

Is the pedagogic practice of elite rowing  
coaches unknowingly underpinned by a  
Constraints-Led Approach?

Nicholas Ward

Oxford Brookes University

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## **Abstract**

### Background

A Constraints Led Approach (CLA) theory has been applied widely to the coaching of a large number of sports, particularly team sports and invasion games. It has, though, seen little-to-no uptake in highly repetitive and technical sports such as cycling and swimming. The experiences of the researcher who has spent many years coaching rowing suggest that there are parts of everyday coaching practice which resemble a CLA, whether the theory is consciously applied or not. This study explores this perspective whether this is the case by exploring current practice in elite rowing coaching and its links to the CLA framework.

### Method

A qualitative approach was taken to the study in the form of a multiple single case study design. Elite coaches of junior rowers, identified through their 1<sup>st</sup> eight crews' success in 2019 National School final six placings, were invited to participate in the study. A total of nine coaches eventually took part with each undergoing a semi-structured interview conducted remotely via zoom on their coaching principles and coaching practice. Interview transcripts were coded for key factors that emerged from the interviews in an iterative process and from these, three main themes were identified: social understanding, barriers & approaches to understanding movement, and learning & understanding 'what works'. The themes were then discussed in the context of the other coaches' experience and with regard to the existing literature.

### Findings

The varied positions and strategies held by the coaches' practice were varied, reflecting differences in background and education. However, there were similarities and overlaps amongst the nine participants that both informed the extent to which a CLA was currently underpinning practice, as well as furthering understanding into the pedagogical philosophy of the coaches. The coaches understood the complexity of the athletes that they worked with, as well as the complexity/chaos of the sport itself. Consequently, they had developed a rationale that attempted to deal with that relationship, which resembled a constructivist learning environment; encouraging athletes to explore and develop movement solutions in accordance with exercises that the coaches set. Although there were

elements of the data that did not wholly support this notion, there is little that directly contrasts it. The coaches were found to highly value internal athlete feeling and replicating races/performance environments which aligns with action fidelity and representative learning designs amongst other cornerstones of CLA-informing literature.

## Introduction

This study examines current practice in elite level rowing coaching and explores the extent to which their practice is consistent with the Constraints-Led Approach (CLA) framework. CLA can be understood as a practical coaching theory for manipulating the environment based on an ecological dynamics framework and was designed to offer a new 'nonlinear' perspective to decision making in sport more generally. This approach has emerged over the last few decades as a preferred alternative to more traditional drill-led approaches to coaching. However, while CLA has gained traction in invasion games and team-sports such as hockey, football, and netball, its application to sports where there is less scope for decision-making such as weightlifting has only more recently been explored, and its usage in rowing coaching has not been investigated at all. The present study looks to explore the current application of CLA to elite level rowing coaching to gain insight into both the theoretical pedagogy that is underpinning their practice, and the practice itself.

## Origins of the CLA

Historically, sports coaching has been dominated by methods based on a traditional pedagogy which focuses on repetition (such as the 10,000-hour rule) and relies heavily on drills for mastery. More recently, a Nonlinear Pedagogy (NLP) approach has developed which views skill development as a more complicated (and nonlinear) process than traditional approaches, which requires greater exploration, experimentation and ultimately more flexibility in developing skill acquisition in order to hone proficiency effectively (Chow et al., 2007).

During the 1960s, an approach to coaching was developing which began to place the athlete more at the centre of the coaching process. This development, and the shift away from a traditional (linear) model of coaching, also saw the growth of a specific nonlinear perspective, further refined through the work of Gibson (1979) and Bernstein (1967) amongst others (see literature review) which became known as the Constraints Led Approach. Gibson's major contribution to this endeavour was in pioneering the application of ecological dynamic concepts to naturally occurring complex systems such as the self-organisation of ecosystems. His thesis was that information regulates action, but one that also moves throughout the landscape in-front of you, with one's actions impacting on what information is received and how that is processed (Gibson, 1979). By implementing a *constraint*,

(to either the performer, environment (or task), *affordances* (such as a teammate with space in a goal-scoring opportunity) will emerge that will invite a potential solution, participants will then *self-organise* to form effective movement solutions that should improve performance.

The CLA further emphasised the role of the practitioner as the environment architect as opposed to being removed from the training environment and more 'hands off' (Renshaw et al., 2019). The CLA has emerged as a viable pedagogical option for teachers and coaches (Renshaw & Chow 2018), whilst other practitioners have used/adapted the theory to look at creativity (Santos et al., 2016), and others still have applied the approach to pedagogies such as *Game Sense* (Hewitt & Pill, 2018) or school-based applications of learning theory to school-age sport such as *Boing* (Roberts et al., 2019). Renshaw et al. (2019) are keen to point out that CLA is no 'magic bullet' however, and that the implementation of the theory does not pre-determine success.

#### Applications of CLA: team sports & invasion games

As mentioned above, CLA has found particular favour in its application to team sports and invasion games. In team sports, most of the information will come through visual or auditory feedback; for example, ascertaining where your teammates are, where the opposing team members are, and consequently where there is a potential numbers overload to be exploited.

Another example of an attempt to apply a CLA can be seen where a rugby team struggles to score against a physically larger pack of forwards. A training session may be designed where the defending team has one more forward on the field to imitate that, and there is a points reward for scoring after catching a kick, thus stretching the defence and affording more opportunities for creative play where the backs may experiment with kicks or more complicated moves. A traditional model, in contrast, might look to utilise drills that practice complex passing setups as well as kicking and receiving. Although potentially useful if done in the right way, the decontextualised information may be of limited practical value to the players when it needs to be applied in a real game. This example also provides an illustration of the importance of Brunswick's (1956) idea of Representative Learning Design (RLD), another key feature of CLA, and which is important in ensuring a positive transfer of skills developed in training.

### Applications of CLA: non-invasion sport

Thus far we have seen that with invasion sports the complexity lies in understanding that the performance environment is an ecosystem that is constantly changing, where teammates and opponents alike will be reacting to the same information you are, and all of these minute decisions are imperative for guiding athletes towards more optimal solutions. Many of the applications focus on managing chaos and co-adaptation where each participant may be making a plethora of decisions every second. Often in these scenarios the information available to the participants is plentiful and skill is developed through learning to identify the relevant cues/affordances to invite goal-oriented action.

Despite an initial emphasis of applying the CLA to invasion games, there has been a more recent increase in the application of the theory to sports that do not meet the same level of chaos (or non-linearity) and decision making, such as track and field events and weightlifting (Renshaw et al., 2019; Verhoff et al., 2019). In an individual sport such as pole vault, for example, and in contrast to invasion games, the majority of the information may be proprioceptive, and the body will make minute adjustments in approach and performance of the skill. Bernstein's (1967) work on self-organisation was pivotal in this regard, presenting CLA as a self-organisation and pattern forming approach that must be understood for the environment to be manipulated in a way that produces effective movement solutions. If sessions are designed to encourage the athletes to self-organise into effective solutions, then knowledge of the self-organisational process is as important as the sport-specific expertise that feeds into how the session may be constrained. The reduced scope for chaotic practice environment is even less common in a sport like rowing, where the goal-oriented behaviours are even more closely constrained and narrowly defined. Consequently, although this does not necessarily mean that an attempt to apply a CLA to a sport like rowing must bend rules, but perhaps assign more weighting and depth to certain areas that traditionally play a smaller role in the CLA.

### The purpose of the present study

The reasoning for the explorative nature of the present study is two-fold. By understanding the current practice that is being delivered and the pedagogy that underpins it, the present study will provide a platform for future research into rowing coaching, and to enhance current understanding as to not only what



current coaching may look like but also how coaches have developed their knowledge and skill. Secondly, analysing rowing coaching from a CLA perspective examines the way that the sport of rowing has naturally shaped coaching behaviours, thereby providing insight as to what extent a pedagogy similar to a CLA emerged naturally through the constraints of the sport itself, without coaches being aware of the CLA the literature associated with it.

The study will provide a thorough analysis of the CLA and the roots it has in ecological dynamics, for the purpose of exploring its application to rowing. Whether or not the CLA pedagogy is consistent with the current rowing coaching practice, the insight gained by exploring this overlap will provide a unique understanding into how learning and skill development in rowing can be influenced by more non-linear pedagogies. Going beyond just the current practice, the study will seek to understand how the coaches have developed their coaching and what factors have been significant in shaping their development.

## **Literature Review**

The constraints led approach (CLA) comprises a theory of teaching and coaching based on the relationship between the performer and environment (Gibson, 1979; 1986). The premise is that athletes will attempt to find effective movement solutions to optimally manage the multivariant aspects of task management, environmental and individual constraints (Renshaw et al., 2010). Recent studies have suggested that there is greater scope to apply a CLA than just team sports where it has seen more traction (Harvey et al., 2018). Consequently, this study aims to explore the potential for applications of a CLA to rowing in a similar way that Matt Wood demonstrated the application of a CLA to track and field (in Renshaw et al., 2019) or Wesley Verhoeff implementing a CLA in teaching the power clean (in Verhoeff et al. 2019). Whilst introducing the CLA, Renshaw et al. (2019) stated *'an understanding of ecological dynamics (ED) is essential as these underpinning concepts manifest themselves as guiding principles for the design of CLA practice environments'* (p.4). Renshaw et al. had critiqued many attempts to apply CLA and found them lacking the applications of ED theories, it is important that before elite-level rowing coaching is analysed, ED is comprehensively explored.

### **The redefinition of movement coordination**

To understand the CLA, we must define what it is to move and to master movement. Bernstein (1967) found that skilled performers had increased variability in their movements when compared to intermediate-level athletes, an observation that at the time seemed at odds with traditional sports coaching which was based around the assumption that variation is wasteful and unnecessary, working towards a 'perfect model'. Accordingly, this work redefined movement coordination as 'the process of mastering redundant degrees of freedom of the moving organ, in other words its conversion to a controllable system' (p.127). Bernstein (1967) argued that humans form biomechanical muscle-joint linkages known as coordinative structures that, with practice, produce variable movements that self-organise. An example of one of these movements can be seen in Figure 1. Of course, one can't see coordinative structures but by tracking the movement of the wrist, the self-organisation to produce efficient striking can be exhibited.

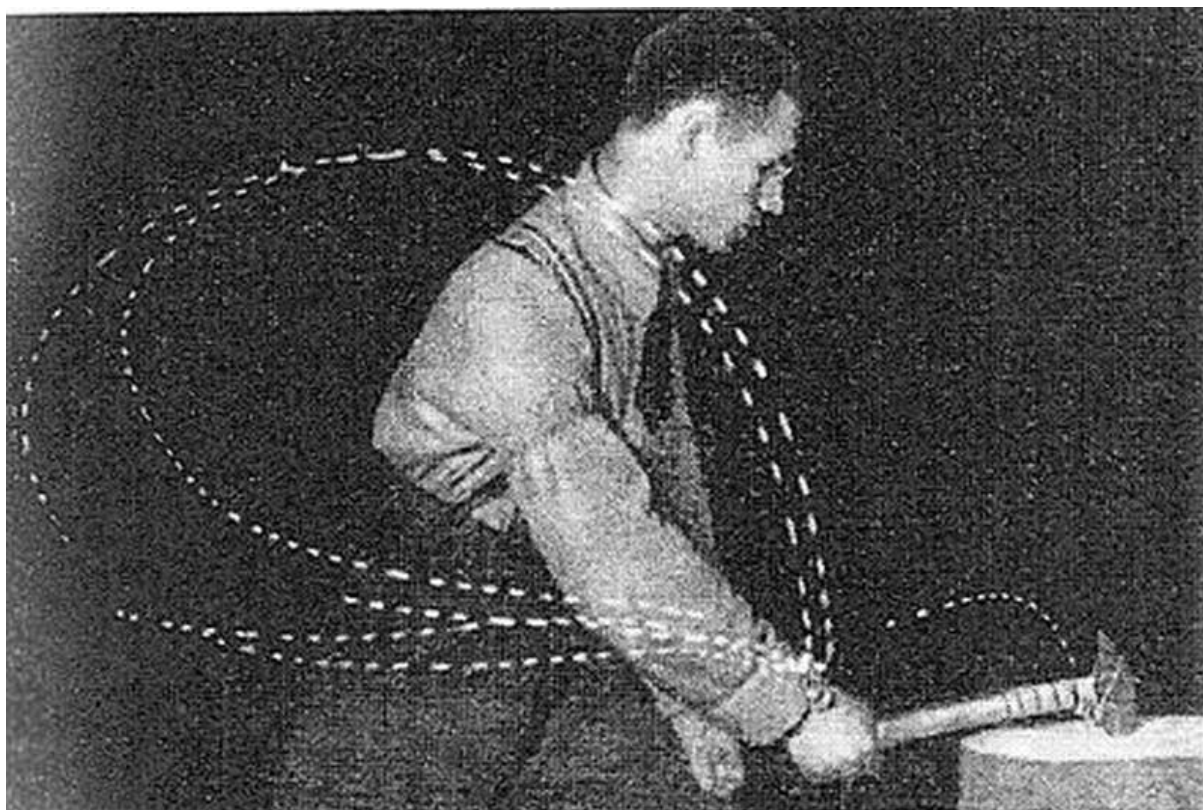


Figure 1. Arm and shoulder self-organisation leading to efficient striking (Bernstein 1967)

### **CLA: a grounding in ecological psychology**

The CLA was developed based on an ecological psychology (EP) model (Renshaw et al., 2016; Seifert et al., 2017). Gordon's (2007) work on EP noted that "naturally occurring ecosystems such as colonies of ants seem to have evolved the capacity to use environmental energy to sustain functional periods of stability that benefit the whole system" (p.35). Consequently, EP holds that learning is a process of self-organising to find a stable solution against an environment (Shaw & Brandsford, 2017). With Lobo et al. (2018) expanding on the definition suggesting EP is "the continuity of perception and action, the organism-environment system as unit of analysis, the study of affordances as the objects of perception, combined with an emphasis on perceptual learning and development" (p.1). For the applications in sports coaching, the environment can be seen as an input, and the athlete's subjective interpretations and resulting movements as an output (Gibson, 1979; 1986). Working backwards through this model, by understanding the intended performance goals and the athletes, it is possible to design an environment that shapes behaviour with accuracy towards a certain performance goal. However, there is an issue around altering a training environment too much. Brunswick (1956), another ecological psychologist,

discussed the importance of Representative Learning Design (RLD), a perspective that highlights the importance of coaches to investigate practice environments to replicate performance environments. His research suggests that when working with a performer-environment relationship, it is necessary to constantly reflect upon the extent to which the environment in which they develop/adapt (which for the case of sports coaches would be training sessions) mimics the performance environment. Thus, the combined works of Bernstein (1967), Brunswick (1956) and Gibson (1979/1986) provide the core that has supported the CLA since its inception.

Going forward, CLA emerged through Newell's (1986) work as a logical bridge between ecological psychology and self-organising human movement (Davids et al., 1994; Williams et al., 1999), redefining the role of the coaches shaping an environment, and consequently, how that environment could influence athlete behaviours (Passos et al., 2016; Seifert, et al., 2014). The effectiveness of the scaffold that emerged from these theorists was then tested across many different environments (Pinder et al., 2011; Renshaw et al., 2010). Examples of these will be explored below.

A CLA suggests that through the interaction of different constraints - task, environment, and organism, individuals will self-organise actions, perception and cognitions in an attempt to generate functional movement solutions (Newcombe et al., 2019; Renshaw et al., 2010). Although the prevalent definition of a constraint is that it is a restriction/limitation, when used in a CLA context constraints are seen as the variables that athletes exploit to allow functional patterns of behaviour to emerge (Newell, 1986). A CLA proposes that coaches can manipulate the physical and/or informational constraints to shape athlete behaviour in a way that constructs effective movement solutions (Davids et al., 2010)

#### What are the considerations for coaches when planning sessions?

Renshaw et al. (2019) identify the following four principles which should be incorporated into environment design (the shaping of the training environment):  
**Session intention:** This refers to the underlying objective of training session. The intention runs through all aspects of a session, from planning, delivery, feedback and reflection. If the session intention is too vague or not clear then all aspects of the sessions will be more difficult, making it much harder to establish whether the

session was a success or not. The session intention could be technical, tactical, emotional or a combination of such factors (Renshaw & Moy, 2018).

**Constrain to afford:** In athlete centred coaching, learners are encouraged to experiment with different movement patterns and adapt individual coordinative structures to achieve functional movement solutions (Tan et al., 2012). Therefore, it is important that the athletes are invited to perform in a certain way that are governed by the constraints on the session (Bourbousson et al., 2014). This invitation to act is also called an affordance. Affordances are an opportunity to act that combines the objective nature of the environment with the individual subjective nature of the learner (Faján et al., 2009). So, simply put, the coach must shape the session to invite the athlete to perform actions that need to improve in line with the session intention (Brymer & Renshaw, 2010).

**Representative learning design:** As mentioned earlier, Brunswick's (1955) theory on RLD holds that, under good coaching, humans will learn from their environment and become more efficient and successful. However, if the environment they are mastering does not represent their performance environment, then the skill will not transfer. Consequently, coaches are required to sample the performance environment to implement in training and ensure that the constraints added to the environment are representative of the performance context (Chow et al., 2011; Pinder et al., 2011).

**Repetition without repetition:** Bernstein's (1967) work showed that it was impossible to exactly recreate human movement, as there are too many coordinative structures interacting to guarantee an exact copy of movement. If movement isn't linear then neither should our practice be. The phrase "repetition without repetition" was coined by Bernstein (1967) to explain where practice had a high level of variance, but the goal was always the same, as opposed to a traditional "rote practice" 'repeating the same task repeatedly'. Although this might appear to suggest that repetition should be avoided, a certain level of reiteration is needed to avoid instability in the movement solution and to ensure the movement is efficiently transferred (Renshaw et al., 2009).

#### Has CLA been proved as effective?

The CLA is divisive because of its highly contextual nature, not just to the athletes but also to the interpretations of the coach (Davids et al., 2003). Two coaches may work with the same group of athletes towards the same goal but approach it completely differently, as the CLA encourages exploration. In terms of potential

comparative analysis, this means that even if coaches tried to take quantitative data, it would be impossible to meaningfully compare data from one study to another. Furthermore, movement testing must be representative of a performance environment. Because this is difficult, studies often lack clear comparable results on the effectiveness of the application of a CLA (Davids et al., 2006). As is the case with most coaching theories the CLA is no “golden bullet” and is only effective if used astutely (Reid & Harvey, 2014)

### Traditional model for sports coaching

The main alternative to this emergent CLA is the traditional coaching approach. There are many identifiable features of traditional sports coaching: Traditionally the variability in the training environment has matched the variability in the performance environment. The learning of ballistic and whole-body tasks (such as rowing) seems to respond well to variable practice (Lee et al., 2001). Consequently, football training would have more “built-in” variability than, say, darts training (Van Rossum, 1990). The role of repetition has come under scrutiny, however, because of the human inability to exactly reproduce a given goal-directed movement (Newell et al., 2006). Consequently, requiring learners to adapt in a variable training environment has considerable merit in helping them learn how to interact with complex environments (Davids et al., 2010). One prevalent traditional coaching technique is part-task practice. Part-task practice refers to the decomposition of tasks into smaller, less complex movements for practice in a more controlled manner. A common example of this is holding a floatation device whilst learning to swim in order to practice the leg kicks of the movement, under the assumption that when the floatation device is removed there will be a positive transfer of the skill developed is used in the full movement (Davids et al., 2010). The traditional approach is very instruction-heavy (Potrac et al., 2007). The information-processing approach suggests that a limited amount of instruction should be used with early learners, whilst a greater volume of more detailed instructions should be used with skilled performers. Instructions can also be used to draw the attention to certain aspects of the task, particularly ones with an external focus (Wulf et al., 2002). Traditionally, external instructions and analogies have been found to be the most effective form of instructions (Liao & Masters, 2001) Demonstrations are traditionally used alongside verbal information in order to contextualise their information (Lee et al., 2014). Many researchers encourage the use of demonstrations to move new information into a cognitive representation

of a skill (Bandura, 1977). However, others have suggested that reproducing a particular movement should not be viewed as achieving the task goal (Lee et al., 2001). Furthermore, process-defined tasks may require more information (that is not necessarily visual) than demonstrations can portray. As mentioned above, human movement variation has traditionally been seen as wasteful, with the role of repetitive practice being to gradually reduce this variability, consequently, traditional models often involved a 'level' or 'medal' system, an example of which can be seen in Figure 2 below. The underlying assumption that has fuelled such pedagogies is that an ideal movement pattern exists for a task and that the practitioner's role is to help learners to recreate that pattern (Williams & Hodges, 2005). (See Figure 2.) However, the knowledge that movement is formed by the individual (from the environment) for themselves suggest that the existence of an 'optimal' or 'perfect' motor pattern for any scenario is a misconception, as human motor performance is inherently variable, (Bernstein 1967; Chow et al., 2007; Glazier & David, 2013)



Figure 2. Fistral Beach Surf School (2020) Surfing levels

CLA views human movement and learning as being different to the traditional model. Consequently, the roles that coaches and athletes take in that environment is different so as to align with ecological dynamics. Contrary to the traditional approach, a CLA would view athletes as nonlinear dynamical systems comprising numerous component parts that interact and self-organize to form stable patterns (Lee et al., 2014). By viewing athletes as nonlinear, there are no assumptions that there is no single clear and defined path to perfection, or that learning is uniform

and transferrable. This acknowledges the reality that athletes are complex and individual (Correia et al., 2019), where they should be dealt with on a case-by-case basis. This means that coaches must consider a multitude of constraints that the individual carries with them, including variables such as height, gender, weight, race, social status, past experience, and mood (Renshaw et al., 2019). The traditional model of sports coaching reflects the concepts outlined above; coaches are technicians that transfer knowledge through instructions and verbal feedback (Callero, 1994; MacDonald & Tinning, 1995; Potrac, et al., 2007). The role of a coach who applies a CLA is a more embedded one. The coach no longer sees themselves as a more informed individual giving knowledge to refine a skill. Instead, they work on the same 'level' as the athlete(s) shaping the environment to guide athlete behaviour in a manner that improves performance (Davids et al., 2003; Kidman, 2010). Under a CLA, the coach is seen more as a problem setter (Denison & Avner, 2011). The consequent considerations include representativeness, manipulation of constraints, attentional focus, functional variability and the maintenance of pertinent information-movement coupling (Chow, 2013).



## **CLA in technical sports:**

### Why a CLA does not transfer as smoothly to a more technical sport

CLA theory is often labelled as a game-based educational theory such as game sense, Teaching Games for Understanding (TGfU) and play practice (Renshaw et al., 2016). These game-based pedagogies emerged as the popularity of small-sided games grew with children (Bunker, 2012; Thorpe, 2005). Consequently, the TGfU framework guides practitioners to the use of open games but has little-to-no recommendations on how to train effectively in highly technical sports (Renshaw et al., 2016). The grouping of a CLA with these theories may be attributed to pedagogues using invasion games to introduce the CLA framework (e.g., Chow et al., 2009; Renshaw, et al., 2010). However, throughout the development of the CLA authors have always implied that there are applications to more technical sports, despite not initially being well-represented in the literature (Davids, 2010; Haudum et al., 2012).

Highly technical sports (e.g. sports with a greater focus on a repeated movement such as running, diving or rowing) have just as much potential to benefit from a Constraints-Led Approach as invasion games (Harvey et al. 2018). The variability that is seen between two footballers might be more evident to inexperienced observers when compared to sprinters or swimmers, which could explain why CLA has seen more popularity through invasion games. However, if coaches can increase the variability in training, then there will be scope for the athletes to explore and develop their own solutions (Newell & Ranganathan, 2009; Schöllhorn et al., 2009).

Coaching highly technical skills is often achieved through task segmented or “whole-part-whole” practice (Kearney et al., 2018). This involves breaking down a movement into sections that resemble part of the skill and removing it to practice in a more direct and focussed manner. However, this brings about questions of representative learning design (Brunswick, 1956; and see also section “grounding in ecological psychology” above), as separating the context from the movement removes the relevant information that the athlete requires to develop their movement patterns (Renshaw & Chow, 2019). This leads to the developed movement solutions as being unrepresentative of the performance goal. One of the main issues with the decomposition of tasks, is that it can remove the influence of momentum gathered from previous movements, meaning that the emerging

motor patterns are not useful in a completion of the full movement unless action fidelity is maintained (Stoffregen et al., 2003). An example of this can be seen in Figure 3 (below). The example from weightlifting shows the multiple phases of the power clean movement. A traditional coach might decompose the task into these phases, which removes the momentum and direction of applied forces.

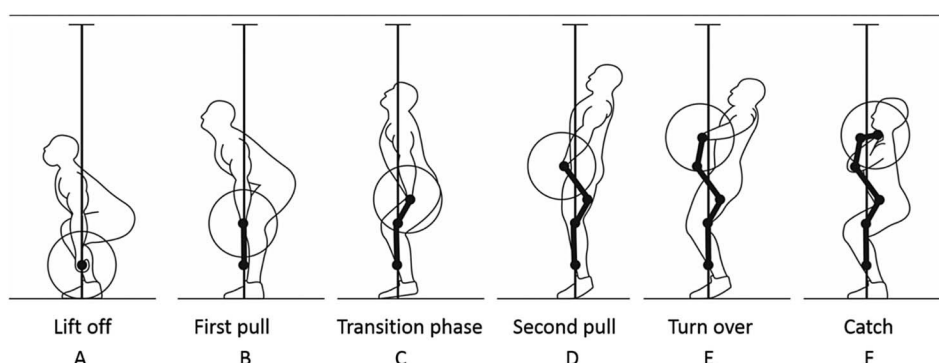


Figure 3. After Verhoeff, et al. (2019) identifying power clean positions.

Brunswick (1956) developed the notion of action fidelity, with the general rule becoming: the more representative the training environment, the greater action fidelity achieved, and consequently, the greater likelihood of a successful transfer to performance. Regarding Figure 3, if the coach decided to decompose training to focus on the movements in the individual stages the movement solutions developed would not be able to consider the prior movements, as demonstrated in figure 4.

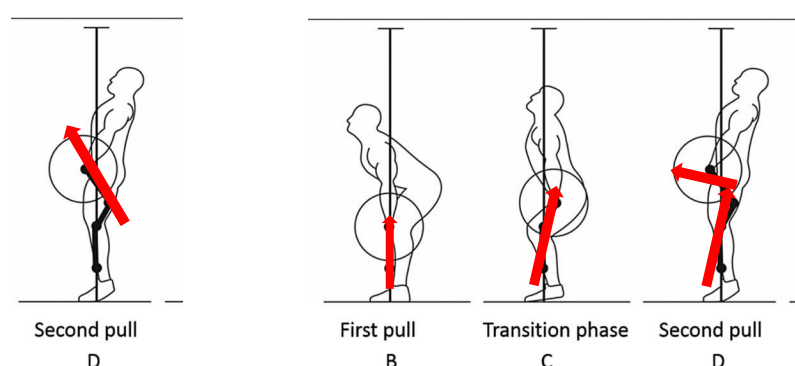


Figure 4. Comparison of forces applied when movement phases are decontextualised

When applying Bernstein's (1967) work to figure 4, the body will be self-organising into coordinative structures that apply force in a manner differently to when existing momentum is considered. Thus, action fidelity and effective transfer to the full lift will be lost.

### Degrees of freedom

If 'Part practice' or 'task decomposition' is criticised for removing the RLD, then what is the alternative that keeps a RLD? The degrees of freedom problem arose from Bernstein (1967) who explained that "the coordination of movement is the process of mastering redundant degrees of freedom of the moving organ, in other words its conversion to a controllable system" (p.127). The manipulation of these degrees of freedom has become central to the CLA framework (Newell & Vaillancourt, 2001; Ricken et al., 2004; Vereijken et al., 1992). The practical application being that by manipulating the degrees of freedom the amount of coordinative structures that are active are reduced and the movement can be practised in a simpler but still representative manner (Berthouze & Lungarella 2004).

Bernstein (1967) proposed a 3-stage approach to manipulating degrees of freedom for maximum efficiency in developing movement:

Freeze – Where peripheral degrees of freedom (those that are further from the centre of the body such as wrist and ankle) are limited in the exploration of the movement (Mitra et al., 1998). An example of the freezing of peripheral degrees of freedom can be seen below in figure 5.

Free – Over time, when the coach deems the athletes to be developing a strong base for the movement, the coach will free (or release) the frozen degrees of freedom so that the athletes will be able to self-organise the peripheral degrees of freedom alongside a sturdy central motor pattern (Pacheco et al., 2019).

Incorporate – Finally, the reactive phenomena (such as gravity) are manipulated and then the most operational movement solutions are learned (Berthouze & Lungarella, 2004).

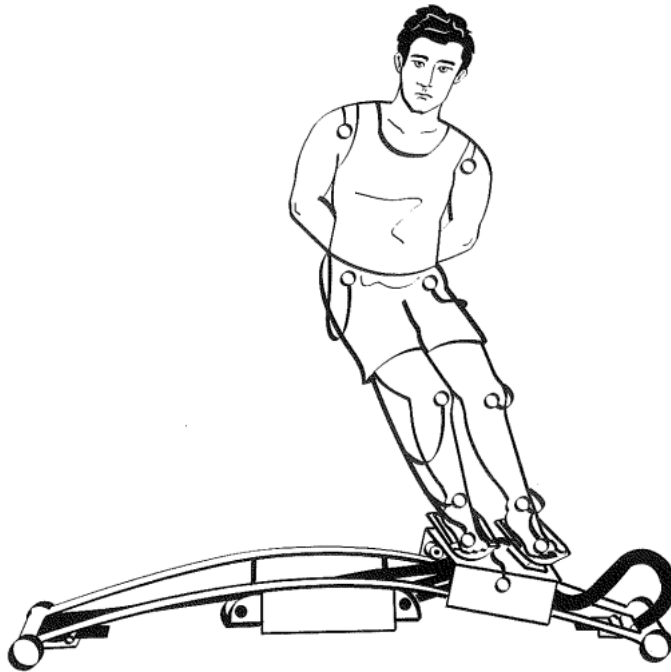


Figure 5. (After Vereijken et al., 1992) Freezing peripheral degrees of freedom in skiing.

Bernstein's model has been criticised on the grounds that the 3-stage process might be too simplistic to account for the nonlinear task of human learning (Haehl et al., 2000; Ko, et al., 2003). However, the manipulation of constraints is preferred to task decomposition even when attempting to coach complex movements, as advocated by Verhoeff, et al. (2019) when analysing decomposed tasks prescribed by coaches (Stone, 2018).

As discussed earlier in the review of a Constraints-Led Approach it is near-impossible to 'prove' that a CLA is more effective than a traditional approach, due to the difficulty in collected quantitative data. However, there are many examples of the applications of a CLA in highly technical sports that offer valuable input when discussing the applications of a CLA discussed below

### Examples

Authors have suggested that skills developed under a constraints-based model have both a broader range of application and are better retained by athletes when compared with a traditional approach (Handford et al., 1997; Lee et al., 2014). These findings are mimicked across highly technical sports as well as invasion games, as demonstrated by Hristovski et al. (2006) when exploring the applications of a CLA to martial arts. Many of the applications of a CLA in technical

sports focus predominantly on the implementation of task constraints. Verhoeff et al. (2019) for example, manipulate a variety of task constraints as well as some environmental and individual constraints, including weighted vests and presence of agility poles. This study promotes the effectiveness of using a variety of constraint manipulations and clearly explains how the study fits within a CLA framework. However, the study focusses on teaching skills to early learners rather than more experienced athletes (as the present study will examine). Verhoeff et al. (2019) build on previous work to clearly showcase the effectiveness of applying constraints in learning the power clean (Marriner et al., 2018; Verhoeff et al., 2018). Consecutive follow-up studies such as these are crucial in exploring the applications of a CLA to sports where it has not previously seen much interest. Thus, although the present study is unlikely to impact the coaching landscape independently, the findings that arise from this study will help provide a platform for future impactful research.

Kidman and Hanrahan (2010) identify one of the largest challenges to adopting contemporary coaching methods for strength and conditioning practitioners is transitioning from coach-centred to athlete-centred practices, particularly in highly technical sports. An athlete-centred approach imbeds the coach within the learning environment, moving towards a “we” style rather than seeing the coach-athlete relationship in an “us” and “them” style. Kidman and Hanrahan suggest that such an approach has the ability to fundamentally change the decisions that coaches make whilst working with their athletes. This revolves around viewing and treating athletes as a resource that coaches can draw on, taking into consideration their past experiences and their understanding of themselves to work out appropriate solutions for them. These considerations help the athletes to feel involved in contributing to their own learning journey which in turn helps them to take ownership of not only their movements, but also their performances. Kidman and Hanrahan acknowledge that this approach views coaching as a complex, needs-driven nonlinear progress which is ill-represented by the explicit, instruction-based, part-practice approach seen dominating the strength and conditioning coaching framework. Furthermore, if similar changes might be made to rowing, similar considerations must be discussed regarding how to enact this change

Atencio, et al. (2014) applied a constraints-based pedagogy to primary PE sessions in sprinting, tennis and netball (See table 1. below). This is an excellent

example of the applications of a CLA, constantly linking the manipulation of task, individual and environmental constraints back to theory. However, the participants are primary school aged, and therefore considered early-learners; consequently, the transfer is not so direct to the present study. Similarly, a modern approach to coaching was found to produce more biomechanically efficient movement solutions in swimming (Komar et al., 2013). Swimming is mostly taught through a traditional structure of information and modelling (Costill et al., 1985). The success found in these studies, moving away from traditional information-heavy coaching towards more constructivist approaches help to demonstrate the potential to apply a CLA to rowing.

Teaching focus	Activity	Features of complex and nonlinear pedagogy
Sprint starts	<p>Activity 1: Improving reaction time</p> <ul style="list-style-type: none"> <li>Race a partner over 30 m or less.</li> <li>On the command 'get set', pause anywhere between 1–4 seconds before shouting 'go'.</li> <li>To make it more challenging, start from different positions (e.g. lying on the ground, facing backwards, closed eyes, etc.).</li> </ul> <p>Activity 2: Pushing off from blocks</p> <ul style="list-style-type: none"> <li>Standing upright, slowly lean the body forward. Use analogy such as the 'Leaning Tower of Pisa'.</li> <li>Bring one leg forward to catch yourself just before falling.</li> <li>Push rear leg off ground and sprint forwards for 30 m.</li> <li>Do the same activity from a slightly higher ground (e.g. a low step) to exaggerate the 'feeling of falling' before pushing off the step.</li> <li>Do the same activity but start from squatting down.</li> </ul> <p>Activity 3: Start from different block positions</p> <ul style="list-style-type: none"> <li>Adjust the starting blocks to start at different gradients for each run.</li> <li>Start with a lower gradient.</li> <li>Gradually increase gradient of blocks: This will move the body's centre of mass towards the start line.</li> <li>Athlete should feel like she/he is about to 'fall forwards' after pushing off from the blocks.</li> </ul> <p>Activity 4: Keep body low at the start</p> <ul style="list-style-type: none"> <li>Put a soft barrier (e.g. Thera-band) about 10 m away from the start, about 0.75 of the athlete's height above the ground.</li> <li>Start from blocks.</li> <li>Stay low beneath barrier for the first 15–20 m of sprint (for acceleration).</li> <li>Keep body in 'Leaning Tower of Pisa' position.</li> </ul>	<ul style="list-style-type: none"> <li>Variation in the timing and starting position trains concentration and encourages the student to be ready for different starting command time intervals, since the starts in races are often initiated by a different individual.</li> <li>Manipulation of the individual's centre of mass with the use of analogy rather than a prescribed movement form so that the student discovers the best position her/his body should be in after leaving the blocks.</li> <li>Manipulation of equipment to facilitate a movement outcome without explicit instructions of body position.</li> <li>The student's body is placed and positioned by the different task constraints in ways that causes imbalance and thus personal instability. This relates to the notion of students existing in a state outside of equilibrium through which they can then develop.</li> <li>Reflect upon presence of others in the complex system. Implications here in terms of social and emotional learning, as well as movement.</li> </ul>
Discovering the sprinting position	<p>Activity 5: Run on different surfaces over 20–50 m</p> <ul style="list-style-type: none"> <li>Grass</li> <li>Sand</li> <li>In knee-deep water (encourages knee lift and drive forward).</li> <li>Trampoline – run on the spot (the springy surface of the trampoline encourages high knees lift).</li> <li>During runs, use cues to encourage efficient sprinting: 'Run tall'; 'Toes towards sky'; 'Look at an object past finish line'.</li> </ul> <p>Activity 6: Play a game of tag</p> <ul style="list-style-type: none"> <li>Any game involving one or more players chasing other players in attempt to tag them (an example is 'Crows and Cranes').</li> <li>Play tag on different running surfaces.</li> <li>Emphasise a specific cue for each game round.</li> </ul>	<ul style="list-style-type: none"> <li>Taking into account individual differences, this activity positions the student to search for and find a pattern of movement that is most efficient for them.</li> <li>Manipulation of running surfaces allows the athlete to discover where to effectively position their limbs in relation to their bodies on varied surfaces, thus building effective affordances.</li> <li>Students learn to adapt movements in relation to diverse and dynamic constraint structures.</li> <li>Introducing a game of tag helps students to focus on the external performance outcome (e.g. running fast) rather than the running movement form.</li> <li>Potential for students to lead games. Discuss and reflect upon key social interactions and behaviours necessary for game to be sustained.</li> </ul>
Running over the hurdles with either leg as lead	<p>Activity 7: Vary distances of hurdles</p> <ul style="list-style-type: none"> <li>Start with running over cones and gradually move to running over low, then higher hurdles.</li> <li>Use foldable/lighter hurdles that easily topple when kicked (for safety).</li> </ul> <p>Position hurdles to allow for athlete to take:</p> <ul style="list-style-type: none"> <li>Three steps between hurdles (Same lead leg).</li> <li>Four steps between hurdles (alternate legs)</li> <li>Five steps between hurdles (same lead leg but more strides).</li> <li>Position hurdles at different distances throughout a run.</li> </ul>	<ul style="list-style-type: none"> <li>Introducing variability in practice, which causes states of (controlled) instability.</li> <li>Adaptability: Being able to adapt to unexpected changes in the environment by artificially manipulating the distance between hurdles.</li> <li>Manipulating task constraints (height of hurdles, distance between hurdles, barrier above hurdles) to achieve the task goal (i.e. getting over the hurdle as fast as possible).</li> </ul>
Running rhythm in between hurdles	<p>Activity 9: Changing rhythms</p> <ul style="list-style-type: none"> <li>Place hurdles at a consistent distance apart from each other.</li> <li>Play a music rhythm (or clap) in a four beats timing (equivalent of '1,2,3, over').</li> <li>Make sudden changes to the music by occasionally changing the rhythm/volume during the sprint. For example, the music could suddenly change to a: <ul style="list-style-type: none"> <li>five or six beats timing</li> <li>faster frequency</li> <li>Greater volume</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Making changes to environmental constraints (such as musical beats) introduces variability in practice. This trains the athlete to maintain running rhythm and timing despite environmental changes.</li> <li>Adaptability to sudden/unexpected changes in the environment.</li> </ul>

Table 1. After Atencio et al. (2014) A constraints-based approach to teaching

## **Coach education**

### Research gap

Coaching research is only worthwhile if there is a successful and practical transfer to a representative setting (Kearney et al., 2018). Unfortunately, recent evaluations of coaching practice have suggested a consistent lack of correlation between suggestions that emerge from current coaching literature and knowledge-bases and behaviours of coaches (Cushion et al., 2012; Low et al., 2013; Millar et al., 2011; O'Connor et al., 2018; Porter et al., 2010)

Many reasons have been listed by practitioners as contributing to the research gap including time commitment, accessibility and the fast-changing nature of the research (Kearney et al., 2018; Reade & Rodgers 2009). The sports world is becoming increasingly interactive through social media (Farrington, et al., 2017). Although social media has many different definitions (Boyd, 2009; Van Dijck, 2013), we will use the definition of Shirky (2008) as being tools to increase the ability to share, co-operate with one another and to take collective action, all outside the framework of traditional institutions and organisations. Research has shown that social media can generate sustained and in-depth insights into the work of other practitioners (Goodyear et al., 2018) that can be used to educate and raise awareness (Williams, 2011). However, it is possible for the spread of misinformation to occur over social media as it is accessible by all and through most forums research-based educated statements are indistinguishable from non-specialist opinion (Allcott et al., 2019).

Although the disconnect between research and practice is all too commonly accepted (Kearney et al., 2018), Newcombe et al. (2019) suggest that there needs to be greater appreciation from academics for what coaches (or at least elite-level coaches) are currently doing with their practice. Although coaches might not be aware of specific theories that have arisen based on ED research such as CLA, this does not mean that their coaching does not share characteristics with ED. Furthermore, the CLA simply provides a way to further understanding of existing practice. By understanding the shortcomings of coach education, the CLA might be able to fill the gap in coaches' knowledge.

### Issues with formal coach education:



Coach learning can be classed as either formal or informal. Formal learning being structured, planned and delivered, often through governing bodies, schools and universities (Irwin et al., 2004; 2005). Informal learning occurs more naturally, often subconsciously through unstructured experiences that would go on to shape coaching behaviour (see Jones et al., 2004). There is a debate around nonformal learning, which fits between formal and informal learning (Schempp et al., 1998). For the purposes of this study, planned education will be considered as formal learning, whereas if coaches learn from unplanned events this will be considered informal learning.

The problem with a coach education framework is that studies have found informal learning to be more impactful than formal, making it hard to isolate/replicate meaningful learning experiences (Jones et al., 2004). Consequently, the coach education practice plays a small role in shaping any coach, nevertheless, it is important to explore formal coach education further as it is the only unifying denominator across sports coaches in the country. Criticism of formal coach education includes scrutiny of presenting decontextualized information, employing coach educators with insufficient training, and discouraging individuality (Cushion et al., 2019; Nelson et al., 2006; Turner & Nelson, 2009)

Nelson, et al. (2006) collated a list features deemed important by past studies to a successful formal education programme. See Table 2. Thus, with the lack of impact from formal coach education, it begs the question: how do coaches learn to coach (Jones et al., 2004)?

		Hamm- ond and Perry (2005)	McCullick Belcher and Schempp (2005)	McCullick Schempp and Clark (2002)	Cassidy Potrac and McKenzie (2006)
1	Knowledgeable and professional coach educator	X	X		
2	Well organised and structured programmes	X	X		

	that progress from a basic introduction through to a complex exploration of concepts				
3	Appropriate content that is pitched at the correct level and endeavours to integrate theory	X	X		
4	Coach educators modelling the behaviours and practices that they wish to see from the coach learners			X	
5	The opportunity to apply knowledge in a practical coaching scenario under the guidance of a coach educator who provides constructive feedback	X	X	X	
6	Exploration of individual learning styles and how learning preferences impact upon coaching practice		X		X
7	The ability to discuss issues, plus share experiences, with other coaching practitioners				X
8	The opportunity to explore issues relating to the coaching process and coaching pedagogy		X		X

Table 2. From Nelson et al. (2006)

### How do coaches develop their practice?

Inquiry into the coaching process needs to adequately examine its social and cultural nature (Jones, 2000; Lyle, 1999). Research repeatedly shows that much of the knowledge acquired by coaches is acquired through lived experiences (see Cassidy & Rossi, 2006; Cushion et al., 2003; Erickson et al., 2007; Harvey et al., 2013). As is the case for any socially learned skill, there will be an abundance of contributing factors to shaping coach behaviour if coaches are deemed to learn from their past experiences. However, many theorists have analysed the social nature of shaping coach behaviour in attempt to understand its complexity.

Not only has research suggested that coaching practitioners learn through experience, but they do so without guidance of others (Mallett et al., 2007; 2009). Wright et al. (2007) discuss the lack of collegiality as being a barrier to 'new' coaches learning from other's in the workplace, and professional coaching has been described as volatile, guarded, and fundamentally competitive (Mallett et al., 2008; Rynne et al., 2008). However, Occhino et al. (2013) found that the most influential factor in shaping practice for high-performing football coaches was reported as learnings from valued and respected coaches. It is unsurprising to find opposing findings, as the socially embodied nature of peer-learning will vary between individuals. These coaching experiences, which are happening outside the formal coach education opportunities, are generally labelled *informal learning* (Nelson, et al., 2006). Naturally, the environment that the coach works in during their most formative years will have a vast impact on their practice. However, this invokes an often-overlooked question: when does the informal learning process start?

The starting point for most coaches begins with their personal experience as athletes (Gilbert et al., 2006; Trudel & Gilbert, 2006; Watts & Cushion, 2017). A competitive athletic career in the same socio-cultural context can be considered as an informal learning environment (Cassidy & Rossi, 2006). The nature of the knowledge developed as an athlete is incidental (Lee & Price, 2016). Thus, it has been argued that coach learning is based on the socio-cultural norms of the sport's (or sports club's) sub-culture (Barker-Ruchti et al., 2016; Hassanin & Light, 2014; Lemyre et al., 2007).

From this point, the coaching pathway that each individual will travel is different. In these cases, it is not only the availability of a range of formal learning opportunities, but the willingness of the individual to engage in those opportunities that will determine the 'sequence' of learning (Rynne, et al., 2006). There is evidence to suggest that the refining of coaching is an ongoing process (Watts & Cushion, 2017), and coaches seek to refine their craft through observing others (limited by lack of collegiality as previously identified). Learning through the various methods proposed by Mallet et al. (2016) fits into the category of social constructivism, a perspective where coaches are seen to develop knowledge as a direct result of their social experiences and interactions with others (Cushion, 2011). The social constructivist approach would also suggest that mentoring schemes (Cushion, 2006; Nash, 2003) and various versions of coaches' learning communities (Culver & Trudel, 2006; Gilbert et al., 2009; Trudel & Gilbert, 2004) are common alternatives to developing coaching practice. However, the effectiveness of any of these options have not been comprehensively explored (Stoszkowski & Collins, 2014)

Although coaches may seek out a variety of experiences in order to develop their practice, there has been insufficient research to comprehensively say how this effects their practice (Stoszkowski & Collins, 2014), and as Stonebridge and Cushion (2018) add "no research has examined specifically the relationships between coaches' educational experience and background and coaching behaviour." (p.637). It was suggested that there is not enough information to determine whether tertiary-level education impacts graduate coaches' practice (Mallett et al., 2013), but it is suggested to provide the 'ability to "intellectualise" the coaching process' (Smith & Cushion, 2006; 364)

### Indoctrination

Indoctrination, defined by Rogers (2002) as "activities that set out to convince us that there is a 'right' way of thinking and feeling and behaving" (p. 53) is a potential consequence in any educational setting, particularly one where the educator is seen as having more power or capital (Brown, 2017). Indoctrination removes choice and decision making for the coaches and will result in a reduction of criticality. Thus, coaches who take an intransigent stance will repeat the same model whilst being less aware of potential alternatives (Nelson, et al., 2006). Indoctrination is a deeply embedded social concept, which creates a cycle that

causes stagnation in coach development and is the direct obstruction to critical practice (Townsend et al., 2018). Indoctrination will be explored in both formal and informal mediums.

Taylor and Garratt (2010) argue that many coach education programs tend to assume there is a commonly shared notion of what constitutes a 'good coach' and that notion is rarely questioned in coach education. However, this lack of criticality is central to allowing indoctrination. Those who deliver formal coach education may not always question what is considered as best coaching practice (Denison, 2007; Markula & Pringle 2006) In an analysis of coach education courses Piggott (2011) suggested that many could be classed as "useless" (p.545) as they adopt a formulaic pedagogical approach which was to be "accepted without discussion" (p.546) by learners in a process of indoctrination (Cushion et al., 2003). As formal education has been shown to be surprisingly ineffective in shaping coaching practice (Jones et al., 2004), indoctrination is likely to come through subconscious learning experiences, due to the highly socialised nature of informal coach development (Nelson et al., 2006; Townsend, et al., 2018). Researchers have suggested that informal learning can be as influential in developing and reinforcing particular perspectives on coaching, especially in terms of what is, or is not, considered "good" coaching (Cushion et al., 2010; Grecic & Collins, 2013)

In practice, coaches aspire to gain certain knowledge that they believe will help to develop their practice, however, there is no research that suggests that the information that coaches seek to develop themselves aligns with what research says is most necessary for their practice (Nelson et al., 2013). Consequently, coach learning is often dictated by the socially mediated image of self, and where the coach deems their own weaknesses to be in relation to coaches that they have observed or have respect for (Abraham et al., 2010). Thus, without a focussed reflective and critical approach to the constriction of professional knowledge, the potential exists for coaches to simply reproduce ineffective or potential harmful ideological interpretations of outdated practices (Cushion et al., 2012; Gilbert & Trudel, 2001; Mallett et al., 2009)

**Summary:**

The CLA has seen a large uptake in team sports ( Passos et al. 2008; Pill 2014; Reid & Harvey 2014) but increasingly, researchers have started to examine the use of constraints in highly technical sports (Renshaw & Chappell, 2010; Renshaw et al., 2019; Verhoeff et al., 2018). There remains, however, a gap in the literature regarding the applications of constraints on the sport of rowing. Therefore, this study will use CLA to explore the current delivery of rowing coaching amongst the most successful coaches in the country. The way that coaches develop their practice is highly subjective, but a common theme that runs through the literature is that lived experiences are key in shaping behaviour (Cushion et al., 2003), thematic analysis will help to provide meaningful understanding of the lived experiences of these coaches.

## **Methodology**

Approximately half of all studies published in coaching science between 1970 and 2001 focus on describing coach behaviour (Gilbert & Trudel, 2004). Consequently, during this period, there has been a considerable amount of research literature published on undertaking such research that can act as a guide for the present study. These studies have typically adhered to one of three prominent paradigms; positivism, interpretivism, and critical theory (Jones, 2014; Lincoln et al., 2011; Smith & Sparkes, 2019). The methodology in the present study follows an interpretivist approach. A few words of background are firstly required to explain how the decision to employ this paradigm was arrived at.

### Paradigm discussion

Positivist research aims to separate two distinct variables to prove causality and discover generalisable information that illustrates a universal truth (e.g., scientific laws). Consequently, research is viewed as the medium to establish how things 'truly' happen (Markula & Silk, 2011). Positivism is deductive, asks questions such as 'what', 'when', and 'how many' (Jones, 2014).

Interpretivism aims to understand subjective experiences and interpret participants' meanings (Smith & Sparkes, 2019). Accordingly, research aims to make multiple meanings of the social world based on the individuals' experiences in relation to particular contexts and in relation to others. Interpretivism holds that as researchers are involved in the production of knowledge they cannot be truly neutral.

The Critical theory paradigm views research through historical realism, shaped by factors such as social, political and gender values which are shaped over time (Lincoln et al., 2011). Critical research looks to critique and transform communities where inequality is prevalent (Smith & Sparkes 2019). Researchers focus on power, dominance, and subordination and use other ethnographic methods as a means to implement change.

Due to the exploratory nature of the current research the present study best-aligns with the interpretivist paradigm (Lincoln et al., 2011; Smith & Sparkes 2019) and consequently, the views consistent with that approach will be explored: The ontology or worldview (Schwandt, 2007) held by interpretivist research is one of

relativism, understanding that there are co-existing realities that are relative and subjective to each individual's interpretations (Guba, 1996; Guba & Lincoln, 2005). Consequently, the decision-making process is subjective, where lived experiences will always be championed by what we do and how we think (Lincoln et al., 2011). Interpretive approaches rely heavily on naturalistic data collection methods such as interviewing and observation and elicits qualitative data (Angen, 2000). The aim of the interpretivist approach is to understand and deduce through construction/reconstruction of meaning of lived experience; such understanding is sought to improve practice (Lincoln et al., 2011). Interpretivist researchers are seen as facilitators of multivoice reconstructions (Guba & Lincoln, 2005) where the researcher uses passion and empathy to gain insight into an individual's reality whilst ensuring not to impose their own interpretations of the participant's recollection of their experiences. This makes interpretivist research unique in its ability to develop a deep understanding of an individual's reality and provides a natural fit for the present study which looks to explore the formation and application of coaching knowledge as a social construct. No other research paradigm could offer insight detailed enough to explore the subtleties of how the coach's behaviours and views emerged and developed. With the present study following a qualitative interpretivist structure, the trustworthiness of the study will be discussed separately in the methodology section.

#### Research design: Case study

Case studies can be important tools for filling 'gaps and holes' in research to advance theoretical understanding (Ridder, 2016). The insights gained through a well-designed case study can go beyond simply exploring what has happened and provide more detailed answers to the questions of 'how' and 'why' than is possible in group-based studies (Yin, 2014). Case studies have been criticised as sharing multiple attributes with hypothesis-testing research (Dyer & Wilkins, 1991). However, as Ridder (2017) suggests, the boundary between theory-development and theory-testing is not always clear-cut.

#### Selection and contact

A purposive theoretical sample was constructed by selecting coaches that either currently coached a GB crew or coached their crew to success -defined as finishing in the top six of an VIII's final, at the most recent national level event, National Schools Regatta (NSR, 2019). Sampling in qualitative research



predominantly consists of purposive or random sampling. Random sampling is often preferred due to the fundamental ability to remove researcher bias (Shenton, 2004). Bouma and Atkinson (1995) write that random sampling provides the greatest assurance that those selected are a representative sample of the larger group. However, there is a wide variety of professionalism in rowing coaching, which can rely heavily on volunteers but will also include many full-time professional coaches. Consequently, the purposive sample was designed to access a group of coaches that were successful at an elite schoolboy level, consistent with their practice, but also offered a variety of experiences and approaches. On this basis, the more senior schoolboy events (J15 onward) showed the most consistency outside of international competition, which would have undoubtedly been interesting, but unachievable with the resources of this study.

Coaches were initially approached via email, having searched through the school website to find contact details for the individuals responsible for the specific crew. If contact details for these coaches were not available, then the head of rowing was contacted. If contact details for the head of rowing was not available than the school's reception was contacted. The coaches of the top 6 crews at NSR 2019 from J15, J16, and Champ VIII's were contacted. These 18, alongside two coaches that are known to the researcher who have coached a Great Britain crew at international competitions in the past two years were all contacted. This sample size was selected with the aim of carrying out 6-10 interviews depending on richness of data collected.

#### Participant information

The nine participants were all Caucasian males that had a mean age of 41.4 (standard deviation of 8.8). They had all rowed competitively as juniors and adults themselves for a mean of 11.2 years each (standard deviation of 3.73). All had been coaching professionally for a mean of 17.9 years each (standard deviation of 7.9)

## **Data collection and analysis**

### **Interview: theoretical justification**

The interview is the most widely used method to collect qualitative data in the sport and exercise sciences (Smith & Sparkes 2019). The purpose of interviews in qualitative research is to create a conversation that does not look for answers or test hypotheses but develop an understanding of the lived experiences of the participant(s) (Seidman, 2006). Thus, interviews must be holistic, encouraging and analyse complexity rather than diminish it (Josselson, 2013) Smith and Sparkes (2016) highlight the importance of thorough consideration around interviews by writing *'Ask yourself, what are the epistemological and ontological assumptions that underpin how I might go about interviewing? This is vital to engage with as these assumptions shape and frame the entire research process and products that are developed'* (p.109).

### Interview format

The interviews were carried out over zoom and took a semi-structured design, which again is the most popular format of interview (Alshenqeeti, 2014) with the initial structure arising from key points identified in the literature such as inquiring into how they learnt to coach that way (Cushion et al., 2003) or whether they think the skill will be will retained (Lee et al. 2014). The idea was that this would result in focussed yet open questions designed to provide the foundation for an organic conversation to emerge. These structured questions were followed up with 'pocket questions' (Josselson, 2013) to draw focus to pertinent areas and away from short or emotion-laden areas. As Demuth (2015) highlights, there is a skill involved in conducting a successful interview. To start with, the researcher must be well organised on the day and consider their appearance (Smith & Sparkes, 2019). They must also acknowledge their role as a co-constructor that shapes the participants experience into a specific shared version of events, as the version of events does not exist before the researcher and participant explore them together (King et al., 2018).

Despite the popularity of interviews as a qualitative research method, they are not without disadvantages. Interviews take a lot of time and can be costly (Seidman, 2006). The morality of interviewing has been questioned, regarding potentially exploiting the participants (Patai, 1987; Seidman, 2006). Interviews will be member checked with the participants to ensure clarity of meaning in order to

improve trustworthiness (explored below) of data (Birt et al., 2016). The interviews were semi-structured in a way that encouraged reflection upon coaching history and skill development. The questions were not followed in a strict order, as is the prerogative when utilising the semi-structured interview technique (Adhabi & Anozzi, 2017). Table 3 shows the interview questions that underpinned the semi-structured interviews. Many of these questions were purposefully left open to interpretation, particularly questions under the heading of '**what is your role as a rowing coach?**', to facilitate naturally emerging conversations with the coaches on their preferred topics that were more ideologically based before guiding them towards questions more focussed on directly addressing the research question.

<b>What is your role as a rowing coach?</b>	<b>What are the decisions you are making?</b>	<b>What does your practice actually look like?</b>
What is your role as a rowing coach?	How do you approach making a technical change? What is your decision-making process?	How do you decide when and where you do your training?
What is skill in rowing?	Can you give an example of an instance where you have been successful in a skill development intervention? Why was it successful?	Would you ever attempt to teach a technical development on the erg rather than on the river? Why/ why not?
Based on your definition of skill: who are the most skilful rowers in the world? Why them?	Similarly, can you give an example of a time when you were unsuccessful? Why didn't that work? Did you try anything else?	What (if anything) do you say to your athletes before they begin their session? What is the most important thing you say before and after a session?
Which 3 things are most important when facilitating skill development?	What are the common issues you first need to address? How do you address that? What do you do if you are unsuccessful?	How much do you talk to your athletes during a water session?
How do you know that learning has taken place?	What are the benefits and drawbacks of breaking down the stroke into smaller sections for technical focus?	What (if any) role does the cox have in skill development?

	What actually changes with the athlete when you make a technical improvement?	Do you practice race environments? How (seat racing)? Why?
		Do you think that competitions are useful for skill development?

Table 3. Interview questions

### Trustworthiness in Qualitative study

The concept of validity arose from positivist research (Sparkes & Smith 2009; 2013) and there have been many different versions of criteriological approaches to ensure high-quality research (Lincoln & Guba, 1985). However, most criteriological approaches have received criticism for their ontological positions which do not align with certain research paradigms such as interpretivism (Smith & Deemer, 2000; Smith & Hodkinson, 2005). Consequently, qualitative researchers developed alternative criteria to work towards, such as the relativist approach and trustworthiness. Unlike the criteriological approach, relativist approach works from criteria which cater for more research paradigms whilst still aiming to discern 'good' from 'bad' research. Smith and Caddick (2012) bring together the perspectives of a range of theorists to ask the following questions (see table 4) against which to judge qualitative research. By linking each of the areas of the relative approach to the present study the validity of the study will be demonstrated:

<b>Questions</b>	<b>How the present study addresses this</b>
Substantive contribution: Does this piece contribute or further our understanding of social life (Richardson 2003)?	By identifying a gap in the literature regarding the lack of application of a CLA to rowing, the present study has merit in providing depth to CLA literature and may offer insight into coach development due to the use of a grounded theory analysis (see "Data Analysis" section).
Impact: Does this affect me? Emotionally? Intellectually (Richardson 2003)?	Although the study is unlikely to elicit an emotional response the product

	may challenge both coaches and academics intellectually.
Width: The comprehensiveness of the evidence. The quality of the interviews or observations and how it is analysed/presented (Lieblich et al. 1998).	By following the interpretivist paradigm, the data gathered from interviews should provide a detailed and comprehensive insight to the perceived reality of the coaches' philosophy and develop an understanding of how they constructed their coaching approach.
Coherence: The way different parts of the interpretation create a complete and meaningful picture (Lieblich et al., 1998).	Through a thorough grounded theory analysis the findings should form a coherent and compelling insight into the development of the coaches and how that may form a natural link to a CLA
Catalytic and tactical authenticity: Does the research promote change to the participants or to wider society (Lincoln, 1995)	By establishing whether the current emerging coaching techniques share similarities with a CLA, this will allow a breadth of coaching resources to be applied to rowing coaching, furthering the practice of the coaches. Similarly, the addition of rowing CLA would provide a fascinating insight into the circumstance that has caused the theory to emerge and be successful in the sport.
Personal narrative and storytelling as an obligation to critique: 'How do narrative and story enact an ethical obligation to critique subject positions, acts and received notions of expertise and justice within and outside of the work?' (Holman & Jones, 2005 p.773)	Due to the personal nature of the narratives, it is possible that difficulties and prejudice may be uncovered through the coaches lived experiences.
Resonance: The research influences, affect or moves readers through	Findings are unlikely to affect readers. However, due to the personal and individual nature of the findings, the

evocative transferable findings (Tracy, 2010)	impact should transfer across many different sports as there is a uniqueness to each coach with their journey and formation of knowledge.
Credibility: Has the researcher spent a significant amount of time with the participants? Were the participants contacted to clarify interpretations? (Tracy, 2010)	Due to the systematic sample and the previous experiences of the coaches, the data should reflect a wealth of experience across multiple different coaching environments. At the end of each interview an opportunity was afforded to the participants to offer any information/experience they feel might be relevant. Interviews were member checked and conversations were had with coaches to clear up any misunderstandings or misinterpretations
Transparency: Was the research scrutinised throughout the methodology? Was alternative explanations or interpretations discussed when processing data? (Tracy, 2010)	The methodology section justifies the reasoning behind adopting the research paradigm applied in the present research

Table 4 to show present studies alignment with Smith and Caddick (2012).

Guba (1981) developed the following four criteria to consider when establishing trustworthiness to facilitate a similar level of positivist rigour to qualitative research:

### Credibility

Merriam (1998) defines what credibility means for qualitative research as how congruent are the findings with reality. Shenton (2004) compiled the following provisions to guide a credible study:

1. The adoption of research methods is well established
2. The development of an early familiarity with the culture of participating organisations
3. Random sampling

4. Triangulation
5. Tactics to help ensure honesty in informants
6. Iterative questioning
7. Negative case analysis
8. Frequent debriefing sessions
9. Peer scrutiny of research
10. Researchers' reflective commentary
11. Background, qualifications, and experience of investigator
12. Member checks
13. Thick description of the phenomenon under scrutiny
14. Examination of previous research findings

### Transferability

In positivist work, transferability means demonstrating that the results can be applied to a wider population. Shenton (2004) highlights why this notion does not transfer as well to qualitative projects:

*In positivist work, the concern often lies in demonstrating that the results of the work at hand can be applied to a wider population. Since the findings of a qualitative project are specific to a small number of particular environments and individuals, it is impossible to demonstrate that the findings and conclusions are applicable to other situations and populations.*  
(p.69)

Koch writes that original context of the research must be adequately described to determine transferability (1994). Thick descriptions lead to readers being able to draw their own conclusions and decide how the research will impact them. Therefore, the responsibility lies with the author to provide a detailed account of the raw data, research design as well as the interpretations of the researcher (Dawson, 2009).

### Dependability

Dependability refers to how stable the data are (Rolfe, 2006; Tobin & Begley, 2004). In positivist scientific research, the reliability lies in the ability to reproduce similar data through a repetition of the study. The issue of dependability in qualitative research comes from the changing nature of the of the phenomena under scrutiny (Marshall & Rossman, 2014). Shenton (2004) addresses the

dependability issue by suggesting: 'the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results' (p.71). Lincoln and Guba (1985) stress that proving credibility goes a long way to proving the dependability of the study.

### Confirmability

Confirmability is viewed as the qualitative interpretation of objectivity (Houghton et al., 2013). Objectivity cannot be 'proved' in qualitative research by use of instruments as intended when defined in scientific origins (Patton, 1990).

However, there are steps that can be taken to ensure that the work's findings are reflections of the participant's experiences and ideas rather than the researcher's preferences. Miles and Huberman (1994) write that a key principle for establishing confirmability is for the researcher to acknowledge their own predispositions.

During the data analysis of the present study, the researcher will clearly lay out raw data as well as the conclusions drawn from it, and reflexively discuss how bias may have influenced the process.

### Data Analysis discussion

The data were analysed in the context of a constructivist grounded theory, and a few words on background is needed to preface why this theory was adopted in the present study. Relatedly, the other two research paradigms that were considered were discussed to clarify why the study follows a constructivist grounded theory. Corbin and Strauss (2015) developed a post-positivist Grounded Theory (GT) saying: "Theory denotes a set of well-developed categories (themes, concepts) that are systematically developed in terms of their properties and dimensions and are interrelated through statements of relationship to form a theoretical framework that explains something about a phenomenon." (p.62). Charmaz (2008) discussed how this post-positivist theory can be adapted and utilised in the constructivist paradigm. The post-positivist GT views theory as a pre-existing lens that is linked to data, removing the researcher entirely, whereas the constructivist methodology sees the researcher as central with their bias and interpretations of data and theory alike, where the researcher aims to interpret, frame, and retell data.

Adopting a constructivist GT requires researchers to think theoretically from the start and use the intertwined theories that arise from the literature to analyse the



data thematically whilst acknowledging their bias in the interpretation (Holt, 2019). This notion is echoed by Charmaz (2014) writing “Grounded theorists evaluate the fit between their initial research interest and their emerging data” (p.32). Due to the recent developments and discussions around using a constructivist GT this will be briefly discussed in the section *Data analysis*.

The constructivist GT is the best fit for the present study, but narrative and thematic analyses were also considered. Narrative analysis refers to a family of methods for interpreting a story (Riessman, 2008). In a narrative inquiry, the researcher strives to locate theory within a participant’s narrative and keep participant stories intact (Lal et al., 2012; p.11). The story itself is considered to be a unit of analysis, whereas in the grounded theory approach, a story is coded and then fragmented based on one or several categories of emerging interest. Although a narrative analysis might utilise a coding procedure, the researcher codes data by looking for narrative features such as plotlines, details of the setting, characters, and actions within a participant’s account (Clandinin & Connelly, 2000). Hence, narrative inquiry differs analytically from grounded theory particularly in attending to more than just the content of a story. Which is essential for the creation of theory rather than the exploration of its fit with a story. Although applying a narrative analysis could provide interesting insight into the coaches’ development including any emotional factors and significant figures in the coaches’ past, it seems that the Constructivist Grounded Theory will be a better fit for developing theory and building on the data provided. Were a series of interviews to be carried out over a longer period, then a narrative analysis would be an interesting method to revisiting practice and establishing how the coaches view their coaching philosophies and exploring the influences that shaped them.

Thematic analysis is only a method of data analysis, rather than an approach to qualitative research (Clarke & Braun, 2015). Through focusing on meaning *across* a data set, thematic analysis allows the researcher to see and make sense of collective or shared meanings and experiences (Clarke & Braun, 2015). Braun and Clarke (2006) developed the following six phases as a guideline to carrying-out thematic analysis:

1. Familiarising yourself with the data
2. Generating initial codes

3. Searching for themes
4. Reviewing potential themes
5. Defining and naming themes
6. Producing the report

However, by focussing on common themes in individual stories a thematic analysis can overlook more subtle messages hidden in details of the accounts. Furthermore, not only can individual accounts/stories be misrepresented, but also this can lead the themes to drive the analysis which can force the data to fit preconceived ideas, which can similarly lead to other similarities and differences being passed by (Smith & Sparkes, 2009). The present study was designed to take a detailed look into the background of the coaches, how they coach, and how their coaching styles came to be. If a thematic analysis was applied to the study, there is a chance that the subtleties in individuals' experiences may be overlooked by trying to draw similarities from a small set of data. I chose to limit my potential participants in order to target a specific group of coaches. If I had cast a broader net with my participants than I would be more likely to adopt a thematic analysis as identifying trends across a larger number of coaches would have been more natural.

### Grounded Theory Background

To understand the rationale for using a Constructivist Grounded Theory (GT) in the present study, a little background is required as to its origins and theoretical position. The original GT methodology was developed by Glaser and Strauss (1967). Shaped by their positivist backgrounds, their approach brought increased scientific rigour to qualitative inquiry (Bryant & Charmaz, 2007). The methodology has since been labelled as the 'paradigm of choice' for qualitative researchers (Miller & Fredericks, 1999).

In the GT methodology developed by Glaser and Strauss, there was a fundamental assumption that there was a 'truth' to uncover and subjectivity was a distraction that impeded the presentation of said truth. Strauss later moved away from post-positivism and toward constructionism arguing 'it is not possible to be completely free of bias' (Strauss & Corbin 1998, p.97). However, Charmaz's (2006) interpretation moved GT further still into the constructivist paradigm, by not only recognising Strauss's adapted stance on subjectivity and truth, but also questioning the way that knowledge itself is viewed (Strauss & Corbin, 1998).

Charmaz framed knowledge as a co-construction that is temporal, cultural and a structurally influenced phenomenon, arguing that if the role of co-constructor is assigned to the researcher throughout the entirety of the research (as opposed to solely during the collection of data), insight into the socially interpreted world can be achieved, which varies from interpretations from traditional and objective GT. Constructionist GT unmistakably holds that any theoretical rendering offers an interpretive portrayal of the studied world, not an exact picture of it (Charmaz 2001; 2006; Charmaz & Belgrave, 2007; Mills et al., 2006). The key notion that prompted Charmaz (2006) to develop the GT methodology was the strength she saw in constructing theories grounded in the data themselves. The inductively driven theory production process that results from the constructivist grounded theory challenges traditional positivist theory development, which involves moving from theory to data testing.

Some researchers have suggested that prefacing data collection with a literature review is likely to impede the emergence of theory from the data (e.g., Glaser, 1998). Glaser also cautions against using “interview guides, units for data collection, samples, received codes, following diagrams, rules for proper memoing and so forth” (p.94), as this can force’ data to represent the researchers needs rather than being a true reflection of the lived-in world the researcher aims to examine. The use of such techniques is a point of much discussion around grounded theory (Glaser, 2002). Acknowledging the role of the researcher in the formation of theories does not dismiss them under positivist notions of validity, indeed, it may offer a valuable window into the relationships and experiences of the researcher in the field. Instead, rather than attempting to completely remove one’s subjectivity, reflexively acknowledging the bias in the study might be more practical and appropriate. Not only might it be impractical to attempt to completely remove subjectivity, but also, as Strauss and Corbin (1998) propose, having previous experience around the lived-in world being researched can draw attention to subtleties hidden in the data.

The Constructivist Grounded Theory holds that there is no step-by-step method to a single ‘optimal’ data analysis. Instead, the data itself must take charge of the paper and dictate the flow and direction of the analysis. In the present study, and in accordance with the grounded theory method, data was coded with key phrases. By compiling numerous codings, an overview of the data was developed,

which was then formed into memos. The gaps that form in the memos then shape and direct future interviews to complete a comprehensive understanding of the world that the coaches are constructing (Charmaz, 2014).

To avoid miss-use of the GT methodology and work that claims to utilise a GT without basis, Charmaz (2014) outlined the following nine strategies that grounded theorist use (p.15):

1. Conduct data collection and analysis simultaneously in an iterative process
2. Analyse actions and processes rather than themes and structure
3. Use comparative methods
4. Draw on data (e.g. narratives and descriptions) in service of developing new conceptual categories
5. Develop inductive abstract analytic categories through systematic data analysis
6. Emphasize theory construction rather than description or application of current theories
7. Engage in theoretical sampling
8. Search for variation in the studied categories or process
9. Pursue developing a category rather than covering a specific empirical topic

By being aware of these strategies the research will be more likely to represent a GT methodology.

#### Data management

In accordance with a GT methodology the data was transcribed and analysed in parallel with the data collection process. The first level of analysis of the data was applying a coding process that highlighted comments of particular and explicit relevance to the study's major focus, and especially ones that provide insight into the participants' ideology (see figure 6).

<p>OLIVER: Yes, this is something which I think is probably changed for me quite a lot over the years and when I first started coaching an which was very much part time and you know it was whilst are still growing and things like that to now it's a career and if I was to sort sum up Now what I'd like is I genuinely want to see the kids getting to the end of the season or end of their rowing and felt at the time that they put in was worthwhile? feel that they very well know. I think that the amount of time and effort put in is massive is, you know at PREVIOUS JOB six or seven days a week at CURRENT JOB is pretty much six days a week for the. The ones and then with a lot of kids won't necessarily win that big race at the end. Most people that row won't win Henley race or won't wear World championship or won't win Olympics an you know, but I thought I'd like is that people either finish at school and one over at Uni and think, yeah, something really wanted to do an or at least I just be like, yeah, that's quality. The time I spent training, you know the mates I made so what am I trying to teach them? Like to teach them the basics of the sport, but ultimately I want to see them enjoying it. And yeah, doing well because I think ultimately that's it. And I suppose for each kid to get as much out of it as they possibly can, whether that's performance or just enjoyment, I guess. So yeah, I guess that's. That's my thing that's changed a bit at PREVIOUS JOB. It was very much. Yeah, we have to win if we don't win, then you know everybody's fails. And I can kind of see with the assets we had there. That might not be the worst thing, but I also think that I still want to ... whoever it was though the time was well spent when they want to come away from it. Be like that's really fun. That was fun. That was enjoyable. I've got the best mates ever now. Fantastic, and that's that I got out of the sport by rowed. And I had three best men at my wedding and they all rowed with me. Were people that I rowed with and I think that's for me and I think as players from a performance point of view because we do have to sort of try to hit performance parameters your school wanna see rowers do well? PREVIOUS JOB wanted to see people. Winning this at the next. And for a... for a point of view that leads down that route, I think it's: enjoy it and the sport, then they're going to try harder, try harder. They probably do better, and ultimately the club school programme will do better because of it. That's sort my yeah. So it's my thoughts.</p>	<p><b>Nick Ward</b> Individual benefit, rather than an overarching statement</p> <p><b>Nick Ward</b> In competitive sport the vast majority of the crews "lose" so drawing focus to more manageable and routine events is easier</p> <p><b>Nick Ward</b> Suggests that his philosophy has changed rather than the nature of the job had changed. Was he both coaches at both times or is there a linear development?</p> <p><b>Nick Ward</b> Friendship making focus based on personal experiences of the sport.</p> <p><b>Nick Ward</b> Happiness/mindset to dictate performance rather than the other way around</p>
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Figure (6) An example of how a first round of codes was elicited from a participant's transcript.

The first round of open coding made it clear where there was some overlap between participants' experiences and helped to guide future interviews into more data-rich conversations. An example of this is the discussions I was able to have around the role of rowing machines in coaching; a conversation about their usage naturally emerged in one of my earliest interviews and subsequently became a focal point for future interviews.

By combining the codes (looking for similarities and patterns) I was able to form memos that painted a more cohesive picture of how the coaches understood their sport and how to get the most out of their athletes. It is important to look beyond the codes as these are simply surface level observations that need either combining with other codes from the same participant or another to demonstrate a deeper meaning. Therefore, it is valuable to have a number of questions that provide context and background as I am not asking yes/no questions to the participants. Trying to gain insight into their practice and understanding without the option to carry out observations increases the need for context.

### Reflexivity

Due to the nature of the constructivist grounded theory methodology, it is important to explore the researcher's bias and how that may impact the present study. The researcher has approximately 7 years of experience as a rowing coach, ranging from early voluntary rolls to part-time coaching jobs. As an individual with

experiences in a similar world to the participants the researcher will be able to interpret and utilise language that resonates with the participants, as well as discuss more complicated technical points to their practice. Having spent years in the field that is being analysed it is possible that there could be a bias to view the coaches in an unreasonably positive light. However, as the focus of the analysis will be on the methods of the participants' practices rather than whether they are effective. This is similar with the experiences of CLA. By keeping the linking of the coaches' comments to the CLA pedagogy well referenced and with no assumptions it should be clear where there is or isn't overlap regardless of the researcher's personal preference.

In early March the global coronavirus pandemic impacted the present study. The original design of the study involved observing coaches during practice at their schools, followed by an interview. When it became apparent that this would not be possible due to schools closing for extended periods, the study was initially delayed in the hope that the original plan could still be carried out as planned in January 2021. However, the presence of the coronavirus was still meaning that schools remained in lockdown. Consequently, the study would not be able to facilitate observations to see the coaches deliver their sessions and discuss that in the interviews.

When it became clear that using observations would not be possible, changes were made with the aim of attaining similar insight without the use of observations. The questions were altered indenting to probe for information on both the ideological beliefs of the coaches as well as starting to understand how they carry out their practice. Unfortunately, having the coaches explain their practice would mean that the data collected in the study would be third hand information, influenced by both the coach and the researchers' biases. However, this can offer alternative insight into how they view their own practice and how they may justify it.

Full ethical approval was awarded by Oxford Brookes University (reference number 0120\_01, see appendix) and all coaches gave informed consent.

## **Discussion**

Following interviews with all nine coaches, six major sub-themes emerged as offering valuable insight into their practice that can be understood through a CLA. These covered a broad range of issues, so they were each grouped into pairs (so, a total of 3 major themes) that shared a clear link in order to provide a framework that helped to make the discussion easier to follow. These sub-themes were paired as below:

Sub-themes i&ii 'The complexity of rowing and the athletes' and 'the technical model' both had roots in discussions from coaches on how they understand their environments and their complexities, focussing on how they came to understand this from other coaches and international models, hence categorised into the single major theme of 'Socialised understanding'.

Sub-themes iii&iv 'limitations to understanding movement' and 'using feedback to understand movement' were two sport-specific themes that focussed on the way that athletes moved and were categorised under the single major theme of 'Barriers and approaches to understanding movement'.

Sub-themes v&vi 'the role of the coach in the learning environment' and 'environmental impact on learning' both discuss practice that the coaches deliver that relates to the athletes' environment, were combined to form the major theme named 'Learning and understanding what works'.

Further detail on the resulting structure is presented below in table 5.

Theme	Sub-themes	Description
<b>a) Socialised understanding</b>	i) The complexity of rowing and the athletes  ii) The technical model	How the coaches view the importance of their work, evaluate success and their understanding of the athletes  How the coaches want the athletes to row and what informs this
<b>b) Barriers and approaches to understanding movement</b>	iii) Limitations to understanding movement	How coaches interpret sport-specific limitations that impact perception of own movement and what coaches do to gain insight on what needs work



	iv) Using feedback to understand movement	How coaches help athletes to understand how they are moving through feedback
<b>c) Learning and understanding “what works”</b>	v) The role of the coach in the learning environment  vi) Environmental impact on learning	Understanding learning/development through how coaches perceive the impact of their feedback and exercises  How coaches understand the implications of the environment and how they can manipulate this to enhance learning

Table 5. Emergent themes relevant to the research question.

Interview data that related to each sub-theme will be discussed and it will be highlighted as to how the data interact to capture coaching philosophy. The interview data will be compared and discussed with pertinent coaching theory identified in the literature review, including CLA, ED and coach education research. At the end of each of the three themes, the analysis and links to theory are briefly summarised before their relationship will be discussed to address the research question. Those points are then used to address the research question and analysed to generate theory relating to rowing coaching and a CLA in the conclusion.

## **Theme a) Socialised understanding**

### **i) The complexity of rowing and the athletes**

When asked what the purpose of their rowing programme was the coaches responses shared many similarities which can be categorised into three areas. Firstly, six coaches commented on enjoyment being a primary focus:

*'I think if they enjoy [their rowing programme] and the sport, then they're going to try harder, try harder. They probably do better, and ultimately the club school programme will do better because of it'. (Oliver)*

*'So, I've got two goals which is to make it fun and to embed, you know, some good technical foundations' (Noah)*

*'There is more enjoyment than the competitive side of things. I want them to enjoy it, but I want them to be competitive' (Jack)*

Whilst Noah, Jack and Oliver all suggested that enjoyment was important, they all swiftly moved on to discuss how that may lead to other benefits. Despite enjoyment being a foundation for motivation and commitment in sport (McCarthy & Jones, 2007) this could be due to avoid being seen to endorse the idea that they are not striving to get the athletes to a competitive standard, or potentially that their employers value keeping a focus on results. The selection criteria for inclusion in the study meant that all the coaches represented schools with a long and successful rowing history, and therefore that there is considerable pressure for results on many of them. By the nature of interpretivist research, the context in which the statements are made is important (Black, 2006). Oliver goes on to reference his own experience:

*'[want them to] be like that's really fun. That was fun, that was enjoyable, I've got the best mates ever now, Fantastic! And that's what I got out of the sport. I had three best men at my wedding, and they all rowed with me (...) I tried my absolute bollocks off because of it. I loved it so I tried so hard, so my feeling is if the kids that come through love it, they try. They put a lot of effort and they will probably try harder was as a result of that. So yes, it was a direct experience of how I learnt to be honest.'* (Oliver)

Past experience was identified through literature as likely to emerge as an influential factor when it comes to shaping coach behaviours, with research indicating that the starting point for most coaches begins with their personal experience as athletes (Gilbert, et al., 2006; Trudel & Gilbert, 2006; Watts & Cushion, 2017). Oliver's comment is consistent with this thinking and provides a clear example of a coach learning from their past practice and reproducing the elements which had a positive impact on them. As highlighted in the literature review the practice is likely to resemble the environment in which Oliver developed. It is important to note that this was at university, which he mentions later in his interview. From his comment above it seems that the sense of common purpose and unity that Oliver found in his rowing, and the more laid back and social environment of university rowing were key factors, as opposed to a more regimented schoolboy rowing system. This example of individuality that comes from developing his practice away from the schoolboy setting shows that there are less likely to be issues of indoctrination (Brown, 2017). By trying to create a similar environment for the athletes to the one he experienced that projection is likely to result in reflection and thought being invested to ensure the athletes are progressing, thus practice is being refined (Watts & Cushion, 2017).

Thomas recalled a less positive learning experience that might have shaped his practice:

*'Maybe this is a slight mental scarring, but I going back to my rowing days as I think I was. J16 at the time at [secondary school] I can't, I can't remember the guy who was coaching me, (...). He just coached me. Almost every single stroke and it was also different things. So be like ohh yeah, "you're not moving your hands away quick enough" and I'm like "okay, I'll think about that for a bit" and then so yeah, "now your catches are off you need to just square a bit earlier". And I was like I wish this guy would just F off and leave me alone. Like you know I'm I was like I'm gonna think about moving my hands a bit quicker. That's what I want to do right now and I think that just kind of remembering that. And trying not. You know be the same because you know I remember as an athlete that that was just ... I don't ever want to be that coach' (Thomas)*

As identified in the literature review, lived experience is a well-established influence for the skill acquisition of coaches (Cassidy and Rossi, 2006; Cushion, Armour, and Jones, 2003; Erickson, Côté, and Fraser-Thomas, 2007; Harvey et al., 2013). This ability to be reflexive and learn from past practice enables coaches to be dynamic and improve their practice, adapting as new information and experience becomes available. Cushion, Armour and Jones (2003) hold that 'Unless coaches reflect on and reinterpret past experiences of coaching, they remain in danger of leaving their practice untouched by new knowledge and insight' (p.224). Hence, both positive and negative past experiences should be learned from, and Thomas demonstrates how that past experience shaped him. The socially imbedded and informal nature of coach learning suggests that if practitioners are reflexive then coaches will be able to learn from each-other and challenge each-others practice for the better.

Secondly, six coaches also cited the development of life skills as a key product of their training programme:

*'within the area that I work in is about trying to develop young people to become stronger, more independent, more confident as people, first and foremost, and the rowing is just a medium to do that'* (George)

*'You're absolutely terrible now, we've got to get you under six minutes which you have to do as a J16 crew these days you know good luck, how are we going to get there and it, it, it's trying to make it a difficult task, broke, break it down and give them the kind of independence and skills to kind of do that I guess.'* (Charlie)

Although both George and Charlie discuss long-term development, the skillset that Charlie discusses developing is firmly grounded in aiding their physical and technical development in rowing, whereas George talks about rowing as being the vehicle for a rounded skill development of the programme, rather than the end point. This holistic and integrated approach to developing life skills and rowing ability at the same time aligns with Gould et al.'s (2007) study into the development of life skills, adopting the view that developing athletes and developing life skills are processes that can often benefit from going hand in hand and be mutually beneficial.

Finally, four coaches promoted a strength of their rowing programme as providing a break from other pressures, with Thomas specifically commenting on the rationale behind this coming from his time as a schoolboy rower:

*'The way in which I learnt, you know, the things I learnt through rowing helped me psychologically deal with other things in life and that sort of format is the same... and I think that's what I try to get through to our kids'*  
(Thomas)

*'You know that that you know there's a bigger world out there than just their classroom or you know, social networking or whatever else that they're involved in'* (Jacob)

Along with the above comments, Jacob, Oliver, and Oscar discussed more individualistic goals and foci:

*'the main thing is that they kind of realise, not necessarily their potential, but what they can actually accomplish'* (Jacob)

*'I genuinely want to see the kids getting to the end of the season or end of their rowing and felt that the time that they put in was worthwhile'* (Oliver).

*'I sent little questionnaires to them the other day actually like to the 15's just cause I wanted to know what, I really want to know what makes them click cause I wanted to get more involved (...) I asked them like you know what do you, what do you want to get out of rowing when we're back on the water?'* (Oscar)

To slightly varying extents, these coaches show they are trying to ensure that the programme is shaped around the needs of the athletes. This individuality and flexibility represent an athlete-focussed approach to coaching, which Kidman and Hanrahan (2010) identified as being one of the main hurdles that limits the extent to which highly technical sports can adopt a constructivist framework. This athlete-centredness naturally leads into the applications of a CLA (Newell, 1986).

*'you get to certain weeks in the school year where all the kids come down and it's like they're glazed over you're like 'we're not gonna teach him anything today'' (Thomas)*

Despite not mentioning that this was specifically for the general benefit of the athletes and their wellbeing rather than for the sake of their rowing progress, this is a pertinent example of a coach being reactive to the needs of the individual athletes. Thomas expands on this by discussing why this is the case with the athletes he works with:

*'if they are thinking the right way, actually, rowing should be the third fourth most important thing in their life. Not the most important' (Thomas)*

*'They might have had a really bad day, they might have had a stressful day at school, they might just have an exam results so their mind's off somewhere else, so it could be just putting them into a mindset that ready to learn and that you know, we very often take it too readily that when someone goes out to row, but that's what they're there for, they're ready to row' (George)*

Thomas and George both comment on the role that rowing is playing in the lives of the schoolboy athletes. They note that the athletes will be dealing with interference from outside sources, namely exam results or other academic feedback. Which, as Thomas points out, should be more important to them than their rowing experience. By having athletes who are variable and unpredictable when they arrive at sessions, this places demands on coaches to be more flexible with their practice. This view of athletes being dynamic further links back to the coaches adopting an athlete-centred philosophy. Charlie furthers the idea of the experimental and inconsistent nature of rowing coaching:

*'Sometimes you have the right input at the right time and it's I don't think it's for the right kid. I don't think there's a one size fits all with this, but I can tell you I've done a bad job more often than I've done a good job in this job' (Charlie)*

Jacob comments that the learning environment is difficult to control, as he highlights that individuals that learn at a different pace end up impacting the others in the boat and their development.

*'you might be challenged by an individual that just simply can't move, so that might be something that takes a lot more energy or work in progress'*  
(Jacob)

Charlie and Jacob's statements such as 'I don't think there's a one size fits all', 'you might be challenged by an individual that just simply can't move' and 'I don't think it's for the right kid' present a view of athletes' learning as being nonlinear and chaotic. Hence, there is an appreciation of Nonlinear Pedagogy (Chow et al., 2007). With so many variables intertwining and affecting their rowing experience it is important for coaches to acknowledge the complicated and unpredictable nature of skill development in rowing. This understanding of the nonlinear nature of athletes naturally leads into a preference for the learning environment to be similarly complex and chaotic, which leads into CLA being implemented.

The data suggests that past experience is an important factor that plays an influential role in coaches deciding how to approach developing newer athletes, and what the goals of training might be, this finding aligns with the literature that discusses the coach education process. Both learning from past experiences and from significant others are forms of informal education. As is often the case with informal education, the learning process is incidental and unpredictable (Jones et al., 2004), meaning that many of the coaches have developed their practice with little in common and consequently indoctrination seems unlikely to be influencing their practice. Thus, due to the individuality of the development of coaching philosophies, some coaches' practices (and intentions) benefit from a CLA analysis more than others dependent on how their own lived experiences have shaped their practice (Cushion et al., 2003; Harvey et al., 2013; Renshaw, et al., 2019). For example, Renshaw et al. found coaches' existing knowledge of cricket to be critical for their ability to design skill learning environments and that this knowledge provided a platform from which to incorporate key performance design features. Therefore, it seems that a coaching rationale that resembles a CLA can naturally emerge based on past experiences and other informal learning that the coach may experience. In the present study, coaches' sentiments that mirror a

CLA arose from instances where learning was viewed as being athlete-centred and viewing the learning environment as being complicated and socialised. The individuality of the athletes is considered, namely, their differing rates of development. Consequently, the programme must be flexible to fit in the rower's educational system. Rowing will not be the main priority for most of the athletes and the programme should encourage the best out of each individual without sacrificing academic or social aspects of their lives. This understanding of athletes as being dynamic and complex is a cornerstone for NLP practice (Chow et al., 2007). With the coaches commenting on the nature of the athletes in such a way it does not necessarily follow that the coaches are unknowingly adopting a constructivist paradigm but it does show that they are not limiting themselves to a traditional linear understanding. The extent to which coaches embrace traditional or nonlinear pedagogies would require further exploration and likely interviews to see the actual coaching being delivered.



ii) The technical model

Coaches demonstrated considerable disagreement as to both how they want the athletes to row, and similarly, what the early stages of that process should look like:

*'I guess I'll just try and strip it back and simplify one thing and for me. Sometimes it's for the back end, sometimes it's for the front end, sometimes with body position'* (Oliver)

*'If you can actually stay relaxed on top of... on top of moving boat and keep yourself still, that's half the battle because once moving parts get involved then it can become exponentially more challenging. So the focus for me would be on establishing a very simple pattern, recognising the parts of the stroke which can actually influence what the boat is doing, positively or negatively um and, and then when, when you were moving keep those patterns as simple as possible'* (Jacob)

Both Oscar and Jacob suggest that they have no preconceptions as to what to focus on when they start to work with a crew they had not seen before. Jacob brings up the process of simplifying the rowing stroke which will be explored in more detail in section (c.i) However, all the other coaches suggested that there were specific areas which they chose to focus on initially, such as the following:

*'I mean I, I think I always try and start to finish. I think in my books always a good place to start with the rowing stroke'* (Harry)

*'I'm sure there's other coaches who work from other areas, but I think it's only the crew area, I think you need to have that, that combined point that everyone works from. Um so to me that that would be the first point, and then you just work from there forward so you know, so, so for me it's always the back end, you know, always, always set up from the back end and then you move on from there'* (George)

*'What I'm often working against... my pet hate is bodies collapsing and moving into the catch for 15s is massive and if the body goes the hands go*

*after it and things or the other hands going down to get the blade out the water because they don't want it to touch' (Oscar)*

The specific phrases that the three coaches used is of interest; for example 'I think I always try', 'In my books', 'I'm sure there's other coaches who work from other areas', 'so to me' and 'my pet hate'. The common theme is that the areas of focus are being presented as the personal preference of the coaches, justified through their past experiences. This aligns with the coach education literature that identifies past experiences as being crucial in shaping coach learning and the lack of guidance from others (Harvey et al., 2013; Mallett et al., 2007; 2009). However, this is not necessarily the case for other areas of their practice, as will be discussed later in this section. Coaches discussed which technical points are important to them and why. With coaches showing these preferences or habits which have been formed from early learning, this type of informal learning may drive their future interest in coaching developments, potentially as a barrier to exploring alternative solutions.

*'I think you have to make sure everything works with your own individual environment in terms of the actual skill level and their actual rowing stroke. I try, I try to look quite a lot into the mechanics of it and think right simply how can this person of this size in this shape get the most out of it' (Oliver)*

*'but what [top international coaches] are doing now is actually almost just thinking again about how to... how to win races and how to move boats faster. So, you're getting quite different sort of levels of technique ... ways of moving boats and people are just trying to analyse for themselves what's the best way for them to move a boat as opposed to trying to go down idealised model if you like?' (George)*

Oliver and George both focus internally on optimising the boat speed, talking about the changes that can be made to that individual crew to improve performance. They simplify the training goals to maximising the output of the individuals that are in the crew. This athlete-centred approach views the athletes as having a unique place in the learning environment due to their role as an individual with their own constraints. Individual constraints provide one of the three classifications identified in a CLA (Renshaw et al., 2016). A traditional practitioner

might have a specific goal in mind, thinking that their crew must row a certain way to be successful. By neglecting to consider the strengths and weaknesses of one's athletes, their full potential may never be realised.

Although having a rigid programme may be unwise, having an identity and common themes may have its strengths as Thomas, Jack and Jacob suggest:

*'I like [the Kiwi] approach to, you know, technical rowing and philosophy behind you know, boat moving. You know, if I was going to be slightly sort of against the grain and I'm not sure we do that as well in this country with the GB team. I would very rarely put a video up of a GB crew and tell my boys this is how I want you to row or perform. Whereas I would happily put on the Kiwi 8.'* (Thomas)

*'I love watching the Dutch row, I'd say they're very skilful, as a, as a nation you know you can always look at Dutch boat and there's clearly something they've got in their program that allows them intergenerationally to be skilful I... I think this, the aesthetic does come from you know, yeah, their coaching systems'* (Charlie)

*'the coaches within let's say the Australian system obviously broken down into sections (...) prior to 92 Olympics Australia had a barren run of what they were doing and the Australian crews worked and put a bit more science into it coming out and really rowing in that style, that effortless style (...) I think that has to be the coaches and the athletes being more, thinking around, trusting what they were doing, it's something that we feel makes our crews technically better (...) So, I think it's the coaches involved and the education around the coaches'* (Jack)

*'So, if you look at the Americans for example, they've got an agreement where "nobody rows from first snowfall" (...) So that could be a good three months of their programme where nobody is rowing, yet they're still able to put out varsity crews that are capable of pushing many under 23 world championship crews, you know and I think that is twofold, I think one it's down to the ability to physiologically develop throughout that time off the water so and Secondly, I think that the rowing pattern, while I think it's*

*important that rowers do a huge amount of base fitness training I don't know, I'm not fully convinced that they need to spend a huge amount of time on the water um right, the way through the year, I think that you know if your six weeks out from an important event, I think that that's when you really want to put your money where your mouth is.'* (Jacob)

Thomas, Charlie, Jack and Jacob all discuss their appreciation of different international rowing identities, although to varying degrees. Jacob, for example, admires the American programme and says that it aligns with his belief of not needing as much water time (although it is not clear if this admiration shaped this belief in any way). Thomas, on the other hand specifically mentions that he prefers the technical model that the Kiwi's demonstrate on the international stage to the technique that the GB crew rows with, Charlie implies a similar preference for the Dutch system. Perhaps most notably, Jack attributes the recent success of Australian rowing to *'the coaches involved and the education around the coaches'* and Charlie to *'their coaching systems'*. During all these conversations about how they developed their practice not a single coach mentioned any kind of formal education. The only two reference points that were quoted as being significant for shaping the coach's perception of the rowing stroke were past experiences and learning from international crews and programmes. There seems to be a notable difference between taking ownership of ideas/strategies when it comes to coaching novices as opposed to how the coaches justify their approach for a technical model for the more experienced crews. It seems that past experience may be called upon more when justifying initial coaching preferences for early stages, but as crews become more experienced the coaches may trust less in themselves and put more stock in what others are doing and what pre-existing models might look like. This transition away from a self-constructed rationale towards a tried and tested method championed by significant others or international coaches could be a barrier for implementing a change to coaching theory. If this were not the case, then it might have taken a handful of coaches experimenting with a CLA to spread their practice for the theory to take off. However, if coaches are heavily influenced by international rowing programmes the implementation of any changes to coaching theory may need to originate from a more formal process such as working with international crews and coaching bodies despite formal coach education being found as less impactful informal learning (Jones, Armour and Potrac, 2004).

In contrast to coaches falling back on past experiences to develop new athletes, coaches seem less confident in asserting their experiences on how they would like the senior squad to row. Instead, they mostly call upon international models and standards, this may be due to fear of scrutiny, or potentially a better explained scientific rationale. Coaches suggest that there is no right or wrong place to start developing less experienced athletes, simply that they should start by addressing changes which makes the most impact to build the rest of the stroke around, often informed by past experiences. Sometimes it may be beneficial to understand what the common issues with athletes at a given stage are but presuming these rigidly would remove athlete-centredness and align much more with a traditional approach than a CLA (Davids et al., 2008). By demonstrating critical thinking as to what makes for effective coaching rather than solely reproducing their own learning experience as an athlete the coaches can break cycles of poor coaching techniques and ensuring they are not prisoners of their own sport history as Jacobs et al. (2014) suggest can be the case. Formal coach education seems to have had little-to-no impact on shaping coach perception on the technical model, which is unsurprising as coaches develop their methodologies with little consideration of empirical data and heavily rely on past experience (Greenwoods et al., 2012). Hence, any changes looking to be implemented in rowing coaching would be most effective through incidental informal learning. However, as discussed by Jones et al. (2004) informal coach education is hard to identify and therefore hard to influence. Working directly with international coaches may be one of the most impactful ways to influence the current delivery of rowing coaching in the country, as international crews seem to be analysed and copied. Further research in the water may seek to address coach knowledge in a similar manner to that of Krause et al. (2018).

## Theme b) Barriers and approaches to understanding movement

### iii) Limitations to understanding movement

Coaches discuss the complexities of the rowing movement:

*'it's the connection between the blade, the foot stretcher and the boat and it's trying to get that connection between that triangle and how your body allows that linkage between those three areas'* (George)

*'If you can actually stay relaxed on top of... on top of moving boat and keep yourself still, that's half the battle because once moving parts get involved then it can become exponentially more challenging'* (Jacob)

George and Jacob explain that although rowing is a repetitive sport there are multiple interacting moving parts within that repetitive cycle, and successfully managing the relationship between these parts is what makes a rower effective. The self-organisation of multiple moving parts to create a consistent movement solution reflects very similar thinking to Bernstein's (1967) discussions around ecological dynamics, where skill movement is seen as a *co-ordinating* and *synergising* process rather than *creating* a movement pattern (Krabben et al., 2019). By starting to acknowledge the natural variability in the performance environment athletes learning is understood to be more incidental than coach specific feedback. This can be seen to develop a robust and adaptable movement solution rather than a rigid "*this is what works*" style approach that a traditional approach may adopt. Whilst acknowledging the complexity and variability in the rowing movement, Noah highlights one of the main barriers that hinders learning:

*'Problem is, it's true what you... ideally if they could visualise it and see themselves externally. Getting that focus on their body positions would. But the problem with that is it's very abstract and... Where they think their bodies are and where their bodies actually are often completely different, and there's no way of bridging that gap.'* (Noah)

Noah implies that when athletes do not know how they are moving they cannot fully understand how to improve on any technical inefficiencies they may have. For example, they may have been told (or feel for themselves) that they are cutting their stroke-length short. There are multiple potential reasons for this, but the

athletes will struggle to understand what the specific issue is for them. This suggests that in rowing it is meaningless to know THAT they need to make a change, as that knowledge is not something that can be implemented accurately or monitored. Instead, the athletes must know HOW to make a change, this challenges literature that suggests that implicit learning strategies better align with a CLA and are better retained (Lee et al., 2014). This is likely due to the perceived complexity of the rowing movement leading coaches to rely more on explicit feedback with more detail (Ellis, 2009). There is a potential for physiological limitations to hinder the efficiency of the stroke, such as flexibility or core strength, but as the present study looks to understand the skill development component of elite level rowing coaching through a CLA lens these factors will not be discussed here. Future research looking to further link a CLA to rowing practice should seek to explore how a CLA may help understand and work around flexibility/core issues.

Thomas discusses the natural learning process which he has observed in athletes:

*'I also think like quite often the default setting of people is what feels comfortable, and that's not always in rowing the fastest - actually there are some bits that you want to feel hard or uncomfortable because it's a sign that they are connected or loaded more than they're getting on it early enough'* (Thomas)

Thomas highlights the large disparity between rowing and other sports: the (often less experienced) athletes may prioritise boat stability, safety and comfort over developing effective goal-oriented changes that will make them perform better. This is a common feature in ecological dynamics, where humans self-organise to find the optimal (and often easiest) solution. Furthermore, the CLA framework would aim to manipulate constraints so that the easiest option is also the best for their development, potentially by experimenting with rewards in the training environment (Renshaw et al., 2016). Bernstein's (1967) consideration of degrees of freedom has direct implications, here. As Jacob mentioned earlier *'once moving parts get involved then it can become exponentially more challenging'*. This statement is a perfect invitation for the freezing of degrees of freedom, so that the task remains true to its origins (and thus the performance environment) but can allow for movement to be explored within the space provided. Using multiple linked exercises and exploring the freedoms and limitations of the rowing movement is

an example of exploring system degeneracy (Roberts et al., 2019). System degeneracy is a neurobiological term (Edelman & Gally, 2001) that in the context of skill development and NLP refers to the robust and flexible development of a skill when learned alongside variability. Skill development in rowing naturally fits the *repetition without repetition* solution that Bernstein (1967) encouraged, in order to explore movements repeatedly but whilst keeping variability and thus flexibility in resulting application. More data would be needed to explore whether this is a reoccurring and significant theme, and this could be gathered through a series of interviews with coaches that probed the relationship between repetition and variability on skill development. When changes are made it is important that the athletes understand how they are moving differently so that they can remind themselves to continue to repeat the change. Charlie and Oliver explain how this can often be straightforward:

*'I think it was actually creating a situation where they were feeling something rather than me coaching into them'* (Charlie)

*'[the] direct result of it changing, the athlete would feel it. I think they feel it. I think you know they would feel like if you if you are working on the catch that we talked about earlier. If the blade is locked on you would feel like you could hang out at the front end'* (Oliver)

In these examples the athlete would feel the change and also feel that it is a positive one that will improve their boat-speed, hence wanting to repeat it and therefore increasing the likelihood that little follow up would be necessary. The performance of the skill in such a way that feels better/stronger/more efficient should be rewarding enough to encourage athletes to repeat the task even if it may be uncomfortable. This “reward” for a positive change will only be present if they know how a change should feel. Hence, in this situation, the role of the coach may be to draw the athletes’ focus towards that specific feeling they are working towards (Renshaw et al. 2019). The implications/benefits of coaching through “feel” will be discussed in *Learning from coaches (c.i)*. However, there are other ways to show that a positive change has been made as Harry explains.

*'I mean a number of ways you know, obviously. Did the test metrics in terms. If you know measurement in the water you know looking at data you*



*know we have, we've got telemetry, which = I do use in this in this in the run up to their regatta season, so you can kind of look at that measurement in terms of how their skills progressing, how their boat speeds progressing'* (Harry)

*'[when on rowing machines] take some film and then even giving the feedback straight away and then you can even do it live at times, they can watch themselves with the you know, with the side on camera'* (George)

*'when you're using video in a bit of feedback individually they can read it and they can slow it down and they could. They can look at it and then because I do like that trying quite regularly, then then that's when I kind of start to look about whether I've really made progress'* (Oscar)

All three of these examples are not only useful to justify why a change is a good one that should be repeated, but also serve to bridge the gap (as identified earlier by Noah) between what rowers are doing and what they think they are doing. However, just as the athletes believe they are moving in a specific way, it must also be true that the coaches perceptions may also be less accurate than they may realise, as the athletes are cognisant of information that the coaches are not, such as balance, proprioceptive feedback, how the boat is moving underneath them etc. Therefore, it is not only pertinent to help the athletes better understand how the boat is moving, but also for the coaches.

Coaches voice that the skill in the rowing stroke can be described as managing the moving parts into an effective movement solution that optimises boat speed. Due to the multiple interacting parts of the stroke the technical points that coaches try to focus on can be hard to understand, particularly when it comes to relating that to the existing movement pattern. The athletes are constantly learning, but it is key that the coaches design the session so that the learning taking place will result in an increase in boat speed, rather than athletes prioritising balance or timing, as this is likely to be a more impactful change, this is not as easy as it may sound due to the oversimplification this presents of the complex rowing movement. Freezing peripheral degrees of freedom (Davids et al., 2012) may enable less experienced rowers to develop movement solutions that will be more beneficial for their long-term development. The CLA acknowledges the Degrees of Freedom

(DoF) as a tool to consider when trying to simplify tasks whilst keeping an action fidelity (Brunswick, 1955) ensuring that developed solutions are transferrable throughout a continued development (Renshaw et al., 2019). The coaches did not demonstrate any application of the DoFs outside of occasional use of exercises that froze peripheral DoFs such as *straight arm square blading* (where peripheral wrist and arm movements are removed to focus on applying an effective drive). Further research into manipulating the DoFs in a similar manner could provide interesting conclusions, but the present study presents no evidence to show that coaches use such techniques more than others, or that they are more effective, instead that some of the exercises they used and preferred can be explained through the DoF problem.

iv) Using feedback to understand movement

As discussed above, it is often difficult for the athletes to visualise how they are moving. In Noah's initial statement he suggested that *'Where they think their bodies are and where their bodies actually are often completely different, and there's no way of bridging that gap'*. However, as discussed in *Understanding movement* (section b.i) there are approaches such as the use of mirrors, video and telemetry that can be used to help athletes understand how they are actually moving, and consequently what needs changing. This is an example of the athletes being able to understand the coaches' point of view. Thomas holds that *'We as coaches look at the outside, you know, but you know if you're looking at a video analysis, we look at how things look. But our perspective is completely different to what it's like being in a boat. The athlete doesn't see the side on-view'*. This is a method of connecting the realities of the coach and the athlete by showing the athlete what the coach is observing. However, as it is the athletes that are in control of changing their movements, it may be more pertinent to explore how coaches can understand the athletes better. Research around this area was not carried out before the study as this was an unexpected focus. However, it appears to be important to the coaches and is an interesting barrier that impacts the delivery/theoretical underpinning of elite level rowing coaching.

As Oliver said earlier, athletes can usually feel when a change has been made. Naturally, they are unable to see that a change has been made, and aside from small amounts of audio feedback, most of the sensory information that they receive when rowing is proprioceptive. By acknowledging this, coaches can understand how to frame their sessions in a way that allows athletes to interpret and implement changes for themselves. This notion is deeply rooted in ecological dynamics through perception-action coupling. By understanding what the relevant cues are that inform movement it is possible for coaches to refine the way they deliver information to the athlete. The use of cues can be viewed as a form of task constraint implemented by coaches to build on a stable movement pattern. For example, Noah discusses guiding novice athletes in pairs with the following information:

*'I want you to, stroke man: Watch the stern of the boat and talk to the bow man and that also gets them communicating. And trying to move the boat so the stern goes absolutely straight. Doesn't wiggle in, you know. See if*

*you can, little things like that. Get them to process what's going on. Even focusing on a detail like: is the stern moving absolutely straight in the wake behind me?' (Noah)*

This not only allows a platform for coaches to deliver information, but also provides a means for athletes to communicate to coaches, as Oscar explains how athletes focussing on how the feeling has changed can offer a unique insight into whether learning has taken place:

*'they can tell you how it feels. You tell them how it, how you think it should feel, and they can. They can notice a difference. I think more if they if they are focusing on the feels rather than going quickly. Sometimes if they're focusing on how the boat goes, there's four other people in the boat. (...) whereas if they can think about how it feels and then they feel like they can describe it, then maybe they've made an improvement' (Oscar)*

In this instance the athletes can tell that a positive change has been made, but by drawing the focus to feeling it may be easier for the athletes to understand and to show development. But as Jacob warns *'I think there's just only so many ways you can continually explain the same point before you realise that you've exhausted all of your perception'*. If coaches attempt to coach through feeling than their comprehension of the skill and the way it feels may be more limited. This is reinforced by Oscar and Thomas by saying:

*'[I] Always find the time I make more technical breakthroughs when I am in a period of getting out on the water every now and then. Which is less and less nowadays, but like I do find that because I think then, then I find myself talking about how it feels now I'll play around with an exercise on the water and then and then I'll just. I'll just copy into the boat and say what I was doing this and then did this and you know, it felt like this' (Oscar)*

*'So, I remember we were doing some ergo stuff and he went through. I think. I think it's to do with suspension and posture and things, but I just remember him like grabbing me and talking me through some stuff and then like also that I felt like so much more hooked up and connected and I think*

*that. Uh, in terms of trying to make sure that when I communicate with athletes that I also try to put it in a way that they feel' (Thomas)*

This is an example of both coaches using their own recollections of experiencing certain technical changes when it comes to implementing them with their own athletes. However, unless there is another way for the coaches to further their understanding of the skills without having experienced them themselves, that places a large limitation on the capacity of a coach. Even if they are a particularly experienced athlete, they are still limited to a single perception of the skill and what worked for the coach when they tried to make the change. Whereas the coach is likely to have tried to make a specific change tens or hundreds of times with their athletes, which will not develop their knowledge of how the change might feel, rather how it looked and what the change was. Coaches are likely to keep returning to how it felt when they learned a specific skill. Therefore, if this was something they developed quickly or unknowingly they may struggle to explain the nuances of overcoming barriers to perform the skill.

The effectiveness of using of mirrors, video and telemetry is limited by the retrospectivity of the process, as well as the fact that again, it only shows that a change is needed rather than offering solutions as to how to facilitate that change. Furthermore, attempting to relate to the sense of “feel” from the athlete limits the coach’s knowledge base of how to deliver the change. Potentially, there may be benefit in trying to bridge the gap and meet closer to halfway, with coaches delivering information in a way that allows athletes to interpret and build their own experiences of the skill. If the athletes and the coaches are unable to experience and live in the same reality it will be as if they are speaking a different language to each-other. Although this is inevitable to some extent, the coach and athlete must attempt to understand the performance environment from the same perspective in order for the coach to effectively communicate or set exercises for the athletes, and similarly for the athletes to feedback accurately how the stroke feels from inside the boat. Therefore, the large amount of proprioceptive feedback that the athletes need to react to limits the ability of the coach and athlete to fully interpret each-others perspective.

Jacob suggests that verbal feedback is normally used to try and bring attention to the relationship between what they are feeling and what they are doing

*'if you're giving verbal... verbal feedback, I think that you're... what you're trying to, what is it that you're trying to accomplish by giving that verbal... verbal feedback? And usually, it's to try and instil a sense of relationship between what it is they're doing and how it is feels' (Jacob)*

Thus, it is pertinent to discuss the role that verbal feedback has, and how it's use may link to how the stroke feels.

If the athletes and the coaches work to align their realities (by using shared language and developing mutual understanding of the sessions/feedback), then coaching is likely to be more successful. This could involve athletes watching videos, taking a session on the coaching launch, or coaches attempting the exercises that they are prescribing. Coaches have limited perceptions of how a skill/exercise feels. Even if they have seen it hundreds of times the coach may struggle to see beyond their initial perception of the skill/exercise, which was likely developed during their own time as an athlete. However, this does not mean that they cannot learn how it may feel to others. The balance between instructing the athletes with verbal feedback and letting them explore exercises through how the stroke should feel is a complex discussion which may not be unpicked through CLA literature. Attempting to connect these realities allows the coach and athlete to be living the same experience. This is an underpinning view of ecological dynamics and a CLA. From as broad as the whole field of perception to the specific cues that prompt action in accordance with Gibson's (1979) work on ecological psychology. Whether environment invites action or not (also see Withagen et al., 2017) all the information that the athletes perceive shape movement, whether visual, proprioceptive etc. Coaches must understand the world that the athletes are living in to be able to influence it.

### Theme c) Learning and understanding “what works”

#### v) The role of the coach in the learning environment

Harry and Oscar both suggested that verbal feedback is their first response when it comes to facilitating a technical change:

*‘I tend to give feedback to start with. If that doesn't seem to be working, then we would break it down into technical exercise’ (Harry)*

As Oscar describes verbal feedback is often the quickest and least disruptive way to facilitate the technical change, rather than implementing exercises or stopping to draw focus to a physical modelling of the skill. Therefore, it is unsurprising that coaches use this as a default. Two statements of specific interest are: ‘try to just remind them of what they already know’ and ‘at least it’s kind of highlighted what the issue is’. These statements align with the conclusion arrived at from section *Understanding Movement (b.i)* namely, that the athletes need to know more than just that they need to change but they need to know how to make the change due to the disconnection between how they are moving and how they think they are moving. Verbal feedback by itself may not be enough to draw the athletes’ attention to an issue and also help them to make the necessary change. However, there are a number of ways that verbal feedback can be utilised. For example, both Oliver and Noah promote the use of analogies:

*‘I use a lot of analogies or whatever and sometimes the right analogy. Just (snaps fingers) make some you know, makes a connection. And they they’re usually a little bit, you know, risqué.’ (Noah)*

*‘The analogy I always use is... 2 analogies always use and one is the classic one. I like to plant seed and allow them to figure in allowing that to grow and the other one I use is that if you are, if you are driving a car you you’re driving. You’re going somewhere that you don’t know where you are, and you got someone giving you directions next to you. If they tell you every single turn, every roundabout, every set of lights where you’re going, you just drive and you get there right? Do they? Again, you probably don’t remember it as well. If they give you little bits along the way, but you have to work the rest out, I think you stand a better chance of remembering them’ (Oliver)*

Analogies are commonly used in a constructivist framework as a preferred method of delivering verbal feedback (Bonnardel, 2000), and with both of his analogies Oliver shows alignment to a constructivist paradigm, with the latter analogy of the coach giving the athletes the right pieces of information at the right time to work out the solutions for themselves placing the coach as the orchestrator of constructivist learning, which is as close to a simplified description of scaffolding in a CLA that could be expected without specialist vocabulary. The main difference lies in the assumptions around the role of the coach and how they fit in the environment. The coach is viewed as the individual that initially gives the athlete the input from which they learn, which would remove notions of perception-action coupling and lean more towards a traditional approach. This analogy is quite idealistic in the sense that it removes the coach from the chaotic learning environment and is only effective if the coach can gain an accurate perception of the athlete and the skill they are learning. However, if following a CLA theory, the development of movement can be seen as a more social process. So, in reality, it is unlikely that the coach would be able to completely remove themselves from impacting the learning of the individual, particularly as they are initially giving the cues that the athletes will aim to self-organise around. Jacob uses a technique which further frames the coach as a facilitator and shows an understanding of the social learning process congruent with a CLA:

*'I always think that um people will learn by very various means, and I think that coaching while it's important, I think that ultimately they're are facilitator, so if you can facilitate a really talented eight right with seven outstanding athletes in the boat and you put in somebody who's you know very close to being a beginner, but has the rudimental basics done, it won't be long until that beginner is at the standard at which you want to actually row to um and by not long, I mean a matter of weeks'* (Jacob)

Verbal feedback has been a widely researched cornerstone of sports coaching for many decades (Kluger & DeNisi, 1996; Mason et al., 2020). Although traditional models of sport coaching may have had an overreliance on verbal feedback (Renshaw et al., 2019) that does not mean that it is a tool that cannot be



implemented through a CLA. A strength of verbal feedback can be described by Oliver and Jacob:

*'[discussing the use of verbal feedback] so I suppose each individual I have to... remind if anything' (Oliver)*

*'So, if for example, you're missing the front end do like are they, are they thinking that I'm being really quick on and I'm being really engaged an and he just can't see it? Or is it a case of that you need to try and break it down further for them to understand' (Jacob)*

Both coaches demonstrate a similar point of view to Oscar. The three coaches suggest that there is a strength in using verbal feedback for reminding athletes of past work and Jacob expands on this when talking about it being difficult to change experienced athletes' minds. At this level even if athletes fully understand the point that the coach is explaining, more time may need to be spent detailing the nuances of the skill, as the understanding of the skill is often not the limiting factor, with the athlete thinking they understand what the coach is asking for, but not clearly enough to make the required change. This would be an example of coaches valuing a conscientious attempt to make a technical change through an exercise rather than just a comment of verbal feedback. The strength of verbal feedback in reminding athletes of things that they already know and scaffolding alongside an exercise seems to remain relevant. Again, flexibility or core strength could be an issue, but this would be difficult to establish without a two-way conversation anyway. Thus, a reliance on verbal feedback coming from the coach may lack the nuance required to facilitate more subtle changes, this is where exploration or two-way conversations might be more impactful. Consequently, it can be implied that a traditional coaching pedagogy may have its limitations when working with a more experienced group of athletes. Jack similarly suggests that he provides less verbal feedback with his more experienced crews:

*'So if it's a junior 18 crew, you might not say too much where if it is a junior 14, junior 15 you're saying a lot more, trying to teach them so, time coaching junior 14/15 invariably talking to them so maybe 80% of the time, it might seem quite high. But regarding giving feedback to junior 18's junior*

*17's, there's less of that, the J15's are more often very reserved and shy, normally very small, they are trusting you to teach them how to row' (Jack)*

*'[when working with junior 18s] I try not to chop it all up, if we will focus on the catch, the finish, the hands down they will just get confused' (Jack)*

Jack's statements seem to express similarities to how Jacob was suggesting that verbal feedback is limited in its effectiveness with more experienced athletes, but it can be all that is needed to bring a less experienced athletes' attention to make a change quickly and effectively. There also seems to be an assumption that more coaching means more talking, and that older athletes may require less coaching. Although it may not be intuitive to reduce the amount of verbal feedback, and therefore coaching (as suggested by Jack), George might offer an explanation as he discusses moving the skill of rowing into the unconscious brain:

*'Sometimes actually its ability not to think is actually really important and the ability to feel, cause sometimes the thought patterns, you know there's those levels of consciousness isn't there about how you learn, but if you, if you got it, you got to get to a point where you can actually release your mind and actually start to learn to feel, now that I'm not saying that happens straight away but there has to come that point where you can transfer from thought into this automatic movement and if you don't get ever get that, you're never really going to go very fast' (George)*

Despite suggesting that it may have more benefits with the less experienced athletes, Jacob and Oscar warn against using too much verbal feedback:

*'You can't just, you can't think about all those things. You only have one brain you can't think about those things at the same time.'* (Oscar)

*'I would suggest that. I think you've got to be very careful of verbal feedback as well, I think that the more you give them, the less engaged you're going to become. So you want to keep that level of engagement to up and you got it that way, you gotta keep your verbal feedback like focused and direct and relevant, and don't let it wander and don't let it become broad' (Jacob)*

Most verbal feedback is given when the athletes are on the water. However, Oliver and George discuss the benefits of giving verbal feedback on the land:

*'If you are in a crew boat situation your week for race, your focus I think has to be on making sure the crew is right. Yeah, there's a few little individual things within that, but I would if I was talking to a group before a session, I've made sure that there were specific things everyone knew that the basic thing that we're working on today in this session is this. This is the thing that's are the biggest. Focus is the one that's probably the primary goal, the others around them'* (Oliver)

*'It doesn't matter whether you're trying to get someone to lift above in weight training a certain way, and I just keep snatching at whatever and again it just comes down very often just to pulling the athletes back, um and slowing them down, getting them to understand what the important things are'* (George)

Oliver's comment is centred around briefing the athletes on land and this is common practice from the coaches. However, George's example shows that often a change can be made through clarity of information and the land is an effective way to improve the communication between the coach and the crew. Verbal communication whilst on the river is more difficult; coaches might have to call through megaphones or work from a bike, and some athletes might not be able to stop due to the demands of the other crews on the water as well as other potential hazards. The unavoidable interference that impacts everyday rowing coaching means that verbal feedback is often less effective than in other sports, but this issue persists for the use of drills. Using drills can severely slow the boat speed, which firstly, will mean that the boat is less responsive to the coxes steering, and also that if the coach has multiple crews that they are overseeing they will struggle to keep them together for the sake of safety. Again, the safety of the learning environment seems to impact the extent to which a CLA may explain current practice. With a few exceptions, rowing takes place on public rivers, thus the safety of the athletes may impact the liberties taken with a session more than a rugby team training on their pitch.

As mentioned at the start of section ci, verbal feedback is often the first attempt to make a change for the crew, coaches Harry and Oscar describe how technical exercises or drills are viewed as a natural escalation if the original verbal feedback is ineffective:

*'I tend to give feedback to start with. If that doesn't seem to be working, then we would break it down into technical exercise' (Harry)*

*'Something's not very good. I'll tell them: that's not good, now try to just remind them of what they already know kind of thing. Sometimes it works a little bit more, doesn't work, but at least it's kind of highlighted what the issue is. And then maybe they can then also relate the fact that it doesn't feel well because of this stuff that we were just being told to do that. We haven't managed to kind of change, you know, and then it then. They might then I'll stop him into a drill and try and link it to what wasn't going so well so that they get by into like we're not doing this drill for the sake of it. We're doing the drill because hopefully it's going and I'll try and explain why I want them to do the drill' (Oscar)*

From these two statements it is clear that the coaches hold exercises/drills in high regard and believe that they can elicit changes where verbal feedback has been unsuccessful. The present study does not have the data to scrutinise the relationship between verbal feedback and exercises (whether one is viewed as superior to the other), which are stated as being the two main mediums of intervention that coaches use to implement changes. However, they are fundamentally different processes. By allowing the exercise to be the teacher, the coach becomes a facilitator which fits the CLA framework, removing the coach as a “giver of knowledge” and becoming a facilitator of development through interactions with the constraints (to oversimplify the theory). As Noah and Oscar point out, though, the skill lies in creating the right environment for the athletes, which means picking out the right exercises:

*'I won't choose the perfect drill, but at least I kind of understand now. I think it's all about getting buy-in to a drill and not them to just to switch off. And then if the drill. If the drill doesn't work, which definitely... Which happens a lot of the time, and. I'll probably try a different drill' (Oscar)*

*'You just try exercises, and you just try exercises and then you can see "ahh they get it and they feel something different".'* (Noah)

Oscar and Noah make the point that some exercises work better than others. There may be hundreds or thousands of exercises that a coach could implement for their crew, but by piecing together the coaches' comments it is possible to establish what they hold as important when it comes to exercises, and consequently facilitate discussions around how the coaches understand skill development. Oscar, Jacob and Oliver offer insight to what might make for an effective exercise:

*'I think it's a good exercise. It should feel like that part of the stroke should feel (...) if you're doing is a different exercise that is then not going to feel like that part of the stroke feels in in rowing, then what is the point'* (Oscar)

*'feel is so important and I think if you can actually give them that sense of feel and relate to that sense of feel you can build on it at any point at a stroke but I think that you need to keep it really relevant initially before you start to make it a little bit more complex, so that yeah'* (Jacob)

*'I think the thing about the feeling is its immediate and I think no matter what you do when you're showing some of the video, (...) So I think the thing about feeling it is it say you can do it the next stroke and then you can do it again and be like oh yeah'* (Oliver)

There is a clear consensus that the ability to feel a difference in a positive change that the exercise is making is essential for development, with Oliver specifically mentioning that this means that they can reproduce it without supervision, as they have the internal feedback and know when it feels right. A CLA practitioner may make sense of this as the coach's direct feedback and/or exercise initially provides the cues that athletes interpret and self-organise from and make a positive change, then athletes develop an internal focus on how that change feels and are then able to reproduce the skill through *feeling* for the new change (Rienhoff, et al., 2016). Being able to repeat the movement is important to the coaches and they believe it plays a large part in the transferability of the skill. All three hold

exercises in high regard unknowingly in-line with a CLA (Moy et al., 2020). Jacob and Charlie go on to discuss exercises in another way that further links to a CLA:

*'there are probably instances where you're in the middle of a mid-rate piece so you probably at 26 um rowing firm pressure and you might throw in a challenge and say right we're gonna go legs only and we're going to do that for until I say so, right? And that might only be for 10/15 strokes, but what it does, it refocuses everybody and what they're doing around the front end and how they're actually applying the leg drive' (Jacob)*

*'we had one session where I demonstrated a, a kind of front-end legs only exercise and I got them to do this at 1000 miles an hour and then I took it right back and said right lets try and do this really slowly and it just kind of that session that you know we made a, a huge gain of speed and it was of the last sort of week and a bit before the schools head' (Charlie)*

Although ultimately both coaches apply technical exercises with a race-like intensity, Charlie uses them to explore a technical exercise and this exploration fits firmly into a constructivist paradigm, where the athletes are assisted in understanding an unfamiliar space and what benefits may come from doing so. Jacob, on the other hand, uses them to refocus his crew and have the crew perform the exercise with more similarity to their race conditions. This fits with Brunswick's (1955) notion of a representative learning design (RLD) to maintain action fidelity through making the training environment more consistent with the intended performance environment, so that the developed movement solutions will be suitable for the intended performance environment. For example, in football this would be similar to having a constraint on an 11 v 11 full pitch game, in order to still have a technical focus whilst remaining as faithful as possible to the performance environment. In contrast to this idea of having an overlap with technical work and fitness work, George outlines a clearer separation between technical sessions and hard-work sessions:

*'You know now it could be: it's a fitness session like today I just want you to go nut it, I just want you to get fit (...) or it could be right okay today got you know today is going to be a technical work out everything to be nice and low, (...) so I would say goal setting early on and making sure that the*

*athletes are aware of what they're meant to be achieving within that session is really critical' (George)*

The lack of time and lengths of sessions may be the limiting factor here but there is potential to further explore how a technical focus may be worked through alongside pressure and higher rate work. This is disagreement surrounding as to whether combining high-rate rowing with more technical exercises may offer an invaluable training opportunity in accordance with a RLD. Oliver, Jacob and Noah all discuss the benefits of using technical exercises in enabling the athletes to work things out for themselves, and why that may be important:

*'Athletes need to be given the opportunity and the stage to work it out'*  
(Oliver)

*'I think that the importance of drills are massive, I think that if you do a drill there are Eureka moments there that will come quicker than verbal feedback, so I think if you actually set a drill but I think that the skill is trying to understand what really are setting what you're trying to accomplish, and explaining that little bit but once they start to figure out the drill, the better they're going to get it' (Jacob)*

*'I think themselves, you know, make their, make their own, you know when they go "ah! I've worked it out" rather than "I've been told", it sticks a bit better' (Noah)*

All three coaches clearly believe that when athletes make a technical change for themselves it is better than being told/directed by the coach. Specifically, Noah mentions that it *'sticks a bit better'*. One of the core benefits of adopting a CLA approach identified in the literature review is the belief that the developed skills will be retained for longer (Handford et al., 1997; Lee et al., 2014). The transferability of the technical exercises is a key point that coaches have brought up multiple times. Thomas further discusses how to ensure changes become habit through repetition:

*'And you know, relax into it and hopefully the repetitive ingraining will become the habit. By, you know, sort of tattoo again in your brain I guess.'*

*But then you know you've got to bring in that flow, and that that rhythm and stuff you know that that is just as important' (Thomas)*

Athletes may struggle to remember a large amount of verbal feedback, which could lead to disengagement (Masters, 2000). Verbal feedback has further limitations when implemented with more experienced rowers. Coaches suggest that this is because they already have a comprehensive understanding of the rowing stroke so the verbal feedback will be used to tell them they are not moving how they think they are. In these instances, exercises may be better suited to guide their development and push them out of their comfort zones. Coaches will initially be giving a lot of cues to the athletes in their initial development, as the initial chaos that the athletes will experience will be hard to navigate without close guidance. However, to better align with a CLA the coaches would need to design the session so that the cues that the athletes are learning from would be coming from the environment or internally, just as they would during competition. An exploration of how this might work would be worth exploring further as it does not seem to be an easy transition. However, the freezing of degrees of freedom (Bernstein, 1967) could offer guidance on how to simplify/reduce chaos whilst keeping action fidelity.

Exercises naturally have a closer resemblance to a constructivist learning approach than solely coaching through verbal due to the more exploratory/environment driven nature of the learning. Coaches also offered that many traits that make for a “good” exercise bare similarities with the CLA framework. Coaches suggest a good exercise should have elements of familiarity and should feel how the normal rowing stroke should feel, this clearly shares similarity with Brunswick’s (1956) work on a RLD. So much so that the coaches even specify that skills developed in an exercise that does not closely resemble the stroke will not transfer. If the coach attempts to change too many things at once the familiarity will be lost and the athletes may struggle to understand how to transfer whatever they are doing into a normal rowing stroke. Coaches can use that familiarity in order to aid transferability, drawing the focus of how an exercise felt.



vi) Environmental impact on learning

As well as the specific feedback from the coach, learning is understood as being a contextual and situational process (as discussed in theme **a**) and therefore the athletes will also be learning from their environment (Button et al., 2020). Jacob and Noah both discuss the difficulties in having many novice rowers learning at the same time and the ramifications of that when combined with limited coaching resources:

*'in the school environment we're trying to teach a great deal of people to row at the same time, so we don't really have the luxury of putting individuals out in a single scull, for example. We're putting out the factory ships of the octos, you know we might have three or four octos on the water and hoping that one of them might be able to figure it out, and then that they'll be able to generate the same pattern in the next bunch'* (Jacob)

*'one of the things that I, I did differently in my first year with the J15s compared to anybody else is I stuck them in pairs (...) the smaller the boat, the steeper the learning curve (...) you're not gonna get individual coaching every stroke, there's gonna be large periods where you're on your own so what I want you to do is, I want you to go out, I want you to think about these things and try these exercises and see for yourself what happens and try and work it out for yourself'* (Noah)

Both coaches highlight an identical issue; the need to manage a large number of athletes on the water. However, Jacob coaches on the tideway, regarded by many as the most volatile stretch of rowing water in the country, whereas the stretch of water that Noah trains on is one of the calmest and least busy in the country. Thus, the risks associated with capsizing or being unsupervised are much more adverse. Noah's approach seems to align with a more nonlinear pedagogy and follows the "let the game be the teacher" notion by creating a training environment in which self-organisation will lead to positive development. The pieces of guidance he offers can be viewed as help directing attention to the relevant stimuli to stop the environment becoming overwhelming and harder to understand for a less experienced performer. When experts encounter an environment overflowing with opportunities, they are able to single out stimuli specific to them and their situation (Rietveld and Kiverstein, 2014), however less experienced athletes may

struggle with this as Roberts et al. (2019; p.15) highlights that ‘it is important for practitioners to help learners with ‘where to look’. Oscar, who coaches in an environment similar to Jacob’s, further contributes:

*‘if there is in a single scull then (...) It's just uncomfortable and you feel like you're in danger of capsizing, and you can't do the little things that probably work ... if people are not thinking about what you're saying because they're worried about the balance and the platform, then then you just gotta work on that’ (Oscar)*

The stretch of water on which the athletes learn to row has significant implications not only for training, but also for racing:

*‘we always do really well at Henley, and I think that's just the river we've got here and the way our River is and the course where we could do pieces really suits it’ (Thomas)*

Jacob, Noah and Oscar’s statements all imply that the learning environment is a constraint that impacts the way in which their crews develop. Similarly, Thomas’ statement directly carries this view, with a particular emphasis on performance with a constraints-led approach framework by implying that the athletes’ development and performances are directly shaped by the training environment. Which is one of the three classifications of constraints that are identified to impact the movement patterns that are developed (Renshaw et al., 2010).

All coaches agree that ergs have a vital role to play in their training programmes. Their perceptions of the benefits, however, are not so unified. The necessity of using the rowing machines for physiological gains are commonly agreed upon. However, George warns that:

*‘Good ergo technique is not necessarily good rowing technique’*

and he justifies this by saying...

*'I think you need to know the limitations of the ergo as we discussed earlier, you know in terms of one of the main things for me is feel and feel of the boat, you're not going to get that on an ergo'.*

Similarly, Charlie suggests that the optimal technique for a rowing machine doesn't necessarily mean the optimal technique when on the water.

*'I think a, a rowing machine, an ergo, concept 2 specifically very much benefits people who aren't as skilful at the change at the front end and I think it benefits people who've got quite a back ended rhythm to a stroke, um and, and I think as long as you understand the, not the limitations but what that machine rewards you know, you can set parameters for the boys to, to technically develop as well as you know just, just physically train them.'* (Charlie)

The main issue regarding "good" erg technique not transferring to "good" actual rowing technique is that ergs can develop and ingrain bad habits for athletes, particularly as they are often performed without supervision. Oliver and George emphasise that the reliance on rowing machines in current practice raises the importance of good technique.

*'I think one thing is, yeah, you probably during your lifetime gonna take more strokes on the ergo than you are in the boat potentially, you know. Depends on where the programme sits and how heavily sort of weighted it is, one way or another I think you are probably going to take as many, at least, strokes on the ergo and you've got the stage to think about it'* (Oliver)

*'In my mind, if you're gonna spend 3-4 hours a week on an ergo you want it to be as replicable and as close in symmetry to what's going on in the water'* (George)

Oliver points out the extent to which ergs are important, but George specifically mentions the importance of them being *'as close in symmetry to what's going on in the water'* which furthers the notion that they need to "row well" on the machines but starts to unknowingly discuss Brunswick's (1955) RLD. A RLD places the organism (the athlete) and environment in a mutual and reciprocal relationship that

reflects the performance environment (Franks, 2018). However, if the environment they are mastering does not represent their performance environment, then the skill will not transfer. Specific cues that inform action are missing such as balance, the natural movement of the boat as seven other athletes move at the same time, and feathering/squaring and tapping down movements. Consequently, the potential transfer between rowing machines and water technique is called into question, this will be re-examined after discussing what the coaches' say on the benefits of using ergs for technical development and how that may or may not transfer.

Firstly, Harry, Jack, Charlie and Oscar identify that using rowing machines improves the ability of the coaches to get closer to the athletes, have two-way conversations, and have clarity of information:

*'It's a bit more kind of hands on. You're closer to the athlete. You can kind of move them into the positions that you kind of are looking for (...) really still showing them how to activate send you know to handle up. Get him to move back on that'* (Harry)

*the benefits are that you can, if they are on the rowing machine you can sort of put them into the correct position, when you are out in the boat you can't get hands on or move them you have to be more sort of verbal where you are on land you can help them to feel.* (Jack)

*'being able to get in and amongst and demonstrate and kind of show, feel and try and, say try this'* (Charlie)

*'you can literally you can get closer, and you can get them to suspend'*  
(Oscar)

By coaching on the ergs there is the removal of the obstacles that were identified earlier, such as hazards on the water as well as the coaches being further away and speaking mainly through a megaphone. This more controlled environment may be utilised as a starting point to implement a CLA, as the coach will have a greater opportunity to alter the training environment whilst keeping a relatively accurate RLD. However, the primary concern of a CLA practitioner may be to what

extent using rowing machines subtly changes the skill. For example, the differences in self-organisation when using a bowling machine rather than a real bowler (Pinder et al., 2011). Coaches also identified another benefit of using the ergs. Oliver, Thomas and Oscar all discussed a major benefit of the rowing machines as being its simplification of the rowing stroke

*'I think the basics of what you're doing is the same and you can actually get to that rower a little bit more. You can just be like it's all stable, everything set and I think using the ergo to go over some changes is is vital I think'* (Oliver)

*'sometimes with a kind of rowing-based skill. Or it's the kind of you get them indoors and on a more stable platform and you take away some of the moving parts and it's easier.'* (Thomas)

*'it takes out the balance aspect of it, takes out two sticks aspect of it and an inside/outside [hand] and so it does simplify things'* (Oscar)

Whilst ergs do indeed provide constraints (freezing DoFs), taking the rowing stroke out of its performance context on the water may have implications for skill transfer. Pinder et al. (2011) found batters who practiced facing bowling machines rather than live bowlers needed to make significant adjustments to their striking action when in a game situation. The coaches' description of the simplification process on ergs links to action fidelity, asking the question: when erging, does the body self-organise into effective coordinative structures for rowing? Oscar and Thomas present opposing opinions on this question:

*'I don't think them rowing badly (on an erg) necessarily means they're going to go into a boat and row badly. I think sometimes they are separate muscle memories'* (Oscar)

*'they show you that you can do it [on an erg] and you go okay. It's just a case of you being able to reproduce that, but with more challenges and we can, we can sort of progress that'* (Thomas)

Neither Oscar nor Thomas' comments outright represent a "yes" or "no" answer to the question, but they hesitantly address each view: Oscar says that sometimes the work you do has no transfer at all, and Thomas states that the technique will transfer with a series of steps and acknowledging that there are more complications to contend with on the water. Similarly, despite not questioning the transferability of erg technique Noah says *'my own personal view is, you know, if the conditions are suitable for going out on the water, I'd rather be out on the water than on the erg'*. The implications of Noah's statements suggest that the erg is simply inferior to being able to go out on the water. A RLD (Brunswick 1956) perspective would support this, as training on the water is closer to the race environment. To extend out this notion into a more theoretical plane: any changes made on the water are likely to transfer to race day. Oppositely, changes may be easier to facilitate on the erg but may be less likely to transfer in a competition. Exploration around freezing the degrees of freedom (and consequently releasing them; Bernstein 1967) could see a middle ground where coaches can utilise the erg training environment effectively and see a successful transfer to future rowing on the water.

The safety of the stretch of water can be very limiting in early years. Athletes aren't allowed to make mistakes and learn from them, instead they are told what to do to keep them safe. The stretch of water on which the athletes train has further implications on racing. Coaches suggest that they perform better at events which resembles their training environment, and that coaches should plan training programmes so that the athletes are exposed to a variety of training environments (multi-lane, non-tidal river, tidal river, lake) to allow for different experiences and develop an adaptable crew.

It is more important to row "water well" than "erg well" on ergs for the sake of the training programme, and the use of ergs performed in isolation should be monitored and cautioned against, especially for less experienced athletes. If you row similarly on the ergs as you do on land, then there is potential to use the ergs for technical development, which can be beneficial by removing many complexities of rowing on water. An exploration around manipulating the degrees of freedom (Bernstein, 1967) on a rowing machine and the subsequent impact on retention/transfer could provide an invaluable tool for coaches and CLA researchers.

Learning to row around other people that are less technically developed stunts the growth of all involved, and where at all possible, rowing with more experienced people should be explored and considered. As well as picking up habits and language that will benefit their development, rowing in a boat which has fewer balance and timing issues will result in the stability that athletes may need to use as a platform/grounding to develop their movement solution.

### **Emergent theory**

The coach education process seems to be unpredictable with no emphasis on the formal education that they have received. Despite all learning with little-to-no shared experiences there are similarities in the way that the coaches view the athletes, their complexities, and how to work around this. The coaches' comments painted the athletes as being nonlinear, hence opening the door to constructivist paradigms and nonlinear pedagogies. Furthermore, the understanding of the skill of rowing is demonstrated to be a nonlinear process which involves manipulating the many interacting variable inputs that influence movement. Thus, both the athletes and the task are thought of as being nonlinear we might hypothesise that it is this combination which has led coaches to unknowingly develop partially into constructivist pedagogues. The athletes are encouraged to explore movement through exercises and changes of environment (such as rowing machines). Both exercises and verbal feedback have the potential to be used in either a constructivist or more traditional approach, but coaches have specifically voiced that they find success and eventually apply techniques which enable them to maintain the feeling of the stroke. No area of the study found the presence of a CLA without alternative (often more traditional) pedagogies being present and offering different insights into each area.



## **Conclusion:**

### Addressing the research question:

Many aspects of the coaches' comments reflect concepts that align to the CLA theory, both in the explanation of their sessions as well as the way they understand learning and skill development.

Thus far, the analysis has been a natural process that has not been constrained into directly addressing the research question. However, the discussions that are directly related to the extent to which the described practice and conversations correlate with the CLA pedagogy are summarised and labelled as either having a positive or negative relationship in table (6) (below). All of the findings that are in the table have been removed from their context but were either touched on by numerous coaches, a fundamental belief of a coach or both.

Although many points were discussed throughout the research not all of them directly address the research question or can be better understood to the research question. The following summaries in table 6 show understandings demonstrated by the participants which can be directly linked to the CLA pedagogy. The similarities and differences will then be compared to inform to what extent the pedagogic practice of elite rowing coaches is unknowingly underpinned by a Constraints-Led Approach.

	Positive relationship to a CLA	Negative relationship to a CLA
Current practice	<p>1a. Use of exercises in combination with verbal feedback resembles the theory.</p> <p>1b. When safe to do so athletes can explore their environment to develop their own solutions.</p> <p>1c. Preferred exercises demonstrate overlap with the CLA pedagogy.</p>	<p>2a. Novice athletes often met with a large amount of verbal feedback to try and give direct and clear instructions</p>
Theoretical rationale	<p>1d. Demonstration of action fidelity when discussing rowing machines</p> <p>1e. Representative learning design highlighted in conversations around the stretch of water trained on</p> <p>1f. Athlete learning described as nonlinear and chaotic</p> <p>1g. The skill of rowing being described as complicated due to the interacting variables.</p> <p>1h. Individual strengths and needs acknowledged in conversations around the training programme.</p>	<p>2b. Still a large focus on repetition and muscle memory.</p> <p>2c. Limited consideration on manipulating environmental constraints</p> <p>2d. Lack of emphasis on decision making</p> <p>2e. Current reliance on explicit instruction, potentially due to complexity of movement</p>

Table 6: Key findings and alignment to a CLA

Overall, there is evidence that a CLA lens offers valuable insights into current elite-level practice for junior level rowing. Two of the five areas that suggest that the current practice does not follow a CLA approach lack sufficient evidence to be seen as supporting a CLA stance, rather than consistently demonstrating an alternative position. To summarise, there is evidence that many elements of coaches' practice both resembles and is justified through a CLA. However, these are statements taken from multiple coaches that work with a variety of different students. The evidence is inconclusive in that it does not show that any or all of the coaches are consistently applying CLA theory but may instead suggest that a CLA is being applied at times by coaches in specific instances.

As well as discussing the extent to which the present study shows that elite level rowing coaching aligns with a CLA it is also pertinent to explore how the three discussed themes overlap with each other, as well as what they offer independently. The **Socialised understanding** theme explored how the coaches understood the athletes and their perspectives on what makes for an effective rowing stroke as well as what has informed that understanding. The **Barriers and approaches to understanding movement** theme discussed the barriers that rowing coaches face, most notably that athletes may struggle to accurately perceive their own movements/flaws, and what the coaches can do to overcome this issue. Finally, the **Learning and understanding "what works"** theme investigated the reasoning behind, and understanding of, what effective coaching is and how the athletes learn.

To some extent these themes can be regarded as independent of each other, but there are areas of overlap, also. To provide a graphic summary of potential interactions, figure 6 provides a Venn diagram illustration of the three themes and how the results of table 6 align with the discussion themes. As with table 6, factors which are consistent with a CLA explanation are in green, and those that do not are in red.

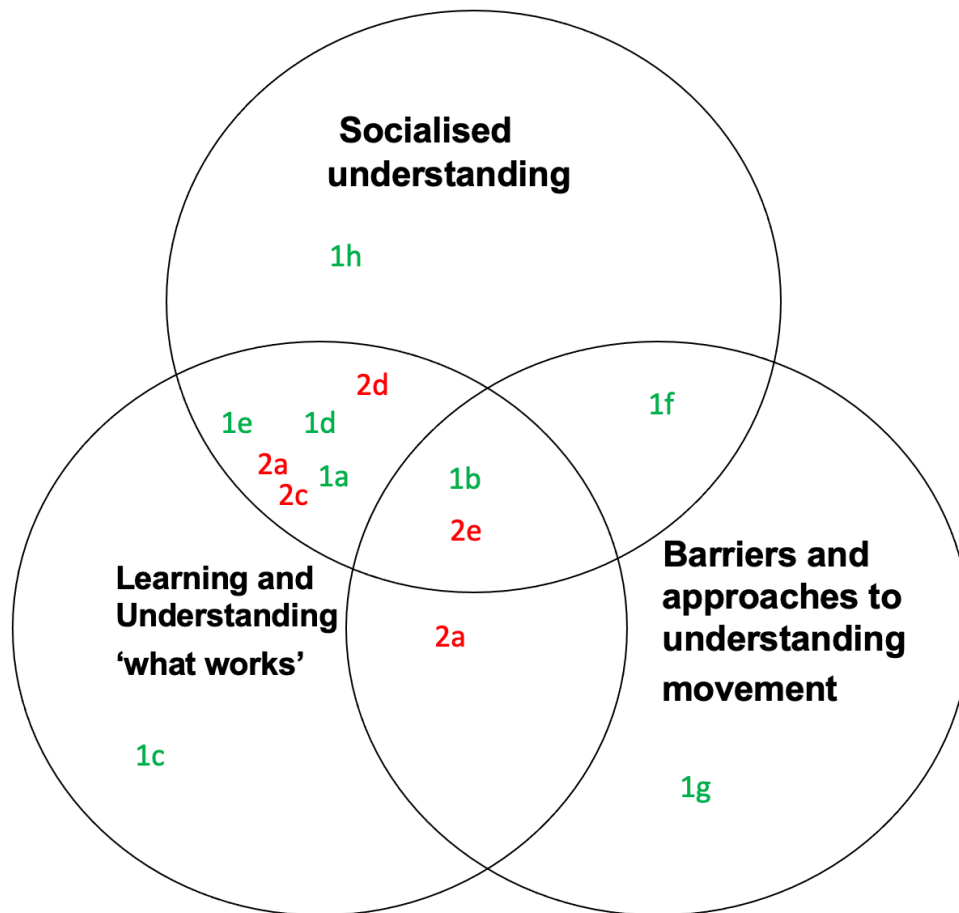


Figure 6: Showing how key findings relate to the research themes.

The present study has found the three research themes to be the most natural way to categorise the key findings from the study. However, this figure shows that the key findings are not evenly distributed across the themes. The emphasis on the **Learning and understanding 'what works'** section may be exaggerated due to the lack of observations, so coaches reflect through their feedback, giving the data a more practical basis and is constantly linked to coaching they have delivered. Two of the conclusions (1b and 2e) both have overlap with all three areas, which identify them as a stand-out as the clearest strength and barrier to the application of a CLA to current elite-level rowing coaching

### Key findings

Despite practitioners not being aware of the CLA pedagogy (Newell 1986) or its ecological dynamics background (Bernstein, 1967; Brunswick, 1956), findings suggest that the coaches have developed into pedagogues that are moving away from a traditional coaching approach (Potrac et al., 2007). Although this change in direction may not be based in the theory that specifically underpins a CLA, athletes are understood (whether naturally or potentially through a changing sports coaching landscape) as being nonlinear and the practice reflects that (Kidman & Hanrahan, 2010). These findings suggest that a CLA lens can help understand what makes for effective elite level rowing practice. However, to say that there truly is overlap between a CLA and current practice at the moment would be premature; the study was specifically designed to explore a potential CLA perspective in elite junior rowing coaching rather than see the approach discussed in a more open forum alongside other modern theories.

### Future research

Findings from the present study provide a starting point from which to further explore coaching practice and the theories underpinning it. One potentially fruitful area would be to investigate the encouragement of exploration in school age novice rowers and how that may resemble a CLA. Similarly, researchers are better equipped to experiment with applying a rowing coaching programmes based on a CLA model. A study of more rowing coaches with a less specific selection could offer information and start to analyse trends, particularly ones that analyse coaches' considerations as to what makes for effective exercises. The present study may provide groundwork for future research to do so.

Data from the present study and the resulting discussions suggest that there may be an option to apply to CLA in greater depth to a rowing programme. Such as the following:

1. Understanding and manipulating the training environment for novice athletes seems to have potentially unexplored discussions regarding a structured self-organisation process where the athletes understand which cues are relevant and which aren't

2. The use of rowing machines as a tool that improves the control the coach has but limits the extent to which athletes can maintain action fidelity and what CLA pedagogues might say about that specific trade-off?
3. How certain technical exercises that align with Bernstein's (1967) Degrees of Freedom problem (straight-arm rowing or square-bladed rowing) may be valuable to understanding what makes for a good rowing exercise and what doesn't.

### Reflection on study

The Covid-19 pandemic severely impacted data collection and meant that direct (face to face) observations were not feasible if the study was to be completed in a timely manner. Although the study was re-designed to function without direct observations, these would likely have added valuable insight to the research.

Working with nine coaches meant that sufficient variety was provided to ensure that any one individual or programme was not presented as representing elite-level rowing coaches. However, without having more coaches involved it is hard to truly say whether comments accurately reflect coach understanding and philosophy across the wider spectrum of elite level rowing coaching. Although the questions and analysis were designed in a way that attempted to reduce any researcher bias the potential for unknowingly bias, here in the form of the researcher's experience of studying a CLA must always be considered. However, as the study looked to explore the relationship between a CLA and elite-level rowing coaching any bias should not detrimentally impact the analysis, but potentially the data collection, thus, the methods section focussing on rigour and trustworthiness. Similarly, bias towards wanting to represent the rowing coaches in the most positive light due to a background in rowing could be possible, but as the primary purpose of the study was to analyse through a CLA lens there is no clear benefit to misaligning the theory to the practice.

Multiple consecutive interviews may offer further insight particularly into the underpinning theory, and ideally the researcher could have taken more time to ensure all of the coaches had an equal opportunity to discuss all relevant topics. The semi-structured nature of the interviews meant that some interesting statements could be comprehensively explored to provide rich data, but similarly this inevitably meant that some coaches covered certain areas in much less depth

than others, thus the combined thoughts of the coaches were not as fully and accurately covered as they could have been.

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**Appendices:**

Appendix I: E3 ethical approval

E3/FH&LS

**Oxford Brookes University**  
**Faculty of Health and Life Sciences**  
**Decision on application for ethics approval**

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The Departmental Research Ethics Officer (DREO) / Faculty Research Ethics Committee (FREC) has considered the application for ethics approval for the following project:

**Project Title:** Is the pedagogic practice of elite rowing coaches unknowingly underpinned by a Constraints-Led Approach (CLA)?

**DREC Ref:** 0120\_01

**Name of Applicant/s:** Nick Ward

**Name of Supervisor/s:** Simon Phelan


Please tick one box

1. The Departmental Research Ethics Officer / Faculty Research Ethics Committee gives ethical approval for the research project.

**Please note that the research protocol as laid down in the application and hereby approved must not be changed without the approval of the DREO / FREC**

2. The Departmental Research Ethics Officer / Faculty Research Ethics Committee gives ethical approval for the research project, subject to the following::

3. The Departmental Research Officer / Faculty Research Ethics Committee cannot give ethical approval for the research project. The reasons for this and the action required are as follows:

Signed: ...  ..... Approval Date: ..... 16.1..20.....

Designation: Departmental Research Ethics Officer  
(Signed on behalf of the Faculty Research Ethics Committee)

Date when application reviewed (office use only):..... 16.1.20.....





## Appendix III: Participant Information Sheet



Contact details of principal investigator:  
Nick Ward – [15064351@brookes.ac.uk](mailto:15064351@brookes.ac.uk) - 07799706298  
Contact details of study supervisor:  
Simon Phelan – [simonphelan@brookes.ac.uk](mailto:simonphelan@brookes.ac.uk) - 07969364403

### **Study title**

Is the pedagogic practice of elite rowing coaches unknowingly underpinned by a Constraints-Led Approach (CLA)?

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully

### **What is the purpose of the study?**

This study will explore the current overlap between current elite rowing coaching and a constraints-led approach (CLA) to coaching exploring the significance they have on each other. Namely; can the CLA framework be used to explain why the most successful coaches in the country are successful, but also, can the practise of elite coaches champion pragmatic examples of how this coaching theory can be applied to a highly technical sport.

### **Why have I been invited to participate?**

You are being contacted because of either your recent results at national-level events or your status as an international-level coach. By interviewing multiple top-level coaches, I hope to gain an accurate representation of what thought out and purposeful practice looks like in this country.

### **Do I have to take part?**

It is up to you to decide whether or not to take part in this research study. If you do decide to take part you will be given this information sheet along with a privacy notice that will explain how your data will be collected and used, and be asked to give your consent. If you decide to take part you are still free to withdraw at any time and without giving a reason, including the withdrawal of any unprocessed data.

### **What will happen to me if I take part?**

If you choose to take part, then we will arrange a time convenient for you to partake in the interview which will last anywhere between 45-90 minutes on an online video call (zoom). The questions will focus on your approach to rowing coaching and establishing how you developed. This interview should take place in a quiet and private location.

### **What are the possible disadvantages and risks of taking part?**

There are no clear risks to taking part in this study. The only disadvantage to you would be the time (up to 90 minutes) spent during the interview.

### **What are the possible benefits of taking part?**

This study has the potential to further our understanding of elite coaching in the country. By using specific coaching theories as lenses to analyse your sessions the findings could impact how we educate rowing coaches of all levels. There will also be a £50 amazon voucher offered for your time.

### **What should I do if I want to take part?**

To 'opt in' to the study please contact Nick Ward either by email or telephone (provided at the top of this document). There will then be a discussion as to when the interview shall take place.

### **What will happen to the results of the research study?**

The results of the research will be submitted as a dissertation for a MA by Research at Oxford Brookes University

The full study will be made available to you, as well as a copy of the executive findings, where the study will be presented in a more digestible size and specific to the parts you are likely to be most interested in.

**Who is organising and funding the research?**

I am conducting the study as a postgraduate student at Oxford Brookes University. Working under the faculty of Health and Life Sciences.

The study is not receiving any funding.

**Who has reviewed the study?**

The research has been approved by the University Research Ethics Committee, Oxford Brookes University.

If you have any concerns about the way in which the study has been conducted, you should contact the Chair of the University Research Ethics Committee on [ethics@brookes.ac.uk](mailto:ethics@brookes.ac.uk).

**Thank you for taking the time to read through this information sheet, I look forward to hearing back from you.**