilitating early exposure to core concepts away from practice to avoid overloading working memory capacity (WMC). Keep concepts few in number, delivered in short time frames of 15 – 40 mins, and revisited.	Good for connecting to previous learning and learners' beliefs and experience whilst layering new understanding or concepts. Connections with typical practice away from practice may allow space for thinking.	Assuming greater range of experiences and established rationale for coaching practice, the focus can be much more on examining connections and complexities of connecting academic theory to personal theory-in-use.
		Can feel divorced from reality and hard to build meaning.	Reliant on learner to take responsibility for being curious and having intent or ability to apply in practice and evaluate.	Easy to take learner curiosity for granted and create too much challenge (cognitive dissonance), leaving too much to do to reconnect to practice.
Work/practice based learning	Development of coaching expertise relying on building extensive context-specific experience. Likely to involve	Good for creating a procedural base to which conceptual learning can eventually connect. Those light on experience may struggle to	Good for using experiential base to start exploring more complex views on coaching. Continue to build experience-based procedural craft	Can draw upon a long-term view of learning and the impact of social and political realities through sense making approaches. Develop

	planning, delivering, and reviewing coaching sessions.	see meaning in new content. Perception of and attention drawn to pertinent practice issues is crucial. Opportunity to ask coaches to consider espoused plans with coaching delivery. Early attempts at coaching delivery can be daunting and may overwhelm WMC. Consider what support is placed around novice coaches.	knowledge. Increased focus can be brought to examining the role of implicit beliefs and their connection (or lack of) to espoused explicit rationale (plans). Is fast thought aligned with slow thought?	metacognitive skills to promote continued learning from practice.
Scenario/problem-based learning	Using realistic problematic scenarios to challenge and instil critical thinking, to be subsequently transferred into practical situations (Jones & Turner, 2007).	Too much WMC capacity may be taken up with applying problem solving methods, limiting mental model development. More direct, instructional guidance and explanation would minimise any misconceptions and help connect information to existing knowledge.	May provide an opportunity to use more organised theoretical knowledge in a practical situation. Evidence suggests strong instructional guidance will still be needed to help prevent incomplete or disorganised knowledge structures forming.	Can encourage learning and development around meaningful problems, through experimentation with different ideas – if mental models are already well-developed.
One-to-one coach developer support and/or mentoring	Coach developer accounting for individual differences when supporting coaches.	Provide a structure for reflective practice that acknowledges and works with the role of individual biography and context. Direct attention to what is relevant and provide help to interpret perceptual cues.	Draw upon coach's experiences to connect personal understanding of what theoretical constructs mean with how to use them in practice. Seek and create 'desirable difficulties' and help integrate	Foster metacognition and more in-depth reflections around 'critical incidents'. Appropriately pitched and managed disruption may be needed to encourage open-mindedness, minimising undue influence of prior

		Provide explanation about what is happening and why.	new knowledge with existing knowledge structures.	knowledge on perceptions of new material.
Modelled practice	Observing others and demonstrations of modelled practice or 'showcase' coaching sessions.	Can bypass the need for lengthy trial and error processes in beginning coaching practice. Help to avoid surface-level 'copycat coaching' by explaining pedagogical foundations and implications of approaches.	Direct attention to coherent messages with relevance to each learner, helping them to connect the model with what they already know or do. Show why and in what situations the model or approach is useful to promote transfer across contexts.	Promote experienced coaches' use of reflection and metacognition to adapt concepts and come to a personal, reasoned understanding of how to practically apply in different contexts.
'Informal' learning situations	Self-directed learning from internet, reading, podcasts, online social networks, etc.	Saliency of information may centre on 'just in time' knowledge. Coach developer can direct learners' attention in the 'right' direction to avoid overload of WMC.	Developing disposition to seek out new concepts and knowledge of where and what information to search for. Challenge integration with prior knowledge.	Create ongoing self-development goals. Facilitate routes to finding the atypical or unexpected, access the most up-to-date practice, and promote ability to connect and make sense of it in own context.

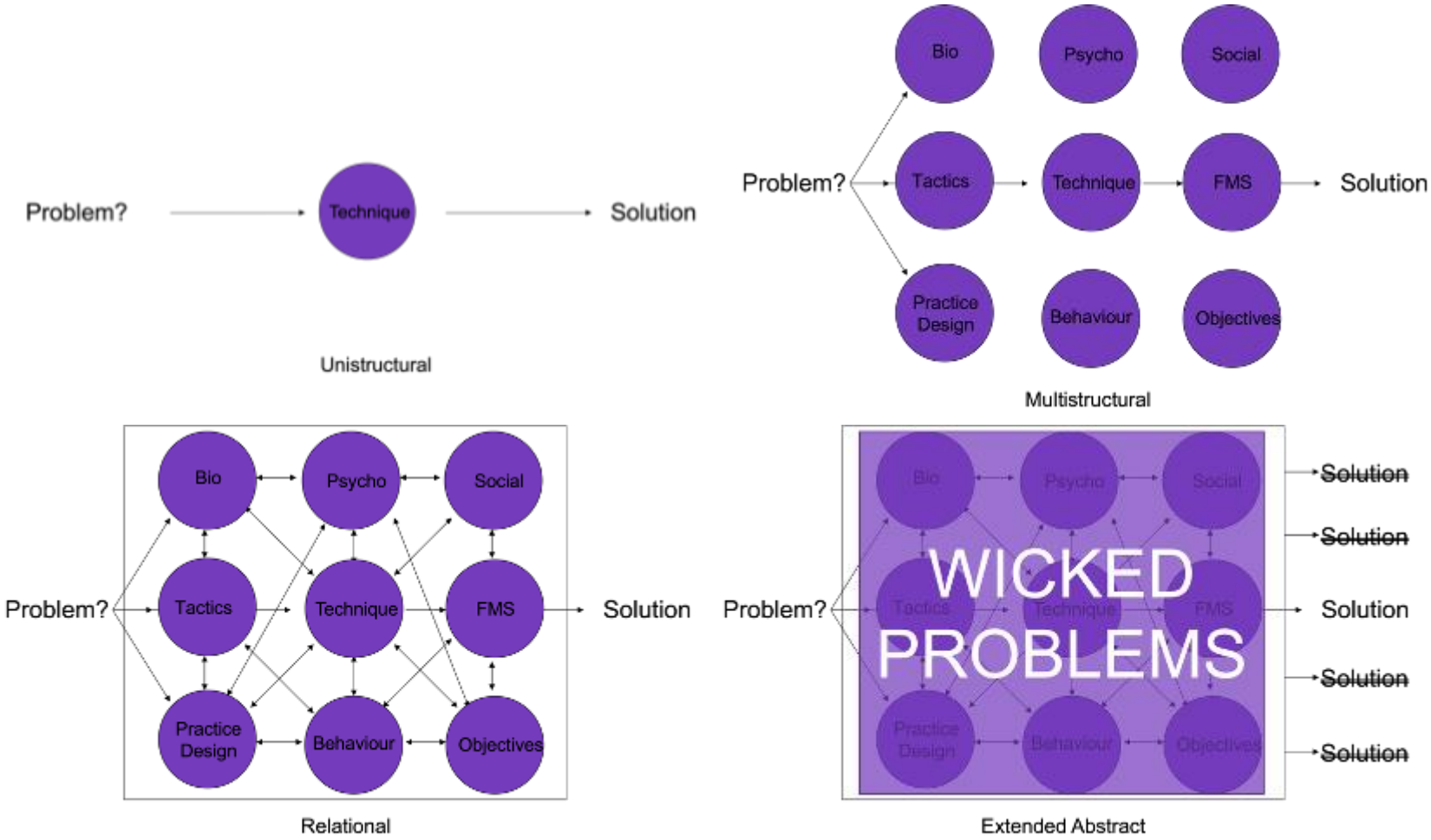

Figure 1. A simplified schematic of Biggs and Collis (1982) Structure of Observed Learning Outcomes (SOLO) Taxonomy. Problem solving has the potential to progresses from Unistructural to Multistructural to Relational to Extended Abstract.