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Nonlinear contemporary coaching approaches are becoming more prominent in academic research, although there is still limited take-up by sport practitioners. Research has investigated why coaches continue to use *traditional* reproductive pedagogical approaches. However, there is limited understanding of insights and experiences of sport coaches who have switched to contemporary approaches in practice. This study aimed to: (i) explore insights of coaches who are adopting contemporary approaches to understand why they eschewed more traditional approaches, and (ii), gain information on their experiences when implementing these contemporary approaches into their practice. To address these aims fifteen, experienced professional individual and team sports coaches from a range of countries (i.e. Australia, Netherlands, Portugal, Sweden, UK, USA), were interviewed. Thematic analysis revealed 59 lower-order themes and 10 higher-order themes, organised into 3 dimensions; (i) factors underpinning the coaches' approach to athlete learning; (ii) learning approaches; and (iii), responses to contemporary pedagogical approaches. Coaches reported a typical culture of traditional methods of learning within their sports, which they believed were not effective in developing athlete performance. Hence, they elected to adopt a contemporary non-linear, individualised, adaptive approach, emphasising representative learning designs. Results suggested that typical reactions to this approach included resistance from stakeholders. However, coaches continued to use this approach and expressed the importance of effective communication with stakeholders to enable acceptance of the contemporary approaches of learning. Findings suggest how continued integration between experiential and empirical knowledge of practitioners may increase the acceptance of contemporary pedagogical approaches, facilitating acceptance of new approaches to learning.

Introduction

Sport coaching is traditionally guided by a reproductive, coach-led approach (Piggott 2015). This perception of athlete learning has traditionally been characterised by highly structured teaching with demonstration of techniques, copious verbal instructions with corrective feedback, and repetitive attempts to reproduce coach-prescribed movement templates during drills designed in isolation from information in the performance environment (Davids et al. 2017). Traditional approaches to coaching have faced criticisms for the limited impact on learning due to limitations of linear learning theories (e.g., the power law of learning), the individuality of emergent movement behaviours, and the inherent non-linearity of the learning process (Newell, 1991; Araújo et al. 2010; Chow et al. 2016). Hence, alternative contemporary approaches to learning design have been proposed and utilised which encourage a more athlete-centred, non-linear perspective on athlete learning and development in sub-elite and elite sports organisations (e.g., Chow et al. 2011; Correia et al. 2019; Clark, McEwan, and Christie 2019; Fitzpatrick, Davids, and Stone 2018; Mckay and O'Connor 2018; Woods et al. 2019, Browne et al. 2019).

One contemporary nonlinear approach conceptualises athletes as complex adaptive systems (Renshaw et al. 2019), guided by the theoretical framework of ecological dynamics, highlighting the importance of complex, dynamic interactions in person-environment relationships (Handford et al. 1997). Renshaw et al. (2019) proposed a nonlinear model of motor learning, such as a constraints-led approach, which views mind, body, and the environment as continuously influencing each other to shape behaviour. The constraint-led approach promotes the understanding of how goal-directed behaviour can emerge as a consequence of attempting to satisfy the interacting constraints (task, environment, and performer) in a learning or performance situation (see Renshaw et al. 2019). The constraints of the learning environment shape the affordances (opportunities or invitations for action)

(Gibson 1979) available in a performance landscape for athletes (see Kiverstein, van Dijk, and Rietveld 2019 for a discussion on affordance landscapes). However, a constraints-led approach only promotes the understanding of how skills are acquired from a motor learning domain and does not provide a framework for designing motor learning programs (Chow 2013). Nonlinear pedagogy (NLP) can advance the constraints-led approach providing an approach to learning that has underpinning pedagogical principles to support athlete development as complex adaptive systems (Chow et al. 2011). NLP emphasises the need to design representative and facilitative learning environments, guided by key principles of information-movement coupling, manipulation of constraints, leveraging functional variability, and reduction of conscious control of movement (i.e. external focus of attention) (see Chow 2013 for detailed overview of NPL).

The less predictable outcomes that emerge through the dynamic learner-environment interactions within an NLP-informed pedagogical approach present considerable challenges to practitioners (Chow 2013). To successfully coach using principles of NLP, requires practitioners to have a clear understanding of the learning process from an ecological dynamic's perspective and excellent observational and analytical skills (Butler 2014; Moy et al. 2015). Current observation of practice shows that coaches of all levels still require assistance in ensuring that key elements underpinning such contemporary approaches are correctly considered when designing practice tasks (Renshaw et al. 2019; Slade 2015). Hence, there is a bias towards continued use of traditional approaches with sport practitioners struggling to use more contemporary methodologies, instead finding it easier to continue using traditional methods (Denison and Avner 2011; Ross, Gupta, and Sander 2018).

Although nonlinear contemporary coaching approaches are becoming more prominent in academic research, take-up by practitioners is still somewhat limited (Almond 2010; Renshaw et al. 2019). Previous research has investigated why sport coaches continue to

employ these traditional coaching methods (Moy et al. 2015; Piggott 2015; Ross, Gupta, and Sanders 2018), despite evidence supporting the merits of contemporary approaches (e.g., Clark, McEwan, and Christie 2019; Fitzpatrick, Davids, and Stone 2018; McCosker et al. 2019; Mckay and O'Connor 2018; Woods et al. 2019). This appears to result in a disconnection between what empirical research suggests may be a good pedagogical approach, and what coaches choose to adopt to do in practice (Jones, Morgan, and Harris 2012). For example, coaches continue to focus on instructing athletes towards adopting "gold stand movement patterns" in comparison to providing learners with opportunities to modify their movement behaviours appropriately in the search for functional coordination solutions (Rothwell, Stone and Davids, 2019). One way to start to address this disconnection is by encouraging coaches to consider implementing contemporary theoretical driven approaches which are guided by the experiential knowledge of coaches using these contemporary practices, an approach used by sport scientists to provide insights into applied scientific research (e.g., Phillips et al. 2014; Greenwood, Davids, and Renshaw 2014; Burnie et al. 2018; McCosker et al. 2019). From evaluating coaches' experiences in their work contexts, a better understanding can be developed on the pragmatic constraints of coaching in different performance contexts (Cooper and Allen 2018).

In line with a proposal (North 2013) for a more focused approach in empirical sports coaching research that has a value-laden practical applicability, the aim of this study was to explore insights and experiences of coaches who are adopting contemporary, theoretically-driven, nonlinear pedagogical approaches. Our main aim was to provide coaches with a 'voice' to consider why they have adopted these contemporary methodologies, how they are utilised, and the experiences they face(d) in this challenge. These insights may help to inform future coach education programmes and provide practical recommendations to support other

coaches to critically evaluate and explore the use of nonlinear contemporary methods in their practice.

Method

Research Design

This study was informed by our relativist ontology and constructionist epistemology, which are underpinned by an interpretive paradigm (Sparkes and Smith 2016). Individual, semi-structured interviews were deemed the most appropriate method for this study as they present opportunities for interviewees to share their experiences of coaching and their current approach to enhancing athlete learning (Sparkes and Smith 2016). The study allowed interviewees to provide rich insights in describing events relevant to personal coaching experiences, enabling an in-depth exploration of how their practice approach has been shaped, their current coaching approaches, and the resulting experiences of utilising these approaches (e.g., Jacobs, Claringbould, and Knoppers 2016; Cooper and Allen 2018).

Interviewees

Interviewees were purposefully sampled, based on the authors' prior interactions with each coach via their professional network of sport coaches developed through academic conferences, coach education events, and sharing of knowledge on applied practice. Each coach was initially contacted via email based on their extensive coaching experience, and current adoption of a contemporary model of learning to guide their coaching practice. Fifteen, experienced professional sports coaches (12 males; 3 females) from a range of countries (i.e. Australia, Netherlands, Portugal, Sweden, UK, USA), from individual and team sports (3 Soccer, 2 Rugby Union, 2 Rugby League, 2 Swimming, 1 Figure Skating, 2 Volleyball, 1 Golf, 1 Field Hockey and 1 Athletics) volunteered to be interviewed.

To ensure anonymity of coaches, their specific roles are not outlined. However, for context, interviewees ranged from working within national level sports teams, coaching

Olympic level athletes and being employed within professional sport organisations. The sample level of coaching experience, defined temporally, at the time of the interviews, ranged from 9 to 28 years. This study was approved by the host Institutional Research Ethics Committee and all interviewees provided informed consent prior to their participation.

Data Collection

A semi-structured interview guide was developed with open-ended questions and was informed by the authors' knowledge of contemporary theoretical understanding of sport pedagogy (e.g. Ecological dynamics theory and NLP, Davids et al. (2017)) and applied sport coaching practice. The guide enabled each interviewee to be asked the same set of core questions while allowing them to lead the conversation, elaborate, and discuss their experiences (Patton 2002). Prior to beginning each interview, the aims of the research study were discussed, at the same time assuring confidentiality, anonymity, and the freedom to withdraw at any stage. Interviews were performed either face-to-face (6), or via video call (9) with the semi-structured interview framework consisting of questions exploring: (1) general background/familiarisation (e.g. ‘can you tell me about your current coaching role?’), (2) current coaching culture within the interviewee’s sport (e.g. ‘can you tell me about the coaching culture within your sport?’), (3) personal coaching approach (e.g. ‘can you tell me about the coaching methods you use?’), (4) experiences that shaped the coaches’s adoption of that approach (e.g. ‘Why do you use these coaching methods?’), (5) experiences and insights using contemporary pedagogical approaches (e.g. ‘How have the athletes adapted to these methods?’), and (6), recommendations for practice (e.g. ‘what recommendations would you give for using these approaches?’). Interview lengths ranged between 35 and 99 minutes (mean 52 minutes) in length and were recorded on a digital voice recorder, being transcribed verbatim, with small grammatical changes made to improve text flow.

Data Analysis

A thematic analysis was conducted due to its suitability in extracting rich descriptive accounts and for identifying common themes across interviewee cases (Braun, Clarke, and Weate 2016). The thematic analysis of the interview transcripts was coded in Microsoft Excel (Version 16, Microsoft Cooperation, Washington, United States). Accepting that theory-free knowledge cannot be achieved (Guba and Lincoln 2005), during the thematic analysis the research team did not adopt an 'either or approach' with regards to adopting an inductive or deductive method (i.e., deductive approach: use of structure, theory or a pre-determined framework, or inductive approach: with little pre-determined structure, theory or framework). Rather, a more pragmatic line was followed that included employing inductive and deductive approaches (Braun, Clarke, and Weate 2016) to analyse the recorded data set as outlined below.

In line with Braun and Clarke's (2006) framework for thematic analysis procedures, the first coding stage was initially undertaken by the lead author, who read through the interview transcript several times, identifying language related to the aims of the research (e.g. coaches talking about adopting contemporary pedagogical approaches, how these approaches were used in practice, and the outcomes of these approaches). Initial lower order codes were then developed by the lead author to ascribe basic meaning to the data. For example, experiences described by coaches in some cases expressed clear meaning without the application of a theoretical lens to interpret (e.g. the code "Coached how they were coached" was labelled to the extract "I would say the predominant way people develop knowledge in athletics is still how they were coached"). In contrast, other experiences coaches expressed were interpreted from a theoretical position (e.g. the code "Task Constraints" was labelled to this extract "I quite often get asked by coaches in hurdles oh can I have your spacings and I say things like but they are not mine, they are Dave's or Jane's [referring to the athlete]. The coach here does not explicitly state they are using task

constraints (a theoretical term) within the dialogue, but it is reasonable to infer this from the content and wider context of the interview. After all transcripts were systematically coded, and the lead author had become familiar with key messages and potential trends across interviewees the analysis process moved on to theme development. Conceptually similar codes and corresponding raw data extracts were identified and grouped where appropriate to form higher order themes (e.g. the lower order themes of: Coach-led; Perfect technique; Template model; Coached how they were coached, were grouped into a higher order theme of Traditional Coaching). These themes were then listed, with the relevant codes and checked against original data exacts to ensure they robustly represented the titled theme. The second author then acted as a critical friend in developing and refining the themes by critiquing and questioning the structure and content of previously constructed themes and revising and renaming if appropriate. Finally, higher order themes were organised deductively into general dimensions which aimed to represent a coherent account of meaning of the data aligning to the aims of the research.

Research Quality and Rigor

With the authors adopting a relativist position, we endeavoured to provide good practice in qualitative research and maintain trustworthiness, accepting the view that universal criteria are included in a socially-constructed list of characteristics (Smith and McGannon 2018). First, purposive sampling was adopted to ensure that the most appropriate coaches were recruited to fully address the research question. Methodological rigor was facilitated by conducting two pilot interviews with experienced sport coaches to evaluate format flexibility and sequencing of interview questions in the context of the interviewee group. Subsequently, some questions were removed due to repetition and other questions reworded to enhance their clarity. From a relativist perspective, the authors accept that subjectivity can influence data

interpretation. To encourage reflexivity on the first author's presuppositions and how they may have impacted on the construction of knowledge, the second and third authors acted as "critical friends" (i.e. an evaluative process of critical dialogue between co-investigators to challenge interpretations made) to provide a sounding board for reflection and exploration of multiple and alternative explanations for emerging data (Smith and McGannon 2018). It is important to acknowledge that the personal biography of the research team was a motivation for undertaking the current study. Each author has worked within academic, practical and applied scientific contexts in the specific theoretical underpinning and topic area of the research. Therefore, it was accepted that this prior knowledge would influence emergent findings. In particular, the extensive prior work of the authors in the use of ecological dynamics and nonlinear pedagogy to inform sport coaching, human movement science, and motor learning research should be acknowledged. This acceptance promotes the notion that the researcher need not be assumed to enter the research process with 'an empty head', but rather with knowledge of the area that increases rather than compromises the theoretical sensitivity for interpreting findings (Weed 2009). The authors have attempted to illustrate sincerity by being transparent about their biases and motivations, challenging whether they are well-suited to explore the topic of interest, and, how these factors may have played a role in the methods (Tracy 2010). The final criteria that we would like this research to be judged on is credibility and, in particular, thick description of the data. By providing thick descriptions of the data that offer enough detail to enable readers to come to their own conclusions (Smith 2017), we aim to demonstrate both the complexity, and the specificity of our interpretations of the coaches' experiences (Sparkes and Smith 2014).

Results and Discussion

Thematic analysis resulted in 59 lower-order themes and 10 higher-order themes, which were organised into 3 dimensions (see Table 1). The results and discussion are presented in three sections, based on the dimensions constructed. First, we discuss the factors underpinning the sample of coaches' approach to athlete learning. We then outline the coaches' current learning approaches in their coaching practice. Finally, we explore the reactions to these coaching approaches from varying stakeholders.

Factors underpinning the coaches' approach to athlete learning

Within the experiences underpinning the samples' approach to athlete learning, three higher order themes of *traditional culture*, *outcomes of traditional approach* and *changes in approach* emerged.

Traditional culture. The dominant learning approach employed in the coaches' experiences suggest that traditional coaching practice based on coach-led, instructional approaches to athlete learning, involving provision of large amounts of specific instructions, repetitive technique rehearsal allied to corrective feedback, are still prevalent in many coaching environments (Williams, Alder, and Bush 2015) as this golf coach outlined:

> Quite traditional. Traditional meaning a lot of driving range practice, a lot of video practice, a lot of mechanical practice, which means working on movement form with internal focus of attention so to speak and well yeah basically that is the traditional coaching model (Golf-Coach).

Traditional coaching was based on encouraging athletes to try and achieve a *perfect technique* based on ideal templates and prescription as this athletics coach stated:

> I would say the dominant culture is very much a reproduction style based around technical templates, so trying to prescribe models for athletes (Athletics-Coach1).

Coaches expressed how these reproductive coaching approaches were normally adopted because of 'path dependence' (Ross, Gupta & Sanders, 2018), that is, they were following how they had been coached when they were athletes (Denison and Avner 2011) or because

coaches were mimicking ideas from more experienced coaches (Stephenson and Jowett 2009), as expressed here:

> I would say the predominant way people develop knowledge in athletics is still how they were coached (Athletics-Coach1).

These findings demonstrate the importance of socio-cultural traditions and norms in guiding many coaches' approaches to developing athlete learning (Rothwell, Davids, and Stone 2018). Coaches can find it hard to disturb the status quo and implement contemporary theories in practice, which results in a dominant reproductive style still being evident in coaching practice (Piggott 2012; Ross, Gupta, and Sanders 2018). This point was emphasised when coaches discussed their own formal coach education, which did not tend to have a great influence on their current approach to developing athlete learning. For example, this swimming coach did not feel the education program fully prepared him for pedagogical practice:

> Do they prepare you? No, not really, but again it can be useful information if you haven't come across it in another context. So I would say that it's inadequate if you want to be good but it can be a useful source of information at some point (Swimming-Coach1).

The views expressed by these coaches were similar to previous reports that formal coach education in many situations did not have an impact on coaching practice (Nash and Sproule 2009; Chesterfield, Potrac, and Jones 2010). Some programs were considered out-dated, and not particularly useful for developing coaching skills to deliver effective learning (Nelson, Cushion, and Potrac 2012).

Outcomes of traditional approach. Despite a traditional coaching culture being dominant in their sports, coaches expressed that this approach resulted in negative outcomes for their athletes:

> My personal opinion now, is it conducive for talent development? No. I think what we are hoping for there is if we get enough numbers, then we will get some that stick. So I don't think it is a very efficient way of developing talent (Athletics-Coach1).

As Vaeyens et al. (2009) highlighted, “talent programs” typically fail to produce significant numbers of future elite athletes, while having high levels of drop-out-rates where sport organisations are searching for the “one gifted athlete” (Fraser-Thomas, Côté, and Deakin 2008). Coaches discussed how an approach used in elite performance preparation coaching, then replicated in development pathway coaching, is not always appropriate for sub-elite or youth athletes. The continued use of a traditional approach was perceived to result in athletes performing too predictably in team sports:

> You have these 11 great players who are just good players but don’t know how to solve any problems in the game so when they came up against a team like *team name* they’re all like looking to the bench waiting for the coach to tell them how to solve the problem (Football-Coach1).

Traditional approaches resulted in performers having difficulty in solving problems during performance, reducing opportunities to develop decision making as they limit each athlete’s ability to explore the performance environment when performers are not able to autonomously respond to competitive dynamics (Holt, Ward, and Wallhead 2006).

Changes of approach. Despite the dominant traditional approaches evident within each interviewee's sport, coaches discussed how a range of experiences had led to changes to their approach to athlete learning, with many coaches describing a 'penny-dropping' moment where their change of approach just fell into place:

> Those were some of the penny-dropping moments that I would get and I didn’t know the word constraints, I didn’t know the words non-linear pedagogy, but re-create the game, do it in context with things I was starting to learn were more beneficial than doing it out of context (Field-Hockey-Coach).

These moments, which led to a ‘paradigm shift’ in approach, are likely to have been supported via attending coach development sessions, some of which the authors had led or attended. The coaches explained how such development events with experts in contemporary coaching approaches enabled them to connect what they were doing in practice, with the theoretical terminology presented in academic research. These events were supported by their

own research, informal education and practical experiences. This stimulation for reflection and change of methodology typically emerged from outside their own sport organisation as this rugby league coach expresses:

> It wasn't until I met someone from outside the sport who made me really think about that and as I said I just started to read around different practices (Rugby-League-Coach2).

Evidence here, supports the view that coaches rely upon a wide range of information sources to inform their coaching practice, including books, conferences, journals, the popular press, and social networking sites (Bailey et al. 2018; Stoszkowski and Collins 2017) as this figure-skating coach expressed:

> I started with pop science, pop science books and after I started reading those I started to dig into the science underneath those. And the more I got into it the more excited I got about it and now I just I can't go like a week without reading at least one book so I think that self-education has been hugely important for me (Figure-Skating-Coach).

Coaches experiences here of informal coach education, learning, and development resonated with Côté's (2006) proposal that formal courses should be designed as 'cooperative learning opportunities', with knowledge created and shared in context. This would remove issues with a 'one-size-fits-all' approach where the coaches' own experiences can be applied to educational information, underpinning their own learning approaches. Elsewhere, this approach has been recognised as the integration of knowledge from empirical (applied scientific) and experiential (coaches' own analyses, understanding and experiences) sources (Renshaw, Davids, Newcombe & Roberts, 2019). By creating more cooperative learning environments, the uptake of information from more contemporary theoretical models of learning could be more likely as coaches co-create their own knowledge, applying it to their own context and practice designs.

Learning approaches

In the dimension of learning approaches, higher order themes *of holistic non-linearity development, a movement outcome focus, coaches as environmental designers and athlete*

ownership via instruction and feedback were identified. The coaches' accounts highlighted how contemporary nonlinear approaches can be implemented into practical applied settings. Many approaches outlined by the coaches were aligned to the theoretical conceptualisation of ecological dynamics, either through explicit reference by the coaches to core elements of the theory in their practice or more implicit expression on their guiding practice which were interpreted by the authors as aligning with the principles of ecological dynamics. These learning approaches were predicated on an athlete-led, non-linear, individualised and problem-solving approach (Chow et al. 2011). Here, coaches expressed how they were not trying to continually instruct their athletes "what to do", but rather create learning opportunities which challenged athletes to adapt their behaviours and become directed to the relations between: (i) what is intended (intentionality), (ii) information that they can perceive, and (iii), action possibilities that emerge in a performance environment (Chow et al. 2011).

Holistic and nonlinear development. Coaches were focused on holistic development of performers, rather than on acquisition of a specific sporting skill set to deal with the inherent complexity of the coaching process (Potrac et al. 2000). These coaches outlined how learning is about developing the person and forming the whole athlete first (See Athletics Skills model, Wormhoudt et al. 2018), rather than the reproduction of specific skills or winning of matches:

> In kids my first concern is to form the athletes. They need to grow as a person and as athletes. As I have dedicated my coaching role to children, my main concern is about their development as a player, but also as a person. My main worry is to promote them a very good development as a player and here I am talking about technical and tactical issues, but also about cognitive issues. With this I mean the understanding of the game for instance. I am really worried about that performance regarding these issues, but as I am saying I am also worried about their development as a person and here we can talk about psychological issues, social issues, so it is very complex and it is difficult for me to say what is most important because everything is connected (Volleyball-Coach1).

The coaches often expressed how every athlete had his/her own specific coaching needs, rather than one general approach for all athletes:

> Every kid now and every swimmer that walks through the door is a new philosophy. I think that's the difference. I think if you'd have asked me 15 years ago I would have had a philosophy and now I've got enough experience to be able to coach the swimmers each with their own philosophy (Swimming-Coach2).

The coaches adopted a nonlinear view of athlete development and coaching which was expressed as the athletes continually changing both physically and psychologically, as this golf coach expressed:

> Players' bodies physically change. They grow, they get stronger, they get weaker, they get more flexible, they get less flexible. I also think there are changes more short term. Some players are more vulnerable at times. The reasons may be hard to pinpoint and it shows in their games. It is hard to change. Subtle changes and of course confidence goes up and down as well. But let's look at the more long-term changes. I feel that I need to be always alert and always watching (Golf-Coach1).

This nonlinear approach is theoretically predicated on the conceptualisation of the performer as a complex neurobiological system from which purposive adaptive behaviors emerge from the spontaneous interactions between system components under different task constraints (Chow 2013). This perspective proposes that the most relevant information for decision making and regulating action in performance environments is emergent during performer-environment interactions (Davids et al. 2017). In practice, this view resulted in training which was very adaptable, depending on the situation or emergence of training in a given session. Finally, this nonlinear approach did not mean that technical elements of skills were never focused on. Indeed, coaches highlighted that there is a time for more traditional technical coaching in athlete development as this rugby league coach expresses:

> I am working within a framework but I don't want it to be the kids turn up on a Monday and know they're doing this or they're doing that. I try and flip it as much as I can like a see-saw. I think that's almost where I find my work sits on a continuum, a little bit in terms of game based scenario, constraint based learning, that type of thing into your kind of closed skill, high repetition practices (RugbyLeague-Coach1).

This perspective resulted in coaches working along a continuum involving mainly these contemporary approaches, but sometimes, less frequently, moving towards more traditional technical coaching (See Renshaw et al. 2019). However, coaches still believed it was important to continually reflect on how representative these traditional methods were of competitive performance demands, while ensuring a decision-making element was included in the training. As Smith (2016) suggested, this integration of more traditional approaches (i.e. basic functional movements), alongside more contemporary methods (i.e. constraints led approach) can aid acceptance of these newer methods and help relieve some of the scepticism associated with their adoption. Furthermore, it suggests a combination of traditional and more contemporary approaches, used in the right context, is good for athletes learning.

Movement outcome focused. The coaches expressed how they were not trying to ask their athletes to achieve an optimal movement solution, but rather were focused on enhanced functionality and increasing movement outcomes. These outcome-based approaches were focused on the macro components of movement (e.g. the combined movement of the whole body during a swimming stroke) rather than micro movement problems (e.g. small changes to hand position in a section of the stroke) as this swimming coach outlines:

> It became obvious to me that like so you'd hear it takes 10,000 times to practice a skill before it gets done. I was like well so if I'm going to fix all 200 of those things, one the athlete's going to have to be super engaged and it's going to take forever (Swimming-Coach1).

This approach linked with the coaches' views on nonlinear development, through harnessing the concept of degeneracy from neurobiology, broadly defined as the same movement outcomes being achieved with dissimilar movement patterns (Edelman and Gally 2001) in each athlete. The result was that coaches were not looking to prescribe movement solutions, but instead were focusing on athletes adapting their behaviours to the performance environment. Bernstein (1967) defined dexterity as the ability to find a motor solution to

solve any emerging motor problem correctly, quickly, rationally, and resourcefully. Bernstein (1967) identified the need for flexibility in skill development to encourage learners to seek different solutions to the same or similar problems, thus advocating the need for practice designs to incorporate variability into learning contexts. Adaptive variability is an important phenomenon underpinning emergent movement patterning, playing a functional role in learning and performance (Davids, Bennett, and Newell 2006). As Correia et al. (2019) proposed, two aspects should be considered when introducing variability in practice designs. First, practice should promote varying ways of achieving the same task goal, (i.e. helping learners explore movement system degeneracy). Second, practice should promote athletes' search, exploration, and exploitation of similar performance solutions to respond to different problems. A belief in the importance of movement outcome variability was demonstrated by this coach describing how the 'ideal way' of performing actions is always evolving as the athlete develops:

> And then of course there's the ideal way of doing things or you were landing this jump last month and now you're struggling, let's go and review the video and see how we can get back on track. I used to be that way and now I say last week or last month was last month, you're a different person now so whatever worked then might not be the right solution now (Figure-Skating-Coach).

Therefore, ensuring variability of actions was seen as important and practice often included limited or no repetition of one specific movement pattern. Rather many coaches used Bernstein's (1967) idea of 'repetition without repetition' to design practice task constraints.

Coaches as environment designers. The coaches in this sample perceived themselves as *environmental designers* and what those environments offered, invited or encouraged learners to explore was vital, needing alignment with a development focus. This learning approach seeks to move away from a traditional view, towards one where learners are encouraged to explore their learning, rather than coaches continually trying to provide deterministic learning outcomes. Coaches discussed how the constraints-based model could

help them guide and understand how to design practice within the interacting constraints in the environment:

> It is about them trying to come to terms and making sense of the environment they are in, so I would use the constraints model and I would look at you know the interacting constraints on that athlete, so the ones that I am imposing typically are how I space my hurdles, the height of the hurdles, if I put any kind of other information into the design of the session, so I use hoopla hoops and tape on the floor and different things like that (Athletics-Coach).

These environmental designs took shape in different ways, for example building scenarios within the training session and ensuring no unopposed practice. Importantly as Roberts, Newcombe, and Davids (2019) recently outlined, there is an under-appreciation of how nuanced the successful application of a constraints-led approach can be, which often leads to vague practice environments, lacking purpose. The coaches emphasised that a key point for effective coaching was the ability to identify and manipulate information in the environment to continually challenge athletes:

> I quite often get asked by coaches in hurdles oh can I have your spacings and I say things like but they are not mine, they are Dave's or Jane's [referring to the athlete]. They are what I set tonight, so it is less about what the spacings are. (Athletic-Coach).

However, currently, for coaches looking to enhance the representativeness of practice there is limited readily available resources to guide practice task design (see Slade 2015 for an exception). For uptake of contemporary models, resources (see Renshaw et al. 2019 for an example of resources emerging) and coach education materials need to be continually developed to guide the effective use of these contemporary methods.

Athlete ownership via instructions and feedback. Coaches often discussed using instructions which promoted an external focus of attention (i.e. where the performer's attention is directed to the effect of the action, in comparison to an internal focus of attention which is directed to the limb movements themselves) for the athletes. Directing attention to

external sources has been shown to support learning (Wulf, Lauterbach, and Toole 1999). However, at the early stages of learning a functional movement pattern may not exist and instructions may need to direct learners to a specific part of an affordance landscape (affordances, or opportunities for action, exist in a varied landscape, for further explanation see Kiverstein, van Dijk and Rietveld 2019), which needs to be searched in practice to help them explore relevant functional performance solutions (Peh, Chow, and Davids 2011). Here, this coach exemplifies how providing opportunities for athletes to gain performance feedback by amplifying it, can guide them towards specific parts of the affordance landscape:

> A couple of my solutions are make the feedback bigger and louder to them and so the idea is they swim with a t-shirt and they go fast with a t-shirt because now they've got all this extra drag and also their skin on their torso is not exposed to the water so it's probably they can't feel as much and then you take the t-shirt off and hopefully now they have a whole lot more sensory information and they can feel things better and that's one way that maybe they can hopefully learn to adjust their body position to keep it skinnier so it feels like the waters flowing over their body better (Swimming-Coach1)

These external instructions were typically coupled with a greater tendency for using questioning during their coaching rather than providing prescriptive, explicit instructions. Effective coaching has been suggested to position learners as active agents in the learning process (Becker 2009; Cushion 2013). For this to work in practice, coaches need to move away from high levels of instructional behaviours towards greater use of questioning (Davis and Sumara 2003). Coaches in our sample talked a lot about shaping behaviours with questions to promote a guided discovery learning approach (Mosston and Ashworth 2002). Contemporary coaching methods such as the constraints-led approach, proposes questioning to help a learner define a path of exploration to guide the discovery and exploitation of information (Chow et al. 2016). However, the assumption that individual responses from questioning of whole groups may instil deep understanding in the full group, or that it instigates personal decision-making, should be taken with caution (Cope et al. 2016; Harvey and Light 2015). Typically, despite coaches using questioning frequently, they often allow

little time for athletes to consider responses, and if answers are not given immediately, a rephrased 'closing' of the question may follow to lead the performers towards the answer (Cope et al. 2016). Hence, Cope et al. (2016) suggested that coaches need to develop a wide spectrum of questions and a dialogical approach alongside complementary pedagogical behaviours to challenge performers' knowledge, techniques, skills, and strategies. However, this can be difficult as coaching norms provide an overriding, powerful, and historical view of what coaches *should* do and what coaching *should* look like (Cushion 2013). One norm suggests that the coach *should* be positioned as the authority and responsible for decision-making (Cushion 2013). Going against this tradition, the coaches in this sample preferred to promote an authentic learner-centred approach:

> I don't like to be the centre of the process. The centre of the process is the athletes, so I try to put some responsibilities during the tasks, during the whole process and I really believe also in those kind of issues because it is very difficult for me as a coach to lead with everything, so if I can put some responsibility and some important things of the process in the athlete I think that is the clue (Volleyball-Coach2).

By enabling a learner-centred approach, coaches expressed how this approach could promote athlete ownership of practice, enabling self-regulating athletes:

> I think to me the idea that technical change happens in one intervention is kind of short sighted. What I try to do, is help athletes learn how to coach themselves and so you give them these concepts of what needs to happen when swimming…a lot of kids surprisingly if you asked them, they have no idea what they're doing. Like literally they can't feel anything, they can't do anything because they're just, their only way to get feedback is from a coach. (Swimming-coach1)

This approach involved promoting the need for athletes to analyse their own performance and them also guiding their own training which deepened athlete engagement in the learning process. When coaches can use a hands-off approach during athlete support, it enables a self-directed, problem-solving environment which can empower athletes to develop effective behaviours during learning (Kidman and Lombardo 2010). This minimalist approach enables the coach to direct a performer's global search for a functional, successful movement

solution, and promote decision-making towards task solutions, linked to their own understanding of the problem. This shift of approach from *how to do it*, to more of a focus on *what you facilitate them to do* creates an environment of 'repetition without repetition'. It provides athletes with freedom to seek and discover solutions to performance problems through exploration (Renshaw, Oldham, and Bawde 2012) and empowerment for the athletes. This process can result in performers developing problem solving, decision-making, and creative thinking skills, combined with increased understanding (Renshaw et al. 2019).

Responses to Contemporary Approaches

Within the dimension of responses to contemporary approaches, three higher-order themes emerged, *positive reaction*, *negative reaction* and *recommendations when using a contemporary learning approach*.

Positive responses. The contemporary learning approaches were generally supported by athletes as they experienced success from that approach to training:

> I think the turning point for that was they had some success and started beating a couple of the top teams at home and away…And I think that for the first time the players realised that actually they adapted to what was in front of them (Rugby-Union-Coach2).

Parents of the athletes were commonly very supportive of the coaches' contemporary learning approaches:

> They're very supportive in terms of the mum and dad always say to us he's had a lot of interest from other clubs and they've always said we're not going anywhere, we're not going anywhere because we feel he's getting the right education here (Rugby-League-Coach1).

Most of the positive outcomes were achieved through effective and continuous communication between the coach, athlete, and parents:

> I have a very good relationship with the parents of my athletes because I communicate a lot with them I just explain to them why I do it and there is a lot of science to back what I am doing, but of course sometimes I have to be smart (Volleyball-Coach2).

These positive responses once again reinforced that effective communication is vital in effective coaching practice (Pankhurst, Collins, and Macnamara 2013), especially at the development phase with not only athletes, but also parents buying into the coaches' approach.

However, coaches also indicated that it took a long time for athletes to adapt to their methods of learning. But after a period of time, athletes started to see these contemporary approaches as the actual norm. Finally, coaches highlighted how it was easier with younger athletes and new coaches to accept their coaching approach, as they had had less exposure to more traditional approaches:

> I do think that I have got an opportunity now to kind of test out this idea if I get them young enough maybe when they are young enough they are open to these ideas and kind of more willing to have a go and they are not comparing it to something else (Athletics-Coach).

Negative responses. Despite some positive responses, the coaches using these contemporary learning approaches were typically going against the national governing bodies' ideal coaching approaches, which often resulted in resistance from the NGB and other coaches. They were perceived to be going against how things 'should be done' (Lemyre, Trudel, and Durand-Bish 2007), resulting in many of the coaches not having 'credibility' in that organisation as this athletics coach highlights:

> Within my role within the *NGB* setup it didn't really carry any credibility. The curriculum was all set around athlete preparation and so they were still hung up on those traditional ideas and they did pay a heck of a lot of their internal budget to old school coaches (Athletics-Coach).

Coaches discussed the need to do it their own way and not wanting to follow the NGB, causing issues for both coach and NGB, as this swimming coach highlighted:

> When you get people coming up through the system that want to do it their own way, not necessarily because there's anything wrong with *NGB* swimming but just because that's the only way you know and that's certainly my situation, it's hard for them to manage it because it doesn't fit into their plan (Swimming-Coach2).

With many of the coaching recommendations of NGBs not being aligned with ideas of contemporary approaches, coaches discussed it being a major challenge to change the learning approach, which often resulted in resistance as this coach highlighted:

> I think some people just maybe it's not worth it to them you know it's a lot of work. It's a lot of work to kind of re-start and honestly you have to give up a lot, you give up a lot of control. I think a lot of people want the 'I'm the coach, I'm in control, these kids are going

> to swim faster because of me' and you have to give that up because you're not just telling them what to do, you're not telling them, like it's not that there's no structure or anything you know, you're giving them the freedom to figure out stuff on their own and that's kind of scary (Swimming-Coach1).

Furthermore, athletes were often not used to a contemporary approach and, therefore, did not always understand how to train using this approach. Finally, others explained how they were seen as a 'weirdo', especially in highly traditional organisations:

> I think people think I'm a weirdo. It would be interesting to see what other people think but I think people would say that I don't know, I'm a clown. (Football-Coach4).

These findings around consistent negative reactions and concerns of other stakeholders, go some way to explain why, despite the powerful theoretical conceptualisation of these contemporary approaches, there is still slow uptake of these learning approaches in practice. For a wider adoption of such approaches, applied scientific research, demonstrating the benefits of taking up such approaches (e.g., Fitzpatrick, Davids, and Stone 2018), should be developed to provide practical evidence to support the continued development of contemporary approaches. The coaches' experiences of using a non-traditional approach often highlighted an issue with adopting a more learner-centred, less autocratic style, in which coaches can be perceived as "just standing around not doing much" (Williams, Alder, and Bush 2015). Coaches explained how people looking at their sessions would say 'it looks like I'm not coaching' as this coach explains:

> He (club chairman) watched the session, he called me over afterwards and he said what have you just done? So, I explained how the session was run and what I was looking at and he actually called it lazy coaching, you're not doing any coaching there, for me they're just playing games (Rugby-Union-Coach 2).

The coaches interviewed here, seem to have overcome previous issues with a change in cultural shift associated with such approach, such as feeling a loss of credibility in a new facilitative role (Roberts 2011) and not knowing when to intervene (Thomas, Morgan, and

Mesquita 2013). Coaches expressed their confidence with adopting a learner-centred approach, despite their previous concerns (Goodyear and Dudley 2015), which could be due to their greater experiences and wider educational opportunities. However, they did reinforce previous reported difficulties that inexperienced coaches may be reluctant to use learner-centred approaches due to limited understanding on how to interact when positioning themselves as a designer of learning experiences (Goodyear and Dudley 2015). Researchers have termed this as coaches' 'epistemological gap', the use of an approach but with limited conceptual or practical understanding of it (Davis and Sumara 2003; Partington and Cushion 2013). Future research and practical coach education need to be developed to enable continued education of coaches on how to apply these contemporary learning approaches effectively into practice.

Recommendations when using a contemporary learning approach. Coaches were asked for their recommendations, based on their experiences, for adopting a contemporary learning approach. The recommendations from these insights and experiences of these coaches for other coaches thinking about adopting such contemporary approaches was to ensure that they used a conceptualised approach to learning to assist coaches to provide quality experiences for athletes and help guide practice during these approaches (Copper and Allen 2018). Furthermore, the need for good communication with other stakeholders was highlighted, as well as to continue to educate themselves and explore varying approaches which align with their adopted learning approach. Another recommendation was to stick to a philosophy despite any negative reactions from stakeholders, as this Rugby coach expressed:

> Yeah don't be put off by sort of constraints from other people. Set your own philosophy and if that's the way you want to coach and the style of coaching that's what you stick to (Rugby-Union-Coach2).

Importantly, the pressures of competitive success signify that many coaches and their organizations are continually searching for new, advantageous ideas to improve their

712 learners' performance, potentially increasing their vulnerability to pseudoscientific ideas
713 (Bailey et al. 2018). This is where sound, empirically-evidenced, theoretical learning
714 approaches need to be encouraged to ensure the "latest fads and trends" do not get
715 uncritically adopted. Coaches here discussed how they felt it was important not to be
716 bothered what other people think of a learning approach:

717 > I think because for me it's certainly I don't give a fuck what anyone thinks. And if you're
718 > constantly thinking about I've got to be this way to suit this person or I've got to
719 > assimilate into this way you can't ever listen to that thing and get that whatever it is, that
720 > inspiration. You can't and you'll just be the same as everybody else which is mediocre
721 > (Swimming-Coach2).
722
723 However, it is worth noting that the coaches here are still in the minority. For other, less
724 experienced coaches who are likely to have limited power or agency, to go against the
725 currently employed approaches within an organisation would constitute a considerable
726 challenge (Moy et al. 2015). Importantly, this approach to developing athlete learning needs
727 to be underpinned by contemporary evidence, emphasising the importance of engaging with
728 ongoing research during professional practice:
729
730 > I would definitely want them to stay in touch with motor learning and performance
731 > research. Because doing that they will not get lost. It might be a bit difficult to read if you
732 > are not an academic and I would say don't be quick to jump to conclusions. Be aware that
733 > you will probably never be completely right. And don't be afraid to test. Don't be afraid to
734 > try different things (Golf-Coach).
735
736 Hence, as part of this continued process of research and development, reflection on current
737 approaches in practice was outlined as important. Many coaches highlighted that it will take
738 time, and failure is part of the process, but such experiences should not prevent a coach from
739 exploring the use of innovative approaches. Interviewee's also explained the need to be
740 *flexible* in a coaching approach which will enable innovative and effective training that
741 support individuals to learn. Coaches discussed how coaches with a multidisciplinary
742 background, with experience in a range of sports tended to have a better understanding of
743 contemporary approaches and that young coaches should gain experience in a range of sports:

744 > But what I find interesting is that coaches that have cross sport experience have a much
745 > easier time of understanding it [contemporary nonlinear approaches]. I am working with a

> Czech coach in Prague and he has both tennis and ice hockey experience as a coach and he has no problems whatsoever understanding it (Golf-Coach).

Conclusion

In conclusion, results presented here, indicate that traditional approaches to coaching are still dominant. However, in line with both theoretical (e.g., Chow 2013), and empirical (Fitzpatrick, Davids, and Stone 2018) evidence, the coaches interviewed here perceived traditional approaches as not being the most conducive for learning. Hence, the coaches in this sample adopted approaches to athlete learning which are based on a holistic, non-linear, discontinuous perspective. The professional role of these coaches was viewed as an 'environmental designer', emphasising athlete ownership of performance during practice through implementing opportunities for 'co-designing' learning experiences. Coaches expressed how these approaches could lead to more adaptive, engaged, versatile, autonomous, and skilled athletes. Despite the coaches receiving some positive reactions and contemporary approaches being well supported in coaching and motor learning literature, they are still not widely accepted within some applied coaching settings (Williams, Alder, and Bush 2015) as evidenced by reports of a wide range of negative outcomes from interactions with NGBs, athletes, parents, and other coaches. This sample of coaches were experienced and knew how to stick to their own philosophies. However, the challenge is still evident, with the traditions of a sport, coaches' intuition, and imitation of other coaches influencing the design of practice tasks, in which less-experienced coaches may find it hard to express their autonomy (Cushion, Armour, and Jones 2003).

These findings present a challenge for sport pedagogues to develop evidence-based methodologies which, through impactful education programmes, can help coaches understand and evaluate the benefits of these contemporary approaches. Here, we have examined how experienced coaches have implemented contemporary methods, however, for further uptake, future research needs to examine how less experienced coaches can deal with the challenges

found here. Furthermore, longitudinal examinations with individuals embedded within sporting organisations (e.g. ethnographic research designs) would enable greater understanding and depth of how such contemporary methods are implemented and received within practice.

Despite the well-accepted theoretical ideas of contemporary approaches, coaches face a hard challenge implementing them in their coaching practice. Continued integration between experiential and empirical knowledge may increase the acceptance of contemporary pedagogical approaches and encourage the uptake of innovative and novel approaches to athlete learning in sport (e.g., see Chow et al., 2016; Renshaw et al., 2019; Wormhoudt et al., 2018) over time.

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Table 1. Thematic map displaying the lower order, higher order and dimensions of the data set.

Lower Order	Higher Order	Dimension
Coach-led; Perfect technique; Template model; Coached how they were coached	Traditional culture	Factors underpinning the coaches approach to athlete learning
Negative outcomes; Predictable; No problem solving; Removal of decision making	Outcome of traditional approach	
Experience led to change; Penny dropping; Formal coach education; Fixed structure not working; Informal coach education	Change of approach	
Personal development; Individualised coaching; Form the athlete; Not all about winning; Continually changing athletes; No repetition; Variability; Complexity; Continuum	Holistic and non-linear development	Learning approaches
No optimal movement; Macro-not micro; Continually evolving	Movement outcome focused	
No unopposed practice; Technique with decision making; Scenario-based training; Manipulations important; Interacting constraints; Task constraints; Representative learning environments	Coach is an environment designer	
Louder feedback; External focus; Analogy; Implicit learning; Hands off coaching; Shape behaviour with questions; Self-regulating; Athlete guiding training; Responsibility; Learner centered; Empowerment; Decision makers	Athlete ownership via instructions and feedback	
Parental perspectives; Takes time; Success gets buy in; Younger athletes	Positive response	Response to contemporary pedagogical approaches
Resistance; Parental perspectives; Looks like I'm not coaching; Hard to change tradition	Negative reaction	
Stick to your approach; Communication; Lots of ways to solve problems; Reflection; Takes time; Multidisciplinary coaches; Flexibility	Recommendations when using a contemporary learning approach	