“THE STUDY OF HEURISTIC BIAS WITHIN DECISION-MAKING RELATING TO OBSERVATION AND ANALYSIS STRATEGIES OF HIGH-PERFORMANCE COACHES”

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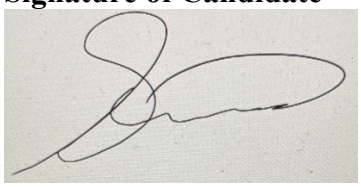

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Dedication

I would like to dedicate this thesis to my wife and children for all the years of support, love and guidance. Without their inspiration and encouragement throughout my life, this journey would not have been possible.

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I would like to take this opportunity to thank several people who have supported me, as without them I could not have completed this process.

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ABSTRACT

In an applied real-world coaching settings observation of athlete movement patterns has traditionally been utilised as an extensive assessment procedure and evaluation tool, that allows the coach to gather, monitor and evaluate performance. The effectiveness of the observer's perceptual sensitivity to the athlete's movement pattern and identification of performance errors are critical in providing feedback and directly impacting the coaching efficacy. However, observation of technique in this context is often characterised by subjective judgements on the observer within the sporting context is complex and criticised due to the inability of the observer to account for *invisible* factors such as cognition, intention or perception of the athlete. Critically, observation within sports coaching while it is universally utilised, it is rarely defined or agreed upon within the literature. In guiding coaching efficacy, observation within the sport is an area with a relative paucity of research and lacks a clear definition, with even less applied knowledge available to guide and educate the coach at the coal face.

In addressing these shortcomings this thesis sequentially examined the observational process of a holistic group of adventure, performance, and Paralympic high-level coaches to examine the development of naturalistic observational [of athlete performance] strategies, associated mental models of performance and associated decisions of high-level coaches in Olympic, Paralympic and Adventure Sports. The research process has used a pragmatist approach of enquiry influenced by real-world naturalistic philosophies to examine the research questions in 'real life' settings, as is the nature of a Professional Doctorate. The examination of coaching decision-making related to observation from such a naturalistic stance, has resulted in the utilisation of an innovative research design, which uniquely blended methods of Applied Cognitive Task Analysis with the approach of Interpretive Phenomenological Analysis and Thematic Analysis.

In meeting the research aim this thesis makes a unique contribution to both professional practice and knowledge. The thesis contributes and extends the body of research, in the area of technical Shared Mental Models (SMM) for individual sports, variance within Olympic and Paralympic athlete individualisation and the use of expertise in generating bespoke knowledge.

The results of the studies found. 1) The SMM can be developed and utilised as an observational tool, at an individual athlete level to identify technical psycho-motor – psycho-social needs. 2) Understanding how the level of cognitive challenge related to observation is reduced. Coaches utilise naturalistic decision-making processes to manage the complexity of coaching and that these processes are linked to experience. 3) Coaches manage observational complexity through experience and the support of experts to develop, augment and create knowledge. 4) Understanding how to reduce this challenge extends the literature in how more effective decisions can be made by the coach, through an enhanced understanding of the SMM. 5) Insights gained within this thesis help to understand observation within the sporting context by making SMMs explicit and understanding associated decision-making.

Accordingly, the thesis offers original insights to support formal para-sport coach education and mentoring regarding the SMM. Through this knowledge exchange process, coaches are able to modify and individualise their practice to the needs of the athlete. The findings add and evidence that these SMMs cannot be transferred from Olympic to Paralympic Sport. The overlay of a generic template derived from coach education based on Olympic SMMs is ineffective due to variance of Paralympic athlete needs.

At an applied level there have been a number of key insights that have provided Great Britain athletes a performance advantage at the Tokyo Games. This work is unique in that it is the first time that the researcher has held a dual lens of being a Head Coach within the same sport of both an Olympic and Paralympic team in considering the SMM and the technical models of observation they utilise.

Table of Contents

List of Figures

List of Tables

Applied Impact of Research

Toky2020 Olympic Games	**Athlete - Event**
Bronze Medal	Liam Heath: K1M 200M –

Toky2020 Paralympic Games	**Athlete - Event**
Gold Medal	Emma Wiggs: VL2W
Gold Medal	Charlotte Henshaw: KL2W
Gold Medal	Laura Sugar: KL3W
Silver Medal	Emma Wiggs: KL2W
Bronze Medal	Robert Oliver: KL3M
Bronze Medal	Stuart Wood: VL3M
Bronze Medal	Jeanette Chippington: VL2W

List of Abbreviations

Abbreviation	Full Term
ACTA	Applied Cognitive Task Analysis
CDM	Critical Decision Making
Classical DM	Classical Decision-Making Theory
DM	Decision-Making
DM Framework	Decision-Making Framework
IPA	Interpretive Phenomenological Analysis
MM	Mental Models
NDM	Naturalistic Decision Making
RPD	Recognition Primed Decision Making
SA	Situational Awareness
SMM	Shared Mental Models
Team DM	Team Decision-Making
TA	Thematic Analysis
Canoe specific terms:	
DPS	Distance Per Stroke
SPM	Strokes Per Minute
SR	Stroke Rate

Publications and Proceedings as a result of this thesis:

Peer reviewed Journals

Simon, S., Collins, L. & Collins, D. (2017). Observational heuristics in a group of high-level paddle-sport coaches. International Sports Coaching Journal, 4(2), 235–245. https://doi.org/10.1123/iscj.2017-0012

Collins, L., Simon, S., & Carson, H. (2018). Para-Adventure: A hyper-dynamic problem for the inclusive coach. Sport in Society, 22(7), 1165–1182. https://doi.org/10.1080/17430437.2018.1504776

Simon, S., & Richards, P. (2022). Individualising Coaching in Olympic and Paralympic Worlds: An Applied Perspective. International Sports Coaching Journal, Vol 9 (3), 382-389.

Simon, S., & Richards, P. & Day-Garner J. (2023; In review). Investigating Observational Difficulties and Expert Skills in Elite Olympic and Paralympic Coaches Using an Applied Cognitive Task Analysis. Journal of Expertise.

Simon, S., & Richards, P. & Day-Garner, J. (2023; In review). An Interpretative Phenomenological Analysis of Athlete Individualisation and Shared Mental Models in Paralympic Sport. Journal of Expertise.

Key Reports/Presentation:

Simon, S. & Richards, P. (2023). A Case Study: Investigating Cognitive Observational Difficulties and Expert Skills in Elite Olympic & Paralympic Coaches Using an Applied Cognitive Task Analysis. NDMA CTA in Action Initiative.

CHAPTER ONE: INTRODUCTION

1.1 Introduction and statement of the research problem

Within my professional role as Head Coach of an Olympic and Paralympic World Class programme, preparing athletes for World Championships and the 2020 Tokyo Olympic and Paralympic Games, I became aware of the complexity and challenges within the coaching team. Specifically, in how a team of experts effectively individualise coaching interventions to athletes. After 20 years working as a high-performance coach including preparation of athletes for Olympic and Paralympics games I was passionate about understanding key aspects of my own coaching. In particular ensuring that my 'real-time' observation of performance could be translated into real-time feedback to best support the individual need of the athlete. Using the vehicle of the DProf, I challenged my own coaching practice and simultaneously explored the cyclic link from theory to practice within the sport of high-performance canoeing.

Within my working practice I spend most of my time in an ever-evolving environment coaching sprint canoeing. The weather, water and athlete are constantly changing, placing a challenge on the coach's ability to compare and contrast like for like observations in providing real-time feedback. Observation in this context is not just about receiving and giving information but rather making sense-of and interpreting multiple information sources on the fly. Elite (and possibly all) coaches are challenged by the ability to sense make of this information, in real-time and consequently need to draw on multiple sources of knowledge, expert opinion and experimentation in getting their observation right.

Further, in leading and managing an inter-disciplinary support team (physiotherapist, strength & conditioning, psychologist etc.,) I noticed that technical coaches struggled to define the shared performance vison they wanted the inter-disciplinary team to support them with in individualising coaching interventions and plans to athletes. The coaching and inter-disciplinary team lacked clear terminology and congruent vision to describe performance,

elements, or phases and often worked from competing technical templates of performance. Consequently, collaboration was limited within the team and resulted in a lack of clarity as to which elements of performance needed to be prioritised, in order to best support individualised athlete development. The challenge of collaboration was further increased as coaches and inter-disciplinary staff worked across Olympic and Paralympic domains and overlayed the same technical model they worked from across both athlete cohorts. In short, the team were unclear as what to observe for, couldn't accurately describe elements of technical performance, or agree on what an individual athlete required to support their progression. Consideration was not given to how the impairment of the athlete required an adjustment to the mental model (MM) of the coaching staff.

My assessment of this issue as Head Coach was that technical coaches were applying technical models as a basis for observation out of context and overlaying generically to each athlete. For example, upper body rotation frameworks for Olympic athletes, overlaid against a Paralympic athlete. Within this exemplar spinal cord injury and corresponding impairment that limited or prevented upper rotation and the overlay of generic technical models. Accordingly, coaches were observing for elements of a generic technical model within the athlete's performance, then prescribing coaching interventions and feedback based against a one size fits all approach, rather than a bespoke model which was determined by the athlete need. In addition, the cognitive demands placed upon the sport coaches in complex environments were challenging, facilitating a setting where coaches experienced a high cognitive workload. Consequently, coaches were cognitively challenged to observe their athlete's performance in real time (e.g., the speed of the paddle stroke cycle). Coaches were, therefore unable to define the individual need of the athlete and corresponding individualised coaching intervention. Therefore, to improve performance and better individualise coaching, understanding how coaches observe performance, create, observe and work from their MM relating to sport

specific demands would help remove observational complexity and allow individual MMs of athlete performance to be generated.

In addition, when leading and co-ordinating inter-disciplinary staff, development of a shared awareness of the athlete would support the creation of a bespoke athlete MM. Accordingly, in understanding the MM of performance the individual athlete required, the technical coach would be more able to define the performance problem and co-ordinate team collaboration to solve and in doing so create a shared mental model (SMM). Consequently, coaches and inter-disciplinary staff would have greater clarity against which they could base their real time observations and better prescribe coaching interventions against a shared vision of performance (SMM). In summary, MMs and within the management context, a SMM may be seen as a vehicle to influence coaching feedback (Richards, 2009), in a manner which was personalised to the athlete. Defining the SMM would also allow the performance specialists within the inter-disciplinary team to contribute their discipline specific expertise.

Importantly, within the applied real-world context of this thesis and supported by the literature (McGarry, 2009), a further challenge is that coaches often may have to rely on their own senses, devoid of performance analysis software, and have a one-off, real-time view of the performance to gather information. Supporting this view, and within the context of this research, coach's decisions are often in extremely stressful situations (Johnson, 2006). Critically, McGarry (2009), contends that in managing these stressful situations, coaches try to shape future decisions based on observation of athlete past behaviours and points out the inherent failings of the human observer (coach), in this process. However, while the current research has highlighted the issue, there is currently very little practical guidance as how to address this challenge at the coalface, and especially at the World Class level across Olympic and Paralympic domains.

In turning to the literature at the outset of this DProf learning journey (2015), it was clear

there was a need for further research in the operationalisation of coaching observation and the adaption of the MM/SMM to the individual athlete, in order to provide practical advice and research to coaches at the coal face. While there has been much written on observation, there is a gap in knowledge when observing in complex situations. Overcoming this challenge for the coach in the real-world isn't just about observation, but rather managing decision-making, near instantaneously, while (in the canoe context) riding a bike, operating a stopwatch, at distance from the athlete (and in a Paralympic context), understanding the effect of an impairment and at speed. Within the context described above, there is a paucity of information relating to observation and associated SMMs. Additionally, there is lack of knowledge within these domains within Paralympic sport, which this thesis aims to address. As sport coaches seek to have a positive impact on their athlete or performers, a key outcome of a coach's decision-making should be the quality of information they observe from their athletes and how this is processed to make accurate, relevant timely and informed decisions. Therefore, creating the ability to feed back to athletes quickly within pressure environments (Cote & Gilbert, 2009). Accordingly, athletic competition requires extremely complex, and coaches are required to make critical decisions in complex situations (Kaya, 2014). A coach is confronted with a bombardment of information that they must make sense of, interpret and act upon to improve performance. Lyle & Cushion (2010), state that the collection of this information and data is fundamental to effective coach decision-making.

Consequently, in translating the research to the real world it was clear there was a gap in knowledge concerning observation within sport coaching that is due to the inability of the observer to inform coaching judgements (Martin, Holder & Winter, 2019). However, as a further applied issue, within my professional domain, this challenge was made more complex by coaches working and applying generic MMs across Olympic and Paralympic domains. within canoeing. As a Head Coach, it was considered that detangling associated MMs would

support enhanced athlete individualisation and the generation of SMMs within the coaching team that would support individualised athlete interventions. While the literature and coach education resources may say that coaches can apply generic MMs to any athlete, my experience led me to believe otherwise, and resulted in this course of study. Therefore, if the coaches had more robust and individualised MMs then the quality and interpretation of information observed would be of a higher efficacy. These questions lead to the thesis aim and research questions (RQs) being created which will be addressed next.

1.2 Research aim and objectives

Aim of the research. To examine the development of naturalistic observational [of athlete performance] strategies, associated mental models of performance and associated decisions of high-level coaches in Olympic, Paralympic and Adventure Sports.

The scope and objectives of the four studies within this research is to examine four RQs:

1. How do elite high-performance coaches working in paddle-sports observe and analyse the performance of their athletes in a naturalistic setting?
2. How do elite high-performance coaches develop shared mental models of performance and integrate naturalistic in-action observations within their decision-making process?
3. When coaching in real time does a high-performance coach in paddle-sport utilise real time observations to inform coaching feedback and individualise their practice or is there an adaptation of predetermined established (Mental Model) models generated by experience?
4. Can the integration of coach's technical observation and knowledge of performance determinants (e.g., athlete, environment) be unified into a sports specific shared mental model which can be understood as a Shared Mental Model and adapted by a

team of coaches collaborating to improve individualised athlete performance in paddle-sport?

In addressing the aim and research questions, the structure of the thesis is presented next.

1.3 Outline of Thesis

Following on from this chapter, Chapter two contextualises the research aim in context of the professional setting and discusses Paralympic considerations. Chapter three then reviews relevant literature relating to observational complexity within sports coaching to inform the reader further of the challenges described in 1.1. Chapter four outlines the methodological considerations in answering the RQs and informs the approach used in the studies. Four studies are then presented in Chapters five, six, seven and eight that addresses RQ's in context of the Olympic and Paralympic campaign for Tokyo 2021. The thesis therefore justifies the approach taken, the methodological processes applied and the findings of each study. The four studies are briefly outlined below.

1.3.1 Chapter Five: Heuristics within the observational process in a group of high-level paddle-Sport coaches. Chapter five utilised an Interpretative Phenomenological Analysis methodology to address the research question of examining the development of naturalistic observational [of athlete performance] strategies and associated decisions of high-level paddle-sport coaches in Olympic, Paralympic and Adventure Sport.

1.3.2. Chapter 6: Adapting observation in para paddle-sport. This Chapter aims to understand how personally constructed observational cues and MMs identified in Chapter five, are transferred to a new coaching context, and individualised to the athlete. This study employs Thematic Analysis to shed light on how elite high-performance coaches working in parasport paddle-sports, observe and analyse the performance of their athletes in a naturalistic setting,

and identify commonalities and differences in how coaches adapt their MM to their athletes and coaching context.

1.3.3. Chapter 7: Shared Mental Models within Paracanoe. This study examines through Interpretative Phenomenological Analysis, a group of Paralympic coaches working within a World Class Programme with the support of multi-disciplinary teams. It explores how the coach's MMs are shared and made usable within those teams. In doing so Chapter seven will shed light on how the SMM can be individualised for athletes to inform coaching feedback and individualise coaching practice.

1.3.4. Chapter 8: A Case Study: Investigating cognitive observational difficulties and expert skills in elite coaches using an Applied Cognitive Task Analysis. In answering the real-world performance questions, this Chapter explores through Applied Cognitive Task Analysis, the challenge of creating an SMM in the Paralympic sport of Paracanoe. More specifically, this chapter explores what are the knowledge and principal components of the performance specific to the start phase of the race and how coaches and performance specialists who collaborate within a World Class Programme have derived their athlete specific SMM for performance. The chapter examines the differences in the Paralympic and Olympic Programme coaching team's SMMs, terminology and definitions of phrases. These differences will be examined within the acceleration phase at the start of the race, which is a vital aspect of successful race performance. The studies are presented in full detail within the specific chapters, before the thesis is summarised and contribution to knowledge presented in Chapter nine.

1.4 Overview of the philosophical stance taken

In managing the complexity of my coaching reality, I am drawn to pragmatic philosophy (Dewey 1910; 1929). Or more simply, having the tools available for coping with my reality (Jones & Hemmestad, 2019). I support the pragmatic stance of Nelson & Groom (2012), in that I will use all available tools to help inform coaching inquiry. Therefore, rather than researching through or of sport, I intended to research for sport (cf. Collins & Kamin, 2012). In supporting this applied application of knowledge gathered through this course of study, I am drawn to the pragmatic nature of abductive reasoning (Morgan, 2007). Abductive reasoning allows thought to be converted into theories, and then assessed through action. In addition, the applied nature of my work (and research context) relies on the ability to work along a subjectivity (coaching art) and objectivity (coaching science) continuum. Here a pragmatic emphasis is required to allow duality as a Head Coach and researcher, that allows communication and shared meaning to develop insight through an intersubjective approach (Morgan, 2007). Therefore, this course of study while qualitative, in nature, should be seen as supplementing, refining, enhancing, and adding a new intellectual property to our daily practices. If it *(the learning from this research)* doesn't make the boat go faster, it will not meet a key personal driver for embarking on this course of study. The pragmatic nature of abductive reasoning in moving back and forth from induction to deduction to connect theory to data (Morgan 2007), will be the overarching focus with the objective of making a difference. To help contextualise the research setting the next chapter provides clarity as to the real-world context in which individualised athlete performance is set. Chapter two presents considerations as to the Paralympic landscape, specifically arguing that it is not acceptable to transfer a non-disabled MM to a Paralympic context.

CHAPTER TWO: THE PARALYMPIC LANDSCAPE

2.1 Introduction

My current professional role and the main motivation for interest in this area of research is that of Head Coach on a World-Class Olympic and Paralympic Programme. This unique perspective brings an applied understanding of the decision-making process, which underpins coaching pedagogy and coaching processes. Therefore, within my professional world and somewhat uniquely within the British World Class sporting system, I have a novel perspective in having a dual lens on Olympic and Paralympic Sport. Paralympic athletes deliver outstanding performance that rivals that of their Olympic counterparts (Wareham et al., 2018). My real-world setting and that of the research is situated in pressurised, high-performance sporting contexts, working in complex, naturalistic environments, with Paralympic athletes. Often the MMs that support Paralympic athlete development in this world, are at least initially nebulous and often modelled on Olympic education, experiences and research. In addition, these MMs of performance may be applied by a coach transferring from non-disabled disciplines, into parasport, via a one size fits all approach to coaching (Fairhurst, Bloom & Harvey, 2017; Wareham et al., 2018). Consequently, this chapter aims to present the professional context of this research, exploring how coaches operationalise performance Mental Models (MMs) and develop a Shared Mental Model (SMM), in the context of the Paralympic landscape.

The exploration of the operationalisation of the professional context in which SMMs are developed within Paralympic Sport refutes the claim that Paralympic sport is a microcosm of Olympic performance. Instead, the Paralympic landscape should be viewed and thus coached, in a bespoke manner that integrates the needs of the athlete, the event, the environment and the coach. All encapsulated in an SMM that is bespoke to the athlete and the

performance. In exploring these issues, it is envisaged the reader will gain useful insight into the Paralympic performance environment in which this research is situated.

Additionally, this chapter also aims to present the context of the research and considers the importance of the alignment of the philosophical lens through which disability and hence SMM is considered in line with RQ 1. In addition, it will consider how an SMM developed by a coach transferring into Parasport may be adapted in addressing RQ 4. Furthermore, consideration is given to exploring how the integration of Parasport coaches' technical observation and knowledge of performance determinants (e.g., athlete, environment) become unified into a sport specific SMM, which can be understood as a SMM. Such SMMs are adapted by a team of coaches collaborating to improve individualised athlete performance in paddle-sport to address (RQ 3 & 4) highlighting how coaching needs to be personalised to the Paralympic athlete. This is a key focus for this thesis.

Having outlined the objective of this chapter above, its approach has been shaped by addressing RQs 1, 3 and 4. To address these questions and objectives the chapter will first outline the challenge of working with the wicked problems (Horn, 1998), in high-performance environments, before exploring these issues by first considering the current definitions and theoretical models of disability within the literature. From there, elite sport will be explored within the Paralympic setting and consider classification. It is hoped this awareness will highlight the complexity of the Paralympic landscape to the reader. Subsequently, I present considerations for the transferring coach moving from Olympic to Paralympic sport, where coaching the athlete and person is the key, highlighting the need to individualise and personalise the coaching to accommodate the impairment of the performer. Finally, the chapter will explore challenges to the coach of working in Paralympic settings.

2.1.1 The Paralympic landscape. In helping to set the naturalistic context of the research presented in this thesis, it would be helpful to consider the Paralympic landscape, in which it

is set. The current growing literature within Paralympic populations within elite sports, while useful in providing insight into coach education, is not considered through a contemporary lens (Fairhurst et al., 2017). Agreeing with Fairhurst it fails to consider the context and specificity of sources of knowledge and application of the parasport coach. Crucially within the context of this research, the pervasive dominant discourse within coaching literature remains misaligned to the effective individualisation of parasport athletes. Such a discourse aligns with assumptions driven through a medical lens (Townsend, Smith & Cushion, 2016) and is viewed through a none-disabled prism. However, if the SMMs described within Chapter three are accepted as needing to be unique or individualised to the athlete, then logically these assumptions must be challenged to generate bespoke SMMs within a Paralympic context. More simply when applied to a Paralympic athlete (or arguably any athlete) within naturalistic settings, an 'off the shelf' SMM cannot apply, as effective SMMs must be bespoke to the context, and the individual.

Indeed, Townsend and colleagues (2016), argue that within parasport populations the reproductive nature of coaching should be critically appraised and unpacked within the complexities of a real-world setting. Such a critical appraisal appears especially important to decipher the multiple, inter-related factors (disability, impairment and performance demand etc) that lack an obvious solution as described in Chapter three. For example, coaching problems with no definable problem statement, no objectively correct answer, and layers of uncertainty and complexity (Maurer & Thomas, 2014). Therefore, what appears key in developing a satisfactory working SMM is not only the knowledge content of the coach (technical side of SMM, Richards et al., 2009), but how the knowledge is contextualised in the parasport environment (non-technical side of SMM, Richards et al., 2012) and even further in context of the individual athlete within the parasport. Consequently, through this contextual critical appraisal, coaching practice is therefore challenged, considered and athlete

experience enhanced. So, in the context of this thesis, it is helpful to understand what are the differences between Paracanoe from the Olympic Sprint disciplines from a pedagogical stance?

2.1.2 Paracanoe: Contextualising the landscape. The unique characteristics and factors that outline the differences between Paracanoe and Olympic Sprint disciplines are presented below. The first consideration is that the Olympic and Paralympic events have subtle knowledge contextualisation differences for canoeing. While Paracanoe and Olympic Sprint share commonalities in an integrated competition format and environment, racing in lanes from A to B on a flat-water regatta course. Olympic Sprint events are raced over 200m, 500m and 1000m distances in single, double and four-person kayak. Paracanoe is raced over the 200m distance exclusively in a single kayak. Within the shared 200m distance, Paralympic race times compared to Olympic Sprint events are between four – 24 seconds longer in relative duration, dependent on boat class, (explored next). Both contexts of para and Olympic paddle-sport from a strategic view, require similar athlete preparation and race plans to support the physical performance and energy system used. However, the additional complexity of the impact of impairment and the strategic delivery of a race plan (bespoke to the individual and their impairment) to manage the effort, may greatly influence what initially at least may appear as a similar task.

While both disciplines may share common principles, these principles relate to the demands of the sport. However, these must be tailored to the Paralympic athlete to influence the approach taken within the coaching process, in turn influencing and shaping the SMM. Secondly, the equipment is different for Olympic and Paralympic canoeists. Paracanoe kayaks while equivalent in regulatory length are wider than Olympic Kayaks to provide additional stability and help mitigate the impact of an impairment. Consequently, the drag factor (the resistance of water) the athlete must overcome to propel the kayak is greater for

the Paralympic athlete. Therefore, to achieve an equivalent boat speed the Paracanoe athlete must exert a greater force than that of their Olympic counterpart. While impervious to the eye of the observing coach, contextualisation of this knowledge is key to understanding the performance demand on the athlete.

Understanding the additional Paracanoe equipment demands requires the coach to consider how the athlete either modifies or adapts their technical or tactical models, in the context of their impairment to achieve success. In addition, the Paralympic athlete may need a bespoke boat modification to be better supported at the seat, footrest etc. to help them balance, stabilise within the kayak and transfer force to the water through the paddle. Such considerations add more complexity to the SMM and associated delivery within the coaching process. Understanding the interface between boat modification and impairment is key in helping provide effective SMMs of performance.

The third consideration relates to individuality, as a nomothetical approach cannot be taken. The one thing humans have in common is their individuality. Therefore, while individualisation is relevant to all athletes, the impact of impairment on any one person requires the personalisation of the SMM by the coaching team. Within the coaching process, general principles that generate a core amount of information are transferable across individuals. In this way, key technical points are delivered generically to all athletes. For example, in kayaking the grip and width of hand placement on the paddle or gait patterns in walking or running. However, within a Paralympic setting, such core information either does not exist or is difficult to decipher as the impairment of the athlete may make the information redundant.

Therefore, technical points need to be made bespoke to the individual as well as the ideographic approach taken in the form of delivery. Such a process requires the technical side of the SMM to be designed in a manner that is bespoke to the Paralympic athlete and their

impairment needs. Through this personalisation of information and delivery, coaches within parasport settings can better understand the functional ability, physiology and psycho-social components of the athlete (what they can do) (Piggott, 2015) and support asset-driven MMs (explored later).

Therefore, this chapter aim is to explore how high-level coaches working in paddle-sports conceptualise, observe and analyse the performance of their athletes in a naturalistic Paralympic setting. In considering this question, the following section will therefore firstly look at the definitions of disability, before considering how disability is viewed through theoretical models. The nature and context of elite Parasport and classification are then subsequently explored before considerations of Parasport and expertise implications for the coach transferring into Paralympic sport are discussed.

2.2 Defining disability

It is relevant to define disability within the course of this thesis as it is essential to understand the context the athlete and coach work within, and the effect of the impairment on performance, or rather perception of performance. While there has been a growing interest in Parasport research relating to athletes, the interest in how both Parasport and Paralympic coaches learn and develop remains limited (Taylor, Werther & Culver, 2014), with much of the research on coach learning focussed on elite coaches of non-disabled athletes, (Fairhurst et al., 2015; Rangeon, Gilbert, & Bruner, 2012). The lack of research in this area is surprising given the increasing status of the Paralympic athletes. In common with Olympic athletes, it is widely accepted that in helping to support the athletic development of Parasport and Paralympic Sport athletes and performers, the role of the coach is critical to improving the performance of athletes with a disability (Kean, Gray, Verdonck, Burkett & Oprescu, 2017; Wareham, Burkett, Innes, & Lovell, 2018).

Disability in this thesis is defined as those with physical or mental impairments which have a substantial and long-term adverse effect on their abilities to undertake day-to-day activities (Disability Discrimination Act, 1995). Within the professional field in which I work and the research context of this thesis, the ter*m parasport* will be used interchangeably to define both competitive and non-competitive sporting activities for people with a disability, (International Paralympic Committee, 2021; Wareham et al., 2018). Paralympic sport is the term used to define High-Performance sports activities undertaken by athletes with a disability within International Paralympic Committee (IPC) governed sports (International Paralympic Committee, 2021).

In helping to understand the world in which this research is situated, it may be important to consider how coaches conceptualise and understand parasport and the effect of impairment and disability on the coach's MMs of performance. The Parasport coach's perception of the individual may be understood by considering the influence of theoretical models that capture how disability is understood and viewed in society (Townsend, Smith & Cushion, 2016). Consequently, if influenced through these models of disability, either knowingly or unknowingly, coaching decisions or methods may be selected based on dogma or incoherent guidance. For example, applying an SMM derived from non-disabled coach education courses to a bi-lateral above knee amputee or the selection of a coaching venue that does not consider accessibility needs such as pontoon height for a wheelchair user. Logically SMMs based on this incoherence would not improve the performance of the athlete. Therefore, understanding the societal factors and the models of disability that influence a person's perception of disability may help provide a curious and critical parasport coach with the tools to deliver a coaching coherence and expose coaching dogma within the parasport domain. These theoretical models of disability are explored next.

2.3 Exploring disability through a theoretical lens: overview of models of disability

Helping to understand the person for whom an SMM is designed is important within parasport (DePauw, 2000; Townsend, Smith & Cushion, 2016). Understanding these models of disability will help coaches to consider how they conceptualise and position disability, and associated impairments, and how these factors influence, either knowingly or unknowingly, the coach's practice and engagement in the coaching process. In other words, how the coaches apply their practice in a parasport setting will be influenced by the lens through which they view disability, and presumably how the SMM is therefore conceptualised. For example, if the coach views disability as something that must be fixed or normalised, the SMM that supports this normalisation, may relate to a non-disabled template or ideal and not allow accurate individualisation. In researching coaching and coach education practices within parasport Townsend, Smith & Cushion (2016), examined and reviewed four models of disability. Through considering these models Townsend and colleagues found that coaches of Parasport athletes could question how they could make sense of, form coaching knowledge and learn to coach in Parasport settings. The models of disability are presented below to inform the reader of the lens through which disability may be conceptualised.

2.3.1. The Medical Model. Perhaps the most pervasive and dominant model within disability research (Smith & Perrier, 2014). Emerging from clinical practice the medical model positions disability as defined by the functional limitations of the impairment (Swain, French & Cameron, 2003), or more simply, what the person cannot do. Viewed through the medical lens disability is seen as something that should be fixed or cured and creates a social narrative of disability as something abnormal. The lived experience of disability is ignored with the person seen as socially and culturally 'different' and viewed as disadvantaged (Oliver, 1996). More simply, a person with a disability is treated as someone who must be fixed, is judged by what they cannot do and gives rise to coaching behaviour that attempts to standardise the

person against a preconceived *normalised* ideal and encouraging a nonethical approach to coaching. Consequently, the medical model ignores the formation of individualised or unique coaching knowledge, focusses on athlete limitations and instead superficially focuses on medical functionality (Denison, Mills & Konoval, 2015). Therefore, SMMs may be based on non-disabled ideals. For example, overlaying a nondisabled running gait pattern and training modalities to an athlete with through knee unilateral amputation whose impairment makes it impossible to achieve.

2.3.2 The Social Model. The Social Model suggests that disability is entirely a social construct, that is overlaid on top of impairment (Thomas, 2014). In 1976 disability activists from the Union of the Physically Impaired Against Segregation (UPIAS) attempted to reclaim the term disability from the medical discourse (Thomas, 2014) and reconstruct disability as entirely socially constructed (Oliver & Barnes, 2010). The Social Model argues that disability is a collection of imposed barriers that create disadvantages and exclusions for people with impairments (Thomas 2014). These barriers permeate all aspects of daily life such as transport, housing, employment and accessibility to many buildings. Put more simply, all people could be considered equal until society imposes a barrier on one of us.

Within sports, social examples may be exclusion policies, restricted venue access, and inadequate changing facilities to name a few. Indeed, I would argue that within academia the paucity of parasport research and consequent stagnation in associated coach education and development could be attributed to a social model lens. This thesis aim is to directly explore this under-researched area within coaching and make a new and unique contribution to the development and application of SMMs within Parasport,

2.3.3 The Social-Relational Model. The Social Relational Model of Disability (Thomas, 1999; 2007) views disability through the social-cultural and historic activities that influence collective activity (Townsend et al., 2016). Therefore, disability is given meaning through the

relational practices that shape how people interact with each other and experience the world. The social-relational model allows coaches in parasport to utilise a dynamic process built on a coach-athlete relationship that allows both agents to contribute to the coaching process (Townsend et al., 2016). Through this model, the athlete can be viewed as a unique person and is encouraged to contribute to the construction of knowledge through sharing the embodied experience of disability, with the coach sharing sport-specific knowledge in a co-construction of a performance solution (McMaster, et al., 2012). While not the primary focus of this research understanding the models of disability is important in framing the person, the athlete, and the performance demands of their sport in conceptualising an individualised SMM.

More simply a personalised social-relational lens helps develop an asset-driven paradigm of what the athlete can do, rather than what they cannot (coach the athlete not the disability). In this way, the coach can consider and respond to the ideographic needs of the athlete and how they might achieve a performance solution to create a unique and personalised SMM even if underpinned by generic concepts. Consequently, if individualisation is the goal of the coaching process, then an asset-driven philosophy of what the person can do is critical in knowledge construction and practical truths (Piggott, 2015).

Furthermore, if a unique SMM is to be designed for the athlete to enhance performance, which has been generated by the coach, then such a bespoke individualised SMM must be personalised to include the characteristics of the person and context in which they perform. Moreover, such a complex process within elite sports occurs within high stakes, complex and chaotic environments where the coaching process occurs. In addition, within a Paralympic setting, the variation in athlete movement may demand a higher level of variance with an SMM and consequently, an off-the-shelf SMM cannot apply. Therefore, a social-relational lens would be useful within coaching and especially Paralympic coaching.

2.3.4 The Human Rights Model. The Human Right Model was the first model to address the diversity and equality rights of disabled people, (Rioux & Heath, 2014; Townsend et al., 2016). The Human Rights Model shifts the view of people with a disability as passive objects without rights and toward facilitating basic freedoms that are taken for granted such as access to and the playing of sports (Rioux, 2011). Therefore, participation in sport is a fundamental human right and consequently, people with disabilities are entitled to participate on an equal basis with others (Hassan, McKonkey & Dowling, 2014). Consequently, the Human Rights model champions inclusive policies, practices and environments that support and involve people with disabilities in sports (Townsend et al., 2016).

2.3.5 The Theoretical models of disability applied to coaching. While a medical model may have some applications in the initial rehabilitation of an acquired impairment, I would argue that it is limited and outdated in a Paralympic setting. As described earlier, the medical model focuses on normalised ideals and what the athlete cannot do and within a coaching perspective on an SMM that may not be possible to attain. The social model has a high application by considering disability through the athlete's perspective and therefore is useful in removing both physical and imposed barriers to allow participation and involvement within the coaching process. The social-relational model allows for an asset-driven philosophy and positions the athlete at the heart of the process of generating solutions and bespoke interventions. However, all of the models are underpinned by the Human Rights Model that provides equity and equality as basic rights, with the consequential policies, practices and environments in which to develop.

While presented and considered individually, all the models have limitations such as considering the athlete's experience and perceptions. However, if the concept of disability could be considered as a whole, it may very well represent a theoretical lens fit for 21st Century Parasport. Indeed Townsend et al., (2016) call for more research in this area to create

a Meta-Model that provides new insight into disability sports coaching with a powerful rationale for researching Parasport. Having discussed the implications of theoretical models of Disability, the nature and context of Elite Parasport Sport are explored next.

2.4 The nature and context of elite parasport

The pinnacle of Paralympic Sport is the Paralympics Games. The Paralympic Games are set within a four-year cycle and have emerged as the second-largest global sporting event (Leprêtre et al., 2016; Purdue & Howe, 2012), with 176 countries competing in the Rio 2016 Paralympic games. The growth of the Paralympic movement, competition and athlete status led to growth at successive Paralympic games (Falco & Bloom, 2015). From humble beginnings in which 16 wheelchair athletes competed in 1948, the Paralympic movement is now professionalised with 4000 athletes expected to compete in the rearranged Tokyo Paralympics (IPC, 2021).

Paralympic Sport is prestigious (Bellieni, 2015), highly competitive, (Prystupa, Prystupa, & Bolach, 2006; Wareham et al., 2018) and professional (Harrasser, 2017). Athletes within Paralympic Sport are elite sportspeople and within the context of this thesis are members of World-Class funded programmes whose aim is to win medals at the World Championships and the Paralympic Games (UK Sport, 2021). The athletes I work with are supported by a range of experts which include technical sports coaches and an athlete support (sport science and medicine) team that includes strength & conditioning coaches, physiotherapists, sport medicine doctors, biomechanists, performance analysts and psychologists. While the role of the coach has been recognised in high-performance sports (Cushion, 2006), the role and influence on how the wider athlete support team is integrated within the performance of the athlete have been neglected (Alfano & Collins, 2021). The coordination of the technical coaching and athlete support team expertise is essential for

maximising performance and an individualised SMM. However, if not properly considered for the reasons outlined above, the coordination of the coaching and support team may be more complicated within Paralympic sport.

Addressing this challenge, this thesis offers a unique contribution to how experts in the athlete support team contribute to a SMM, resulting in a coordinated SMM, thereby enhancing the athlete's performance. Further, it offers an additional contribution to examining how the allied professions within performance sport, transition into Paralympic sport. Such insight will help shape the vision of an SMM through collaboration and innovation and inform professional practice and the development of specialist roles in elite sports.

As highlighted earlier, the current literature reviewing parasport coaching highlights the medical model as the dominant mode of conceptualising and framing disability (Townsend et al., 2017; Townsend, Huntley, Cushion & Fitzgerald, 2018). From my own experiences of working with elite Paralympic athletes, an important aspect of individualising the coach's SMM is the expert knowledge and insight the sports science team offer. However, often professional training of allied professions such as physiotherapy is delivered through a medical model lens, therefore neglecting asset driven SMMs and instead focussing on textbook ideals. Supporting practitioners in understanding and reframing their expertise, to an asset driven social-relational model, is important in developing individualised athlete *beta* or SMM of performance, where the athlete is empowered to be part of the process (Richards et al., 2016). However, from my own experience working within Paralympic sport the true expert on the impact of any impairment is the athlete who owns it. It is wise to consider the athlete's voice and consult as part of any effective solution finding. Therefore, the athlete should be part of an integrated interdisciplinary approach to address both technical and non-technical elements of performance.

2.4.1 The Paralympic Athlete classification system. Paralympic athlete classification is the cornerstone of Paralympic sport and determines how athletes are grouped in sports classes and events in the competition (International Paralympic Committee, 2021). The demands of each sport require different performance elements and determinants to be successful such as running, propelling a wheelchair or in a paracanoe context propelling a kayak. Consequently, while any person can compete, the impact of an athlete's impairment will influence their ability to succeed in a sport. Returning to the example of a single leg below knee amputee, they will have an advantage over a bilateral above knee amputee in a running or jumping event. Classification aims to; 1) define who is eligible to compete in Paralympic sport, and 2) group athletes into sports classes to minimise the impact of an athlete's impairment on their ability to compete within a sport and aims to allow sporting excellence to determine the victor (International Canoe Federation, 2021). It addresses this by grouping athletes with similar impairments or effects of impairments together based on the demands of the event. Therefore, classification must be sport-specific (International Paralympic Committee, 2015). However, to be classifiable within a sport, not all disabilities are eligible or can be classified. There are 10 IPC eligible impairment groups that are often considered as three distinct groups: a) physical impairments, comprising the eight impairments that cause activity limitations that are biomechanical in nature – impaired muscle power, impaired range of movement, limb deficiency, leg length difference, hypertonia, ataxia, athetosis, and short stature; b) vision impairment and c) intellectual impairment, (International Paralympic Committee, 2021). Table 2.1 below outlines the IPC eligible impairment groups and classifications in the context of Paracanoe.

Table 2.1: IPC Eligible Impairment Groupings and Classification

Distinct Grouping	International Paralympic Committee Eligible Impairment	Paracanoe Eligible Impairment (Key: Yes=Eligible to compete in Paracanoe)
Physical Impairments	Impaired Muscle Power	Yes
	Impaired Range of Motion	Yes
	Limb Deficiency	Yes
	Leg Length Difference	No
	Hypertonia	No
	Ataxia	No
	Athetosis	No
	Short Stature	No
Vision Impairment	Vision Impairment	No
Intellectual Impairment		No

2.4.2 Paracanoe Classification. Paracanoe as described earlier is a Canoe Sprint racing discipline for athletes with a permanent impairment, contested in two boat classes. It is relevant to understand how athletes are assigned and grouped into these classes through the process of classification. The Kayak (KL) boat class is propelled with a double blade. The Va'a (VL) boat class is an outrigger canoe, with an additional float pontoon that is propelled with a single blade. Each boat class has three different classes depending on an athlete's impairment (KL1-3, VL1-3) with both classes contested over a flatwater, laned 200m course (International Canoe Federation, 2021).

Each athlete is required to provide medical documentation to confirm their impairment type and underlying health condition. Athletes with Impaired Muscle Power, Impaired Range of Motion and Limb Deficiency are eligible to compete in Paracanoe (Bjerkefors et al., 2019). Athletes with the most severe impairments with limited or no leg function combined with partial trunk function, for example, spinal cord injuries, (impaired muscle power) will be awarded KL1–VL1 classifications. Athletes with limited or no leg function combined with full trunk function will be awarded KL2-VL2 classifications, for example, a bi-lateral above knee amputee. (Limb deficiency). Athletes with near full leg function and full trunk function will be awarded KL3-VL3 classifications, for example, a fused ankle (Impaired Range of

Motion). KL3-VL3 is the minimum eligibility criteria to be classified as a Paracanoe athlete (Bjerkefors et al., 2019: International Canoe Federation, 2021). Through understanding the classification system, it is possible to argue that the evidence suggests the nature and extent of any impairment will require a unique approach to coaching the athlete and the development of a bespoke SMM.

2.5 Considerations of parasport coaching

Having presented the definitions, theoretical models of disability and classification system in the context of the Parasport landscape above, it is now relevant to consider the considerations of coaching within this world. If the goals of individualising coaching to all athletes within the parasport context are to be achieved and sustained, it is important to understand how systems, structures, stakeholders and pedagogical applications involved are integrated and function to deliver a proficient service. Indeed, such evaluations offer the opportunity to assess and address issues such as workforce skills (the ability to design and adopt a SMM to fit the performance setting of each athlete), efficiency and attitudes, whilst concurrently providing insight into human psychology under novel constraints. Consequently, it is important to understand how coaches, experts (sports scientists), allied professionals and agents bring expertise and experience in the form of existing SMMs developed from previous engagement in none parasport settings and apply to them in a Paralympic setting.

2.5.1 Expertise integration: coaching transitions into parasport. Coaches working within Paralympic sport are often non-disabled themselves. They are highly experienced coaches of none parasport performers, who have "transferred" into the Paralympic domain from non-disabled sport (Fairhurst et al., 2015). While coaches entering parasport with previous parasport athlete experience is rare in some sports, there are as yet no coaches who have

entered Paracanoe in the UK system without transferring from non-disabled disciplines. Therefore, a transferring coach has not experienced Paralympic sport in the manner or context that they have experienced in their parallel non-disabled disciplines. In short, they bring a pedagogical framework that does not integrate the impairment and needs of the athlete. Consequently, most of these coaches have established, and sometimes very well-defined SMMs from non-disabled sports developed either as an athlete, existing coach or both, in another paddle-sport discipline. However, as previously mentioned they are without experience in parasport (at least initially) and will need to adapt to any SMMs (both technical and non-technical aspects of SMM). Existing SMMs are normally created through previous experience in non-disabled sports, often with little formal or informal coach education resources (Fairhurst et al., 2017; Wareham et al., 2018). Therefore, the transferring coach may have difficulty in creating clear SMMs (see Chapter three) in the Paralympic setting and often are unable to cater for the diverse aspects of performers who may have a disability (Taylor et al., 2015). Indeed, this is either because suitably diverse SMMs do not exist for such performers as none have been derived due to the hyper-dynamic nature of the environment, or a combination of both of these issues. Consequently, the transferring coach relies (at least initially) on SMMs derived in non-disabled settings and may assume these SMMs can be reapplied within a parasport context.

The reliance on non-disabled SMMs may be further limited by a parasport pedagogical shortfall, resulting from a lack of education and training (Wareham et al., 2018). Such training needs to consider the Models of Disability (discussed in section 2.3), as well as sport and event considerations, understanding of impairments, individualised SMM and the modification of equipment to support these SMMs. In researching the transfer of coaches into parasport and shedding light on how SMMs may be adapted, work by Cregan, Bloom and Reid (2007), describes how elite Paralympic swimming coaches began their careers coaching non-disabled

swimmers. Their study outlined the challenges faced by the coaches. For example, when a Paralympic athlete arrived at their facility, the coaches were forced to independently develop and acquire parasport knowledge (experimenting to integrate additional information relating to impairment) due to a lack of clear learning paths or formal training, (Fairhurst et al., 2017).

Such works highlight the challenges of working in a parasport environment where coaches are required to explore and create unique and bespoke athlete SMMs and move away from standard generic performance templates. Accordingly, it is important that the challenges facing parasport coaches are recognised and that these processes are sufficiently addressed within the coaches' (and other performance specialists), coach education, training and professional development. Consequently, this may then assist in the coaches' ability to utilise experience but effectively address performer needs, apply knowledge in context, and design SMMs for an individual in a bespoke manner relating to the parasport context and improving performance.

Therefore, evidence and insight suggest several potential challenges are impacting on effective delivery of good coaching for coaches transferring into Parasport and within Paralympic disciplines, the sport of paracanoe. For instance, the important information needing attention to design and create an appropriate SMM for an individual athlete may be unclear to the coach. This may be owing to a lack of impairment-specific knowledge or difficulties in deciphering the impact of the impairment in the context of the performance setting owing to inadequate education or experience. Other issues may be challenges with applying their previous experience to a new context or over-reliance on the application of non-disabled SMMs.

Accordingly, these challenges lead to potential miscalibration on what performance goals to agree on and what training environment to select, or the ability to consider the adaptation of an existing SMM and bring individualised coaching into fruition. Another

challenge might be the reliance on information passed down from others' previous experience, including generic SMMs employed within a non-disabled context such as the Olympic version of the sport. This previously constructed SMM may now be invalid due to changes in regulations, technological advances etcetera (Carson & Collins 2011; Chow & Knudson, 2011) or even societal norms in the treatment of minority populations (Bourdieu, 1984).

From an educational perspective, there may be a lack of formalised resources to aid coaches in creating, or identifying, declarative knowledge needing to be adapted for performers (Fairhurst et al., 2017; Taylor et al., 2014). Equally, there is a lack of training in the skills that allow the coach to derive that knowledge from their own experience (Taylor, et al., 2014; Taylor et al., 2015), which in turn potentially limits the coach's ability to optimise their actions by being adaptive and flexible. Logically if an individualised athlete SMM is required, adaptability and flexibility are critical elements of the coaching process.

While these challenges highlighted above could ultimately lead to suboptimal coaching practice, there is also the potential that fear of action, or non-action, may be equally as counterproductive (McDonnell, Hume, & Nolte 2013; Paul 2010). By focusing on these implications, I adopt the perspective that performance development should be driven by the functional ability of the performer (Paul, 2010) and see past any disability (or ability). I take the position that adaptability and flexibility to achieve individualised SMMs of performance development lie at the heart of good coaching and particularly inclusive coaching. More simply, it is more important to understand what the person can do, rather than what they cannot do and integrate this in a coordinated manner into the development of the performance and SMMs.

2.5.2 Coaching Paralympic athletes. To meet all of an athlete's needs, coaches must *individualise* their practice to meet the bespoke needs of the athlete. Coaches must

understand the demands of the sport, contextual factors, and physiological and psychological factors of the performer and assess these factors against the athlete's current performance status and aspirational performance goals. Coaching the Paralympic athlete is about having a template that is relevant to all but having the ability to adapt it to the person and individualising the coaching practice to the bespoke needs of the athlete (Chow et al., 2016).

Therefore, I suggest that individualisation requires the integration of principles and structures of coaching to meet the performance and event demand that creates a template (Alpha Performance Vision, Richards et al., 2009) that is operationalised to meet the needs of the athlete, and hence a bespoke SMM is created. Within the technical component (psycho-motor, Richards et al., 2016) coaches must understand the technical elements of the sport and the contextualise these elements to meet the needs of the athlete and the performance demands. However, perhaps more importantly the athlete must have a voice to understand their lived experience and perception of the performance. Factors such as the environment parameters (cultural, physical and political, Richards et al., 2009) and event (the task and role of the performer) must be integrated, resulting in individualised coaching for the athlete. Consequently, environmental demands can then be synthesised into non-technical aspects of an SMM and blended with event-specific technical elements.

Expanding on this work, in the context of Paralympic sport, the biomechanical templates, kinematic ideals, physiological training zones and strategic aims can then be *individualised* as an SMM (Richards et al., 2016) that are prescribed to the athlete to help close performance gaps. However, in Parasport as previously mentioned coaches need an additional understanding of the nature of the athlete's impairment against the demands of the sport to generate individual solutions and provide optimised individualisation (Morriën et al., 2017). Indeed, owing to the nature of the disability and individual impairments, it might be said that all Parasport coaching interventions could *or should* be individualised.

Therefore, given the individual nature of impairments upon the generic psycho-motor elements of parasport performance, then a one size fits all approach cannot or should not be generalised. Consequently, an individualised SMM relating to performance must be created for each athlete and therefore a shared understanding of performance is understood and operationalised by the coach, athlete and support staff. Importantly, while a deviation from an idealised technical psycho-motor norm into a bespoke SMM might be more obvious within parasport, the kinematic and kinetic differences such as height, weight, muscle type, and lever lengths, in non-disabled athletes, is equally worthy of consideration if individualisation is to be achieved to maximise the performance of any athlete. Indeed, if individualisation is the goal, a bespoke SMM is critical for all. More simply, we are all unique and should be considered this way. By focusing on these implications, I reiterate and adopt the perspective that performance development should be driven by the functional ability of the performer (Paul, 2010). I take the position that adaptability and flexibility to achieve individualised development lie at the heart of good coaching and particularly parasport coaching and is fundamental to success. Therefore, an individual SMM should be created for every athlete and developed into an SMM with the athlete, the coaching team and the support staff. Through this SMM as discussed in chapter two, the athlete support team will be more able to coordinate effort, innovate, remove the complexity of parasport coaching and ensure athlete needs are met. Indeed, the collaboration and support of experts to help the coach decipher *wicked problems* and adapt SMMs that are fit for purpose.

Moreover, while useful SMMs derived in non-disabled sports cannot be simply rolled over and applied to Paralympic populations. Paralympic coaching is specialised and different due to both subtle and far more obvious differences in non-technical and technical elements of the SMM. For example, while the casual observer may be unaware, a Parasport athlete with a spinal cord injury may have a catheter fitted to help manage the physical effects of

their disability. Therefore, technical elements that would be considered an essential requirement for a performance may be hindered, blocked or not possible because of the catheterisation. In addition, from a nontechnical perspective, the athlete may require additional time to prepare either before the session, during or post-session. Further, catheterisation may have a psychological impact such as embarrassment or a reluctance to discuss the issues it may cause.

2.5.3 Individualising or personalising the coaching process: coaching the person. Although widely used in the sports coaching literature, individualisation or differentiation has a wide range of meanings and definitions. Whilst these definitions differ, there is a consensus that individualisation is a method of working and catering for a wide range of individuals, (Bon, 2009). Therefore, within this thesis, I adopt the stance that individualisation is coaching an individual where the principles, organisation and structures can be applied on a bespoke basis, accounting for the individual's needs, characteristics and attributes to attain a performance goal.

In developing an individualised athlete SMM for performance, an important consideration is the characteristics of the person. Understanding the person and the context of their progression towards an aspired performance standard such as an Olympic or Paralympic gold medal could help to further refine the principles, organisation and structural elements of individualisation. However, individualisation could be applied crudely and not necessarily effectively if we are to just sketch out and apply a prescribed plan. Elements such as physiological training principles or kinematic ideals that create technical frameworks can be prescribed differently based on the bespoke and unique needs of the athlete. However, care should be taken to ensure athletes are not just doing 'the same thing differently'. Bespoke individualisation could, therefore, be described as attending to the bespoke needs of the person into unique possibly one-off or a linked series of interventions designed specifically

for the uniqueness of the athlete. Therefore, individualisation could be made unique or tailored in a bespoke manner through the use, not just of technical prescriptions but also through using the psycho-social elements as to how the information is shared and communicated (Richards et al., 2016). Such factors include pedagogy, coach-athlete relationships, psychological and environmental understanding to develop the 'what, how and why' of coaching.

Indeed, in emphasising the individualisation of SMMs, I suggest the individual expert in terms of the Paralympic athlete, is the athlete. Empowering the athlete to contribute their expertise, knowledge and understanding of the impact of their impairment upon the sports performance demand would enhance the relevance and development of the SMM. Therefore, the athlete has a critical part to play in the adaption of the coach's existing or *alpha* templates and offers a unique, individualised and personalised aspect to the relevance of a *beta* SMM (Richards et al., 2016).

2.5.4 Coaching in the Paralympic landscape. Given the aforementioned individuality of an athlete and specifically of a Parasport athlete competing in Paralympic sporting settings, the coach's ability to create unique knowledge representations and therefore develop bespoke knowledge representations or SMMs personalised to the performer's needs is critical (Cotterill & Discombe, 2016; Harvey, Lyle, & Muir, 2015). In helping the coach to create, adapt and apply these unique knowledge representations into bespoke SMMs, the use of collaboration to provide expert knowledge to supplement knowledge in areas such as physiology, impairment etc, is considered essential (Carson & Collins, 2011).

However, within my professional setting, I often observe barriers across allied domains such as biomechanics and clinical settings, favouring the view of disability through lenses such as the medical model described earlier. Consequently, the lens through which sports skills are observed and conceptualised may be incongruent within the athlete support team.

Accordingly, misalignment of individualised performance goals may be at odds with the technical coaches' views, such as competing medical and social-relational models of disability. Therefore, I suggest that collaboration is more than the provision of acquisition of knowledge, but the alignment of a shared vision of asset-driven philosophies. Without this philosophical alignment, the novice coach may be challenged in creating a shared understanding and associated clarity of the coaching task to enable the alignment of the team to achieve that task. Consequently, misalignment impacts the effective development of collaboration and the establishment of SMMs (Carson & Collins, 2011; Stadifer & Bluedorn, 2003). Accordingly the need for all support staff and coaches to not only have a shared understanding and vision of the SMMs for the event but in the adaption of the SMM to meet the complex needs of the individual athlete to drive innovation and the development of beta SMMs (Richards et al., 2016).

2.6 Coaching: transitioning to the bespoke

The research and experience reflected within my journey as a Parasport coach transferring from nondisabled discipline faces challenges in accessing formal knowledge sources to create MMs and therefore bespoke SMMs. The nature of the challenge specifically relates to understanding the impact of the impairment within the performance setting. Without this understanding, coaches are reliant on SMMs created from experience and coach education (specialist CPD) formed with non-disabled athletes. These generic SMMs which can be considered to be 'off the shelf' SMMs, formulated through structured non-disabled coach education present a considerable challenge to the coach working with Paralympic athletes. The generic nature of none parasport SMMs makes them too rigid for parasports athletes and the context in which they compete. Consequently, the coach inexperienced within the Paralympic landscape often may be over-reliant on existing non-disabled SMMs,

until they have developed knowledge relating to the individual athlete they work with and the experience and meta-cognitive ability to sense-make.

In overcoming these wicked performance problems, coaches experienced in working with Parasport athletes need to engage in a high level of sensemaking (Klein, 2015; Weick, 1995) to understand 'what's going on' and to start to notice critical information relative to the athlete and frame it in the context of the performance. Therefore, the coach can start to connect dots, run mental simulations and develop an alpha SMM from which they can work (Klein 1998; Richards et al., 2016). Subsequently, coaches and support staff should utilise each other's expertise to develop a shared understanding of the individual and hence develop bespoke SMMs that are truly individual.

2.6.1 Implications for the thesis. Parasport and the challenges of the applied research context presented within this chapter offers an excellent opportunity to explore the research aims of this thesis in a naturalistic setting. The nature, context and opportunity presented above piercingly call for research that not only adds to the paucity of Paralympic research but also offers cross-discipline learning to technical coaches, support teams and coach educators in non-disabled sports is abundant.

In addressing the opportunity to contribute to the literature presented above, the insight gained through the research within this thesis, will also directly contribute to the effectiveness of a World Class Programme to positively impact Individual athlete performance at the Tokyo Olympic and Paralympic Games, (a personal and professional motivation to research). The ability of the team to develop richer, SMMs that drive innovation and collaboration through improved personalisation is pivotal in meeting these challenges. These key components are an important point in terms of the applied nature of the Professional Doctorate and a key motivation in entering this course of study.

2.7 Summary of the Chapter

This chapter has addressed the theoretical models of disability and the lens through which Paralympic sport may be viewed. Further, it presented the reader with an applied understanding of the naturalistic nature of coaching and the development of SMMs, within the Paralympic landscape. Coaching in the Paralympic landscape is in line with non-disabled complexity. However, Paralympic coaching is more complex due to the lack of formal and informal education for the transferring coach and the need to be more adaptive driven by performance characteristics and the athlete's impairment. Individualisation in Paralympic sport is therefore different due to the complexity and nature of athlete impairments, with a greater reliance on experts to help make sense of and create individualised SMMs. Consequently, coaches are required to move away from standard templates and create bespoke athlete SMMs. The research presented in the following chapters initially explores the personalisation of the technical side of SMMs and how the coach can navigate the wicked challenge to create bespoke SMMs that are further refined. In refining the SMMs the coach, therefore, needs to understand their alpha vision (Richards et al., 2012) and then how the complexity of the performance vision is shared within the athlete support team through the leadership of the coach. In exploring the challenges presented above this thesis will consider the research aim in the following chapters and how observation is operationalised amongst experts (e.g., athlete, sports scientist, physiotherapist). We, therefore, need to understand the content of SMMs of para coaches and support staff. In doing so the research will explore how the existing performance MM of the coach and support staff can be adapted and unified into a sport specific SMM for Paralympic coaches. The following chapter will outline the underpinning theory which will be explored to investigate how coaches can construct SMM and how these will inform both content and format of feedback provided to the athlete in real time observations.

CHAPTER THREE - THEORISING OBSERVATIONAL COMPLEXITY WITHIN SPORTS COACHING

3.1 Introduction

In an applied real-world setting, such as those found within Paralympic sport, coaches often must utilise subjective means from limited observations of athlete performance in training and competition to gather information. These observations are informed through experience and operationalised by the coach's use of mental models (MMs) or, cognitive representations of performance (Richards, Collins & Mascarenhas, 2016; McGarry, 2009). High coaching efficacy requires the coach to adapt their generic MM quickly and effectively into an individualised athlete-specific MM of performance (Holder & Winter, 2017; Martin, Winter & Holder, 2019). The adaption of the generic MM is often compounded by situational complexity (Lees, 2010) whereby feedback to the athlete may be limited. For example, the ability of the coach to enter the field of play or set within a high stakes sporting context and under time pressure to provide insight and influence performance. Consequently, placing a high cognitive load on the coach's observation process that is further challenged by contextual factors. For example, within a paddle-sport context, the velocity of the athlete's stroke cycle, of up to 170 strokes per minute, and the coach's distance relative to the athlete, from which they are able to observe (perhaps hundreds of meters away) can influence feedback.

Within Paralympic sporting populations, observation can be further challenged as the unique interplay between athlete, their impairment and the performance problem, complicates traditional assessment methods used by the coach, adding to the cognitive complexity. Therefore, observation within the sporting context is complex and frequently commented on, owing to the inability of the observer to account for *invisible* factors such as the cognition,

intention or perception of the athlete (Gillham, 2009; Holder & Winter, 2017; Martin, Winter & Holder, 2019).

Observation of athlete movement patterns within naturalistic settings as found in sports coaching (and especially outdoors), has traditionally been viewed as an extensive assessment procedure (of athlete performance) and evaluation tool (Lees 2010; Holder & Winter, 2017) that allows the coach to gather, monitor and evaluate performance. The effectiveness of the observer's experience, knowledge and perceptual sensitivity, through situational awareness (Endsley, 1995), to the athlete's movement pattern and identification of performance errors through sense-making (Weick, 1995), are critical in providing feedback. Accurate feedback, therefore, directly impacts the coaching efficacy and the role of the coach (Giblin, Farrow, Reid, & Abernethy, 2015). Importantly, observation of technique in this context is often characterised by subjective judgements on the observer's (normally the coach) part (cf. Lees, 2010) and it is this subjectivity this thesis aims to explore. Specifically, the application of the observation of Paralympic athletes, which in most situations, are framed by MMs constructed from working with nondisabled athletes. A stance this thesis will argue is incorrect. In addressing this challenge, this chapter, will explore the underpinning theory of coach's decision-making within the context of real-time observations and therefore, addresses RQ 1, 2, 3 and 4 as presented in Chapter one.

In considering just how do coaches manage and navigate this observational subjectivity when coaching the dominant coaching literature, which is largely derived from non-disabled research, does provide a tool. However, when an athlete has an individual need, coaches are required to adapt their MM/SMM based on the information gathered through observation. Consequently, a one size fits all observation process, where Paralympic athletes are mapped, against a generic template or MM cannot simply be overlayed from athlete to athlete. At this

point, it may be helpful to present and discuss observation within sports coaching and highlight current limitations within the literature.

3.1.1. Observation within sports coaching. The process of observation within sports coaching while it is universally utilised, it is rarely defined or agreed upon (Martin, Winter, & Holder, 2017). In guiding coaching efficacy, observation within the sport is an area with a relative paucity of research and lacks a clear definition, (Holder & Winter, 2017; Martin, Holder & Winter, 2019). The lack of a clear definition may reflect the variation of and complexity of observation across sporting domains. Additionally, limited research or applied knowledge is available to guide and educate the coach at the coal face as to how to observe performance in 'real time' (Lees, 2010), this limitation is especially apparent when the performance context is complex, continually changing and is dynamic (e.g., outside, canoeing on a river). Observation provides the foundation for feedback to improve performance (c. f Lees, 2010). Supporting this view Lees (2010) suggest the term *Technique Analysis* be used across allied domains such as sports coaching, biomechanics and clinical settings, as an analytical method through which sports skills are observed. However, Lee's view while useful is limited. It requires all available data, (velocity, joint angles, stroke rates, force production etc.) and the time to process, in considering and analysing to aid decision-making. It is also important that such an approach (technical) cannot be maximised outside of the performance context (Richards et al., 2009), as the 'skill' needs to be fed back on (doing the technique in the performance setting) and not just the execution of the technique. The lack of consensus from sports science and coaching perspectives as to how coaches can best observe and feedback, along with a lack of education and knowledge, has been reflected along my professional journey as a paddle-sport coach.

Critically in the real-world coaching setting of sprint-canoe coaches have to rely on their own senses to observe sport specific skills. The observation of technique allows coaches to better rationalise their feedback and utilise their knowledge and experience. Analysis of

the information gathered through observation is constructed based on an existing MM of a performance held by the coach, (an Alpha vision, Richards et al., 2009) and operationalised within the coach's subjective judgements (Knudson & Morrison, 2002). However, gathering, prioritising and making sense of the information collected through observation, presents a considerable challenge in several ways (Hughes & Bartlett 2002; Johnson 2006; Lees, 2010). The coach has to quickly generate an optimal, correct option for feedback to the athlete. For example, identifying the most relevant aspect of the observed technical or tactical element of performance, which is then prioritised to elicit the maximum gains. However, in quickly generating a feedback option, coaches' decisions are often executed in extremely stressful situations, which is related to, but distinct from, the dynamic nature of sports decisions (Johnson, 2006). Individualised coaching is, therefore, reliant on the coaches' ability to observe and interpret the unfolding performance presented and create bespoke athlete solutions for the unique context, in the sporting moments that matter. Logically, if coaches' decision-making that inform individualised coaching, could be better understood and therefore developed, associated athlete performance would be enhanced. Such a concept is a personal and professional goal for my thesis journey.

In helping to support knowledge development to support a coach's observation and perception to overcome some of the challenges discussed earlier, recent developments in quantifying kinematic variables (Lees, 2010) have become possible with improvements in technology. However, the utilisation of technology within the sporting context in which this thesis is set is often limited in practical terms by cost, availability of equipment, the context of the sport, nature of the environment in outdoor sports and the time required to process. Therefore, a reliance on the coach's observation, analysis, technical understanding (technical template) and application (mental model) is essential and remains the foundation for performance analysis in most coaching situations, including canoeing. Consequently,

observation of performance compares the observed movement outcome and tactical puzzle the athlete is attempting to solve, against the coaches MM. The MM affording the coaches with evaluative criteria, against which they can make informed decisions.

The structure of this chapter will first explore the complexity of coaching observation within Paralympic sport before going on to introduce decision-making in the real world, through Heuristic decision-making paradigms (Taversky & Kahneman, 1975). Naturalistic Decision-Making (NDM; Demir & McNeese 2015; Klein 2015) is then introduced with key associated concepts such as Recognition Primed Decision-Making (RPD; Klein, Calderwood & Clinton-Cirrocco, 1993), Situational Awareness, (SA; Endlesey, 1995) and Sense-Making (Weick, 1995). The integration of these concepts demonstrating the complexity of real-time observations in naturalistic coaching contexts. The chapter then explores how these decisions become represented in cognition through MM and within a team as a Shared Mental Model (SMM; Richards, et al., 2016) to aid individualised coaching. Professional Judgement and Decision- Making (PJDM; Martindale & Collins, 2007) is then introduced before the chapter is summarised.

3.2 Coach observation and coaching pedagogy

As previously discussed in chapter two, individualisation across sports and particularly within Paralympic sport, involves complex practical challenges in tailoring interventions to the athlete (Simon & Richards, 2022). Consequently placing a high emphasis on the coach's cognitive ability to manage the coaching process and adapt information to the needs of the athlete (Abraham, Collins & Martindale, 2006; Collins & Collins, 2016; Miller & Rollnick, 2012; Rynne & Mallett, 2012). The ability of the coach to effectively observe the athlete's performance and identify errors is central to the coaching process and in this regard a refined mental representation of the task is fundamental. In doing so this thesis presents an argument

that an adaptable SMM which can be personalised to the athlete, is fundamental when working within a Paralympic (or any) sport.

Supporting this view and critical to the development of an individualised MM, many researchers caution against a one size fits all approach (Handford, Davids, Bennett & Button, 1997; Simon &Richards, 2022), to understand how a motor control task is affected. In the real-world athletes' biological systems exploit good enough (Chow et al., 2016), solutions to achieve a performance outcome and may deviate from an ideal solution. Critically, within the context of Paralympic sport, where the observation of athlete performance should be considered at the individual level and while useful, generic MMs must be adapted to the athlete. In other words, generic or expert models may not apply or hold, when being applied out of context or transferred from one athlete to another.

In addition, skilled performance relies on the ability of the athlete to adapt and vary the movement solution to achieve the task (Newell, Liu & Meyer-Kress, 2001; Thelen, 1992). Performance variability (Davids et al., 2006), between and within individuals proposes that athletes will achieve solutions within a bandwidth of task success. These solution manifolds (Muller & Sternad, 2004), allow the athlete to modify the component of performance required to achieve the task. For example, within a canoe context, an athlete will subtlety shift the centre of mass (body), to maintain balance on an unstable platform (boat), and in the process may place the paddle (blade), in a different water entry point relative to the kayak to achieve power.

Critically degeneracy (Hong & Newell, 2006) or the ability of athletes to achieve the same outcome in different ways due to structural and kinematic differences, may also challenge the observation of the coach in overlaying a generic MM, onto an athlete without due consideration of those individual differences. Crucially then, in the context of this research, if variability and degeneracy are central to effective task solutions and motor

control, then how should the coach factor this variation into their observation strategies and make good decisions from the resultant information? In managing the resultant cognitive challenge in observing for and understanding individual athlete variation in technical performance, heuristics have been shown within sporting populations to be a useful tool in some contexts.

3.3 Heuristics & Bias

Heuristics are rules of thumb, that allow decision-makers to make decisions with incomplete information that provide a satisfactory rather than optimum solution (Tversky & Kahneman, 1973). Pertinent to the scope of this research and the applied world of sport, Kahneman and Klein (2009 p.520) highlight "the role of expertise in developing heuristic decision making". Kahneman and Klein critically identify two conditions that must be satisfied to allow the development of expertise; an environment of high validity and an opportunity to practice the skill. When these conditions are met and the environment predictable, experts can operate with a high degree of success. Tversky & Kahneman (1973) originally identified the role heuristics play in decision making. Heuristic bias is particularly prevalent in complex situations (Hepler & Feltz, 2012), which I contend could also apply to live coaching. However, in dynamic competition environments, the conditions of a predictable environment may be hard to meet. Tversky & Kahneman (1973) identified over one hundred and fifty heuristics, used in everyday life and demonstrated how these 'rules of thumb' biases can affect decision making. In summarising for the reader, Table 3.1 collates Cox's (2007) explanation of heuristics.

Table 3.1. Heuristics and Bias in Individual Judgements.

Heuristic/Bias	Explanation
Anchoring	Judged probabilities, frequencies, or values remain too close to initial values (perhaps based on irrelevant cues), despite new information.
Availability	Background information is underweighted compared to readily retrieved information.
• Primacy and recency	• Initial events and/or most recent events are most easily recalled and hence receive excessive weight.
• Saliency	Salient information is over weighted compared to other information.
• Status quo bias	• Historical experience is more vivid and is weighted more heavily than hypothetical alternatives.
Base rate neglect	Base rates are neglected or underweighted in many situations.
Overconfidence, miss-calibration	Assessed probabilities are not accurate. (For example, events judged to be impossible in some experiments happen about 20% of the time, while events judged to be certain happen only about 80% of the time.
Credulity/superstition	Evidence that supports patterns and causal explanations for coincidences is too readily accepted.
Confirmation bias	Evidence that supports previously formed hypotheses (especially about likely causes or diagnoses) is overweighted compared to other evidence.
Conjunction fallacy	A conjunction of events (e.g., patient was exposed and exposure caused observed symptoms) is considered more probable than the individual components of the conjunction. This violates probability theory.
Conservatism	Sample information is often underweighted.
Focal effects	Recalled or stated values are binned into approximate categories.
Disjunction ("irrational prudence")	A decision maker who will take the same action whether or not an event occurs may still prefer to wait for the uncertainty to be resolved.
Framing	Presentation of data (e.g., in ascending or descending order) affects judgments of likelihoods or estimates for uncertain events or quantities.
Gambler's fallacy	Belief that random fluctuations will tend to occur to cancel out previous unusual patterns and restore the representativeness of the sample.
Hindsight bias	Belief that whatever happened was inevitable or was predictable in advance.
Illusion of control	Subjects perceive that their skill can affect outcomes of chance events.
Law of small numbers	Subjects assume that small samples are representative of the populations from which they are drawn. Since representativeness is not sensitive to sample size, they tend to gather too little data and to overgeneralize.
Regression to the mean	Many subjects expect that observed patterns will continue (i.e., that observations are representative), rather than expecting unusual fluctuations to be followed by a return to more usual levels ("regression to the mean").
Representativeness	Pr(X | E) is estimated by how "representative" evidence E is of explanation X, ignoring c being inadequately sensitive to base rates for Pr(X) and Pr(E) and violating the probabilit rule, Pr(X | E) = Pr(E } X)Pr(X)/Pr(E).

Adapted from Cox, (2007), Girgerenzer, Todd, & ABC Research Group, (1999), Hammond, Keeney & Raiffa, (1999), McCamon (2004), Plouso, (1993), Renfrew, Martin, Micklewright, & St Clair Gibson, (2014), and Russo & Schoemaker, (1989).

As an example of the heuristics collated in Table 3.1, the representative heuristic (Tversky & Kahneman, 1982), inherently contains bias because of its relation to the experience of the observer. As an example, the Gilovich, Vallone & Taversky (1985), study asked observers to estimate the probability of success in basketball shooters with a shooting percentage of 50% who had just scored (Hot Hand) as opposed to just missed (Cold Hand). The results showed that observers miss-weight the outcome between successive shots.

Miss-weighting leads to a miss-calibration of the factors in the decision-making process, an example of which may be the hot-hand phenomenon. Representative heuristics may be further complicated by familiarity heuristics (Mussweiler, 2003) in which judgments are comparative, and assume that the circumstances that lead to a particular behaviour hold true in all contexts. Tavesky & Kahneman (1973) showed that familiarity heuristics allows people to base judgements on the ease with which events can be retrieved, instead of retrieving all relevant and salient information. For example, the ease in which the first unexpected victory of an athlete may be recalled may lead to an overestimation of their ability.

Coaches encountering novel situations may be prone to this miss-calibration as a result of the combination of heuristics. Indeed, the increased cognitive effort may itself generate an escalation heuristic (Cialdini, 2001), in which increased value is placed on certain elements of information because of the cognitive or physical effort associated with them. The "affect" or feeling heuristic as described by Bennis and Pachur (2006), may become open to a negative bias in situations that are time-pressured or where incomplete information is available such as is found in live coaching situations. However, what is not clear is the positive implications heuristics may have in aiding the observation process within live coaching pressurised situations and managing the cognitive load and associated stress (c.f. Johnson 2006). The impact of heuristics is further complicated by the potential for traps themselves to inter-relate (see also Klein, 2015). The weighting of information gained from

observation depends on the tacit knowledge and experience of the observer (cf. Bar-Eli et al., 2011).

However, when a novel situation is experienced and experience lessened, the observer may utilise expertise in some but not all areas, and in this way utilise "fractionated expertise" (Kahneman & Klein 2009p. 522). The Heuristic community view fractionated expertise as a source of error in that decision-makers, who when faced with a delay in feedback to assess the validity of their observation, may not recognise overconfidence and other heuristic bias such as the illusion of validity (c.f. Kahneman & Klein 2009). Opposing this view, the NDM community argue that the expert observer would recognise fractionated expertise as beyond the boundary of their area of competence. If coaches recognised the boundary or their expertise, then how might they seek out those with higher knowledge or utilise communities of practice to consult in developing a MM?

Within complex situations such as those found within live sport, heuristics may be susceptible to generic decision-making traps that could affect the whole decision-making process, given its nested nature (Collins & Collins, 2016). Collins and Collins go further and comment on the weakness of heuristic approach, if used in isolation because of these 'traps'. This point is pertinent to this thesis and will be examined in greater detail below and the following chapters. Bar-Eli, Pleaser and Rabb (2011), also comment that these "judgements are often constructed on the spot, and thus are prone to reflect the properties of the judgement context that can lead to the wrong direction in certain circumstances" (p. 24). Logically if the observation of an athlete is equally affected by these traps, then it would be reasonable to assume that observation itself is flawed and hence feedback to the athlete is sub-optimal. Hence exploring this phenomenon would be of interest to the sport-coaching community. However, while heuristics may be helpful to the coach on one hand, for example by speeding up the observation process, any rule of thumb would be limited if the goal of the coach was to

individualise their coaching to the need of the athlete. In other words, the heuristic might be wrongly applied. More simply, we can't assume a one size fits all 'rule of thumb' based on generic technical templates would transfer to the individual need of the Paralympic (or any) athlete. Therefore, within Paralympic populations observation must sit in the context of the athlete, the impairment and the performance, rendering heuristics as be limited. Accordingly, turning to the literature, NDM paradigms offer a useful tool to explore how the coach may be able to draw on to shed a light on observation in complex environments (Richards et al., 2016) and overcome the limitation of heuristics for Paralympic coach observations.

3.4 Naturalistic decision-making

Naturalistic Decision Making (NDM), was introduced in 1989 (Demir & McNeese, 2015; Klein, 2015) and explores how people make decisions in applied real-world settings. Zambok and Klein (1997, p.5), define NDM as "…the way people use their experience to make decisions in field settings". In 1988, a tragedy occurred when the USS Vincennes shot down an Iranian Airbus, resulting in an International Incident and the resultant loss of life. The incident prompted the US Navy to initiate a programme of research on the failure of expert decision-making and became the focus of the emergent NDM community and galvanised the developing field to explore decision-making in applied settings (Klein 2015). Although originally explored in fire and military populations its relevance has been applied and found in sports (Richards, et al., 2009).

NDM research aims to explain how experts make decisions under conditions of low fidelity, time constraints and inadequate information (Flin, O'Connor & Crichton, 2008).

Key features of NDM are centred around ten elements that attempt to understand how humans make decisions in complex environments. These are ill-defined goals, structures and tasks, uncertainty ambiguity and missing data, shifting and competing goals, dynamic and continually changing conditions, action-feedback loops (real-time reactions to changed

conditions), time stress, high stakes, multiple players, organisational goals and norms, experienced decision-makers (Klein, 2008). These ten features of NDM are recognisable and symbiotic with core characteristics of elite-sport. Therefore, NDM paradigms are justified as a vehicle to explore observation within this thesis.

NDM helps overcome the limitations of Classic Decision-Making (CDM), that derived from option generation (Kahneman, 2011). Interestingly CDM supports Lee's (2010), view of technique analysis which was introduced in 2.1.1, in that to be effective, CDM requires all available data and the time (or technology), needed to process and consider it. Within my professional context within High-Performance sport, CDM is favoured amongst professionals such as Performance Analyst, Biomechanist and Sport Scientist, in contrast to the coaches who appear to favour NDM. Presumably, CDM supports the filtering of the abundance of data and code that can be gleaned from technology, possibly due to the professional setting the work is applied within, such as labs and analysis suites that allows multiple options to be considered, contrasted and analysed. However, the isolation of discrete technical components is frequently engaged with out of context. Consequently, resulting in a limitation where focus is on the 'technique' and not the skills (technique performed in context).

However, CDM has been criticised as overly complex, time-consuming and ill-suited for dynamic environments such as those found within the live sporting arena (see Connolly, Arkes & Hammond, 2000). Consequently, the evolution of the NDM field has shone a light on decision-making in, complex environments which are dynamic, continually changing, with opposition and time constrains (Flin et al., 2008; Zambok & Klein, 1997) and therefore which have an affinity with sport (Richards et al., 2016). Researchers such as Klein, Calderwood & Clinton-Cirocco (2010) found that managing real-world high-pressure, time-constrained situations was heavily reliant on intuition to make decisions. For example, such

as those situations elite coaches working in a dynamic competition or training environment find themselves.

However, an aim of NDM research lies in demystifying intuition, (Klein, 2015) and identifying how people draw upon experience, which enables them to recognise familiar patterns or cues that allow them to quickly assess situations without having to compare options (CDM). Critically, Klein argues that these patterns are not generic tools but "specific accumulations of direct and vicarious experience" (Klein, 2015, p. 165). Therefore, the NDM community view intuition as an expression of experience (Klein, 2015) and recognises the role of expertise in decision-makers (Banks, Gamblin & Hutchinson, 2020). Anecdotally, in making decisions the expertise and tacit experience within the Paralympic and paddle-sport setting in which this thesis is situated often appear intuitive.

While Ashford, Abraham & Poolton (2020), make the case for NDM within team sports, no research has examined real time naturalistic observation in Paralympic sport or paddle-sport coaching through an NDM lens. Consequently, NDM theory may offer insight into how coaches develop and utilise their expertise to provide feedback. Therefore, the process of investigating and understanding how expert coaches observe within real time sporting context would add to the literature in this under-researched area.

The ability to recognise cues and act quickly within an area of expertise, which is an essential component of providing real time feedback (naturalistically) could possibly be explained by drawing on Recognition Primed Decision-Making (RPD), which will be explored next.

3.4.1 Recognition Primed Decision-Making. The RPD Making Model evolving from the NDM paradigm (Klein, Calderwood & Clinton-Cirrocco, 1993), to explore how experts recognised familiar and typical patterns within the situation they faced. Klein originally studied fire commanders to discover how they managed conditions of uncertainty when

fighting fires. The fire commanders saw themselves as intuitively acting and reacting to the evolving scene. Instead of contrasting options (CDM) to make the decisions they generated, modified and monitored plans to satisfactorily control the fire. The commanders were able to draw upon tacit experience in dealing with fires and understood typical responses that would allow them to quickly deal with the situation (Klein, 1993).

Klein's (1993) RPD model expands work on Chase & Simon's (1973), research on how Chess mastery was developed as a perceptual skill to recognise patterns within play. Chase & Simon estimated that chess Grand Masters are capable of recognising a repertoire of between 50,000 to 100,00 patterns that allows them to identify moves intuitively without having to compare all possible scenarios (Klein, 2015). This led Simon to define intuition as the recognition of patterns stored in memory (Klein, 2015). Importantly, if coaches utilise intuition within observation as mentioned earlier and intuition uses patterns, then a coach may use patterns of information within their observation process. Therefore, understanding RPD may help us to understand how coaches observe, develop SMMs and provide feedback to their athletes.

Klein proposed RPD relies on the recognition of cues stored in memory and that these cues are gained from experience (Banks, Gamblin & Hutchinson, 2020). When cues can be matched to those stored in memory, they can be said to be *recognition primed* or intuitive decision making (Klein et al., 2003; Klein, 2015). In this way RPD comprises a; *matching* component, a *diagnose* component and a *simulation/course of action* component. Klein's model proposes that experts identify typical and familiar problems, based upon patterns that *match* and are stored in memory. As the patterns are confirmed as suitable to solve the problem encountered, an action is initiated. If the problem is unfamiliar, the decision-maker would *diagnose* the situation further to gather more information. Finally, the

decision-maker would evaluate and run mental *simulations* until a suitable *course of action* is chosen and implemented, (Klein, 1998; Patterson et al., 2009).

Crucially, the RPD model requires the decision-maker to identify and *match* cues and patterns from their observation of the situation to recall familiar events built upon previous experience in context (Demir & McNeese, 2015). In working from and recalling and MM of performance, developed through a coach's experience in context has patterns, would appear key. So, if we look for those cues and patterns and that drives our observations then PRD would be important within coaching. It appears that familiarity of and understanding the context influences and supports this matching process. Therefore, Situational Awareness (SA; Endlesey, 1995) is important with contextualising the observational cues and will be discussed next.

3.4.2 Situational Awareness. The widely accepted definition of SA is provided by Endsley (1995, p36) as the "…perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future". In essence, SA is "knowing what is going on around you" (Flin et al., 2008 p.17). Situational Awareness integrates a decision-maker's understanding of the situation as a whole (Klein, 1998.)

Endsley proposed that SA is composed of three levels. Level one, perception of elements in current situation, or *'What?'* This typically means establishing if the situation is usual and familiar and is therefore easily recognisable. Level two, comprehension of current situation, or *'So what?*' This level either diagnoses the situation if recognisable, or if not complex collects more information. Level three, projection of future status, or *'Now What?'* allows the decision-maker to evaluate single options by imaging future actions, (Klein, 1998). Consequently, within the recognition or *matching* phase of the RPD model, the cues that are perceived are recognised through a process called feature matching, (Demir & McNeese,

2015), that is utilised to develop SA. In short, the observer (coach) connects the dots (technical phases) and can respond seemingly intuitively by recognising cues, interpreting the cues to understand what is happening (the performance), and finding solutions.

In principal SA allows the decision-maker to gather information or cues, interpret and run mental simulations to find a solution (Flin et al., 2008; Richards et al., 2016). However, if the decision-maker in a sporting context and lacks suitable experience or an unfamiliar situation is encountered, then an alternative solution needs to be considered through the process of sensemaking in which information is explored and connections made. Sensemaking therefore integrates RPD and SA to provide a theory to understand the process how a coach makes sense of the observations to inform the performance of the athlete.

3.4.3 Sensemaking. In situations that present high levels of task complexity or uncertainty such as those found in live sporting situations, little is known of how decision-makers decide upon actions, coordinate and collaborate with other agents, (Macquet & Kragba, 2013). Weick (1995) proposes that Sensemaking is the ongoing process through which meaning is constructed and explanations developed in an attempt to explain what is going on, (Duffy et al., 2013) suggesting in and on-action metacognition, (Collins, Collins, & Carson, 2016). Slightly contrary to this view Macquet & Kargba (2013) propose that sensemaking is the process of analysing events retrospectively, explaining anomalies, and anticipating the future suggesting post hoc rationalisation. Both views support the notion that sensemaking connects the dots (events, knowledge, outcomes etc.) to build a frame. It determines what is a dot about the goal and prioritises importance (Macquet & Kragba, 2013). In prioritising which are the important dots to connect, Richards et al., (2009; 2016) suggest that noticing information and framing it in the context of the situation is critical. Through this noticing, and framing to make sense of the observation, the coach creates a vision of performance they can work from, or an “alpha” or ideal version of the MM (Richards et al., 2012).

Consequently, Sensemaking should be considered as a forerunner to any coaching decisions, as it considers the central question of what is happening (McMaster & Baber, 2012) and is directly linked to informing SA (Duffy et al., 2013) and allows mental simulations to find solutions, (Richards, 2016).

However, in many high-performing teams, the coach's *performance vision (alpha* SMM; Richards, 2012), must be shared to allow collaboration. In addition to allowing the individual coach to refinement of the MM for the athlete by drawing upon additional sources of expert knowledge, such as physiotherapists, strength coaches etc. In doing so, shared perception is generated amongst the management team and alignment of thinking created to develop a *beta* (Richards et al., 2012; 2017). A *beta* vision being a dynamic evolution of the alpha SMM. Such an approach is known as Collaborative sensemaking (Duffy et al., 2013) and may help the team to consider and agree on the fundamental question of what is happening, so that they attend to and prioritise information in the same way (Richards et al., 2016). Within coaching and aligning a multi-disciplinary support team, collaborative sensemaking would result in the construction of an MM and SMM to inform the performance context.

3.4.4 Mental Models (MM). Mental models are relevant as they integrate the cues (RPD), the context (SA), through the process of sensemaking as outlined above. The acquisition and implementation of expert practice within dynamic environments such as those found within sporting settings, rely on the coach's ability to create diverse knowledge representations, or MMs, that aim to satisfy performer's needs (Cotterill & Discombe 2016; Harvey, Lyle, & Muir 2015). The concept of MMs grew from the work of Johnson-Laird (1987; 1989), who suggests that people build MMs of verbal descriptions and pictorial elements to cognitively represent the corresponding situation. Doyle and Ford, (1998), initially defined MMs as a relatively enduring and accessible, but limited, internal conceptual representation of an external system whose

structure maintains the perceived structure of that system. MMs are cognitive representations that correspond to the structure of the referred situation (Jarvelin & Wilson, 2003). In context of this thesis, they refer to the vision of how the performance should be executed. In this way MMs allow coaches to make bridges between the cognitive and physical world and make inferences to create their alpha version of a MM (Richards et al., 2012; 2016). Therefore, presumably, coaches can reduce the huge amount of observable information into manageable chunks and make decisions by manipulating and exploring internal representations of performance (Khalidi, 1995). Consequently, the observer will be able to chunk together perceptual elements (Kessler, 1999) and evolve the alpha model to make decisions against (Richards et al., 2016). As such, if a more vivid, robust, and accessible MM of performance is available, it makes knowledge retrieval of these aspects faster, more consistent and efficient (Zhou et al., 2018). Clearly, within a dynamic competition environment, a faster and more consistent recall of the MM would be of benefit to the coach in making more accurate and timely observations to support feedback. However, in considering the application of the MM within sports, is relevant to outline and explore MMs in more detail in relating to technical and non-technical components of the MM. Richards et al., (2017) referred to these as psychomotor (technical) and psychosocial (non-technical) within a sporting context and is addressed in the next section.

Nevertheless, what this literature has not yet addressed, are the challenges and processes undertaken when a coach, with an existing and well-established MM for performance (Richards et al., 2012; 2016) must adapt the MM and make it bespoke to a Paralympic performer. For example, when coaching an athlete for the first time, transferring into Paralympic Sport with the adaptation of a nondisabled MM for a disabled individual. Or, joining a new coaching team and adapting a SMM of performance to a new athlete cohort. Therefore, what is of interest within this research, is what information does the coach fixates upon within their observation, when providing real-time feedback to build their

representation of a MM and SMM. In addition, what is not clear is what is the genesis of these models and how are they adapted and refined by the coaches to individualise the athlete being observed to aid collaboration with other experts such as a multi-disciplinary support team (Physiotherapist, Strength Coach etc) which is essential in high performance sport. Importantly, all performance specialists must have the same SMM to effectively collaborate and influence performance. The challenge then, is not only in the ability to adapt MM/SMM in context of impairments of disabled athletes, but to have a convergent way of doing this for all the multi-disciplinary team. The multidisciplinary team must therefore have one SMM which is defined, agreed and allows alignment of effort.

3.4.5 Shared Mental Models (SMM). Within real-world coaching situations where coaches must collaborate, such as in many high-performance sports settings (Collins & Collins, 2012), a SMM of performance is vital, to develop an agreed area of individualised athlete need (Simon & Richards, 2022). In identifying and agreeing on an area of development, coaching teams must make important decisions and coordinate activities to be effective (Stout, et al., 1999). In this regard, a *shared* understanding of the task is essential (Stadifer & Bluedorn, 2003) and helps create an SMM. Within coaching, it is essential that the specialist inter-disciplinary team have a shared understanding of the task and their contribution to it in supporting the athlete. The shared understanding of the task, allows teams to better explain phenomena, innovate, draw inferences and identify relationships between concepts (Stadifer & Bluedorn, 2003). In effect this shared understanding allows coordination of effort and each team member to contribute expert knowledge, derived from their technical experiences, in converging on an agreed area of athlete development. In this way, the technical elements of an SMM *(the what)* are supplemented and made useable by the psycho-social elements *(the how)* as each team member integrates expertise to collaborate and socially construct an SMM (Richards et al., 2016; Stadifer & Bluedorn, 2003).

Consequently, performance may be considered through the lens of distinct professions, yet critically be understood and a shared SA created within the team, to agree *(or not agree)* on a convergent direction in developing a shared athlete-specific MM of performance. Within sport Richards and colleagues (2012; 2016) suggests the SMM is made up of two distinct elements, 1) psycho-motor, or *the what*, and 2) psycho-social or *the how* that must be considered to allow alignment of cognitive thought process throughout the team. Psycho-motor elements (e.g., performance vision, technical elements, MMs) are concerned with the team members valuing, perceiving and interpreting information in the same way. In the context of coaching paracanoe this relates to clearly defining the technical needs of the athlete and the end goal of where the athlete is required to be in winning a Paralympic medal.

The psycho-social elements (e.g., common language, generation of concepts, tactics, SMM) along with reflective practice combine to develop shared SA and alignment of the team around performance goals. In this way, a SMM provides the basis for collaboration and reliable decision-making (Richards et al., 2016), amongst the multi-disciplinary team. Logically, and within my professional context in ensuring athletes' requirements are met, coaches will need to develop an athlete specific SMM and be able to communicate the ideal performance vision (alpha vision; Richards et al., 2016), to the athlete and within the inter-disciplinary support team experts (Carson, Collins & Kearney, 2017).

An SMM may go some way to help remove the wickedness (Horn & Webber, 1998) of the complex nature of coaching that has led many to describe it as "chaotic" (Collins & Collins, 2013; Rynne & Mallett, 2012). Indeed, this is most apparent when information attended to by the coach is difficult to decipher and manage, perhaps due to there being multiple interrelated factors that lack consensus in terms of their definition or solution. For example, having multiple definitions of key movement phases or innovating a unique technical solution to an athlete's kinematics that an impairment may present. As an example,

coaches working in Paralympic (elite) or inclusive adventure sports (non-elite) are often nondisabled coaches who "transfer" into this domain with clear MMs of technical aspects of a performance, developed within nondisabled sport, that fails to consider the performance boundaries of Paralympic sport (Taylor et al., 2015). The application of the MM to the Paralympic athlete may also be further limited by a pedagogic shortfall, resulting from a lack of education and training. Accordingly, there are clear implications for the coaches' current training experiences, influences and, therefore, ability to effectively reflect, analyse performer needs, create knowledge, and adapt MMs of performance to allow effective collaboration (Purdue & Howe, 2012). Indeed, adaption of the generic MM and technical psycho-motor elements that create an alpha vision (SMM) is critical to effective athlete individualisation as described earlier. In addition, to work from this alpha, the athlete and support team must have an agreement on the SMM and then construct the beta version (agile SMM that evolves), adding in elements to fully align the cognitive process and generate team cohesion in the shared performance vision.

Crucially in applied settings, if SMMs are absent, there is no obvious, or single, solution and no clear actions emerge for the coach or practitioner to prioritise (Ward et al., 2020). An SMM of each athlete's performance, that is understood by all the agents involved would facilitate coherence in structuring the athlete's development, enhanced by the social construction of knowledge (Saldana, 2011) and utilise support elements within the coach's Community of Practice (CoP; Stoszkowski & Collins, 2012). However, if there is an absence of understanding of the SMM and the coaching team operates with incomplete information, decision-making can be affected by heuristic bias. Critically, what is as yet unclear, is just how do the coaches adapt their SMM with the support of the coaching team. Therefore, in order to understand the social construction of knowledge and interplay of how NDM decision

making is operationalised in the development of the SMM, Professional Judgement and Decision-Making may offer a useful guide.

3.5 Professional Judgement and Decision-making in relation to the Shared Mental Model

The development of expertise within sports coaching and the subsequent decisions and development of an SMM can be argued to be operationalised within the Professional Judgement and Decision-Making approach (PJDM). Martindale and Collins (2007; 2012) and Abraham and Collins (2011), originally conceptualised the PJDM approach, as a synergy of nested decision-making over short, medium, and long-term timescales to achieve a predefined set of intended and individualised outcomes. A similar concept is outlined in more detail by Richards and colleagues (2009), highlighting a continuum from classical decision-making to rapid naturalistic decisions make of the coach. In outdoor activities, Collins and colleagues (e.g., Collins, Collins, & Carson 2016; Collins & Collins, 2016), conceive PJDM as a graded continuum in which the interaction of logical linear "slower" processes or Classic Decision-making and "faster" Naturalistic Decision-making processes (Kahneman, 2011), are differentially integrated, depending on the nature and context of the decision to be made (Cotterill & Discombe 2016; Harvey, Lyle, & Muir,2015). Practically, PJDM is developed and deployed through in-action, on-action, and on-action/in-context reflections, which are underpinned by a metacognitive ability (Collins, Collins & Carson, 2016).

The CDM process is characterised as deliberate, analytical, consciously considered actions with multiple sources of information, providing the decision-maker with a sufficiently deep understanding of the problem and important issues, (Cruickshank et al., 2014; Martindale & Collins, 2012). In working within complex, chaotic and time-pressured environments such as found within sporting competition, Cotterill and Discombe (2016) and

Harvey, Lyle, and Muir (2015), identify the acquirement and execution of expert practice within dynamic environments and rely on the coach's ability to generate diverse knowledge representations or SMMs. However, what is yet unclear is just when within a coach's development of expertise do NDM behaviours emerge, that allows a coach to effectively observe in real-time.

3.6 Researcher perception of the chapter

In considering the literature in relation to the aim of this thesis, effective observation is linked to experience. However, what is not clear, is if observation driven by experience is subjective then presumably so will be the SMM, or at least idiosyncratic to the coach. Additionally, both heuristic and NDM communities argue a strong case for their own paradigms, with the literature supporting a myopic stance of one or the other. Challenging the literature, empirical observation of coaches working in the real-world would recognise coaching behaviour characteristic of both NDM and Heuristic decision-making co-existing. Heuristic literature is largely focussed on bias and negatives and fails to identify the positive benefits to coaching. NDM paradigms offers a tool for high-level coaches who have developed domain expertise, but is limited in offering insight as to how coaches develop this expertise. Importantly, both heuristic and NDM research is limited within sport coach and Paralympic context but would appear to offer a useful tool in allowing us to better understand how a coach makes decisions in the moments that matter, characterised by stressful, high-stakes environments with incomplete information. Therefore, t this research exploring observational expertise within paddle-sport coaching, may offer insight into the observational strategies that are developed in the individualisation of the SMM.

3.7 Summary and overview of the chapter

Logically, as athletes transfer into coaching roles and coaches transfer across athlete groups (Taylor, Werthner, & Culver, 2014), it would be reasonable to assume that past experiences and sporting context, would also form the base of coaching expertise from which they observe. However, coaching is complex, and as previously described observation is even more so. The context in which coaches transfer observational skills needs to be considered, as the skills being transferred, need to be adapted and contextualised for the athlete and the context. Consequently, expert athletic performance does not translate to expert coaching performance. Within specific coaching populations studied in this thesis, this complexity is further enhanced by the need to adapt or in some cases create the SMM from scratch, for example within Paralympic populations. In addition, the complexity may be exacerbated by the need to collaborate with a inter-disciplinary support team and share a SMM, to effectively individualise a generic or coaches alpha MM to the athlete. This is essential where performance needs an interdisciplinary approach. While observation (mainly feedback) has been extensively explored within mainstream psychology, the process through which coaches observe athlete performance and make decisions is a relatively under-researched area within sport (Girgerenzer et al., 2004, 2006; Martin, Holder & Winter, 2019; Miller et al., 2012) specifically in relation to observation.

Accordingly, this thesis explores observational expertise within paddle-sport coaching, and the strategies that are developed, integrating experiences, skills and situational context. Specifically, it sets out with the aim of examining the development of naturalistic complex, real-time observation [of athlete performance] strategies and associated decisions of high-level paddle-sport coaches in Olympic, Paralympic and Adventure sports. In meeting this aim, many methodological are available and will be discussed in the next chapter.

CHAPTER FOUR: METHODOLOGICAL CONSIDERATONS

4.1 Introduction

As presented in previous chapters, the naturalistic real-world coaching context in which I work, and research is complex. As an inquisitive coach I recognise I am pragmatic in researching and this influences my methods of pragmatist enquiry. In exploring appropriate methods to examine the research aim, qualitative research is a range of methodologies that uses non-statistical methods of analysis (Borbasi & Jackson, 2012), to examine subjective human experience (Ingram-Bloomfield, 2014). In exploring the subjectivity of human beings, qualitative research can provide a holistic and naturalistic pathway through which the complexity of human experience can be explored (Ingram-Bloomfield, 2014). In researching 'lived' human experience, qualitative research designs do not use hypotheses and instead look to state an observational question to be explored (Ingram-Bloomfield, 2014). In contrast, quantitative research is based on scientific methods and a clear hypothesis that has many applications within sports, such as biomechanics and physiology for example. However, quantitative research is unsuitable for complex, subjective enquiry into a coach's subjective human experience, such as the RQs within this thesis. The nature of enquiry within this thesis, aims to explore the lived experience of the coach's cognitions, in both training and competition environments, whilst managing the cognitive load of coaching. In doing so I take a pragmatists perspective on the research. Accordingly, the purpose of the research methods employed in this thesis aims to unravel the complexity of the coach's lived experiences of creating and adapting SMMs, by exploring their cognition, social interactions, and professional transitions in both Olympic and Paralympic worlds. Through a pragmatic approach, a mixed methods research design can be utilised to best answer the RQs within each chapter and hence meet the aim of this thesis.

This chapter will firstly discuss ontological and epistemological assumptions, before then presenting the position and role of the researcher. Qualitative methodologies are discussed before mixed methodology design considered. The qualitative methodologies of Thematic Analysis (TA; Braun & Clarke, 2006), Interpretative Phenomenological Analysis (IPA; Smith 1996) and Applied Cognitive Task Analysis (ACTA; Militello & Hutton, 1998), were specifically selected to examine the RQs within this thesis, are then discussed. Each address the social and psychological aspects of the complex world of high-performance coaching. Ethical considerations are discussed before then presenting the overview of the research design for each study chapter. Finally, the chapters will be summarised and concluded.

4.1 Ontology & epistemological assumptions

At the outset of the research journey I was confronted with many choices to support qualitative research that are well grounded in the literature. Guided by the works of Creswell (2003) and Robson (2011), I considered three fundamental philosophical assumptions about what constitutes knowledge, the general principles of research and strategies of enquiry, and the procedures or methods of qualitative research. In considering these questions, I challenged my own assumptions of how to best approach the research aim through a number of approaches. The main philosophies and elements of enquiry considered centred around, 1) socially constructed knowledge claims of how an individual seeks to understand the world in which they live and work and how the researcher makes sense of and interprets this world. 2) Postpositive knowledge claims that reflects a deterministic philosophy of cause and effect to shape knowledge. 3) Realism which looks to generate knowledge claims through understanding how and why, with research conducted in the real-world. While useful, these approaches were rejected in favour of a pragmatist approach (discussed further in 4.2.1), as the problem itself is most important. In considering the research problem pragmatism

supports the duality of researcher and head coach with knowledge claims arising out of actions and consequences. Further, with the problem at the heart of the research, pragmatism supports the use of multiple methods to consider the research aim through a number of qualitative methodological lens. Therefore, assumptions about what constitutes knowledge, the general principles of research and strategies of enquiry have shaped my qualitative methodological approaches. As a practitioner working within high-performance sport, (World-Class Olympic/Paralympic athletes), of Paracanoe and Olympic Canoe-Sprint, I am motivated to pursue naturalistically valid problems, that will deliver real-world findings. Therefore, impacting the coal face of sport (specifically Great Britain's World-Class coaches, athletes, and multi-disciplinary support teams). My main professional interest, therefore, lies in enhancing the ability of the coach, to work devoid of technology and enhance their understanding of individual athlete SMMs.

Within the field of sports coaching Rajashinghe (2020), specifically highlights qualitative research as being particularly suited as an enquiry method due to the subject (coaching), subjective and contextual nature. This is a view supported by Passmore and Fillery-Travis (2011), who due to dominant positivist approaches within coaching research, highlight the need to generate deeper insights through qualitative approaches. Therefore, if exploring how coaches use their subjective experience and knowledge, to make sense of their world, is a valid line of enquiry, then qualitative methods seem a suitable paradigm of research (Bachkirova & Kauffman, 2009; Passmore & Fillery-Travis, 2011). Qualitative research data is collected in naturalistic situations (Pietkieicz & Smith, 2014), such as those found within my professional setting (Simon & Richards, 2022). Consequently, throughout the course of the research, this thesis has employed a qualitative research methodology that has been used as a form of enquiry for over three decades within the broad field of sports research (Smith & McGannon, 2018). Qualitative methods when properly applied can be seen as a reliable way

of producing results from a representative sample, that can be generalised to wider populations or contexts (Smith, 2018). In this way, qualitative methodologies allow for a richer deeper meaning to be developed and explored, by embracing the responsibility of assessing the value of the research (Robson, 2011). It is in the applied context, at the naturalistic sharp end, working with athletes in the training and competition setting, while managing the plethora of complexities coaching brings, that this research was conducted.

Accordingly, qualitative methodologies have been chosen to help explore and understand the complex world of the coach in naturalistic settings as described in chapter three. In doing so, a richer, deeper understanding will help answer the RQs. Three qualitative research methods have been selected, to best provide insight. These methods are presented and discussed within this chapter, each enhancing our understanding through a different lens. First, it is important to consider the role and position of the researcher.

4.2.1 The role and position of the researcher. In managing the complexity of my coaching reality, I am drawn to pragmatic philosophy, (Dewey 1910; 1929). Or more simply, having the tools available for coping with my reality (Jones & Hemmestad, 2019). John Dewey and later luminaries such as Schön, (1983) and Moon (2013), have through the use of reflection been instrumental in developing insight, in and on my professional practice. This constant reflective process has developed a pragmatic emphasis to my coaching and research practice that allows me to apply theory to practice and assess its efficacy.

The pragmatic philosophy. In supporting this applied application of knowledge gathered through this course of study, I am drawn to the pragmatic nature of abductive reasoning (Morgan, 2007), that allows thought to be converted into theories, and then assessed through action. In addition, the applied nature of my work (and research context) relies on the ability to work along a subjectivity (coaching art) and objectivity (coaching science) continuum. Here a pragmatic emphasis is required to allow duality as a Head Coach and researcher that allows

communication and shared meaning to develop insight through an intersubjective approach (Morgan, 2007).

Reflecting on this pragmatic intersubjective approach, I was keen to draw on both theory and empirical research in generating new insight to enhance my own and others' coaching practice, with an emphasis on understanding naturalistic human experience (Dewey, 2008), in addressing the research questions. Thereby, directly impacting the success of Great Britain's athletes at major events, including the Tokyo Summer Olympic and Paralympic Games 2020. Pragmatically, in the naturalistic setting studied, coaching intersubjectivity is required to provide a balance and consider the coaching process, in a world in which quantitative and qualitative can co-exist as real-world tools (Nelson & Groom, 2012). As a pragmatist, this allows me to place the performance challenge at the heart of the research and identify the methods most suitable to examine this complexity. In doing so, supporting the pragmatic stance of Nelson and Groom (2012), in that I will use all available tools to help inform coaching inquiry. So, at the applied day to day level of preparing athletes for the Olympic and Paralympic Games has integrated both empirical findings which have been contrasted with qualitative analysis of athlete performance. For example, the technological perspectives gained via performance analysis carried out by a qualified expert via GPS. However, while quantitative perspectives may provide notational analysis as an objective measure of performance, they may lack the subjective meaning to the coach or athlete (Lees, 2010).

Therefore, this course of study while qualitative in nature, should be seen as supplementing, refining, enhancing, and adding a new intellectual property to our daily practices. If it *(the learning from this research)* doesn't make the boat go faster, it will not meet a key personal driver for embarking on this course of study. Indeed, this supports the stance of Creswell and Garrett (2008), who pragmatically argue that the blending of qualitative and quantitively sources of knowledge, leads to a greater approach than either can

achieve alone. Nevertheless, in utilising quantitative methods Ofoghi et al., (2013), reviewing performance data mining in elite sport, contend that these objective methods are vital for performance outcome, but recognise the complexity of the problem of converting raw data into meaningful information. In other words, raw data may not tell the whole story of successful athlete performance, the action, or behaviours in the context of sport, may be effective but not necessarily optimal, (Oliveira et al., 2014), or optimal but not effective. In short, data is meaningless without interpretation. In helping to solve the complexity highlighted by Ofoghi and colleagues, a secondary pragmatic motivation within this research is to evolve the new working practice. As discussed above, it is common practice within the World-Class environments for coaches to draw on both qualitative (GPS etc) and quantitative sources of information (observation etc), in constructing the SMMs they work from. The pragmatic nature of abductive reasoning in moving back and forth from induction to deduction (Morgan, 2007), will be well received at the coal face in creating insight and application.

Ultimately, the coach must convert raw data to information, information to knowledge, and knowledge to wisdom to form the 'Wisdom Hierarchy' of Rowley (2007). The ability to act upon knowledge derived from observation is crucial to the success of the coach. Accordingly, this course of this research considers live observation from a coach's subjective perspective, to understand just what the coach observes, interprets, and decides to act upon. Reflecting on my context and motivation to study, some of the findings of this thesis have been published to expand the literature, share knowledge, and stimulate discussion. Additionally, there has simultaneously been a parallel applied strand of learning that impacts my professional effectiveness as a coach and inform professional practice. Most importantly, through the link between my professional practice and research, I have delivered innovations and improved my own and the extended coaching team's professional practice. The insights gained through this

research have positively impacted my work with athletes, coaches, and support team members. In addition, they have generated new ways of collaborating and developing solutions to promote performance. Evolving as offering Great Britain athletes a competitive advantage.

4.2.2 Using Multiple Methods design. In offering a pragmatic and balanced view of answering the RQs within this thesis, the use of multiple methods allows an approach to research, that has the best chance of shedding light on the areas of study (Hoshmand, 2003). In doing so, multiple methods allow the research question to be evolved and followed, in offering the best chance of obtaining useful answers (Johnson & Onwuegbuzie, 2004). In answering the complex RQs this thesis aims to address, the use of multiple methods allows the RQ to be explored through methods that are compatible with the naturalistic setting in which the research is set (Johnson & Onwuegbuzie (2004). The fundamental principle of multiple methods of research, utilises differing methods in such a way as to result in complementary strengths (Johnson & Turner, 2003). Consequently, multiple methods are justified as superior to monomethod studies in answering complex RQs (Johnson & Onwuegbuzie, 2004).

Accordingly, the utilisation of multiple lenses of enquiry would be justified to explore the multiple ways in which coaches appear to construct, adapt, and deploy their SMMs to the individual athlete. For example, the social construction of SMMs through Thematic Analysis (explored later). The relevant lived experience relating to the development of the SMM through Interpretative Phenomenological Analysis, and the cognitions through Applied Cognitive Task Analysis methodologies. Therefore, multiple methods have been selected to explore the RQs within the complex, chaotic and challenging naturistic world of High-Performance coaching and allow the insights derived from answering the RQs to be evolved and followed (Johnson & Onwuegbuzie, 2004). In providing a framework to ensure the quality of results derived from the use of multiple qualitative methods, standards must be met. In maintaining these standards,

the use of component methodology has helped guide the lines of enquiry utilised within this thesis.

4.2.3 Component Methodology. Schwandt (1996) argues that the criteria for qualitative inquiry are "standards, benchmarks, and in some cases regulative ideals, that guide judgments about the goodness or 'quality' of inquiry processes and findings'' (p. 22). At the micro-level, the criteria outlined by Schwandt can be organised into five components (Bickman & Rog, 2009). Maxwell (2009), summarises and provides a model for these five components, that provide a framework for the researcher and provide the quality of inquiry required. Therefore, qualitative research can be described as comprised of five components (Maxwell, 2009). These are: 1) Purpose: What is the worth of your study? Why do you want to conduct the study and why should we care about the results? What is the question you intend to clarify? 2) Conceptual context: What literature, preliminary studies and personal experiences will you draw on to help understand the issue you are studying? What do you think is going on and what beliefs, theories and prior research findings will inform and guide the research? 3) Research questions: What specifically do you want to learn or understand by conducting this research? What specific questions or questions will your research answer and how are they related to each other? 4) Methods: What will you do in conducting the research, and what techniques will you use to collect and analyse data to answer the RQ? How does the method constitute an integrated strategy? 5) Validity: What are the threats and plausible alternative interpretations of your results? How might your results be wrong? How will you deal with these threats? How could the data you collect challenge your ideas of what is going on? Why should you believe me? The qualitative components presented above are closely tied in a relational model where each element combines to form an interactive and interrelated whole (Maxwell, 2009). For example, the RQ should have a clear relationship with the purpose of the study. Further, the RQ should be informed by what is known about the phenomena being studied. Having outlined the

purpose, conceptual concept and outlined the RQ in previous chapters the main methodologies chosen to answer the study aims will now be discussed. Following the study methodologies employed within this thesis sequentially, the first to be presented is Interpretative Phenomenological Analysis.

4.3 Interpretative Phenomenological Analysis

Interpretative Phenomenological Analysis (IPA; Smith, Flowers & Larkin 2009), was first used as a research method in the mid-1990s. Smith (1996), introduced an approach to research that captured experiential and qualitative dimensions by drawing on theoretical views of phenomenology, hermeneutics, engagement with subjective experience and personal accounts (Shinebourne, 2011). Smith and colleagues (2009), describe IPA as 'an approach to qualitative, experiential and psychological research, which has been informed by concepts and debates from three key areas of philosophy of knowledge: 'phenomenology, hermeneutics and ideography' (p.11). Therefore, within the research, the definition of IPA is to explore the process in detail, through which participants make sense of their own experiences and seek to utilise an assumed universal inclination towards self-reflection (Brocki & Wearden, 2014; Chapman & Smith 2002). In more simple terms the primary goal of IPA is for myself, as a researcher to make sense of how people make sense of their personal and social world and draw meaning from these experiences, (Smith & Osborne, 2015). For example, myself as a researcher and coach, making sense of other coaches, making sense of their own coaching practice.

Interpretative. In investigating the participant's world, IPA methods emphasise the dynamic nature of the research process and the active role of the researcher within, to understand the participant's experiences, and through interpretative activity make sense of the studied world (Pietkieicz & Smith 2014). Through an ideographical process, the

relationship of personal meaning between the person and the world is operationalised at the individual level (Larkin, Shaw & Flowers, 2019). Ideography in IPA seeks to understand how a given person (me as a researcher), in a given context (Olympic and Paralympic setting), makes sense of a given phenomenon (coaching an athlete; Cohen et al., 2007). Consequently, IPA research is a dynamic process with the researcher active within the research method to understand and interpret the participant's world (Smith & Osborne, 2015). The participants are trying to make sense of their world, while the researcher is trying to make sense of the participant, trying to make sense of their world, in a two-stage interpretation, or double hermeneutic phenomenology (Smith & Osborne, 2015).

Phenomenological. Phenomenology is concerned with focussing on the way things seem to individuals through the lens of their own experience and identifying the essential components of phenomena, or experiences which make them unique or distinguishable, from others (Pietkieicz & Smith, 2014). Consequently, IPA can be used to explore complex phenomena and cognitions (Tuffour, 2017). Phenomenology was introduced by Edmund Husserl and developed by Martin Heidegger and seeks to understand lived experience, perception of human experience and how they appear to the consciousness (Tuffour, 2017; Smith et al., 2009). Therefore, narratives of the experience are attached to the data without the influence of external theory (Tuffour, 2017). Accordingly, phenomenological studies concentrate on how people perceive, describe, and talk about their experiences, rather than describing phenomena according to scientific criteria (Pietkieicz & Smith, 2014). In short, phenomena are allowed to speak for themselves with the researcher's role, to interpret and translate the participant's experience and the personal world through an interpretative process.

Analysis. The analytic process within IPA can be described through a dual interpretation, or double hermeneutic cycle that can be considered as looking at the part and

looking at the whole (Smith & Osborne, 2015). For example, participants make meaning of their world, while in a dual process, the researcher tries to decode that meaning to make sense of the participant meaning (Smith & Osborne, 2015). In decoding this meaning, researchers engage in an interpretative relationship with the transcript, to become as familiar as possible, make sense of the account, and create insight. This insight is transformed into emerging themes, before a more logical clustering of related themes into superordinate concepts (Smith & Osborne, 2015). Due to the detailed case by case nature of IPA, most studies are conducted on small sample sizes of one to six participants, as the individual analysis of transcripts takes a long time (Smith & Osbourne, 2015). In addition, it is common to employ purposive sampling and select a homogenous group sample, for whom the research question will be significant (Smith & Osbourne, 2015). Therefore, to explore the complexity of live observation of an athlete's performance within the coach or practitioner's cognitive context, IPA was considered a suitable research methodology for inclusion in this thesis. The application of IPA within this thesis has followed the four-stage process outlined by Richards and colleagues (Richards, Penrose & Turner, 2015). The process will be described in Chapter five but in brief, consists of four stages:

1) Preparing the study. Aims, sample sizes, inclusion criteria, sample methods.

(2) Data Collection. Of lived personal experience.

(3) Analysis. Following the nine-step procedure of Shaw et al., (2009)

(4) Presentation. Writing up reflexively.

Interviews are transcribed verbatim, and data is analysed using an IPA approach (Smith, Flowers, & Larkin, 2009), to comprehend the personal meanings behind the 'lived' experiences of the coach (i.e., why certain actions are taken). Transcripts are re-examined to generate themes for individuals using the double hermeneutic cycle. The themes for this stage, are the extraction narratives from the transcripts. The approach used to analyse the interviews from

the expert coaches, drew upon key statements to allow for phenomenological and interpretative data coding. The key statements are used to analyse the data and generate inductive themes for each study. These were:

i. Descriptive accounts of?

ii. Exploration of the?

iii. The identification of cues?

iv. Tactical concepts relating to?

v. Personal interpretation of how I understood these points.

The specific IPA detailed procedure was in line with Richards et al., (2015), recommendations presented in Table 4.1 below.

Table 4.1 - Outline of the IPA process (Richards, Penrose & Turner, 2015).

Stages of IPA	Description
1	**Preparing the study.** Study design – objective of study, inclusion criteria, sample size, sampling, data collection method.
2	**Data collection** Collecting rich and personal data of the participants lived experience.
3	**Analysing the data** Data analysis is complex and involves a series of analysis steps. Data can be analysed at an individual level, group level or both. Shaw (2015) presented a nine-step procedure to IPA data analysis. Shaw's (2015) steps for IPA analysis are as follows: i. Familiarise yourself with the data. ii. Phenomenological coding. iii. Interpretative coding. iv. Identification of themes. v. Clustering themes. vi. Peer review (not in all cases). vii. Multiple case analysis – moving to another. individual case. viii. Integrative analysis – compared across cases. ix. Construction of a narrative. Adapted from Shaw 2015.
4	**Presentations of findings** - writing up IPA analysis and reflexivity.

After transcription, an in-depth familiarisation process is undertaken which involved reading transcripts multiple times. Themes are then analysed into categories for each individual case, before being examined at a collective group level. Having presented IPA, the second methodology to be discussed is Cognitive Task Analysis.

4.4. Cognitive Task Analysis

As presented in Chapter two, the research setting within this thesis is Naturalistic in nature. It is in the applied context, at the naturalistic sharp end, working with athletes in the training and competition setting, while managing the plethora of complexities coaching brings, that this research was conducted. Within the paradigm of NDM research Cognitive Task Analysis has evolved in offering insight as to how people use their experience to make decisions in field settings, (Zambok, 1997). However, understanding how experts think in the real-world is a challenge. In meeting this challenge, Cognitive Task Analysis (CTA: Militello & Hutton, 1998), has evolved as a methodology to capture this information.

CTA is concerned with real world cognitions, in real world settings. In addition, it is a methodology that is used within these real-world research settings. Further, as discussed in Chapter two it is based on the theory of expertise and therefore relevant to this course of study. While there are several methods of CTA to address the complexity of elicitation of knowledge from real-world experts, one such method is Applied Cognitive Task Analysis (Militello & Hutton, 1998).

4.4.1 Applied Cognitive Task Analysis. Applied Cognitive Task Analysis (ACTA) techniques (Militello & Hutton, 1998), were originally developed by the US Navy, with the goal of evaluating and designing techniques to understand the difficult cognitive task subject matter experts performed when successfully navigating a task. From this understanding system and

instructional designers could then design interventions to develop educational interventions (Militello & Hutton, 1998). Consequently, ACTA has been developed as a set of methods for practitioners who want to identify critical cognitive elements of a task to feed into the design of training (Militello & Hutton, 1998). These interview methods help the researcher extract information and represent it in a way that will help improve training and education. (Millitello & Hutton, 1998). ACTA allows key information to be elicited and for experiences to be explored in great depth within context. Militello & Hutton (1998) designed an ACTA that enables aspects to be probed related to aspects of expertise. This is presented in the respective study chapter.

Owing to the nature of the ACTA being performed within the naturalistic setting of high-performance sport, the method of ACTA was integrated into the normal pedagogical mechanisms of high-performance coaching (Richards et al., 2012). Integration of CTA approaches, and hence ACTA, into training settings has been identified as acceptable (Hoffman & Militello, 2009; Richards et al., 2012). The ACTA research conducted within this thesis included proficiency scaling (Hambrick & Hoffman, 2016). Proficiency scaling is used to narrow the focus of research to coaches who are experts in the studied phenomenon of Olympic and Paralympic acceleration phases. While all participants are considered experts within the 200m canoe Sprint race discipline, proficiency scaling identifies coaches who are most proficient or expert (Simon & Richards, 2023). ACTA involves four stages (Crandall, Klein & Hoffman, 2006), as outlined below:

1. Task Diagram and Interview. Participants were firstly asked to construct a task diagram in line with the procedures described by Militello and Hutton, (1998), in less than six but more than four stages that represented the process they go through when observing and analysing the start or acceleration phase in sprint kayak. The diagrams were then checked and compared against the related discussion transcript.

2. Knowledge Audit. Within the second stage a knowledge audit was conducted. Probes and questions were utilised to elicit examples of domain-specific knowledge and skills. Initial probes were followed by increasingly specific questions that examined the coach's examples, cues and strategies of decision making. Finally, potential errors that a less experienced coach could make in their observations within the scenarios and examples given by the coach were discussed. The ACTA knowledge Audit and Task Prompts can be found below in Table 2.

3. A Simulation Interview. At the third stage of the process a simulation interview was conducted. The interview presented a challenging scenario that the participants were familiar with. The simulation interview was completed independent of the knowledge audit and presented a video recording of a known paracanoe athlete completing an acceleration phase to examine, compare and contrast observational processes of the coaches, (Militello & Hutton, 1998). The interview focused more specifically on the coach's cognitions within the coaching process. A simulation interview guide was constructed with questions influenced by Principal Component Analysis (Daffertshofer, Lamoth, Meijer, & Beek, 2004), as a "knowledge elicitation strategy" (Flin, O'Connor, & Crichton, 2008, p. 222). The interviews allowed key information to be elicited and for experiences to be explored in great depth within context.

4. Cognitive Demands Table. After conducting the first three stages of the ACTA process, the cognitive demands table is constructed to sort through and analyse the data. The cognitive demands table is intended to provide a format for the practitioner to identify themes within the difficult cognitive aspects that are identified in stages one, two and three of the ACTA. The cognitive demands table presents the information from the difficult cognitive elements of the four ACTA techniques.

Having presented ACTA the final methodology employed within this thesis is Thematic Analysis, which will be discussed next.

4.5 Thematic Analysis

A third qualitative research method utilised in the course of this research is Thematic Analysis (TA; Braun & Clarke, 2006), and was selected for answering complex questions such as what are the reasons the coaches studied within this thesis, have for using a procedure or process. TA is an umbrella term for analysing qualitative data through a range of approaches, that aim to identify patterns of meaning or theme development. TA was originally proposed by Braun & Clarke (2006) and is now a widely used research method in social, behavioural, sports and exercise research (Braun & Clarke, 2019). TA and IPA have similarities in terms of results, particularly with a phenomenologically informed TA method. However, IPA provides an entire framework for conducting research, while TA allows more flexibility to understand people's experiences and perspectives (Braun & Clarke 2006). This was an advantage in considering the RQs as not only did it complement IPA and CTA, TA, it provided an insight as to the process coaches had developed within their observation.

TA is suitable for answering complex questions such as what reasons people have for using a procedure or process? In answering these complex questions, TA aims to provide a rich and detailed account of the data to provide a purely qualitative, detailed, and nuanced account to find repeated patterns of meaning (Braun & Clarke, 2006; Vaismoradi, et al., 2013). Braun & Clarke (2019), now describe their concept as Reflexive TA, in that it is theoretically flexible and can be utilised to answer different research questions by applying different frameworks of TA. A semantic framework, (i.e., coding and theme development reflect the explicit content of the data), has been chosen as a theoretically coherent method to address the research questions of this thesis. Semantic coding is recognised as offering a more realistic and descriptive account

of participants' experiences, (Braun & Clarke, 2006). Braun & Clarke offer guidance that the TA research sample will be dependent on the size of the project however, the minimum sample size should not fall below five and ideally, be between six and 10 for a small TA project. Braun & Clarke propose a six-phase sequential process for reflexive TA. While the phases follow each other, the researcher is encouraged to move back and forth between the phases to interrogate the data. In brief, the six phases are:

Phase 1. Familiarisation. This involves the researcher immersing themselves in the data, repeatedly reading actively to search for meaning and patterns. Note-taking and informal coding can begin to emerge at this point.

Phase 2. Generating initial codes. This phase involves the production of codes within the data, (semantic or latent content), that appear of interest to the researcher that can be assessed in a meaningful way regarding the phenomenon. The entire data set is coded and collated together for later stages of analysis.

Phase 3. Searching for themes. This phase re-focusses the analysis at a broader level, to sort codes for potential patterns of meaning or potential themes. It then involves coding the data relevant to each candidate theme so that themes can be worked with, and the viability of themes reviewed.

Phase 4. Reviewing of themes. Braun & Clarke (2006), define themes as patterns of shared meaning underpinned by a central concept. In this phase, themes are reviewed against the data set to determine that they tell a convincing story and answer the research question. In this phase, themes can be split, combined, or discarded.

Phase 5. Defining and naming themes. In this phase, themes are developed via detailed analysis and scope and focus are determined to tell the story of each theme.

Phase 6. Writing up. The final phase involves developing the narrative and data extracts and contextualising the analysis of the literature.

The use of multiple coders to guard against misinterpretation and researcher subjectivity (Morrow 2005), is not an approach supported by Braun & Clarke, (2019). Instead, they argue that inter-rater reliability is underpinned by the realist/positivist assumption that there is an accurate reality in the data that can be identified through coding. Braun & Clarke see coding as flexible and organic, with coding evolving through the phases highlighted above. Therefore, coding is a reflexive and active process that bears the mark of the researcher who is immersed in the process. Consequently, with no singular way to code data the logic behind inter-reliability and multi-independent coders is redundant and instead can be explained as two researchers being trained to code in the same way, rather than that their coding is accurate (Braun & Clarke, 2006).

TA was chosen as a research method to help answer the RQ's by examining the lived experience of coaches, who had transferred into Parasport disciplines and were required to adapt or create new SMMs of performance for the athlete. An overview of the process and application will be presented later in 4.8. While the coaches shared the same generic training, they worked in differing contexts that allowed a comparison of how the coaches may have adapted their SMM. Within a sports setting, understanding the context of the coaching task is vital for the researcher to interpret data, make sense of and construct meaning (Vaismoradi, et al., 2013). Interpreting this data applies minimal description to the data sets and instead, relies on the researcher to interpret various aspects of the research topic (Braun & Clarke, 2006). Therefore, the experience of the researcher in context, maybe a limitation to the use of TA. In addition, limitations may be experienced through the paucity of information within the current literature and may limit the diversity of perspectives in considering the research context and question (Vaismoradi, et al., 2013). The paucity of research relating to the context of this thesis

and RQs would fit with the limitations presented above. In dealing with data in which no or limited studies may guide the researcher, inductive TA is used in interpreting the phenomena studied and consequently coded categories are derived directly from the text data (Elo & Kyngas, 2008).

Therefore, unless familiar with the context, researcher subjectivity could misinterpret the data (Morrow, 2005). In addition, TA is often criticised as deriving broad data, that again requires careful reflection and interpretation, (Braun & Clarke, 2006). In guarding against the contextual understanding limitation, the researcher holds extensive experience within the research context, holding United Kingdom Coaching Certificate Level 4 status, International Paralympic Classifier Status, Accredited Strength & Conditioning Coaching status, and is Head Coach of an Olympic and Paralympic World Class Programme. However, the experience of the researcher is a limitation, if they have a theme in mind. Accordingly, the use of member checks and supervisory teams to guard against researcher subjectivity has been utilised within this thesis.

4.6 The research setting and gathering data.

In utilising TA, IPA and ACTA as instruments to examine the research aim, convenience sampling (a form of purposive sampling) within three high-performance contexts of Adventure Sport, Paralympic and Olympic Canoeing settings was used (Robson, 2011). Consequently, convenience sampling or choosing the most convenient respondents (Robson, 2011), was considered appropriate for the research within this thesis. Convenience sampling allowed access to World-Class coaches due to the researchers' professional role as Head Coach. In addition, it reflects the limited coaching workforce within Elite Olympic and Paralympic Sprint Canoeing and Adventure Sport Coaches with para-sport experience.

4.6.1 Inclusion criteria. In answering the research aim within this thesis, the experience, currency, and expertise of coaches studied was considered vital. In studying current and expert coaches, the participants were able to describe their experiences of the phenomena studied in rich detail and articulate their real-world views. Hence, overcoming a limitation of qualitative enquiry by describing in depth events, perceptions, and reflections about the RQs. The research participants met a demographic profile of being a current and active coach within paddle-sport and holding the highest level of qualification within their discipline for a minimum of five years. Inclusion criteria specific to each study is included within the respective chapter.

4.6.2 Issues of trustworthiness and reliability. Through the use of IPA, TA and ACTA methodologies, the lived experience, cognitions and social elements of the coach's experiences could be interpreted through multiple lenses, and hence provide contrasting interpretations of the RQ in question. Led by the evolution of the RQs, the homogenous sample of coaches was initially across adventure, performance and Paralympic disciplines.

4.6.3 Ethical approval. Ethical approval for the course of research within this thesis was approved by the University of Central Lancashire ethics committee and is included in Appendix 4.2. All research was carried out in accordance with the recommendations and conditions of the University of Central Lancashire's ethics committee, in accordance with the Declaration of Helsinki. All data has been safely stored on an encrypted external hard drive. All information collected during the course of the research was confidential between the researchers involved and anonymised and disidentified by coding. All studies have been anonymised and pseudonyms have been used. In addition, steps have also been taken to avoid deductive disclosure within all studies. Apart from on the interview consent form, names and contact details will be removed from any information supplied. All electronic data will be stored on a password protected computer during collection. Any hard copies of data/information will be stored in a private and secure location at the University of Central

Lancashire. The data will be kept for up to five years and will then be destroyed. Video was captured within as per the normal coaching environment and applied nature of this research. Video was again, stored safely on the external hard drive. Within the supervisory team I was able to discuss any unexpected outcomes confidentially and signposting to any professional support to mitigate any adverse effects as a course of individualised action. Having discussed method, ethics and inclusion criteria, an overview of each study method will now be presented.

4.7 Study One – Chapter Five: Heuristics Within the Observational Process in a Group of High-Level Paddle-Sport Coaches.

IPA was selected as a research method in Chapter five to explore the lived practical challenges faced by high-level coaches, within my working context in paddle-sport. This initial study explored the practical challenges faced by high-level coaches within my working context within paddle-sport in relation to working within competitive and none-competitive sports domains. Heuristics within observation are explored in the context of high-level paddle-sport coaches operating with similar skills and experiences but in different domains of the sport (Performance, Adventure-sport & Multi-discipline). While Adventure Sport is none competitive it does require an ideographic approach (Collins & Collins, 2016), to coaching and shares a generic coach education system with performance coaching and allowed comparison within a range of differing learning environments. IPA was used to capture the cognitions concerning the coach's development of SMMs to the individual athlete. Six coaches were interviewed to examine how they made sense of their performance world of elite coaching and to understand the lived experience of individually before moving to explore the analysis at a group level.

4.8 Study Two - Chapter Six: Adapting Observation in Para Paddle-sport

Study two presented (Chapter six), explored the nature of challenges faced by coaches within two related professional contexts, adventure-sport and paracanoe, who work with para-sport athletes. This chapter aims to understand how personally constructed observational cues and SMMs identified in Chapter five, are transferred to a new coaching context, and individualised to the athlete. Further, it aims to shed light on the commonalities and differences in how coaches that work within the parasport discipline adapt their generic SMM to their athletes and coaching context. In doing so, this study employs a Thematic Analysis method to examine the process and strategies behind the observational process of five paddle-sport coaches who worked with disabled performers and shared generic training. Coaches working in differing Para contexts and domains were selected to allow comparison of competitive and adventure-sport addressing the technical side of SMM. The participating coaches were observed delivering a coaching episode within either an adventure or performance environment and then subsequently interviewed. Interview questions were informed and guided by the work of Crandall and Getchell-Reiter (1993). The full results and study narrative is presented within Chapter six.

4.9 Study Three - Chapter Seven: Shared Mental Models within Paracanoe

Chapter seven examines a group of Paralympic coaches working within a World Class Programme, with the support of multi-disciplinary teams. The study explored how the individual coach's MMs are shared and made usable within the extended management teams. In doing so it is hoped that this study will enhance our understanding of how SMMs can be adopted by the multi-disciplinary team and individualised for athletes. Consequently, this study narrowed the focus of research to examine a group of Paralympic coaches working within a World Class Programme with the support of multi-disciplinary teams. The study aimed to

explore how the coach's SMMs are shared and made usable within those teams. To understand the lived experience of coaches and the cognitive challenge of creating an individualised SMM, IPA (Smith, Flowers, & Larkin, 2009), was again chosen as a research method. The IPA process developed by Richards et al., (2015), work on Elite coaches was used. A purposive sample of three participants was identified for this investigation and is appropriate following the recommendations of Smith et al., (2009), for conducting IPA research (given the bespoke expertise of the environment). The full results and study are presented within Chapter seven.

4.10 Study Four - Chapter Eight: A Case Study: Investigating Cognitive Observational Difficulties and Expert Skills in Elite Coaches Using an Applied Cognitive Task Analysis

Following on from previous chapters the utilised methodologies that allowed the RQs to be examined through lived experience, chapter eight presents a case study integrating ACTA. ACTA was chosen to explore the cognitively challenging observational elements of coaching, within the acceleration phase of sprint kayaking that informs the SMM. ACTA required the coaches' cognitions in relation to the start phase of the race to be captured, in order to better personalise the SMM to each athlete. ACTA was also innovatively used to capture the expertise of the inter-disciplinary coaching team to; 1) explore the similarity of task diagrams with coaches; and 2) explore cognitive skills through knowledge audit, to inform continuous coach development. A total of eight coaches participated in this investigation. As a result of understanding how the SMM is operationalised across multiple experts, this research has been able to provide a Cognitive Demands Table that shows how coaches and inter-disciplinary specialists overcome coaching challenges through the use of strategies and tactics. The novel insights gained through this research provide original guidance that is bespoke and unique to the High-Performance Coaching community and provides a unique insight into the operationalising of SMM within the world of Olympic and

Paralympic sport (Richards et. al., 2012). In addition, the insights can also be interpreted to inform coach educators and developers that can be used to inform the professional development of coaches and allied inter-disciplinary professionals.

4.10 Researcher Perception of Chapter

In considering the literature at the outset of this research journey, consideration was given to three fundamental philosophical assumptions about what constitutes knowledge, the general principles of research and strategies of enquiry, and the procedures or methods of qualitative research. In challenging these assumptions as a researcher and at the applied level as Head Coach of a World Class programme, qualitative methods were chosen to explore subjective human experience as found in observation. These assumptions were also balanced against the real-world question of *'does it [the knowledge gained from this research] make the boat go faster'?* In supporting the *'boat to go faster'*, all methods bring a value. However, a pragmatic stance allowed the RQs to be considered through multiple lens, in an effort to understand the problem at the heart of the research.

4.11 Chapter summary

This chapter has provided an overview of qualitative methodology and set out the rationale for the methods used within this thesis, the role and position of the researcher, research context and philosophy. It also included epistemological and ontological assumptions that shaped theoretical perspectives on qualitative research and the methodologies employed within this thesis. These methods are IPA to understand lived experience, TA to understand process and ACTA to understand the cognitions of the coaches studied and consequently meet the research aim. These methods therefore support Chapter five, six seven and eight. This chapter has presented the thesis aim, the relevant literature, the research landscape and methods

for the reader. The next chapter presents the first study, which will examine naturalistic observational [of athlete performance] strategies and associated decisions of high-level paddle-sport coaches in Olympic, Paralympic and Adventure Sport.

CHAPTER FIVE: HEURISTICS WITHIN THE OBSERVATIONAL PROCESS OF HIGH-LEVEL PADDLE-SPORT COACHES

5.1 Introduction

Effective profiling of a performer within paddle-sport sits at the heart of individualised coaching (Collins & Collins, 2016; McGarry, 2009), and is the focus for this chapter. Observation and questioning at a macro level provide the primary mechanisms for gathering information on which the profile is built (Giblin et al., 2015; Martin et al., 2019). At the meso level, the observation process allows the athlete's understanding of a performance to be ascertained and the effectiveness of a given coaching intervention to be assessed or modified. At the micro-level, observation allows the coach to manage the corresponding individual differences in the coaching process, such as technical development needs or rate of development (Newell, et al., 2001), and the efficacy of a coaching intervention to be measured. Observation, therefore, acts as the catalyst for the coach's adaptability and flexibility.

In real-world sporting settings, the coach makes fast, intuitive, gut feelings responses within the live sporting situations that are characterised by time pressure and suboptimal information available. Therefore, observation during a performance suggests there may be a potential bias towards NDM processes (Harvey et al., 2015; Johnson, 2006). For example, consider observing and quantifying factors such as joint angles or speed of limb segments relative to the torso in individual sports such as jumping or sprinting, or in ball sports the ball relative to the athlete or defender to inform coaching decisions (Sports Coach UK, Research Summary 23, 2015). Observation presents a significant challenge to the coach in live sporting situations when devoid of performance analysis software (Lees, 2010), and reliant on their senses. Thus, the decision-making process is dependent on a deep understanding of the situation and the demands of the athlete. For example, within the adventure sport context the interplay between the dynamism of the environment and the skill level of the athlete to manage

the environmental demands. Or, in the competition arena the high stakes of performance and the athlete's ability to manage psycho-motor and psycho-social factors to execute the race plan. In the context of both competitive and non-competitive paddle-sport, this means coaches making live observations in complex, dynamic and high stakes situations in real-time.

However, a point of weakness within the management of the decision-making process is the potential for bias to influence the delivery of information with the utilisation of heuristics as discussed in Chapter three. The heuristics that form part of the NDM process influence decision-making as the coach simplifies the complex and time-pressured problem utilising their experiences and reflective skills. The use of heuristics is understood to support fast decision making through the use of simple rules of thumb (Chow & Knudson, 2011). Employing heuristics in observation may have advantages by reducing the number of observations required before a speedy workable though sub-optimal conclusion could be reached. Additionally, heuristics may also act to reduce cognitive load on the coach by providing shortcuts derived from the coaches' experiences and reflection. However, the use of heuristics is unlikely to provide solutions to complex or novel problems if the rules of thumb are oversimplified (Taversky & Kahneman, 1974). Crucially, in a competitive or white-water context, this could lead to miss-placed strategy or safety concerns. When heuristics are misused they are said to result in heuristic traps (McCammon, 2004), leading to suboptimal decision. In Paralympic athletes it seems logical that misuse is strong owing to lack of domain experience and familiarity with disability. Alternatively, within the adventure paddle-sport coaching context the information gathering, and associated decisions may be susceptible to such traps driven by environmental complexity (see Chapter three). Heuristics therefore, would appear to have a significant role to play within observation.

Reflecting on these challenges, the coach may select from personally constructed observation cues that are based on a coaches' experiences and reflections. This may provide

sub-optimal results because key information is missed, ignored, miss-prioritised or negated. Bar-Eli et al., (2011), comment that this is due to a cognitive capacity constraint. These interrelated heuristics may generate a highly complex problem for the coach. So, reflecting this potential challenge to the veracity of the decision-making framework built around observation in the coaching process, the extent to which heuristics play a part in observation within a small group of paddle-sport coaches is examined to expose the complexity and nature of heuristics within the observation. This initial study explores the practical challenges faced by high-level coaches inside my working context within paddle-sport within competitive and none-competitive domains. For this study, heuristics are explored in the context of high-level paddle-sport coaches operating with similar skills and experiences but in different domains of the sport (Performance, Adventure-sport & Multi-discipline) and how heuristics may positively or negatively influence the observation of athletes by examining a small group of coaches engaging with the technical development of competitive and non-competitive paddlers.

This chapter will first present the methodology used, before presenting the findings, and subsequently interpreting the findings in the context of literature and drawing conclusions. In doing so, this chapter will examine the development of naturalistic observational [of athlete performance] strategies and associated decisions of high-level paddle-sport coaches. Specifically, research question one (RQ1). How do elite high-performance coaches working in paddle-sports observe and analyse the performance of their athletes in a naturalistic setting? In addition, RQ2; How do elite high-performance coaches develop MMs of performance and integrate naturalistic in-action observations within their decision-making process?

5.2 Method

5.2.1 Participants. A purposive sample for six participants was identified for this investigation following the recommendations of Smith et al., (2009), for conducting IPA research (see Chapter four for a full review). Six UK based coaches (1 female and 5 male; M_{age} = 42 ± 5 years) from three domains; competitive (*n* =2), adventure paddle sport (*n* =2) and multi-domain (n=2) domains participated in this study. The inclusion criteria for coaches included the following criterion: (1) Minimum of 10 years coaching experience since senior accreditation, (2) currently working with internationally competitive and/or higher-level performers, (3) holding the highest-level coaching qualification within their respective discipline. Pseudonyms have been used and gender data omitted due to prevent deductive disclosure and to protect participants' identity. Table 5.1 below highlights the demographic data of the participants.

Table 5.1 *Highest Coach Qualification and Experience*

Coach	Highest qualification held and years of coaching experience
1	UKCC Level Four Certificate in Paddle-Sport. 15 years' experience.
2	British Canoeing Level Five Coach. 18 years' experience.
3	Multiple British Canoeing Level Five Coach. 23 years' experience.
4	UKCC Level Three Coach - Great Britain Olympic Programme - 10 years' experience.
5	UKCC Level Three Coach - Home Nation Programme - 10 years' experience.
6	British Canoeing Level Five Coach. 24 years' experience.

5.2.2 Equipment. Data were recorded using a digital Dictaphone and stored electronically in an mp3 file format in a secure encrypted external hard drive.

5.2.3 Procedure. As outlined in Chapter four, IPA is a qualitative method that focuses on the philosophy of phenomenology. Specifically, it examines how the coaches in this study made sense of their performance world of elite coaching. IPA requires the focus to initially begin with understanding the lived experience of individuals before moving to explore the analysis at a group level, in this case, the population of expert canoe coaches. Participants received an information

sheet (Appendix 5.1) one week before the interview and completed consent forms (Appendix 5.2). Following consent IPA interviews (Smith, 1996) were conducted (see Table 5.2).

Table 5.2: Interview Prompt Guide

Question	Aim
Do you have any questions? What do you understand of the process? What do you consider makes you high performance? What are your key qualifications and skills? What are your key roles? What are your key Experiences?	What skills & attributes are important in coaching?
Repertoire - What does a normal coaching performance look like for you? What challenges do you face within your normal? coaching environment? What factors influence your coaching? What other options could you take?	What is the depth of experience? Adaptive expertise Naïve or sophisticated understanding of domain?
Observation Strategies What tools do you use to profile performers? How do you observe your performers throughout their performance? What do you look for? What options/strategies to you choose? Why do you look for this? Do you use any aids? How long do you have to observe in your normal coaching episodes?	Why do you look for this? What does the coach respond to? What does the coach attend to? What is the coaches situational assessment?
Analysis Strategies How do you analyse the performance? When does this differ? What aids this analysis? How do you make time to analyse the performance? What informs this process? How have these strategies developed? How do your strategies vary depending on the context/environment? How does this impact on the next action taken? How do you apply information gathered? What drives the next intervention?	How do you arrive at this judgment? What factors does the coach ignore? Is it individualised to performer and context? Why have you formed this judgment? Understanding the situational context. Social and environmental factors. How does the coach develop situational awareness? How does the delivery match the plan? Fast & frugal heuristics? The informed judgment and decision-making process Are there any heuristics evident? Rational or naturalistic decision making?

The interview schedule covered the lines of questioning relating to coaching repertoire, observation and analysis strategies and is presented in Table 5.2. IPA interviews allowed the respondent to talk freely with probes deployed when necessary to funnel general views to more specific (Smith, 2015). Participants were encouraged to consider and explore the process

through which they gathered information when coaching, how it was analysed and applied in action. Each interviews lasted approximately 60 minutes.

5.2.4. Data Analysis. Transcripts were analysed using the approach outlined by Smith, et al., 2009 for IPA to comprehend the personal meanings behind 'lived' experiences of the coach and in line with Richards, et al., (2015), with elite performers (See Section 4.3, Table 4.1). Using the process outlined, transcripts were re-examined to generate themes for individuals using the double hermeneutic cycle. Themes for this stage was supported by the extraction narratives from the transcripts. Meetings with my supervisor enabled discussions relating to themes to be explored and initial interpretations were validated. These discussions included exploring the data at a generic level (high-level canoe coaches) and at a sub-discipline level.

5.3 Results and discussion

Results are presented in three parts. Firstly, in the format of individual analysis and then combined group analysis to illustrate the findings relating to the lived experience of expert canoe coaches. With a further third level analysis exploring the differentiation of expertise according to domain specialism within canoe (performance coach, adventure-sport and multi-discipline). Part one, individual analysis, part two, group analysis and part three, domain analysis is presented below.

Part 1: Individual analysis. Coding at an individual level was based on the interpretative process outlined by Smith et al., (2009). Audio recordings were transcribed verbatim and anonymised. Transcript data was then read and re-read as an immersive process to familiarise myself with the narrative. The next step allowed me to identify patterns in the text and allowed the recognition of patterns to be connected in a meaningful way. Inductive and deductive thematic analysis was conducted on the transcribed interviews for each coach that allowed phenomenological and interpretative themes to emerge in line with Richards et

al., (2015). The 58 individual themes are presented in Table 5.3 in line with Smith et al., (2009), below by providing a visual overview.

Table 5.3 Visual illustration of identified themes for Coaches: Individual Analysis

Subordinate	Coaches					
	1	2	3	4	5	6
Knowledge of student/athlete needs and wants (observation, questioning)		X	X	X	X	X
Knowledge of student/athlete ability (observation, questioning)	X	X	X	X	X	X
Goal setting and long term aims	X			X	X	
Profiling of student/athletes (short- and long-term)				X	X	
Learning/performance outcomes (Needs and wants, syllabus constraints)	X	X	X	X	X	X
Individualisation	X		X	X	X	X
Group/squad needs (competing performance/development needs)	X	X	X	X		X
Syllabi delivery – working from scripts		X		X	X	
Measurement of student/athlete skill progression (within session or series)			X	X	X	
External pressure (Ego/Social/Environmental/Performance)	X		X	X	X	X
Weather (past, present and future)			X			X
External constraint (Time/Environment)		X	X	X		X
Conditions (tides, snow, wind, competition, inter relationship)			X	X		X
Performance outcomes required, (selection/qualification)				X	X	
Expectation of success, (from athlete/performer/manger)		X	X	X	X	X
Real risk perceived by coach and by student			X			X
Replication of Observation, (One off performance)		X	X	X	X	X
Decision-making in own practice	X	X	X	X	X	X
Reference of personal philosophy	X	X	X	X	X	
Continued education	X		X	X	X	
Role (Guiding, coach, performance coach, coach education, education)	X	X	X	X	X	X
Currency of practice (familiar/unfamiliar)		X	X	X	X	X
Broad repertoire within domain	X	X	X			X
Explicit, Tacit	X	X	X	X	X	
Decision-making (see meta process)	X	X	X	X	X	X
Reflective process (see Reflective skills)	X	X	X	X	X	X

Community of Practice	X	X	X	X	X	X
Coaches' skill as reflective practitioner	X	X	X	X	X	X
In-action (intuitive basis to reflective practice)	X	X	X			X
On-action (Classic basis for reflective practice)	X	X	X	X	X	X
On-action in context create time to think, pedagogic and practical strategies)	X	X	X		X	X
Pre-action (Aspect of Planning, creation of contextual framework for decisions in action)	X	X	X	X	X	X
Considered process, planning (Pre-action, on-action, creating time)		X	X	X	X	X
Intuitive process (on action/in-context, creating time, selecting options),	X		X			X
Replication of observation (actual or video review)		X	X	X	X	X
Observation and analysis intuition present (NDM)	X		X	X		X
Observation and analysis structure present (CDM)	X	X	X	X	X	X
Condition for NDM Attractors described	X		X			X
In session (In-action and on-action in context, nested)	X	X	X	X	X	X
Adaptability, Flexibility			X			X
Pre-planned intervention strategy	X	X	X	X	X	X
Recognition of previous success strategies	X	X	X	X	X	X
Commitment to the course of action (little deviation)		X		X	X	
Creativity			X			X
Educated Guess / Hunch	X		X	X		X
Meta-decision, how best to make the decision	X	X	X	X	X	X
Time to think (RDM/NDM)	X	X	X	X	X	X
Understanding of technical templates	X	X	X	X	X	X
Time to think (pedagogic, practical strategies)	X	X	X	X		X
Prioritizing most effective coaching interventions	X	X	X	X	X	X
Benefits of proposed action	X	X	X	X	X	X
Adaptation of technical performance template variables for the context, (individual/environment/equipment).	X		X		X	X
Application of previously successful intervention strategies, (applied to similar athlete/learner/contexts)	X	X	X	X	X	X
Meta-decision, Check and challenge of decision		X	X			X
Evidence-led (measurement of long-term progress)				X	X	
Optimal performance outcome selected				X	X	
Sub-optimal performance outcome selected (to achieve success)	X		X			X
Personal Preference, pros and cons (macro and micro process)	X	X	X	X	X	X

Table 5.4 Example of seven individual themes captured from all expert coaches for Paddle-sport Coaches

Identified Theme	***Key word quotes from Coach 1, Coach 2, Coach 3, Coach 4, Coach 5 & Coach 6***					
	Coach 1	***Coach 2***	***Coach 3***	***Coach 4***	***Coach 5***	***Coach 6***
Knowledge of Environment	"I've spent a lot of time coaching in different environments and domains".	"Very much living on site surrounded by people who would chat over a beer over what you were doing and what you were thinking, to working in the states with (mentor) again where you have people who are keen to talk about what they're doing".	"An intimate knowledge of the environment to be able to read, respond and anticipate to maximize learning".	"Hugely I change from home to race because it wasn't so long ago, I was an athlete because it wasn't so long ago I was in the environment where I need to, I was racing, 4yrs ago I was at World Championships. You need something different in racing, the change, what you need from a coach is different'.	"Yes and no, it comes from experience first experience as an athlete then watching athletes and also then watching athletes".	"Understanding sophisticated domains and using tactics to stagger and buy myself time to think and manage the environment"
Knowledge of Self	"What you would call probably life experience, in terms of dealing with people, and reflecting on what works, and what doesn't work with people and being	"What I believe to be important what I have worked out to be important based on experience, based on syllabus, based on my own values".	"Well I never, I think I've gone through a number of stages, and I'm excited to know where the next stage is going to be".	"I actually got to develop myself along with the athletes. I quickly got to get a lot more experience in that world with lots of athletes, there's group athletes, then I got into UK sport	"I simplify my own complexity, it's kind of a philosophy, on a day-to-day basis at some point and I think at early age, exploring it	"I've done so much, I'm comfortable with myself and my knowledge. It's about maintaining that balance now".

	comfortable in your own skin, about who you are".			an athlete to coach program, which is a year program but quite intensive".	finding a quality in the delivery".	
Reflective Skills	my own education through completing a degree, in (pause), doing a post grad, so I guess I'm learning now as well.	Talking to the other staff, lots of reflection with other staff. What's covered what's not covered, from that whole process from planning it to the pre-chat for running past ideas. What you're going to cover what you're not, face to face stuff, then to post chat as to what you saw what you didn't see, where the gaps were".	Working alongside I've been lucky enough to work alongside a lot of good coaches and discussing things through, a lot of good coaches. And I think time to reflect on where you are, where you're at".	I spent a lot of time quizzing them about the good bits about what they did as well as recognising the bits I thought I could do better".	The experience as an athlete is one thing because you have a life experience of what it takes, the thing that as an athlete you have to be careful with that, what your athletes really go through, you have an understanding of the emotion".	I'm a worrier. I'm constantly thinking about the session pre-event and the next day. Constant pre-flection and reflection to help me deliver client goals".
Aspects of Observation Process Observing performance	"You're sort of, you're having your own observation and understanding and where they	"Now it's a lot more planned and targeted when I was doing white water slalom coaching, I would	"So those observational strategies will be, at their start at their core very holistic, drawing in as much	"1 or 2 strokes can tell me quite a lot, we're talking seconds, in a second you can pick up stuff. Depends on	"From race analyses because you maybe, look at data during races, if a question of	I'm pretty deductive looking at outcomes and looking for generic themes. It's pretty intuitive to

(selecting options)	should go, matching with where they want to go"?	find it easy to see the important things, whereas now I feel I definitely have to plan what I am going to look for and think about it ahead of the game what might be important so that I don't, because things aren't jumping out at me quite as much".	information from as many different sources, above and beyond just looking at performance. I kinda quite pride myself on noticing the wee things, how people are responding".	the session, if I was focussing more on a technical, I would give them a build session, give them a period of time to change it".	analysis. You are not reading because you have a fast time, where does it come from, I would be much more focused on the outcome of the athlete, and looking at the gap during the key events as that's focused on the athletes. I would be more about gaps in the scope of what you are able to deliver the technical pallet".	manage groups and situations".

Analysis – Audit (Interpretation of observation)	"Uhhm, I don't think too much about it so I guess it must be fairly intuitive? Based, based on experience, I guess? But of course there's then, (Sigh), you use observation but its' also then like under the deck what are you doing under there, what are you, what do you think you're doing"?	"Definitely compare it to what I want to see what I think is necessary for the individual to achieve what they want to achieve".	"So that will then springboard onto two things, if we're looking at performance and that will be the picture in my head and therefore how is that I've noticed mapping against the picture in my head which is the picture of where they've asked me to take them to"?	"I am not deeply analysing then, I analyse with video is the only way to get down and all think about it but if I can see an instant change then that's the area we're working on, I can see that, you can see the difference in height".	"Look at the pointing position, how you're anticipating, how you use your body as. It's not only your it's the biomechanics. That's something that the scope, that would be the benchmark rather than the outcome".	"It's individualised to the person, but I have themes I work through. I'm not necessarily looking for textbook but unique solutions".
Decision-Making – Application of coaching intervention	"I think I've almost gone through, what is the silver bullet that is going to make the biggest difference? What will have, almost sort of prioritized, ok is that going to make the biggest difference".	"That's a bit complicated Is the person, is it going to benefit the person are they ready for that information and how I give the information, so you're trying to read all of those things to sort of, I might have something that I think is really	"And if it is great I can move on, if it's not then I'll think well therefore, based on previous experience, I think it must be that. So I'd give that a go but I feel I still need to be as objective as I can, but I feel I'd still go around the objective loop, to	"When I have it on video, if I need to I will spend 1 or 2 hours looking at that video really trying to break it down or I will ask another coach to look at it".	"It's a lot of work on, there's a lot of observing, time spent watching videos & videos, & videos again, it's not only demonstration during the session but it's your own work you're doing".	"I'll often brass neck it and then deal with the outcomes to see if I'm right or not to see how the performance develops and when I can add technique shortcuts. The clients will let me know if they've hit the outcome".

		important for that person to progress but will they be, are they ready to receive it and how do I deliver that in a way they can receive it and how am I going to do it, is it now is it later is it in front of the group not in front of the group is there another".	check and challenge and be as evaluative and objective as possible".			

The individual analysis identified allowed 262 raw themes to emerge as 58 phenomena themes across the coaches. Owing to the volume of data analysed, Table 5.3 illustrates the individual 58 phenomena themes identified for all six coaches to provide a strategic overview, with Table 5.4 providing an example of quotes from all six coaches for seven identified superordinate themes. The individual analysis outlined above was repeated for all six coaches. Table 5.4 exemplifies the quotes for each coach for all the identification of themes identified at stage iv of the IPA process outlined by Richards and Colleagues (2015). Table 5.4 above provides an example of the coach quotes supporting and illustrating the narrative of each of the six coaches. Appendix 5.3 presents the double hermeneutic interpretative, phenomenological IPA process for Coach 3 and is provided as an example of how interview transcripts were analysed and concepts identified before concepts were clustered into themes.

***Part 2: Group analysis*.** The second level of analysis was conducted to identify individual specific areas that the coaches utilised within their specialist area. Through this stage of interpretation, I remained conscious of my cognitions in relation to the interpretation of the data and the identification of patterns. My interpretation of the data was further challenged by my DoS who provided additional perspective to the data in line with stage *v* of Richards et al., (2015), recommendations. At the second stage of analysis, the 58 identified phenomena themes were further clustered, arranged and re-arranged into higher-order themes that provided the basis for subordinate themes to emerge at the second level of analysis. Table 5.5 on the next page provides a visual representation of individual phenomena within specific areas (Performance, Adventure, or Multi-discipline) that the paddle-sport coaches utilised as well as shared areas that were common across disciplines. Below presents individual coach-specific subordinate themes for each Domain.

Table 5.5 Domain-Specific Themes for Performance, Multi-Discipline and Adventure Sport Coaches.

Dimensions	Superordinate	Subordinate	Performance Coaches	Multi-Domain Coaches	Adventure Sport Coaches
Learning Environment	Knowledge of Performance	Knowledge of student/athlete needs and wants (observation, questioning)	X	X	X
		Knowledge of student/athlete ability (observation, questioning)	X	X	X
		Goal setting & long term aims	X	X	
		Profiling of Athletes (short & long term)	X		
		Learning/performance outcomes (Needs and wants, syllabus constraints)	X	X	X
		Individualisation	X	X	X
		Group/squad needs (competing performance/development needs)	X	X	X
		Syllabi delivery - Working from scripts	X		X
		Measurement of student/athlete skill progression (within session or series)	X		X
		External pressure (Ego/Social/Environmental/Performance)	X	X	X
	Knowledge of Environment	Weather (past, present and future)			X
		External constraint (Time/Environment)		X	X
		Conditions (tides, snow, wind, competition, inter relationship)			X
		Performance outcomes required, (selection/qualification)	X		
		Expectation of success, (from athlete/performer/manger)	X	X	X
		Real risk perceived by coach and by student			X
		Replication of Observation, (One off performance)	X	X	X
Reflective Based Practice	Knowledge of Self	Decision-making in own practice	X	X	X
		Reference of personal philosophy	X	X	X
		Continued education	X	X	X
		Role (Guiding, coach, performance coach, coach education, education)	X	X	X
		Currency of practice (familiar/unfamiliar)	X	X	X
		Broad repertoire within domain		X	X
		Explicit, Tacit	X	X	X
		Decision-making (see meta process)	X	X	X
		Reflective process (see Reflective skills)	X	X	X
	Reflective Skills	Community of Practice	X	X	X
		Coaches' skill as reflective practitioner	X	X	X
		In-action (intuitive basis to reflective practice)		X	X
		On-action (Classic basis for reflective practice)	X	X	X
		On-action in context (create time to think, pedagogic and practical strategies)	X	X	X
		Pre-action (Aspect of Planning, creation of contextual framework for decisions in action)	X	X	X
Managing Complexity	Aspects of Observation Process	Considered process, planning (Pre-action, on-action, creating time)	X	X	
		Intuitive process (on action/in-context, creating time, selecting options),		X	X
		Replication of observation (actual or video review)	X	X	X

	Observation and analysis intuition present (NDM)	X	X	X
	Observation and analysis structure present (CDM)	X	X	X
	Condition for NDM Attractors described		X	X
	In session (In-action and on-action in context, nested)	X	X	X
	Adaptability, Flexibility			X
	Pre-planned intervention strategy	X	X	X
	Recognition of previous success strategies	X	X	X
	Commitment to the course of action (little deviation)	X		
	Creativity			X
	Educated Guess / Hunch	X	X	X
Analysis - Audit (interpretation of observation)	Meta-decision, how best to make the decision	X	X	X
	Time to think (RDM/NDM)	X	X	X
	Understanding of technical templates	X	X	X
	Time to think (pedagogic, practical strategies)	X	X	X
	Prioritizing most effective coaching interventions	X	X	
	Benefits of proposed action	X	X	
	Adaptation of technical performance template variables for the context, (individual/environment/equipment).		X	X
Decision-Making – Application of coaching intervention	Application of previously successful intervention strategies, (applied to similar athlete/learner/contexts)	X	X	X
	Meta-decision, Check and challenge of decision		X	
	Evidence-led (measurement of long-term progress)	X		
	Optimal performance outcome selected	X		
	Sub-optimal performance outcome selected (to achieve success)		X	X
	Personal Preference, pros and cons (macro and micro process)	X	X	X

A total of 23 of the 58 subordinate data themes showed individual discipline-specific expertise, within seven superordinate themes that made up the three-domain headings. The remaining 36 of the raw data themes highlighted shared use of the specific elements within the coaches. Table 5.5 The subordinate themes initially emerged from the clustering of phenomena that were common across the sub-specialisms of the paddle-sport coaches. However, on deeper analysis and through the use of the double hermeneutic process, differences in how the coaches operationalised and utilised the sub-ordinate themes began to emerge. For example, while all

of the coaches valued and used recognition of previously successful strategies as an observation tool, the performance coaches observed little deviation from the MM against a race plan, whilst the adventure-sport coach valued creativity of the application of the MM to manage a hyperdynamic environment. These differences appeared to be linked to how the coaches established and maintained situational awareness and made sense of the unfolding coaching scene to guide their decision-making. The subordinate and superordinate themes will now be discussed in detail below.

5.3.1 Superordinate and subordinate themes and discussion. The themes emerged from my interpretation of how the six expert coaches' coached athletes within their specialist areas from their lived experiences. Following the inductive process of analysis, three dimensions within the specific coach populations emerged that identified commonality of themes as generic superordinate themes. The seven superordinate themes are discussed under three dimensions for ease. These three dimensions are Individualised Observation, Reflective Practice and Managing Complexity in observation. See Table 5.6 below.

Table 5.6 Identification of Subordinate and Superordinate themes for all coaches for the expert paddle-sport coaches

Dimensions	**Superordinate**
Individualised Observation	1, Knowledge of the Individual
	2, Knowledge of the Environment
Reflective Based Practice	3, Knowledge of Self
	4, Reflective Skills
Managing Complexity in Observations	5, Aspects of The Observation Process
	6, Analysis - Audit (Interpretation of Observation)
	7, Decision-making (application of Coaching Intervention)

Unpacking the superordinate themes the following section will now drill into the coach specialties in an attempt to understand what may not be initially obvious and compare how paddle-sport coaches may operate generically as a whole and within their specialist

coaching domain. Construction of a narrative of Richards et al., (2015), utilising Step viii. Integrative analysis – compared across cases, IPA process was again followed. The seven superordinate themes are presented and discussed next.

The seven superordinate themes were;

Theme 1: Knowledge of the Individual.

Theme 2: Knowledge of the Environment.

Theme :3 Knowledge of Self.

Theme 4: Reflective Skills.

Theme 5: Aspects of the Observation Process.

Theme 6: Analysis – Audit (Interpretation of Observation).

Theme 7: Decision-making (application of the Coaching Intervention).

5.3.2 Dimension: Individual observation. This dimension has two superordinate themes *i) Knowledge of the Individual and ii) Knowledge of the Environment.*

Theme 1: ***Knowledge of the Individual.*** The nature of the observation and its desired outcome was linked closely to the coach developing knowledge of the performer and the learning context. This was key in the coaches' focus and allowed them to create individualised coaching interventions. Coach 4 described how the observation worked in structured synergy with the other parts of the coaching process:

> *"The opportunity to be individual, individualised training plans, planning by far, like things that are purposefully done, not taking a stab in the dark all the time, not happening to fall upon on a result. You're organising, doing things in a set way, a practised way. You're using evidence-based to do what you do [observed], I think that's the difference".*

The adventure paddle-sports coaches discussed performers' goals and aspirations prior to observation or intervention and attempted to meet and exceed the performer's aspirations with

these interventions typically lasting between one and two days. As a result, the observation was time pressured. Consequently, adventure coaches initially profiled athletes in a less challenging area of the environment to manage the complexity of the coaching process in a dynamic environment, (river, sea etc), that may not appropriately challenge or identify key areas of individual technical development. In addition, an element of risk of injury associated with repeated observations also increased pressure on the coach to modify performance. The exposure to environmental risk (white water rapids etc), was managed within the adventure-sport coaches by facilitating rapid development of the student, potentially at the expense of individualising longer-term skill retention or acquisition. A pragmatic observation of the athlete's/performer's needs was felt to be significant by all of the coaches. Coach 3 described this process happening in an adventure-sport context as follows:

> *"So, because there's those time constraints, because folks are wanting to get as much from me as possible within these 2 days to 5 days, I'm trying to give as much to them as I can."*

Such challenges lead to a potential dilemma, that of balancing athletes' actual observed needs as opposed to their perceived wants (needs vs. wants). The coaches' function shifts from just development to developing the athletes' perception and understanding of performance to the management of the athlete's expectation and comprehension of the performance requirements. Coach 3 elaborated *"I'm mindful of the shortcuts that may not be the best for learning, they may not be needs but maybe wants".* At this point, observation is combined with questioning to clarify and negotiate the needs v's wants requirements. This appeared to differ when the coach was working in a competitive context.

> *"It comes from race analyses because you may be, look at data during races if a question of analysis. You are not reading because you have a fast time, where does it come from, I would be much more focused on the outcome of the athlete and*

looking at the gap during the key events as that's focused on the athletes". (Coach 5).

This desire by the coaches to also meet the athlete's perceived wants, as opposed to their needs, had the potential to influence the coach and combine to create an overlap of heuristic biases such as miss-calibration, familiarity, and framing effects to occur in a conflict between needs and wants. This combining heuristic could act as a force multiplier, having a greater single impact but often appears to be neglected or superficially covered within both sets of coaches. The significance of the multiplier effect is possibly accommodated over time and with experience.

This needs versus wants paradox (Barnston, 2014), is not so apparent among experienced coaches who appear better able to identify and respond to the athlete's needs, modifying their actions dependent upon the situational context than their less experienced colleagues (Grey & Collins, 2016). Interestingly, however, this was still prone to error when faced with complex, novel or time-pressured situations. Less experienced coaches may fall into the traps of miss-calibration bias, confirmation bias or illusion-of-control bias exists, as a heuristic to fill the blanks within their knowledge base. However, this should be balanced against an assumption that, if performance development is the aim, the nature of performance in adventure sports is not fully understood and requires further investigation.

Theme 2. Knowledge of environment. During the observation, awareness of the "affordances" (Chow et al., 2016, p. 55), of a given environment allowed the coach to consider how to manipulate variables and construct practices. Attention was paid to the performer and environment. However, adventure-sport coaches were unable to effectively profile performance deficits when the environment was highly dynamic. This will impact the coach's ability to optimally individualise their coaching to the athlete. Instead, coaches resorted to a more holistic observation approach that may be more prone to heuristics bias. To this end, Coach 3 stated the following:

"So, I guess that initially, I've noticed something that isn't quite right. So, there will be a link to something I've noticed that isn't quite right, so there will be a link to something I've seen before that didn't work for somebody else, with quite a few years of coaching there are quite a few memories in the head".

Within a performance setting the athletes' perceived wants (personal best etc) influenced the coaches' observation, prioritising outcome (wants) above observed needs in terms of individual athlete development. This reflects the paradox highlighted earlier. In the initial stages, the observation process may require rapid skill development; for safety reasons, once a suitable level of skill has been developed longer-term approaches could be employed though this warrants further study. This prioritising of wants over needs may illustrate a misunderstanding of individualised coaching or independent performance and represents an epistemological gap between the coaches' views and expectations (Lyle, 2002), and certainly challenges the epistemological chain identified by Collins et al., (2014), in a similar group of adventure-sports of coaches. This also illustrates potential control, saliency, anchoring and miss-calibration heuristics, as the wants may not be achieved without addressing the needs.

5.3.3 Dimension: Reflection based practice. The theme of 'Reflection Based Practice' was divided into 2 subordinate themes*, i) Knowledge of Self, ii) Reflective Skills*

Theme 3. Knowledge of self. The participants articulated their philosophies and beliefs about their observation suggesting high levels of self-awareness and reflective skill. The reflective skills in particular, allowed the coaches to manage the complexity of the in-action observation by constructing their contextual frameworks for observation. These frameworks are built upon an intimate and in-depth knowledge of their discipline, its context and their cognition as a coach, athlete, and performer. This was articulated by Coach 1 contextualises that: *"it wasn't so long ago I was an athlete because it wasn't so long ago. I was in the environment*". These constructs allow the coach to anticipate, react to, and manage the

coaching processes as a micro-cycle. This micro-cycle of in-action and on-action/in-context reflective processes (Schön, 1983), is integrated into the coaching process (Richards et al., 2016), and drives the decision-making. A macro-cycle of on-action reflection contributes to the constant construction of the contextual framework that informs and deepens the coaches' understanding of the context, their epistemology, philosophy, and declarative skills (Collins & Collins, 2012), this is supported by coach 2 who stated:

> *"....very much living on-site surrounded by people who would chat over a beer, over what you were doing, and what you were thinking. To working in the States with Joe Bloggs, again where you have people who are keen to talk about what they're doing".*

These lived experiences supported in and on-action reflection, (Schön, 1983) situated within a community of practice that habitually reviewed their daily coaching interaction to make sense of and validate their MMs and associated coaching decisions. In practical terms, this experience and reflection constructs the coaches' generic model for their observation and underpins a more specific individualised MM for the performance itself which will form the basis of research in later chapters. Coach 2 further states:

> *"I guess I will add my own opinions about what is right and wrong. I definitely in terms of technical performance, I wouldn't describe myself as black and white, this is how it needs to be done. I'm definitely, I have a few things I would say are a must, a whole heap of things that are moveable depending on the individual, the physique, the boat they're in".*

The adaptation of the MM and underpinning knowledge and philosophies was facilitated through the development of experience and operationalised through on-action reflection when considering the individual athlete. This allowed the coach to explore away from generic MMs developed previously and adapt and flex them to the individual athlete in front of them.

Theme 4. Reflective skills. For the moment, the MMs appear to be constructed through shared and personal experience that the coach applies to the performance being observed. In effect the coach makes sense of what is going on through sense-making (Weick, 1995), supporting Macquet & Kragba, (2015), view of this process of analysing events retrospectively, explaining anomalies, anticipating the future suggesting post hoc rationalisation. The coach's MMs are critically appraised against set models for observable performance that are presented from expert sources within the coaches' community of practice or technical sources such as manuals. Coach 4 commented, "*I've been lucky enough to work alongside a lot of good coaches and discussing things through, a lot of good coaches*". The expert influence was, however, viewed with a questioning scepticism by the participants, such pragmatism allowed adaptability and flexibility by allowing the coach to utilise their own experiences with that of the experts' model.

These expert derived models act as a starting point for the less experienced and as a reference for the more experienced coaches. The value of these models appeared to lessen as the coaches' experiences grew to suggest they act as an initial MM template. Coach 4 highlighted the expert models as being influential in his observational practices. Coach 3 describes this process of development as "*based on experience…what I've seen before, models, memories. With quite a few years of coaching, there's quite a few memories in the head."* This process when sufficiently experienced may be akin to elements of naturalistic decision-making such as recognition-primed decision-making (Klein et al., 1998), that allowed the coaches when suitably experienced to connect identify and match cues from observation. Therefore, allowing the coaches to develop situational awareness (Endesley, 1995) and through this sense-make (Weick, 1995). Therefore, coaches were able to interpret, contextualise the experiences and, ultimately, to reapply that generated knowledge.

Consequently, these MMs become shared and retain a degree of consistency within the community of practice, though this requires further study across a larger sample size. This implies a pragmatism in the development of these models. Coach 2 reflected as follows:

> *"...in a slalom coaching job, you're always chatting; those moments in my development have definitely, they've been real shoves in terms of my own development; you peak for example and then you might bimble along then there might be another one, so definitely that kind of community practice has been critical".*

Such interaction allowed the coach to make sense of and settle on beliefs around technique and the MM that held steady for a period of time before further experience allowed the MM to be further enhanced and refined. Critically, however, the community of practice was considered with a degree of scepticism as the coach's experience increased.

Coach 4 expands on the use of the community of practice and expert sources:

> *"We've got a big team here. I quiz, I ask questions I, if I have problems, I ask about those problems, I try and take as much as I can and keep developing as a coach. I've spent a lot of time asking questions of coaches and the coaches I have worked with, the one's I liked actually. The ones who were like myself and I had the opinion they were great".*

Interestingly, direct replication of the expert practice out of context was recognised as a negative by the coaches in the study. Importantly this suggests a shift in the heuristic and NDM interplay with coaches lacking in expertise more reliant on heuristic reasoning. As the coach developed expertise the bridge from heuristic to NDM was made. This supports the notion of fractionated expertise (c.f. Klein, 2015), discussed in Chapter three with domain experts recognising boundaries of context, whilst less experienced coaches may default to a heuristic decision.

Notably, McCammon (2004), identified the influence of experts as heuristic traps (the expert halo), impacting the perceptions and conformity of others. A positive impression of the expert may result in less experienced coaches ascribing skills, abilities, and competencies that they [the expert] may not necessarily possess, or that is then miss-applied out of context. In other words, passed down coaching craft or MMs derived from experts while useful, should be viewed with a high degree of scepticism to ensure they are relevant and fit for the individual and context in which they are re-applied.

Interestingly the coaches articulated an ability to appraise and interpret the observed performance that was unfolding in front of them in the context of the performance and mitigating against the effect of the *expert halo,* highlighting the links to situational awareness and athlete demands as Coach 2 expands, *"I spent a lot of time quizzing them [the source] about the good bits about what they did as well as recognizing the bits I thought I could do better"* However, time pressures and social factors, including those from within the community of practice, could create conditions in which the coach failed to fully audit the sources of information for its relevance to another athlete or a new context (Williams & Ward, 2003). Consequently, the over-reliance on previously developed MMs due to factors such as time or social demands has the potential for the coach to miss-apply any proceduralist approach, such as the Body, Boat, and Blade model (Ferrero, 2006, p. 29), out of context. Therefore, if not properly considered the potential for miscalibration heuristics (Cialdini, 2001), may lead to less optimal coaching decisions as the individual and their MM needs is not met. This suggests that in-depth comprehension of the situation and ability to project its impact would be essential (cf. Endsley, 1995), in the development of the MM. The construction and use of these MM/SMMs warrant further research and will be explored in later chapters.

5.3.4 Dimension: Managing complexity in observation. The dimension of Managing Complexity in Observations was divided into 3 sub-ordinate themes, i) Aspects of The Observation Process, ii) Analysis - Audit (Interpretation of Observation), iii) Decision-making (application of Coaching Intervention).

Theme 5. Aspects of the observation process. The coaches illustrated nested decision-making processes when observing in challenging and complex situations. The observed interaction of the athlete/performer with the environment, the skill that the coaches are trying to refine within the performance, and the tactical puzzle they are trying to solve is a complex and situation-specific challenge (Bennis & Pachur, 2006). The coach has a particular challenge in trying to understand the athletes' intentions and the observable outcomes, (Renfrew et al., 2014). Coach 3 described this process as follows:

> *"So, I'd say I'm educated guessing, but I'm getting a better-educated guesser so the more I do. It can never be more than an educated guess because I've never worked with that particular person, in that particular weather, in that particular craft before".*

This is an area fraught with heuristic bias, as it is the coaches' interpretation and not the athletes' perception that is often acted upon. The complexity of the observational task can create "environmental noise" (Renfrew et al., 2014, p. 157). It is this 'noise' that detracts from the coaches' ability to effectively select the optimum intervention. The ability to manage the noise suggests collaboration and a higher level of thinking (cf. meta-cognition) and may serve to filter or prioritise distracting 'environmental noise and clutter', implicitly addressing a potential misrepresentation heuristic.

Theme 6. Analysis - Audit (Interpretation of Observation). Outwardly naturalistic in nature, these real-world decisions under real-world conditions (Harvey, Lyle, & Muir, 2015), drew upon previous decision-making strategies akin to recognition primed processes in action

while also drawing on the MM that were developed via a CDM process. Coach 1 describes this process,

> *"I am not deeply analysing then, I analyse with video it is the only way to get down and all think about it, but if I can see an instant change then that's the area we're working on, I can see that you can see the difference in height".*

This is also illustrative of a meta-cognitive component to the nesting aspect of the decision-making process. However, and challengingly, this was described by the coaches as intuitive in nature, an aspect of NDM. Coach 1 testified,

> *"I don't think too much about it so I guess it must be fairly intuitive. Based, based on experience I guess?"* In describing this, coach 3 said, *"I'm definitely, whether you want to call it intuition, system 2 [c.f. Klein 2009], whatever gobbledygook you wanna call it, but that's where those short cuts come in, which is just experience".*

I conjecture that the amount of post hoc thinking might question the validity of this assertion of intuition (consider Harts & Billett, 2013). This appears to reflect comments by Collins et al., (2016), who suggested that this posthoc rationalisation bore relation to a CDM-like process that is operationalised via NDM supporting the notion of nested PJDM processes (Martindale & Collins, 2007) about the observation of performance. (Abrahams & Collins, 2011; Collins & Collins, 2015). Outwardly, intuition allows the coach to balance the complexity inherent in the observation process without apparent conscious thought. This ability to perceive better (Rabb & Johnston, 2007), is a characteristic of expert performance and allows the coaches studied to make better choices. However, the capacity to post-hoc rationalise suggests the ability to select from a set of options. What is perceived as intuitive may, in fact, be ease of access to relevant MM and may be constructed through on–action-reflection of experience and may go some way to demystify intuition (Klein, 2015).

Theme 7. Decision-making (application of Coaching Intervention). A rich repertoire of the MM is stored within the long-term memory in such a way as to facilitate easy access and utilisation that allows the nested PJDM process derived from observation to operate in the complex, novel, and chaotic environments (Abraham & Collins, 2011; Collins & Collins, 2016; Martindale & Collins, 2007, 2012). However, the MMs seem logically susceptible to availability, representativeness, and anchoring heuristics within the decision-making process, as suggested by coach 1, *"if I have a particular thing I am looking at then I am used to seeing it".* In effect the influence, availability and representative heuristic are strong and as the coach looked for validation of the fault, they expected to see in their observation they may overlook and fail to prioritise more critical elements of the MM relative to the athlete.

Crucially, the weakness of such heuristics appears to be recognised by the coaches; Coach 3 states *"I'll take a punt? It's reality? But I'll accept it's a calculated punt based on what's worked before. I chose the word tongue in cheek, but I'll accept it's a punt and punts aren't always right."* The awareness of the coach to recognise the 'punt' is suggestive of a meta-cognitive aspect about the decision-making process and self-awareness to identify the boundary of their expertise (Klein, 2015) and the management of the complexity in observation. When prompted to elaborate, Coach 3 described the process as follows:

> *"I'm not going to use the word watching, I'm gonna use the word noticing quite specifically because you notice things through multiple senses if that makes sense as opposed to watching? Watching implies you look at something from afar through a set of binoculars, and I often feel that observation implies that you are observing from afar through a set of binoculars, whereas I think I like to notice things".*

The implication here is that when novel situations are encountered the coach used a more holistic observational process to check and challenge what was initially obvious within their observation thereby guarding against potential bias. The coach if possible sought multiple data

points (Richards et al., 2016), against which to cognitively consider and contrast their observation and hence, individualise their intervention. Having presented dimensions and themes domain specific cases are explored in detail within the next stage of the analysis. The next section provides a comparison across all cases within an integrative analysis and consequently a construction of a narrative.

5.4 Part 3: Domain-Specific analysis

The introduction of dimensions. IPA methodology stops at the case study and part 2 analysis above. However, as there are multiple coaching sub-domains represented within the analysis of the homogenous paddle-sport coach sample, the IPA methodology has been extended to include dimensions. In the context of this chapter and thesis, dimensions refer to the similarity of superordinate themes that exist within specific populations. Within the paddle-sport coaches studied the three specialist domains are performance coach, multi-domain coach and adventure-sport coach. A performance coach is defined as working with competitive athletes within a world-class programme over an Olympic/Paralympic cycle. Adventure sport is defined as typically working in dynamic environments (rivers, sea etc), with athletes/learners, over one to five days. Multi-domain coaches had worked across both performance and adventure domains for defined periods of their career, or on a freelance sessional basis.

Table 5.7 below, presents the specialist subordinate themes within each superordinate theme that were found to be specific to each performance, adventure and multi-domain coach specialism. Importantly, during this extended phase of analysis what initially appeared as common superordinate themes shared across all coaches was not represented within the subordinate themes (see Table 5.7).

Table 5.7 Identification of Specialism specific Subordinate and Superordinate themes for all coaches for all paddle-sport coaches

Paddle-sport Coach Specialism	Superordinate Themes	Subordinate Themes
Performance	Knowledge of the performance	Profiling of Athletes (long term)
	Knowledge of the environment	Performance outcomes required, (selection/qualification)
	Aspects of the observation process	Commitment to the course of action (little deviation)
	Decision-making (application of coaching intervention)	Evidence-led (measurement of long-term progress)
		Optimal performance outcome selected
Multi-domain	Decision-making (application of Coaching Intervention)	Meta-decision, Check and challenge of decision
Adventure Sport	Knowledge of the Environment	Weather (past, present and future)
		Conditions (tides, snow, wind, competition, inter relationship)
		Real risk perceived by coach and by student
	Aspects of The Observation Process	Adaptability, Flexibility
	Observing Performance (selecting options)	Creativity

At the subordinate level, there were distinct differences that separated coach specialisms. Of the 58 subordinate themes identified across the coaches studied, the performance coaches identified four subordinate themes that were specific to their specialism; 36 that were shared across all three coaching specialisms, four they shared in common with multi-domain coaches only, two they shared with adventure-sport coaches only and 12 that were not reported. The four specialist specific phenomena are related to the long-term nature of their coaching relationships, the stability of their environment and the need to optimise coaching decisions.

The multi-domain coaches identified, one specialist phenomenon, 36 shared, four in common with performance only, six in common with adventure-sport, 12 not reported. Perhaps

unsurprisingly the multi-domain coaches appeared to utilise a hybrid approach with commonality to the performance coach regarding long term behaviours and optimising coaching interventions. The commonality with adventure-sport coaches was more centred around environmentally dynamic factors such as the weather and managing risk. However, the hybrid approach of the multi-domain coach does appear to require checks and challenges from more specialist experts to support their meta decision-making and sensemaking.

The adventure-sport coaches had five specialisms specific phenomena related to the dynamic nature of the environment in which they worked and associated with the need to manage risk. This also included the rapid skill development of the athletes they worked with to manage risk in the adventure environment. As discussed above, adventure-sport coaches had 35 shared phenomena, two in common with performance, six in common with multi-domain and 10 not reported. Importantly, if coach education courses and learning content are constructed at the holistic superordinate level, then this content may not be effective as it may miss domain-specific requirements that emerge from subordinate phenomena. In other words, coach educators may consequently miss important subspecialist, context, situational awareness and sensemaking elements represented in subordinate themes that are critical for real-world effectiveness within the generic dimensions. The learning environment, reflective practice and managing complexity dimensions are discussed next.

5.4.1 Learning environment. In structuring a learning environment to support athlete development the performance coaches utilised knowledge of performance to develop long term goals that supported individualised athlete development in a stable daily training environment. However, due to the short-term nature of the adventure-sport coaches' athlete relationships, the need to develop long term goals was less important. This divergence of how the sub coaching domains manage the learning environment was reflected in the agreement and importance the coaches place on individualisation across all specialisms. The stability of

the performance coaches learning environment that was presumably reliant on the long-term coach-athlete relationship and the nature of the coaching interaction over a Paralympic cycle. Therefore, allowing the coach the opportunity over multiple weeks and months to measure, monitor and thereby refine coaching sessions to meet long term athlete aims. Contrary to the stable learning environment found in performance settings the adventure-sport coaches encountered a more dynamic learning environment and utilised an implicit knowledge of the physical environment to select a learning location suitable for their athletes. The selection of the learning environment was based on a more holistic view of managing and selecting external factors such as weather, tidal streams, and elements of perceived risk to meet their session goals and provide an element of safety in a dynamic environment. Additionally, the short-term nature of the adventure-sport coaching interaction limited the comprehensive profiling opportunities afforded to the performance coaches and instead learning environments were skilfully selected through this environmental knowledge to allow gaols to be met and managed.

5.4.2 Reflective practice. The use of reflective practice within the adventure-sport and multi-discipline coach specialisms utilised a high level of in-action practice presumably to monitor the dynamism of the environment in which they coached (i.e., white water), and the ability of the athlete to cope with the environmental dynamism. This appeared to be underpinned by a broad repertoire of athlete and environmental interaction that allowed the coaches to intuitively respond to the athlete's needs and exposure to perceived or actual risk in creating a learning environment. Opposing this view of the environment, the performance coaches appeared to only consider the performance outcome required and their athlete's ability to deliver session outcomes. Performance coaches also had a much narrower repertoire and planned session structure they utilised within coaching sessions and were more reliant on reflection on action (post-session) to consider how effective their coaching was and how it

linked with the next session. Presumably, this is reflective of the highly stable daily training environment that the performance coaches worked within. Adventure-sport coaches utilised reflection-in-action to continually monitor, select and manage the interplay between a dynamic environment and how the athlete was able to cope, manage risk and develop in that environment.

5.4.3 Managing Complexity. To manage the complexity of the observation process, the performance coaches spent a considerable amount of time pro-actively planning coaching interventions and progressions again presumably afforded by the long-term nature of the coaching process. The in-depth, long-term understanding of the athletes they coached allowed the coaches to commit to a long-term process of achieving goals over multiple years. The long-term relationship also allowed the coaches the time to identify and work towards an optimal MM of performance for each athlete. This was contrary to the adventure-sport coaches who utilised a more intuitive flexible and adaptable naturalistic observation process built upon experience to support their coaching over a time frame that may be one-off in nature or between two and five days. The coaches acknowledged the challenge within this compressed time frame and verbalised using strategies such as educated guessing suggesting naturalistic and heuristic decision-making to help support athlete development and the use of MMs. In developing and working towards a MM the adventure-sport coach acknowledged they often created sub-optimal though effective performance solutions, such as rapid skill development at the expense of long-term retention to help learners manage the environmental dynamism in which the coaching was situated within. Through this process of managing the environment, athlete and performance, the adventure-sport coaches were able to develop domain-specific MM.

5.5 General discussion

The coaches studied demonstrated naturalistic decision-making behaviours and through this appeared to be susceptible to the heuristic as a mechanism to manage complex, dynamic, and time-pressured situations. Consequently, decision-making appeared to be connected to environmental cues (Klein, 2015). However, within this study, the use of heuristics to manage coaching complexity was also linked to the development of experience and expertise in line with the findings of Bennis and Pachur, (2006) and Oliviera et al., (2014), who observed similar findings in athletes. Importantly, the use of heuristics as a tool appeared to be linked to experience, and as the coach developed experience, they appeared to be less reliant on heuristics as a way of managing observation and instead utilised the NDM process. Critically, however, if an experienced coach encounters a novel coaching situation, such as in an adventure-sport context working on a new section of the river, or in a performance context transferring between athlete groups or Olympic/Paralympic contexts, then experience may be sufficiently fractionated (Klein, 2015), to no longer be valid. If experience is diminished then default to heuristic decision-making would logically follow, and if not recognised the coach may be susceptible to the negative effects of heuristics.

Therefore, it could be said the coaches can utilise both heuristic and naturalistic decision-making synergistically as they manage familiar and novel elements within coaching sessions. The ability to post-hoc rationalise those decisions, and the use of the coaches' MMs for observation (Oliveira et al., 2014), derived from accepted knowledge both suggest a higher cognitive aspect than the term intuition implies and, in this aspect, draws on naturalistic paradigms. Importantly, the development of expertise appears therefore to bridge heuristic and NDM paradigms as experience grows although this requires further research across sport.

Heuristics do play a part in the observation process of the coaches in this study and act both positively and negatively on the coaching process. These heuristics appear to work both

in isolation and in combination to influence the decision derived from the observation process and warrant further investigation. The coaches frequently referred to these speedy decision-making processes as intuitive, although it seems doubtful these are truly intuitive and believe that they are more naturalistic in nature, given the coaches' reliance on experience to guide that aspect of the decision-making process. The outcomes that coaches attended to and observed were developed through experience and reflection based upon the beliefs held by the coaches. The personally constructed observational cues and mental models of technique were fallible to "framing effects", "representativeness" and familiarity bias. The risk of an illusion of control and miss-calibration can also be identified in the coaches studied (Cox, 2007). However, the desire to meet the performer's needs was strong and steered the observation process.

In relation to the use of heuristics in coach observation, this study supports the suggestion that coaches in principle utilise heuristics in their observation and, presumably, that observation is, therefore, susceptible to the advantages and disadvantages of this association with heuristics. Heuristics appear vital for the coaches studied to act effectively given the time pressures and the risks associated with observation in these contexts. Firstly positively, by speeding up the observation process and in some cases reducing risk exposure, but also by enabling the potential to act negatively, leading to poorer decisions based on miss-calibration that evolves from either a limited experience or from poor learning from a broader experience. The latter exposes a potential weakness in a coach's ability to learn from such experience. Additionally, it seems probable that heuristics play a role in managing the complexity of the coaching process, particularly auditing and decision-making elements derived from observation which also warrants further investigation but falls beyond the scope of this thesis.

However, it seems likely that the MM/SMM may be susceptible to heuristic biases in creation and application. The in-action audit creates a high cognitive load, as the coach attempts to manage complexity. Finally, the influence of the athletes' perceived wants appeared to guide

the coaches' observation, prioritising outcome (wants) above observed needs. This represents the coaching paradox highlighted by (Barnston, 2014), as the coach in an effort to provide a performance outcome or in meeting a learner's expectation may prioritise these wants above the needs. Therefore, illustrating a misunderstanding of individualised coaching or independent performance. The possibility of this coaching paradox may represent an epistemological gap at best or signify a 'force multiplier' of overlapping heuristic bias and would merit further research.

5.5.1 Researcher Perception of Chapter. The insights gained through this study has demonstrated that coaches do utilise heuristics within their observation and through this process develop SMMs of performance. While the Heuristic decision-making community view heuristics as a source of bias or error, this research has shown a positive aspect to heuristic observation and associated SMMs in speeding up the coaching process due to safety implications or a need to fast-track athlete skills to manage complex learning environments such as those found in a white water context. However, we can't assume a SMM can be overlaid from one athlete to the next. While heuristics may be suitable for the less experienced coach in their early days, they do not meet the bespoke needs of the athlete. Consequently, if coach education is derived from generic education, it is unsurprising generic SMMs may be overlaid on athletes that do not effectively transfer. Therefore, while useful, heuristics are limited and NDM may offer a more appropriate tool through which to explore observation and the development of SMMs for the experienced coach.

The chapter has considered how high-performance coaches observe and analyse in naturalistic settings and through this process develop MMs of performance based on their experience. In narrowing the focus of the research, understanding how coaches work in the absence of an established MM, generated form experience is explored in the following chapter. Accordingly, the following chapter will narrow the focus of research to examine the challenges of coaching and adapting a MM within a Parasport context.

CHAPTER SIX: ADAPTING OBSERVATION IN PARA PADDLE-SPORT

6.1 Introduction

For some coaches, and those that transfer into Para-sport from non-disabled-bodied disciplines, working with athletes who have a disability is a highly unique situation (Taylor et al., 2015), adding to the already complex job of the coach. The uniqueness experienced by coaches, coupled with the complexity found within these para-sport situations, further challenges the coach's decision-making as to the important elements of performance they must attend to (Lees, 2010). Specifically, within Paralympic sport, this complexity arises partly from the reality of coaches needing to draw on their skills and experiences and transfer them from other able-bodied sport coaching contexts. However, these skills and experiences may not be sufficiently developed to meet the new coaching challenge as discussed in Chapter five. Presumably, in managing this complexity and meeting the needs of the Paralympic athlete, coaches transferring from a non-disabled context will need to adapt the generic MM of performance often established in able-bodied settings. Adapting an existing MM requires the Paralympic coach to enter a unique situation, where coaching needs to be individualised towards the athlete with whom they work. Such a coaching process requires the coaching MM to be individualised to the context (Paralympic Sport), the attributes of the athletes and the performance demand of the event. Therefore, Paralympic Sport requires a need for flexibility, adaptability, and application of knowledge to manage the increase in individual athlete variance found within a Paralympic setting. Consequently, common technical elements and pedagogical process used in non-disabled sport, cannot simply be transferred as a 'global approach', as the technical elements and pedagogical process needs to be tailored and personalised to each individual athlete. Accordingly, providing a 'profiling template' does not work with Paralympic athletes.

Logically, if individualised athlete coaching is the goal, then the adaptation of the MM to the athlete, from which performance observations are built, becomes paramount. It is therefore relevant to this course of research to understand how coaches adapt generic MMs formed in non-disabled sports and make useable within a Paralympic environment. As an example of the challenge of observing an individual athlete's technique within paddle sport, consider an athlete's rotational movement of the torso within the forward paddle-stroke. Rotation within the forward paddle stroke may be achieved through either angular rotation or the speed of movement of the torso around the spine. The same observable outcome, rotation, but achieved in two very different physiological ways (McKean & Burkett, 2010). Either solution to rotation is dependent on the context and performance problem the athlete is trying to solve. For instance, consider the paracanoe athlete whose physiology may not allow angular rotation paired with a coach who is dependent on a MM based on angular rotation.

In the example and within Paralympic paddle-sport there are several potential challenges to the adaption of a generic MM to meet the needs of an athlete. For instance, the construction of generic models may be passed from coach to coach via 'coaching craft' (Chow & Knudson, 2011, p. 229), or found within coaching manuals and may reflect either an absence of para-sport knowledge, fashions in the formal education of paddle-sport coaches (Wareham et al., 2017), or societal norms in the treatment of minority populations (Bourdieu, 1984), as discussed in Chapter two. In many cases, MMs can be based on subjective coaching beliefs which explain the lack of consensus amongst coaches around exactly what the component parts of the MM may be (Chow & Knudson, 2011). As an example, within Olympic Sprint Kayaking, both Michael, Smith and Rooney (2009) and McDonnell, Hume and Volker (2012), highlight interchangeable terminology, definitions of, and differentiation between the paddle stroke within the MM. In short, different terminology is used between coaches, athletes, and disciplines to describe the same thing, making clarity of communication difficult. Even if

accurate and agreed upon, the MM does not reflect the context, individual performer physiology and kinematics, or the situational demands of the performance. Logically, this lack of consensus, weaknesses in coach education (Wareham et al., 2018) and lack of agreement among coaches add to the complexity of coaching practice (McDonnell, Hume & Volker, 2013; Michael, Smith & Rooney, 2009). Accordingly, there is a need to understand and conceptualise the nature and management of challenges in adapting generic MMs (observed in mainstream Olympic sports), used by coaches working with Parasport athletes.

Consequently, this study addresses the nature of challenges faced by coaches within two related professional contexts, adventure-sport and paracanoe, who work with para-sport athletes. This chapter aims to understand how personally constructed observational cues and MMs identified in Chapter five are transferred to a new coaching context and individualised to the athlete. Further, it aims to shed light on the commonalities and differences in how coaches that work within the para-sport discipline adapt their MM to their athletes and coaching context.

In doing so, this study employs a Thematic Analysis method to address firstly; (RQ1) How do elite high-performance coaches working in parasport paddle-sports observe and analyse the performance of their athletes in a naturalistic setting? Secondly, (RQ2) How do elite high-performance coaches develop MMs of performance and integrate naturalistic in-action observations within their decision-making process? Thirdly, (RQ3) When coaching in real time does a high-performance coach in paddle-sport utilise real-time observations to inform coaching feedback and individualise their practice? Or is there an adaptation of predetermined established MM generated by experience? In exploring these questions, the chapter will first outline the method and procedures, before presenting the analysis. The results will then be organised in two parts as a narrative of high-order themes. Finally, key findings will be discussed before the chapter is summarised.

6.2 Method

Design. The research was designed to address the RQs outlined above, by examining the observational process of paddle-sport coaches who worked with disabled performers and shared generic training. Coaches working in differing contexts and domains were selected to allow comparison of competitive and adventure-sport addressing the technical side of SMM.

6.2.1 Participants. Five British para paddle-sport coaches (M=5) from both adventure paddle-sport (n = 2; Mage = 37 years, *SD* = +/-5) and paracanoe sport (n = 3; Mage = 43.3 years, *SD* = 9) domains participated in this study. Purposive sampling was employed based on the following criteria: (1) a minimum of 5 years coaching experience at UKCC Level 3-4 since National Governing Body accreditation within paddle-sport, (2) participants are currently working within para paddle-sport with internationally competitive and/or higher (e.g., world-class programme) performers; 3) individuals hold the highest level of comparable coaching qualification within their respective sport.

No disability or paracanoe-specific qualification is available from the National Governing Body (British Canoeing), therefore all participants were qualified within non-disabled paddle-sport disciplines, although currently working in para-sport. Coaches were deliberately chosen due to the current positions they held in elite performance and the environments in which they worked with parasport performers with a disability. A summary of participating demographics can be found in Table 6.1.

Table 6.1. Demographic Data Coach Experience and Qualification

Coach	Age	Highest Qualification	Coaching Experience (Years)
1 (PC-1)	38	British Canoeing Level 4	20
2 (PC-2)	54	UKCC Level 3 Certificate. Great Britain Paralympic Programme	10
3 (PC-3)	45	UKCC Level 3 Certificate. Great Britain Paralympic Programme	23
4 (AS-1)	43	UKCC Level 4 Certificate in Paddle-Sport British Canoeing Level 5	22
5 (AS-2)	36	British Canoeing Level 4	10

Key: PC = Paracanoe Coach; AS = Adventure Sport

6.2.2 Equipment. Data were recorded using a digital Dictaphone and stored electronically in an mp3 file format in a secure encrypted external hard drive. A paper-based approach to coding was followed (Robson, 2011).

6.2.3 Procedure. Participants received an information sheet (Appendix 6.1) by email one week prior to the interview and, after consenting (Appendix 6.2). The interview strategy was delivered as outlined in Table 6.2. The interview guide in Table 6.2 asked participants to recall and evaluate coaching episodes with para-sport athletes and how they utilise or adapt MMs of performance. Probes were deployed to gain additional information relating to interesting/important responses, to check ideas against emerging literature and concepts, and to encourage participants to recall and evaluate coaching episodes as broadly as possible to ensure sufficient depth of response across all participants. Table 6.2 can be found below.

Table 6.2 Interview strategy: Questions and Prompt Questions

Question	Probes	Stimuli	Purpose
1.Can you tell me about a recent coaching episode in your field?	What did you do and with what aims? did you have?	Performance improvement Athlete/team development Philosophy	Explores incidenc of reflective practice and 'insightful Experimentation' and Philosophical position
	What did you believe were the key? parts for achieving these aims?	ID of the problems Generating and considering alternatives Experimentation? Criteria for decision-making Link to Philosophy	
2. Can you tell me about another coaching episode when you worked with a student who had a disability?	What did you do and with what aims?	Performance improvement Athlete/team development Experience provision How as that chosen/ agreed/ identified?	Explores incidenc of tacit knowledge link to philosophy epistemological chain?
	Can you post hoc rationalize your course of action?	Just popped into your head. Whilst coaching or away from the context? Something which was on your mind for a while? How does this link to your coaching philosophy	
	Can you think of any learning, knowledge or training which helped you generate this solution??	Recent or past training, reading or viewing? Discussions with peers/ CoP's Reflective experiences	
3. To what extent are your coaching decisions different in each session?	Context for each	Philosophy, chain Challenges complexity Tensions, pressure, skills	How do they differ and why?
	Personal factors	Social pressures Political Pressures	
	External factors	Effectiveness, in effectiveness How is that, measured?	
	Formal/informal balance	Highlight previous successful learning	
4. Where do you usually gain knowledge on coaching with disabled people? Can you relate this to any differences between the session which you have made'	What is good about preferred approach	Fits personal style The absolute best against theory In my experience	Explores source of learning and philosophy
	What is bad about non-preferred approach?	Inverse of above	
	Have your preferences changed over time?	Younger versus now preference and why?	

5. How do you adapt your MM for para-athletes?	What do you look for?	Profiling Methods	How do coaches adapt their observational and MM for the individual athlete's needs?
	Why do you look for that?	Observational Methods	
	When do you look for it?	Interpretation of technique	
	What does performance rely on?	Beliefs and values	
	Intelligence	Cognitive Capacity and load	
6. Can you tell me about any <u>personal attributes</u> and <u>skills</u> that you believe were important for carrying out the changes?	Open mindedness	Experience of disability Experience of people	What does it take to be an innovator?
	Critical reflection	Thinking skills	
	Adaptability	Creativity or flexibility, adaptability	
	Recognising pivotal moments in the process	Situational Awareness	

6.2.4 Data Analysis. Data were analysed using reflexive thematic analysis involving a six-phase sequential process (See 4.5, p.74-76) that allowed movement back and forth between phases to interrogate the data (Braun & Clarke, 2006). Within the first phase of analysis, data was repeatedly read to actively to search for meaning and patterns. Note-taking and informal coding can begin to emerge at this point. At the second phase initial codes were generated through semantic content, that appeared of interest and was assessed in a meaningful way regarding the phenomenon. The entire data set was coded and collated together for later stages of analysis. The third, phase re-focussed the analysis at a broader level, to sort codes for potential patterns of meaning or potential themes. It then involved coding the data relevant to each candidate theme so that themes can be worked with, and the viability of themes reviewed. Within the fourth phase of analysis, these themes were subjected to review and further refinement to define themes as patterns of meaning underpinned by a central concept. A meeting was held between myself and my academic supervisor to discuss and compare the analysis. Codes were clustered into a conceptual pattern and subsequently grouped into an organising concept or lower-order theme.

Coding at this stage was a flexible and organic process that evolved through the stages highlighted above in a reflexive process (Braun & Clarke, 2019). In addition to the steps outlined above my academic supervisor was utilised as a critical friend to challenge assumptions and support reflections and interpretations of the data to construct meaning. At the fifth phase again as a cooperative process my academic supervisor supported me as a critical friend in defining and naming themes according to the essence of data codes within, and how these might be perceived in relation to other existing themes. The final phase involved developing the narrative and contextualising the analysis of the literature which is now presented.

6.3 Results analysis

Within this section, the 13 lower-order themes within the analysis, and the progression into four mid-order and two higher order themes will be presented. The lower-order themes were defined, named, organised and codified from the grouping of 499 raw data codes (see Appendix 6.3). The 13 lower-order themes, along with exemplar transcript narrative quotes these themes were derived from are presented in Table 6.3.

Table 6.3 below presents the 13 lower-order themes identified within the analysis. Exemplar quotes have been provided from the two coaching sub-domains (paracanoe and adventure-sport) to help contextualise and audit the development of the 13 lower-order themes. The exemplar quotes highlight commonalities and differences in how the coaches reported their experiences in relation to the lower-order theme they related to.

Table 6.3 Lower-Order Themes and Exemplar Quotes.

Lower Order Theme	Exemplar Quotes (Para Coach)	Exemplar Quotes (Adventure-sport Coach)
Individualisation	"It's about how you individualise your coaching to the individual's needs, it's not disability specific as such, it's function specific & psychological". (PC-1). "I think it's really helped me better understand how to individualise my delivery, I think I understood it before but para forces you to, there's no rulebook…" (PC-2)	"Observation analysis into the paddler and much more probing, observations into paddlers, more probing into folks with disability to figure out what we were going to do and into how we were going to do it". (AS-1).
Innovation of MM	"I coach a slightly different technical model for the pair of them the paraplegic can't use leg drive but is completely balanced left to right and I can lock her down at her hip an she has full function above that point. So, she's like a slalom technical model to some extent. Whereas my amputee has also got complications around his core so the whole chain is imbalanced from left to right…." (PC-1).	"By having all those experiences with different disability charities and organisations has informed the speed that I can get up and running or how quickly or not I need to adapt to whatever that individual has kind of got for sure". (AS-1).
	"….Ok, this is what it looks like for an able bodied paddler. If I take out their legs this is what they do". (PC-2).	"Previously I would have just been this is what we're doing and just doing it without much thought adapting and changing really. That's certainly evolved over time". (AS-2).
Performance focus development	"So, anything you can do that helps with that you are going to get a performance gain. So that's quite easy to measure, you can actually see whole seconds improvement". (PC-1).	"It was then just helping them to understand how they interacted with the craft and the paddle on the water, almost to the same extent as the guy in the canoe was working guy how he interacted with the paddle in the water or the boat". (AS-1).
	"We are aiming at in terms of absolute performance on the water trying to shift from where to was last year 2 to 2.5 secs which would put her in the medal zone but be consistent in doing that". PC-2.	"My process is along lines of can they do some of the tasks that are required when they get to rapid, make their boat accelerate, turn the boat, change direction effectively, can they correct". (AS-2).
Community of practice	"Accept that you are the generalist, you are going to need to be on the lookout for information, gathering new information all the time, have those conversations with other coaches, service providers so you can constantly up skill yourself". (PC-1).	"I'd have loved to have had more, to seek out more mentoring opportunities, don't try to do it all on your own, it was a painfully long process to gather it myself". (AS-1).

	"I have been very isolated as a coach before being in that group, and the wider group in Nottingham all makes you think"? (PC-2).	
Discuss ideas with athlete/performer	"Ask the athlete what works for them bear in mind it might not be the best for them, then you can track what you're doing, make sure you are planning and reviewing all your sessions so that you are as informed as you can be in your decision making". (PC-1).	"Usually starts via email at start then I'll meet the group it starts often with an informal process". (AS-2).
	"… look this is what we're seeing here, and this is where ideally, we'd like to get, what do you think? Is it possible to get to that position or that rotation or whatever, or where do you think we can get to?" (PC-2).	
Learning from coaching experience	"I'm fortunate to try things like para, I've been working in para since the start I have 5years experience of trying stuff and it not working, trying different things, I have worked with a lot of different athletes with different disabilities, they are all different". (PC-1).	"Yes, all been informal through my own trial and error, with folks with disabilities who allowed me to trial and error. Not through any formal training". (AS-1).
	"I think people learn as a para coach, because each of them are different (the coach), you have a technical template, it can be thrown out a little bit, in fact sometimes completely. You've got this athlete and you've got experience and then you're looking at we know how to create power in the boat and how to move as fast as possible….". (PC-3).	"If you had asked me that 10 years ago my process might have been let's make a plan on the bank when I meet the client or the group and we'll do that as opposed to having to spend the 1st hour or maybe even up to half a day observing where they're at, previously I would have just been this is what we're doing and just doing it without much thought adapting and changing really". (AS-2).
Generating/considering options systematically	"Another philosophy I believe in strongly is to build a technique correctly, then add the power, if the technique goes away when you add the power go back to the technical". (PC-1).	"With things I am not so familiar with or do as often I definitely have a huge amount more systems I go through, I guess with the folks with the disability I probably go more systematic a bit quicker". (AS-1).
	"You know it gives you a framework and it's then working out what's applicable, what's not, what could change in tha framework?"…PC-3	"My process is along lines of can they do some of the tasks that are required when they get to rapid, make their boat accelerate, turn the boat, change direction effectively, can they correct if of course so all of those things will ultimately affect my observations…". (AS-2).

Integration of reflection as part of practice	"Understanding yourself, it's a bit of a cliché, but in my own words if you understand yourself as well as you can and you understand the athlete".(PC-1).	"I'd have loved to have had more, to seek out more mentoring opportunities, don't try to do it all on your own, it was a painfully long process to gather it myself". (AS-1).
	"I have become more and more aware of what I am and how I operate and how I come across to people. More self-awareness..." (PC-2).	
Broader and adaptive coaching repertoire	"Yes it's massively holistic coaching and the more I do it the more I realise you are the psychological and you are the technical coach and you're using the specialist to help you do that job". (PC-1).	"Experience of being around folks with disabilities, having a wife who has Cerebral Palsy that informs decision making that way". (AS-1).
Learning focussed environment	"Now I think a whole lot more about the training environment, optimising that athletes ability to improve as an athlete, making right decisions and being helpful to themselves..." (PC-1).	"I guess I will start working with results to begin with then work it back from there". (AS-1).
Critical thinking	"You kind of learn rules that apply, you are looking at minimising dampening and maximising connectivity as a rule…." (PC-1).	"I think my process in how to observe and analyse is there I can see past the disability and I can see the outcome". (AS-1).
	"With some of the guys I've work with (athlete), I'd have the whole team in there or part of the team along with me and the athlete and then between us if there was something I was looking for technically…". PC2.	"It gives me more information about what will happen when they're placed into that environment, a little bit more, evidence, a bit more understanding when they are actually placed in that environment, can I get an idea of what's going to happen". (AS-2).
Patience	"I think patience, time and that ability to problem solve and to help the athlete". (PC-3).	
	"Probably para coaching you have got to be a little bit more patient". (PC-2).	"I do think there's potential for an extra level of patience required". (AS-2).
Emotional intelligence	"It's understanding the athlete, getting to know the athlete, how they communicate, how they are emotionally". (PC-1).	"Empathy and understanding and context, so where and when what's the outcome of what you want to do with the boat, so that that keeps context alive to see past disability". (AS-1).
	"You've got to be empathetic with where they are at but not to the point where you don't then challenge them". (PC-2).	"Putting myself in their shoes, people have to slow things more than they usually do or change their expectations". (AS-2).

Key: PC- Paracanoe Coach; AS- Adventure Sport Coach.

The quotes within Table 6.3 highlight that while both sets of coaches identified the same coaching challenges, how they solved them at times appeared to differ between the specialist domains. For example, in relation to the lower-order themes of 'Communities of Practice' paracanoe coaches utilised a wide range of experts to augment and supplement their critical thinking skills in the adaption and development of the MM, *"I have been very isolated as a coach before being in that group, and the wider group in Nottingham all makes you think".* (PC-2). In contrast adventure-sport coaches reported a more solitary experience reliant on their own observation process. *"I'd have loved to have had more, to seek out more mentoring opportunities, don't try to do it all on your own, it was a painfully long process to gather it myself".* (AS-1). The utilisation of informal, peer to peer learning to share, upskill and make sense of knowledge appeared vital for both sets of coaches in both transitioning into para-sport but in making their MMs useable. Those coaches based within the WCP were fortunate to have this network at hand. However, adventure sport coaches were more isolated. This isolation was also reflected by novice performance coaches, as PC-2 highlighted above who was *"very isolated"* in their development before employment of the World Class Programmes.

As another example, within the lower-order theme of 'individualisation' the Performance coaches were able to profile and understand their athletes needs in much greater detail on and off the water, *"It's about how you individualise your coaching to the individual's needs, it's not disability specific as such, it's function specific & psychological",* (PC-1). While in contrast the adventure-sport coaches utilised their observational skills and experience to understand how they might individualise their coaching to the athlete. *"Observation analysis into the paddler and much more probing, observations into paddlers, more probing into folks with disability to figure out what we were going to do and into how we were going to do it".* (AS-1). The difference in the depth of individualisation the coaches could work at, appeared to be linked to the length of the coaching intervention. With performance coaches working with

their athletes for a Paralympic cycle whilst the adventure-sport coach may have just a one-off coaching intervention with their athlete and consequently was compromised on their ability to individualise. The 13 lower order themes were then grouped into four mid-order themes before. The four mid-order themes generated two high-order themes. The relationship between and grouping of the low, mid and high order themes is presented at Table 6.4 below. These results will be expanded on within the results narrative at section 6.4.

Table 6.4 High, Mid and Lower-order Themes.

Higher-order Theme	Mid-order Theme	Lower-order Theme
Conceptualising the mental model	Mechanical features	Individualisation
		Innovation of MM
	Sharing the mental model	Performance focus development
		Community of practice
		Discuss ideas with athlete/performer
Reflection in adapting the mental model	Coaching process	Learning from coaching experience
		Generating/considering options systematically
		Integration of reflection as part of practice
		Broader and adaptive coaching repertoire
		Learning focussed environment
	Personal characteristics	Critical thinking
		Patience
		Emotional intelligence

Within Table 6.4 the relationship of the 13 lower-order themes were grouped into four mid-order themes. These were 1) mechanical features, 2) sharing the mental model, 3) coaching process, and 4) personal characteristics. The first mid-order theme of mechanical features comprised of two lower-order themes relating to individualisation and innovation of the MM. The second mid-order theme of sharing the mental model was comprised of three lower-order themes namely, community of practice, discussing ideas with the athlete and performance

focus themes. The third mid-order theme of coaching process related to five low-order themes derived from learning from coaching experience, generating options systematically, integration of reflection as part of practice, broad and adaptive coaching repertoire and a learning focussed environment. Finally, the fourth mid-order theme of personal characteristics was grouped from the three low-order themes of critical thinking, patience and emotional intelligence themes.

Two of the mid-order themes, mechanical features and sharing the mental model formed the high-order theme of conceptualising the MM. The second high-order theme was derived from the coaching process and personal characteristics mid-order themes. The high-order themes will now be utilised to organise the following results narrative.

6.4 Results narrative

The results will be organised into two parts representing the higher-order themes. Firstly, the findings will present in Part one higher-order theme of conceptualising a mental model. Part two will then present findings of the second higher-order theme of reflection in adapting the mental model.

6.*4.1. Part One: Conceptualising the Mental Model. (Higher Order Theme).* In adapting the mechanical features of the MM within para paddle-sport, it is perhaps unsurprising that coaches discussed the task of comprehending the technical components involved. Notably, both populations of coaches reported basing their observation on the same generic technical elements of the MM they valued within non-disabled performance and overlaid these to disabled performers. As the following quotes explain:

> *"Within para you are still looking for the same things. I want to make the connection, lock the blade, move the boat past the blade as best I can. OK, this is what it looks like for an able-bodied paddler, if I take out their legs this is what they do. (PC-3)".*

In effect, the comparison of the observed athlete performance to a non-disabled MM allowed a fixed point from which coaches could explore from and come back to in individualising their coaching and adapting generic MMs to the individual athlete. These generic MMs were developed by both sets of coaches through experiences as able-bodied athletes and coaches. The utilisation of generic MMs at least initially, aided the transferring coach in working with disabled performers. Importantly, the reliance on non-disabled MMs diminished as coaches gained experience working with parasport athletes. Coach PC-2 expands,

> *"I think it's really helped me better understand how to individualise my delivery, I think I understood it before, but para forces you to, there's no rulebook, like you say you take a template and modify it so by default you have just got to look at the problem with the person haven't you?"*

In addition, Coach PC-1 stated, *"You kind of learn the rules that apply [from able-bodied to disabled], you are looking at minimising dampening and maximising connectivity as a rule. That's quite easy to measure".* These rules in effect allowed both sets of coaches to observe and analyse how an athlete was creating a successful performance. By utilising these rules, sport-specific performance factors allowed the coaches to appraise the effectiveness of the adaption of the MM. For example, the performance factor of applying force through the paddle and reducing energy loss described as *"minimising dampening and maximising connectivity"*" as described by PC-1 above was considered a universal principle of the sport and allowed the coaches to appraise the effectiveness of their adaption of existing MMs to the athlete.

However, due to the differing nature of the adventure-sports coaching interventions lasting from hours to a few days, success was often interpreted as the need to quickly accelerate skill. In doing so the focus of the adventure coach was more on creating successful outcomes. In contrast, the paracanoe coach had a very long-term relationship, that allowed a focus on the process of performance with success measured at a competition that was often months away. More simply,

adventure-sport coaches often focussed on the want of the athlete, while the paracanoe coach prioritised the need.

In addition, despite these differences and the focus on performance outcomes being a priority for both sets of coaches, the need for innovation on the adventure coach's behalf was more apparent. The adventure-sport coaching context was free of competition rules that constrained the paracanoe coaches. Consequently, the freedom enjoyed by the adventure-sport coach allowed more venue choices to meet athlete needs, meaning the coach's ability to innovate was enhanced. The innovation due to the lack of regulations allowed more flexibility to adapt not only MMs but equipment to the athlete. Importantly, in adventure-sport the MM wasn't always innovative for the athlete, but allowed modification of equipment and environment to enable the athlete to cope with environmental demands and subsequently meet a more generalised MM Coach AS-5 described how consideration of a performer's disability led to the use of modified equipment as a means of minimising the demand on the performer:

> *"I dealt with a participant last year who expressed she had physical difficulties. My initial thoughts were 'let's try and get the boat more stable and easier to paddle and something that maybe wouldn't be as much of an issue if it capsized for example. That led me towards sit on tops, certainly something I hadn't done previously to that, understanding how kit needs to be adapted potentially is important".*

However, the extent of innovation differed depending on the nature of the performer's disability. For example, an athlete with a fused ankle required minor equipment modification such as adaptation of the kayak footplate. In contrast, an athlete with a spinal cord lesion may require, supportive seating, leg support and strapping to help maintain position in the boat. Consequently, MMs were considered by the performance coaches as easier to adapt for some

athletes than others. Athletes with low impairment needs were perceived to have many similarities to the non-disabled MM coaches initially worked from. Coach PC-1 explains,

> *"Understanding the functional limitations of the athlete. Then striving towards minimum dampening and maximum connectivity are the first two rules I would have. I believe that actually the able-bodied model is pretty close for KL3 and KL2. For the KL1 athlete, it's quite a bit different, as soon as you take the rotation out the whole stroke dynamic becomes quite a bit different".*

Performance coaches typically began with pre-determined non-disabled mental models in mind as highlighted in PC-1's quote above. However, as the coach grew in experience the MM could be considered against the impairment limitations of the disability and applied in the context of the individual athlete. For example, PC-3 describes the process. *"I think people learn as a para coach, because each of them are different (the coach), you have a technical template, it can be thrown out a little bit, in fact sometimes completely".* Accordingly, the Para coaches identified the need to transfer existing MM (predominantly derived from non-disabled athletes) through a reframing process to the disabled performer. PC-3 explains,

> *"You know it gives you a framework and it's then working out what's applicable, what's not, what could change in that framework? What's going to work for that individual? I think it comes back to that team of people including the athlete in that team as well, what's going to work for them so they can maximise their performance".*

The reframing process provided a reference whereby the coaches could contrast their observations. In this way, the MM acted to guide coaches in problem-solving (rather than fixed rules), allowing the flexibility and innovation required to meet the performers and the contextual needs. Again, PC-3. "*But then every athlete is different, but we can use similarities between them to maybe shortcut and try and get possibly more effective methods".*

However, as the following account from Coach PC-1 reveals, efficiency trade-offs were sometimes an accepted part of the decision-making process. These trade-offs were seen as an accepted part of the coaching process, such as the wants v needs described earlier. They were at times considered necessary to create athlete buy-in or concede on an issue for longer-term gain.

> "*I coach a slightly different technical model for the pair of them. [Athlete X] can't use leg drive but is completely balanced left-to-right. I can lock her down at her hip and she has full function above that point. So, she's like a slalom technical model to some extent. Whereas [Athlete Y] has also got complications around his core so the whole chain is imbalanced from left-to-right, I use the non-disabled model as it's the same kind of full use of leg drive, full use of everything but I know that some things aren't going to get to the gold standard of the technical model".*

Whether similar to their previous coaching experiences or not, there was general acceptance from both sets of coaches that 'good coaching' needed to focus on the individual. In this context, 'good coaching' is referred to as effective performance development through an athlete-first, individualised and asset-driven philosophy of what the person can do.

Evidence to support this is seen in statements from Coach PC-3 exemplified when saying: *"I think you're aware of the [person's] disability but you are coaching the person. You understand how the disability is possibly affecting them, but you are coaching the person".* Similarly, as Coach AS-1 put it, *"Empathy and understanding and context, so where and when what's the outcome of what you want to do with the boat, so that that keeps context alive to see past disability".* The shared asset driven philosophy of all the coaches, in line with the social-relational lens of disability described by Townsend et al., (2016), in Chapter two was strongly shared by both sets of coaches and developed through experience in working with disabled athletes.

As well as understanding the MM themselves, paracanoe coaches identified the beneficial input provided by their support team colleagues in shaping such a vision. Thus, establishing and adapting SSM of performance. Primarily, these coaches reported consulting on the physical aspects of the performance, either technical or regarding areas such as strength and conditioning or sports medicine to help adapt their MM and in doing so creating a shared model with the support team. For instance, Coach PC-2 described how involving the team with athlete at this stage could inform the technical developments that were desired by stating:

> *"With some of the guys [athletes] I've worked with I'd have the whole team in there [physio, sport scientists, etc.], or part of the team along with me and the athlete, and then between us if there was something I was looking for technically or tactically or physically from the athlete. Then working with them to see me giving them an understanding of what I want from a technical point of view".*

Coach PC-3 also expressed that working together alongside the athlete was highly performance-focussed:

> *"You know it gives you a framework and it's then working out what's applicable, what's not, what could change in that framework? What's going to work for that individual? I think it comes back to that team of people including the athlete in that team as well, what's going to work for them so that they can maximise their performance".*

Through the process of consulting and utilising support teams and experts, the paracanoe coaches were able to acquire new knowledge. In addition, the support offered by experts also allowed the contextualisation through other examples of successful interventions with similar athletes. This allowed the paracanoe coaches to adapt and augment MM, whilst further defining the performance vision and aligning the support team to achieve it. Reflecting attitudes in other high-performance sports, Coach PC-3 expanded his earlier comment by going one step further, he

utilised the support team to know how much he could challenge the athlete during their technical development, and therefore adapt the MM as he explained:

> *"Maybe challenge that [performance outcome] and get a little bit further than that based on what I have seen or what I know [mental model observation], because I have spoken to the strength and conditioning coach and physio and I know there is probably a little bit more there [physiologically] than what she [the athlete] thinks".*

In contrast, however, the adventure-sport coaches expressed a much more isolated, lonely experience of the process, as Coach AS-4 explains when reflecting on a previous experience with a performer: *"I'd have loved to have had more, to seek mentoring opportunities, don't try to do it all on your own, it was a painfully long process to gather it myself".* Paracanoe Coach PC-3 emphasised this difference by comparing his practice before having joined a paracanoe community: *"I have been very isolated as a coach before being in that group, and the wider group in Nottingham it all makes you think".*

Such a statement indicates the shortfall in disability and Paralympic coach education, lack of formal education resources and mentoring. In contrast, however, the statements above demonstrate the strength of a community of practice and informal routes of learning in supporting parasport coach's transition, development and adaptation of MMs to the parasport athlete. While access to expert support may be provided to the paracanoe coaches through the World-Class programme, the decentralised nature of adventure-sport coaches presents its own challenges in creating effective communities of practice and sharing knowledge. Consequently, the adaptation of MMs for the adventure-sport coach is often a more experimental process reliant on the coach and the reflective process. The reflecting process in adapting MMs will be presented next in Part Two of the results.

6.4.2 Part Two: The use of reflection in adapting Mental Model (Higher Order Theme).

Crucial to creating these MMs for performance was the coach's use of reflection both to the coaching process and to themselves (i.e., a meta-reflection). Taking a macro view towards their practice, both sets of coaches suggested the need for a more considered, deliberative approach in-action to adapt within this context, as Coach AS-2 suggests when looking back on many years of experience:

> *"If you had asked me that 10 years ago my process might have been 'let's, make a plan and we'll do that as opposed to having to spend the first hour or maybe even up to half a day observing where they're at'. Previously I would have just been 'this is what we're doing' and just doing it without much thought, adapting, and changing, really. That's certainly evolved over time as well, I think my understanding of how long to observe for has adapted over time".*

The use of a pre-determined coaching plan suggests that initially within adventure-sport the coaches utilised scripts and based on narrow experiences to help manage the complexity of the coaching process. Over time and with added experience of coaching para populations the coaches were able to audit their established MMs to their individual needs of the athlete and context and hence adapt the MM. Coach AS-5 supported this view, elaborating on the novelty of the coaching context as being a reason for needing a more systematic approach in developing the MM:

> *"I would be a very holistic observer, I could quickly technically, tactically pinpoint where I want to go based on my experiences. With things I am not so familiar with or not do as often, I definitely have a huge amount more systems I go through, I guess with the folks with the disability I probably go more systematic".*

However, despite the coaches' high coaching status, this did not mean that they were always successful in achieving their desired outcomes and experimentation was needed to allow them to

test and adjust the effectiveness of their MMs. In fact, previous errors were valued by Coach AS-1 as an important underpinning factor in enabling his ability to coach inclusively, this is reflected in the following narrative:

> *"I needed to have trial and errors. I needed to have got it wrong, to reflect on, I needed all those experiences. By having those experiences with different organisations and charities has informed the speed that I can get up and running, or how quickly I need to adapt".*

In common with the adventure-sport coach, the performance coaches also valued the ability to utilise experimentation in assessing the effectiveness of any adaption to the MM as described by Coach PC-1: *"I'm fortunate to try things in para, I've been working in para since the start. I have five years' experience of trying stuff and it not working, trying different things."* Echoing similar approaches to constructing and adapting the MM, Coach PC-1 discussed his pedagogic development, meaning that he is adaptable irrespective of the context:

> *"The biggest thing I do differently is in terms of the individualisation, in terms of coaching isn't because of the disability. It's actually one of those athletes likes quite logical feedback and the others like emotional-supportive feedback. That's the biggest difference in how I coach the two, I think the disability is a minimal part of that".*

As both sets of coaches attempted to solve the challenge of adapting an existing MM derived from non-disabled sport, the use of reflection became key. With unique athlete impairments requiring unique solutions experimentation became pivotal in developing knowledge to fill the void of formal parasport learning in meeting this challenge. Moving away from, and back to a stable frame of MM reference allowed both sets of coaches to experiment and effectively adapt MMs to fit the needs of the individual athlete in front of them. Presently, at least since their experiences of inclusive coaching, reflection was employed by these coaches across multiple levels

of practice and helped to create and adapt individualised athlete MMs. At a micro level the immediate issues identified via observation and questioning are parametrised, a solution planned (via peer or support group discussion), implemented, and crucially, continually reflected upon. At a macro level the coaches fundamentally considered the suitability of their approach to coaching in this context. This metacognitive process of continual reflection is important to prevent decisions being made based on inappropriate heuristics for the task at hand which could lead to undesired outcomes as identified in Chapter five.

To facilitate the coaching process in experimentation to adapt MMs the coaches reported changes to their personal characteristics that they considered necessary for successful inclusive coaching. The development of emotional intelligence and self-awareness allowed both sets of coaches to problem solve more effectively. Hence, developing the understanding that created a more accurate MM, Coach PC-2 explained that patience was required:

> *"Problem solving and searching wide and far with that problem solving. Patience, the two of them go hand in hand. You have to be willing to try anything and get your athlete to try anything. Encouraging them and supporting them".*

Likewise, Coach PC-3 emphasised the need for patience, alongside other characteristics such as emotional intelligence:

> *"Probably para-coaching you have got to be a little bit more patient. You've got to be empathetic with where they are at, but not to the point where you don't then challenge them. You have to be, have the flexible approach, adaptable approach to sessions when you need to switch and change them, maybe try to be a little bit more innovative if necessary, in how you deal with the injury. You've got to be very aware of how much you are pushing them. Whether they are going to break more easily or not".*

Both sets of the coaches became more aware of their personal characteristics to increase their critical thinking skills through enhanced emotional intelligence and patience the coaches reported an increase in their own self-awareness and ability to empathise with the athlete. The development of these qualities was considered important in coaching para-sport athletes. Or more simply, as quoted by AS-2 *"Put myself in their shoes".* Coach PC-3 explained how transitioning from an athlete to coach required him to think more critically in terms of coaching style, but also when and how they adapted the generic MM to the athlete: *"I was a single blade paddler, prior to that I was in a kayak, so my technical templates have come from experience as an athlete"* and when prompted:

> *"I think I have become more and more aware of what I am, and how I operate and how I come across to people. More self-awareness, that you maybe think when I'm delivering that [technique], you need to switch that a bit for this person [with a disability], to flex that for individuals, not necessarily, before it was probably just one mode".*

The coaches across domains reported how their own self-awareness had increased as they developed over time as a parasport coach. The ability to empathise with the physical effects of an impairment allowed both sets of coaches to systematically compare and contrast the psycho-motor elements of technique to adapt their MMs to the individual athlete. This increase in empathy allowed both sets of coaches to also adapt their own coaching process to better meet the psychosocial elements of the MM. This allowed better communication and collaboration with the athlete in adapting the MM. In addition, coaches were more patient and understanding of how they might again adapt the coaching process to the individual. For example, allowing more time to prepare for a task, the physical demand of the task on an athlete with functional limitations, or the increase in perceived or actual environmental risk an athlete may have in performing paddle-sports with a disability.

6.5 Discussion of findings

Based on the findings above the need for adaptability in coaching practice for parasport coaches appears clear and consistent with previous studies documenting this feature as an important characteristic (e.g., in mountaineering; Collins et al., 2018). However, adaptability did not mean that both sets of coaches were unable to utilise knowledge already gained from coaching able-bodied performers, primarily since not every movement within the established MM needed adapting. In fact, for some athletes' coaches did not change much at all within the paracanoe setting dependent on the effect of impairment. From a practical perspective, it is interesting to notice an important difference between paracanoe and adventure-sport contexts in this regard and what implications adaption of the MM might have on each coach's scope of innovation. For example, the sit on-tops employed by an adventure sport coach (AS-2). More generally, equipment in paracanoe competitions will be regulated to meet classification requirements (ICF, 2017) whereas, in adventure-sport its use is dependent on safety and performer needs as judged to be necessary for development by the coach. As such, in a paracanoe context the coaching decisions in training may be more highly directed by constraints imposed during competition. Whereas the innovation afforded in adventure-sport can be much greater due to an omission of regulation governing equipment. In other words, while the MMs were often adapted for the performer in paracanoe, it can be the case that the performer and their equipment are adapted to generate closer alignment with a more commonly employed MM in adventure sport.

In either case, however, adaptations were reportedly underpinned by individual athlete differences. Such evidence is certainly supported by fundamental research suggesting the need for consideration of performer's predispositions and capabilities, accepting the individual as the unit of analysis when it comes to development beyond initial learning (Kostrubiec et al., 2012). Consequently, and common across all coaches a narrower set of technical aspects become perhaps

more anticipated with experience and accommodated by the coach while other, more universal principles of movement remain preferentially fixed in the coach's MM.

All coaches reported pressure to advance performance and achieve success. However, this took a different form between the coaching specialisms. Paracanoe coaches were focused on competition outcomes across a season and subsequently took a longer more process-driven approach to meet the performance need. In contrast, adventure-sport coaches took a more outcome focussed approach to meet the performance need and looked at meeting the wants of the athlete within the session. Furthermore, in meeting performance needs the differing roles and contexts of paracanoe and adventure-sport coaches did emerge as factors that may influence the individualised development of MMs within practice. Specifically, the paracanoe coaches operate in a collaborative community of practice that encompassed the support staff for the athlete (Stoszkowski & Collins, 2014; Wenger & Snyder, 2000). Consequently, paracanoe coaches have a clear demand and need to establish a SMM and understanding across the support team (Collins & Hill, 2016). In contrast, adventure-sport coaches reported a more lonely and solitary coaching context and lacked an obvious support network.

While there are clear benefits to having an extended network of expertise available to help adapt MMs, this too increases the potential risk for miscommunication, confusion, and frustration amongst members and, more importantly, the athlete. Of course, not only must this MM be shared, but also consistently promoted and applied (i.e., internalised and governed), by each member once decided upon (cf. Cruickshank & Collins, 2012), relating to program development for culture change. How this MM is shared will be discussed in Chapter seven. As such, the paracanoe coaches provide an explicit managerial role within the group when compared to adventure-sport coaches (cf. Collins & Collins, 2012), which represents a potential challenge for those transitioning into such environments. Involving the athlete when adapting a MM was common to both adventure-sport and paracanoe coaches. This approach is inherently sensible by the coach

since they will be more able to empathise with the athlete in terms of executing the movement, or understanding the precise sensations being encoded by the performer (Carson, Collins & Jones, 2014). In turn, athlete involvement in adapting MMs would expectedly increase the level of buy-in, motivation and commitment from the athlete (Butler & Hardy, 1992), since the evolution of the MM will truly reflect a personally meaningful representation. Accordingly, and consistent across all coaching, this process of contemplation should be viewed as part of any technical intervention, even though no training "action" has been taken at this stage (Prochaska, Di Clemente & Norcross, 1992).

An alternative, but possibly additional, interpretation, is that coaches in an unfamiliar context seek reassurance amongst their peers regarding good professional practice in this novel and less familiar context. This added social dimension of work with disabled athletes (Paul, 2010), primarily concerns weighing up options with peers to determine what actions are within acceptable levels of risk. Reflecting the nature of their work and lack of social support networks this need for assurance seemed stronger in the adventure sport coaches. Indeed, this uncertainty may reflect the (relatively) early stage of coaching development in paracanoe and the very small number of adventure sport coaches working in this context. In conceptualising the MM as either an adventure-sport or paracanoe coach, these recognisable naturalistic decision-making processes reflect a distinct separation from normative behaviours within traditional coaching contexts. The social dimension common across the coaches in response to having no formal support available, appeared more congruent with the expertise approach (vs. competency approach) advocated by Collins et al., (2015) and indicative towards effective deployment of informal socially constructed coach knowledge through critical discussion and being open-minded (Stoszkowski & Collins, 2015).

Again, common across paracanoe and adventure-sport coaches in developing and constructing coaching and MM knowledge, was a willingness to adapt, trial and improve in

response to the needs of the athlete and situational demands. Supporting both sets of coaches ability to respond was an increase in self-awareness, empathy and patience and reflects aspects of emotional intelligence (Goleman, 1996). Consequently, both sets of coaches reported an increase in social or emotional learning and concepts of professionalism such as upskilling in response to the nature of coaching challenge (Taylor & Garratt, 2010), as well as elements of metacognitive capacity constraints (Dunning, 2011). Put simply, these findings support the notion that coaching is nonlinear and complex, consequently, high-level coaching is cognitively taxing, and the coaches know it!

In practice, for both sets of coaches reflection and the adaptation and development of MM are integrated within the coaching process, in and on-action when in context (Collins & Collins, 2016) and as an explicit on-action process (Schön, 1983). Whereas the paracanoe coaches supplemented this on-action process by utilising the community of practice, adventure-sport coaches relied on multiple cycles of reflection against their intended outcomes. Importantly, as coaches become better at reflecting on their practice, this process is suggestively more efficient in that the important elements of performance are more easily identifiable and thus the demand on cognition naturally declines.

6.6 Summary of Chapter and conclusion

This chapter explored the nature of challenges faced by coaches within two related professional contexts, adventure-sport and paracanoe, who work with para-sport athletes. The chapter explored how personally constructed observational cues and MMs were transferred to a new coaching context and individualised to the athlete. Further, it explored the commonalities and differences in how coaches that work within the para-sport disciplines adapt their MM to their athletes and coaching context.

The findings suggest that in adapting their MMs to meet the individualised athlete needs both sets of coaches initially worked from previously established MMs, based upon the generic elements of performance they valued. In practice, the established MM proved valuable in providing a stable, non-disabled to para-sport comparison of technique and thus, the basis for the coaches of constructing or adapting MMs for an individual athlete. As the coaches gained context-specific experience in adapting their MMs to the individual athlete, they utilised experimentation and reflection to audit the effectiveness of the MM. Consequently, they were able to develop critical thinking skills in problem-solving, exploring away from a generic MM, and adapting the MM to the individual athlete.

In supporting both sets of coaches to appraise the effectiveness of their interventions informal peer-peer networks were established to upskill, make sense of and share knowledge. While Paracanoe coaches could utilise a wide range of experts and coaching peers to provide this supportive community of practice function, the adventure-sport coach faced a more isolated existence and was forced to rely on their own critical thinking and reflective skills. Both sets of coaches had developed asset-driven philosophies, seeing past any disability and coaching the individual at the centre of the process. In tandem with the asset-driven philosophies, both sets of coaches reported developing greater emotional intelligence, empathy and patience. These personal qualities allowed a deeper understanding of the athlete, the impairment and the performance problem. Through this enriched understanding, communication, valuing the athletes voice and collaboration with support teams were enhanced, and a SMM was developed. The findings also show that in common with other areas of para-sport, there is a shortfall in para-sport coach education within paddle-sport. This shortfall is exaggerated by a lack of formal knowledge sources, mentors or experts to help transferring coaches make sense of their new context and speed up their ability to individualise MMs to the athlete. Consequently, training coaches to work within inclusive coaching should particularly emphasise the need for critical judgment and decision-

making skills within a similarly oriented social structure of mentors, coaches and experts where available.

6.6.1 Researcher Perception of the Chapter. The findings of this study have shown that coach education within paracanoe is not fit for purpose. Consequently, coaches develop their own knowledge sources and support networks. While care should be taken not to generalise this finding, the results are similar to findings in other Paralympic sports, possibly demonstrating a system wide coach education issue. In adapting and individualising the SMM to the athlete , expert knowledge is required to augment the coach's existing knowledge and make useable in context. Through this knowledge exchange process coaches are able to move beyond templates and create bespoke SMMs to meet athlete needs.

In conclusion, this chapter has illustrated how coaches generate and adjust MMs to aid observation within the coaching setting, where no bespoke MM for parasport previously existed. In generating bespoke MMs, the coach is able to construct meaning around stable generic MM elements However, what requires further investigation is how the generic MM is further adapted by the coach to suit the performance demands and develop athlete-specific MMs of performance. Specifically, how these MMs are then made usable and shared within the athlete support team to drive performance. The following chapter will explore the individualisation and personalisation of SMM within a specific Paralympic context. Such a deep dive relates purposely to understanding both the technical and non-technical side of SMM in paracanoe settings.

Chapter 7: Shared Mental Models Within Paracanoe

7.1 Introduction

So far, the empirical chapters within this thesis have shown that coaches work from stable, personally constructed SMMs based on generic technical templates. However, retrieval of these SMMs and technical elements within observation needs to be made bespoke for the athletes they work with. In constructing an individualised SMM, coaches will seek to understand important kinematic and biomechanical patterns, which must be personalised for that individual based on a more generic technical template. Expert coaching practice would, therefore, result in a greater ability to create individualised MMs according to the various performer characteristics, and so managing this complexity through adaptability should be recognised as a hallmark of expert practice (Hatano & Inagaki, 1986). As such, if a more vivid, robust, and accessible individualised SMM of performance is available, it makes knowledge retrieval of these aspects faster, more consistent and efficient (Carson & Collins, 2016), within the coaching process. However, individualisation within paracanoe, in common with many other coaching contexts, involves complex practical challenges in tailoring interventions to the athlete which places a high emphasis on the coach's cognitive ability to manage the coaching process (Collins & Collins, 2016; Rynne & Mallett, 2012).

As identified in previous studies in overcoming the challenges presented above, chapter six showed that coaches utilise a network of experts to supplement their knowledge to individualise the MMs of performance they work from. Through this knowledge source and in line with previous studies (Cotterill & Discombe, 2016; Harvey, Lyle, & Muir, 2015), the acquisition and implementation of expert practice within dynamic, sometimes even hyper-dynamic, environments inform the coach's ability to create diverse knowledge representations, or SMMs, that aim to satisfy performer's needs. However, given the established need of the

coach to augment their knowledge through sources such as experts (inter-disciplinary team; physiotherapists, strength coaches, etc.) logically a shared MM will be critical in understanding and enhancing athlete performance. Consequently, collaboration to support and individualise coaching interventions, combined with the coordination of effort of the athlete support-team performance would be enhanced.

Accordingly, Chapter seven examines a group of Paralympic coaches working within a World Class Programme, with the support of inter-disciplinary teams. The chapter will explore how the individual coach's MMs are shared and made usable within the extended management teams. In doing so it is hoped that Chapter seven will enhance our understanding of how SMMs can be adopted by the inter-disciplinary team and individualised for athletes. Specifically, the chapter will explore research question three, (RQ 3). When coaching in real-time does a high-performance coach in paracanoe utilise real-time observations to inform coaching feedback and individualise their practice? Or is there an adaptation of predetermined established SMMs generated by experience? Secondly research question four, (RQ 4). Can the integration of a coach's technical observation and knowledge of performance determinants (e.g., athlete, environment) be unified into sports specific SMMs? How can these SMMs be understood and adopted by a team of coaches collaborating to improve individualised athlete performance in paracanoe? In exploring these questions, the chapter will first outline the method and procedures, before subsequently presenting the analysis. The results will then be organised into two parts before key findings are presented and discussed as a narrative of four superordinate themes before finally the chapter is summarised.

7.2 Method

7.2.1 Participants. A purposive sample of three participants was identified for this investigation and is appropriate following the recommendations of Smith et al., (2009), for conducting IPA research (given the bespoke expertise of the environment). All participants

were current British Paracanoe coaches (n=3) coaching within British Canoeing's (BC) World Class Performance department and employed on the Paralympic programme (Mage = 40.0; years ± 8). All three coaches were male and held the British Canoeing UKCC Level 3 coach award. To ensure a sufficient level of domain expertise, experience, and inherent quality in terms of participants' self-reflective ability, the following inclusion criteria were applied: (1) a minimum of 5 years of coaching experience since senior accreditation within paracone specialist paddle-sport; (M = 5.4 years ± 1.0); (2) have coached athletes at a Paralympic Games and be currently working within paracanoe with athletes. A summary of participating coaches and their experience can be found in Table 7.1 below.

Table 7.1: Demographic Data of Coach Participant

Coach	Age	Highest qualification held	Years of World Class Programme Paracanoe coaching experience
1	37	UKCC Level 3 coach – British Canoeing Paracanoe programme	5 years
2	48	UKCC Level 3 coach – British Canoeing Paracanoe programme	6 years
3	35	UKCC Level 3 coach – British Canoeing Paracanoe programme	5 years

7.2.3 Equipment. Data were recorded using a digital dictaphone and stored electronically in an mp3 file format in a secure encrypted external hard drive.

7.2.4 Procedure. Participants received an information sheet (Appendix 7.1), one week prior to the interview and also completed consent forms (Appendix 7.2). Following consent being obtained IPA interviews (Smith, 1996), were conducted. IPA interviews allowed the respondent to talk freely with probes deployed when necessary to funnel general views to more specific ones (Smith, 2015). Participants were encouraged to consider and explore the process through which they gathered information when coaching, and how it was analysed and applied in action. Interviews lasted approximately 60 min. Interviews were held at a convenient time and location which was agreed upon in advance for the participants. The interview schedule is presented below in Table 7.2.

Table 7.2 Interview Prompt Guide

Question
1. Can you tell me about a recent coaching episode in your field?
2. How do you adapt your mental model of performance
3. How do your technical template and SMM interact?
4. Who is important in supporting the process of individualising the SMM?

The interview schedule (Table 7.2) explored coaching episodes in context, the coaches' SMMs of performance, and the interaction of the SMM, inter-disciplinary team and athlete in addressing performance needs.

7.2.5. Data analysis. Transcripts were analysed using the approach outlined by Smith et al., (2009) for IPA to comprehend the personal meanings behind the 'lived' experiences of the coach and in line with Richards et al., (2015), with elite performers (See section 4.3, Table 4.1). Transcripts were analysed using the process outlined in Table 7.3. Narratives from the transcripts were extracted to support the identification of themes. Audio recordings were transcribed verbatim and anonymised. Transcript data was then read and re-read as an immersive process to familiarise myself with the narrative. The next step allowed me to identify patterns in the text and allowed the recognition of patterns to be connected in a meaningful way. Specifically, transcripts were re-examined to generate themes for individuals using the double hermeneutic cycle. Inductive thematic analysis was conducted on the transcribed interviews for each coach that allowed phenomenological and interpretative themes to emerge in line with Richards et al., (2015). Coding at an individual level was based on the interpretative process outlined by Smith et.al., (2009) and a list of initial themes generated for each participant. Individual themes were then checked before being examined in relation to cross-case comparisons to establish connections. Minor changes were then made to the clusters to identify superordinate themes (Smith & Osbourne, 2015). Meetings with my supervisor enabled discussions relating to themes to be explored. Initial interpretations were validated and supported the interpretive processes. The findings are now presented in a narrative.

7.3 Results and discussion

The results are in two parts. Part one outlines individual analysis, while part two examines cross-case comparison, combining individual analysis to illustrate the findings relating to the lived experience of expert paracanoe coaches. The results are then presented and discussed in relation to the four superordinate themes identified from the analysis.

7.3.1 Part 1: Individual analysis. The individual analysis identified 38 themes across all of the coaches. Through the process of individual analysis, the 38 themes were grouped and resulted in the identification of 19 sub-ordinate themes. Table 7.3 below in line with Smith et al., (2009) that the coaches referred to. Additionally, Table 7.3 provides the frequency of coach response against sub-ordinate themes identified for each of the three coaches to provide a strategic overview. Table 7.4 on the next page provides an example of quotes from all three coaches for 19 identified sub-ordinate themes.

Table 7.3 Sub-ordinate Theme and Frequency of Coach Response: Individual Analysis

Sub-ordinate Theme	Coach 1	Coach 2	Coach 3
Understanding the athlete.	3	7	19
Sources of knowledge (experience).	9	13	23
Sources of knowledge (experimentation/innovation).	10	10	10
Sources of knowledge (experts).	5	8	6
Sources of knowledge (formal learning).	1	1	1
Fixed generic MM elements (coaching beliefs).	10	8	11
Comparison of technique (para-para) (ab-ab) (ab-para).	10	1	14
Individualised athlete MM	21	10	18
Development of the SMM (coach-expert-athlete).	15	32	22
Challenge of observation.	1	4	4
Observational strategy.	1	6	5
Objective measure of performance (technology).	8	10	11
Subjective measure of performance.	2	2	7
Critical thinking/problem solving.	5	6	10
Naturalistic decision-making.	2	4	2
Sense-making.	6	11	6
Intuition.	2	-	4
Pattern recognition.	1	5	5
Leadership.	2	6	7

Table 7.4 Coaches Narratives Supporting the Identification of Themes and Key Quotes

Identified Theme	***Key word quotes from Coach 1, Coach 2 & Coach 3.***		
	Coach 1	***Coach 2***	***Coach 3***
Understanding the athlete (Psychosocial/motor).	"Different abilities, functions, lever lengths. Then working with athletes through trial and error, discussion, and monitoring performance data to decide what avenue to go down or not. Refining it from there, Athlete X and Y different sizes, different functionally".	"Listen to what the athletes saying and collectively what is the solution to that. How far can we go? What does great look like? How close can we get to great with where we are now"?	"I think it's just how quickly you can understand the person, how quickly you can recognise how they learn, what they'll learn, how you can get them to this point as quickly as possible".
Sources of knowledge (experience).	"What has worked and what hasn't. It's constantly updated by what I am doing day to day".	"I think it's come through experience and models we have".	"Purely experience, absolutely time. You can't stress how important it is".
Sources of knowledge (experimentation/innovation).	"Some you have to go through an element of trial and error and after the trial and error maybe the performance impact is so minimal you can't measure it".	"You actually become curious and go off and read something. But that something is relevant to what you are trying to do rather than just looking at something holistically because you have had them check and challenge. It allows you to get there".	"I made a template and a scoring system and I went through with it. And what I learned, whether pictures are right or not, I am likening it to something. I've got a zero point".
Sources of knowledge (experts).	"If I am struggling to make a change technically, I will look to the other coaches in the room for advice on other avenues that I can explore".	"Availability of professionals and trusting their bit, I see them as my education".	"I have sucked information from everyone, support services have helped with my vocabulary, and helped with how to explain things. Conversations with other coaches, watching other coaches, watching other athletes, speaking to other coaches. Everywhere working with S&C, the physios".
Sources of knowledge (formal learning).	"There is a technical model we follow put together by British canoeing, but it's pictures. They are of an athlete I have never even heard of, and not highly descriptive for a coaching basis. It's fine but no actual details, it doesn't define down to details. In an elite coaching you couldn't gain much from using that".	"I think it's come through experience and models we have. And through being the person that delivers course".	"Its's derived from able-bodied. We had a lot of pushback when we first did this even from myself. We work beyond this template. We create, we have to come up with these ways around it".

Table 7.4 Continued Identified Theme	***Coach 1***	***Coach 2***	***Coach 3***
Fixed generic MM elements (coaching beliefs).	"Try to pick out non-negotiable key points within stroke that have absolutely to be in place. For example, you don't want the paddle blade to go over vertical as then it's having a negative impact on the propulsion of the boat".	"Rotation is different in every body, their capabilities but there's some factors that make that stay the same".	It's taken from the starting point you had from the able bodied and possibly your own experience as an able-bodied athlete & taken it to where you have got to now, what process do I go through".
Comparison of technique (para-para) (ab-ab) (ab-para).	"You are down to gut instinct and looking at videos and copying good paddlers".	"The rotation around an able bodied versus para canoe".	I am constantly assessing technique, looking at able bodied technique. If you look at look the French XXX (able-bodied athlete) look at YYYY, the German, the 1000m guys, ZZZZ, great technique. But you know what, they are all different".
Individualised athlete MM.	"Actually, it's more individualised [to the person] rather than classification specific. I think things like length of levers has a massive impact as well. It's not disability specific. Different people in and within different classifications, will have different limitations".	"I have that template, but I am really aware that everyone's different and there are some key factors that need to be great but not everybody can get to all of those key factors".	last year I had KL1, KL2, two KL3 men and a KL3 woman in my training group, and it was great opportunity. All with different disability very different disabilities. Looking at how I could individually improve them".
Development of the SMM (coach-expert-athlete).	"You need to work with them, to empower them and gradually challenge them softly, softly""	"The team around the athlete. So, the strength and conditioning coach, the physiologist if you have one. I have spoken to nutritionists and physio before, get them out see what they are seeing. Listen to what the athletes saying and collectively what is the solution to that".	He was taught how he should use his abs how to use his movement. I had no idea how to do that, that was above me, the physio managed that, he was too disabled but it just sometimes show's you".
Challenge of observation.	"You can't realistically measure anything which means you are you are led down a more subjective what it looks approach".	"I find it hard to be really critical at that level, as I haven't got the experience. I haven't been there as an athlete at that 130, 140 strokes a minute".	"The challenge comes when you have this great technique at 70 stroke rates and try to get it to 100, 110, 115, 120 that when it all goes out window".

Table 7.4 Continued Identified Theme	***Coach 1***	***Coach 2***	***Coach 3***
Observational strategy.	"Have a clear idea of what they need to work on, so you need to observe what they are doing. Look in slow motion, spend plenty of time to find out what's happening over a period of time not jumping to conclusions, you are measuring, comparing as opposed to just jumping in".	"What is the boat telling me? 20% of that gives you some clues and then 60% in middle would have been the body the other 20% would have been around the blade but the body influences the boat and blade".	"I have these pictures, I have the set-up, lock the blade, essentially catch, dry phase, weight on blades, end of pull and exit. So basically, a stroke broken down to six points".
Objective measure of performance (technology).	"Working with athletes through trial and error, discussion, and monitoring performance data to decide what avenue to go down or not".	"I really struggle with being critical at that speed. That's what I have to use the video for".	"Constantly we are doing GPS stuff. More often than not you see the patterns".
Subjective measure of performance.	"The first part would be understanding what people are doing. So actually, being able to measure what people are doing objectively with markers".	"So, I would see myself as the engineer and the athlete needs to be feeling things, to me, for me the engineer, to help them make those changes or to speak to other people to help them make those changes".	He was t6 complete, really high up disability, almost too disabled. I'm really struggling, to work from the model. I was trying to but was impossible. it wasn't working, trying to get weight on the paddle blade. Trying to get the movement positions, it wasn't happening".
Critical thinking/problem solving.	"You have to make some assumptions. Some you are more confident on than others. Some you have to go through an element of trial and error and after the trial and error maybe the performance impact is so minimal you can't measure it".	"Opens up critical thinking and thought and your reflection on that. It becomes really focused which is key".	"And what I learned, whether pictures are right or not, I am likening it to something. I've got a zero point. I have got a place to start, I've a basis, I can write notes next to it".
Naturalistic decision-making.	"So, my opinion is in canoeing at the moment is, you can't make any clear definitions of what is and what isn't important".	"The body gives me many clues now at this level".	"I make assessments as I go through the process before I give them a paddle and they actually paddle, purely visual purely looking for certain cues".

Table 7.4 Continued Identified Theme	***Coach 1***	***Coach 2***	***Coach 3***
Sense-making.	"Other coaches, other athletes, my own reflection, what has worked and what hasn't".	"My first initial observation, it would have been what is the boat telling me? 20% of that gives you some clues and then 60% in middle would have been the body the other 20% would have been around the blade".	"Having a physio in terms of having a disability like that, just someone saying he's too new to injury he doesn't know how to use his body like that yet".
Intuition.	"Which means you are down to gut instinct."		"We work beyond this template. We create, we have to come up with these ways around it. There's the whole mystique and artistry about what we do."
Pattern recognition.	"You should be able to join the pictures up a little bit and work out what is and what isn't important to the technical model",	"Maybe the in the shape of the boat in that it does what it does, and the clues are harder to see from the boat".	"When we talk disability in my job role as para, I know the lines KL2, KL2 and KL3. I have a clear idea".
Leadership.	"Also constantly review what you are doing, and check what other people are doing and constantly learn. What you view. You never ever get to a point that you are an expert, you always got to have to keep pushing and finding out more information".	"I see that as team around that athlete is that something I have picked up from previous managerial experiences where everybody is part of your team and equal. So, I ask the question, there's lots of managerial skill I take to my coaching".	"I went on you tube downloaded videos & gave them videos to watch, of abled bodied athletes. I asked them to analyse different technique, what happens, how they feel, help them understand technique, become a student, understand".

An example of a sub-ordinate response within Table 7.4 was reported about the need of the coach to generate sources of knowledge through experimentation. Experimentation was considered important as the coaches needed to create bespoke athlete SMMs with no rule book. With each *experiment* the coaches assessed, refined and applied their SMM whilst concurrently generating new knowledge as to the effectiveness of the intervention. In effect, experimentation allowed the coaches the freedom to explore away from and return to generic templates through a process of *"trial and error"* as described by Coach 1.

Interestingly, coaches, one and three reported utilising intuitive processes when meeting a novel or complex live observational challenge, such as observing an athlete at high stroke rates or working with a new athlete. Coach 1 describes this at times as: *"down to gut instinct".* The use of intuition allowed coaches one and three to prevent over attending in the moment and draw upon experience that enabled them to recognise familiar patterns or cues. Consequently, intuition allowed coaches one and three to quickly assess situations without having to compare options. Coach 3 describes this as: *"There's the whole mystique and artistry about what we do".* However, while the coaches may describe their process as intuitive, when considered against the other data gathered within this study and thesis, the decisions the coaches made appear to be linked to the accumulation of experience in line with Klein (2015). In contrast Coach 2 did not explicitly mention or report intuitive phenomena. However, coach two did report utilising sense-making more frequently than coaches one and three. Presumably and supported in the narrative, Coach 2 relied upon a more systematic rather than intuitive process to connect the dots and make sense of real-time coaching challenges.

7.3.2 Part 2: Group analysis. Further analysis was conducted to identify cross-case individual comparisons. Through this stage of interpretation, I remained conscious of my cognitions in relation to the interpretation of the data and the identification of patterns. My

interpretation of the data was further challenged by my supervisory team to support the interpretative aspect of the IPA. The 19 identified sub-ordinate themes were clustered, arranged and re-arranged to provide the basis for super-ordinate themes. One sub-ordinate theme of intuition was not included within the superordinate due to coach two not reporting the phenomena. Consequently, the remaining 18 sub-ordinate themes were arranged into four superordinate themes. Table 7.5 provides a visual representation of superordinate themes within specific areas.

Table 7.5 Subordinate and Superordinate Theme Relationship.

Super-ordinate Theme	Sub-ordinate Theme
Sources of Knowledge.	Understanding the athlete. Sources of knowledge (experience). Sources of knowledge (experimentation/innovation). Sources of knowledge (experts). Sources of knowledge (formal learning).
Individualising the SMM.	Fixed generic MM elements (coaching beliefs). Comparison of technique (para-para) (ab-ab) (ab-para). Individualised athlete MM Development of the SMM (coach-expert-athlete).
Observation of the SMM.	Challenge of observation. Observational strategy. Objective measure of performance (technology). Subjective measure of performance. Critical thinking/problem solving.
Leading the SMM.	Naturalistic decision-making. Sense-making. Pattern recognition. Leadership.

Table 7.5 presents the four superordinate themes and their relationship to the 18 sub-ordinate themes they were derived from. These superordinate themes were;

Theme 1: Sources of knowledge.

Theme 2: Individualising the SMM.

Theme 3: Observation of the SMM.

Theme 4: Leading the SMM.

The four superordinate themes are presented and discussed next.

7.3.3 Superordinate Theme 1: ***Sources of Knowledge.*** The first Superordinate theme was made up of five sub-ordinate themes *i) Understanding the athlete, ii) Sources of knowledge (experience), iii) Sources of knowledge (experimentation/innovation,) iv) Sources of knowledge (experts)* and *v). Sources of knowledge (formal learning).* The subordinate themes all connect to different components of knowledge that the coaches utilise to understand the athlete. The knowledge sources consequently allow the coach to develop an individualised athlete SMM. The narrative below will unpack the first superordinate theme in line with the subordinate common elements.

Understanding the individual athlete. The individual as an athlete, learner and person sat at the heart of a holistic process. All three paracanoe coaches reported developing a deeper understanding of the individual athlete as fundamental in helping to inform and develop their SMMs. Through this understanding, the coaches were able to adapt the technical elements of their own generic MM and generate SMMs to the bespoke needs of the athlete and their impairments. Coach 1 describes the process: *"Different abilities, functions, lever lengths. Then working with athletes through trial and error, discussion, and monitoring performance data to decide what avenue to go down or not".* The two-way collaboration with the athlete was considered critical in developing the understanding of the individual. Crucially, the understanding of the individual's non-technical elements of performance was considered just as important as testified by Coach 3: "*I think it's just how quickly you can understand the person, how quickly you can recognise how they learn, what they'll learn, how you can get them to this point as quickly as possible".*

Therefore, understanding both the technical and non-technical nature of the individual's disability, the athlete as a person and the performance potential of the athlete, allowed the coaches to fully individualise their practice. Accordingly, in collaboration with the athlete, an SMM could be created to work from, and individualised goals agreed upon. In more simple

terms, the coach and athlete cannot do it alone (Jowett, 2017) and both need each other to achieve in sport (Jowett & Shanmugman, 2016).

Sources of knowledge (experience). In developing a SMM of performance the coaches all highly valued their own experience as critical in developing their working knowledge of, and context of paracanoe as described by Coach 1: *"What has worked and what hasn't. It's constantly updated by what I am doing day to day".* Through this experience, the coaches were able to adapt generic MMs and continually modify them into individualised SMMs for the athletes they coached.

However, the analysis showed the coaches all considered the understanding of the nuanced elements of parasport a lengthy process that was developed through experience over multiple years. Paracanoe Coach 2 elaborates and states:

> *"Purely experience, absolutely time, you can't stress how important it is, the more people you deal with, the more you understand the person as well, the more you build a rapport. I don't know how you put it into words, just trying to see and pick up on that person, what are they going to be like, how they are going to be like on the machine, how they pick up [learn] and how they will respond to your cues".*

Therefore, with experience, the coaches developed a richer understanding of disability, paracanoe and how to individualise their coaching and develop bespoke SMMs as Coach 3 explains: "*I think it's come through experience and models we have".* Consequently, supporting the findings of Chapter six experience was often gained through "*trial & error",* (Coach 2) and therefore had shortcomings. This may in part reflect the lack of formal paracanoe education available that forced the coaches to experiment as a source of knowledge. The use of experimentation reflects the findings of Wareham et al., (2018), in a similar group of Paralympic swimming coaches to augment knowledge gaps.

Sources of knowledge (experimentation/innovation). The stable sources of information the coaches valued in the construction of their generic MMs of performance, in common with the findings of Chapter six, allowed the coaches to explore away from their generic SMM and develop an individualised athlete SMM. Exploration was aided by auditing the individual athlete, against stable deterministic factors such as distance per stroke and stroke rates measured by technology. Through this experimentation process, the coaches informed their understanding of just how the athletes were able to produce techniques within the constraints of their impairments. Coach 3 explains: *"I made a template and a scoring system and I went through with it. And what I learned, whether pictures are right or not, I am likening it to something. I've got a zero point".* Consequently, through the process of experimentation, the coaches could overcome the limitations of a lack of formal or athlete specific knowledge sources. Accordingly, the coaches were able to modify and adapt previously constructed MMs and assess the effectiveness of the SMM whilst concurrently developing a deeper understanding of the athlete. Therefore, through experimentation, the coaches were able to explore away from the stability of previously constructed SMMs and innovate individual SMMs.

However, the effectiveness of any innovation derived from such a process was not always clear as coach one explains: "*Some you have to go through an element of trial and error and after the trial and error may be the performance impact is so minimal you can't measure it".* Consequently, in innovating effective interventions coaches were forced to search for information and in the process develop their own expertise. Coach 2:

> *"You actually become curious and go off and read something. But that something is relevant to what you are trying to do rather than just looking at something holistically because you have had them check and challenge. It allows you to get there".*

Experimentation was considered important by all three coaches in meeting the challenge of adapting a generic MM in the absence of a 'rule book' to the bespoke needs of the athlete and their impairments. Critically, while there may be similarities amongst athletes, each was a unique coaching challenge for the coach and consequently, experimentation allowed the adaption of any SMM to be individualised. Importantly experimentation and innovation allowed the coaches to develop context and athlete-specific knowledge and hence, overcome the challenges of adapting non-disabled expertise as highlighted by Fairhurst et al., (2017), or the deficiencies in coach education highlighted by Wareham et al., (2017).

Sources of Knowledge (Formal Learning). All three coaches reported very little paracanoe formal education either through British Canoeing or generic parasport educational pathways. What formal learning was available was derived from non-disabled coach education and not considered relevant for the paracanoe setting as Coach 3 explains: *"It's derived from able-bodied. We had a lot of pushback when we first did this even from myself. We work beyond this template. We create, we have to come up with these ways around it".* In working beyond the template, the coaches identified the need for paracanoe technical information to supplement their knowledge. However, non-disabled coach education resources had to be modified for the paracanoe athletes by all three coaches. As Coach 1 explains:

> *"There is a technical model we follow put together by British Canoeing, but it's pictures. They are of an athlete I have never even heard of, and not highly descriptive for a coaching basis. It's fine but no actual details, it doesn't define down to details. In elite coaching, you couldn't gain much from using that".*

The analysis showed the overlay of able-bodied to parasport does not meet the need of the parasport coach and subsequently athlete supporting the findings of Fairhurst and colleagues (2017). The lack of formal para-specific technical knowledge and experience forced the coaches to explore the individual elements required to construct an SMM for the athlete. In doing so

they utilised informal sources of knowledge to support overcoming the lack and suitability of formal learning sources in common with the findings of Cregan, Bloom and Reid (2007), in a study of Paralympic swimming coaches.

Sources of Knowledge (Experts). In overcoming the shortfalls of the lack of formal sources of knowledge, all three coaches highly valued the insight and support experts within the athlete support team (physiotherapists, strength coaches etc.) offered. The experts helped educate and contextualise coaching knowledge, and through this exchange process, SMMs developed. Coach 2 outlined: *"Availability of professionals and trusting their bit, I see them as my education".* In this quote, the coach highlights how they utilise the expert to augment their parasport knowledge, removing professional silos and making the SMM relevant to the athlete.

The results show that expert knowledge was sought and utilised in two ways. Firstly, the coaches called upon fellow coaches, offering a breadth and depth of knowledge and different perspective to help specifically develop technical understanding, and thus enhance the coaches own generic template into an SMM (Gilbert, Gallimore & Trudel, 2009; Taylor, Werthner & Culver, 2014). Secondly, with the specialist inter-disciplinary support staff to develop a better understanding of the athlete as a performer and learner, informing the SMM, (Townsend et al., 2018). Coach 3:

> *"I have sucked information from everyone, support services have helped with my vocabulary, and helped with how to explain things. Conversations with other coaches, watching other coaches, watching other athletes, speaking to other coaches. Everywhere working with S&C, the physios".*

The support network became a function of an effective community of practice (CoP) as identified by Stoszkowski and Collins (2012), who support the need to critically challenge coaching beliefs. The coaches valued and utilised their support network not only to provide

expert knowledge but in addition, to act as informal mentors in transferring and adapting their existing knowledge. Through this process knowledge was exchanged, components of performance defined and a richer SMM developed within the team. This knowledge exchange process supports the preference for the social construction of knowledge as found in Chapter six.

Summary and discussion of the source of knowledge superordinate theme. Through the development of the coach's understanding of the individual (athlete), a deeper insight into the nature of the disability and the person could be gathered. The understanding was developed through a collaborative process with the athlete and supplemented through expert knowledge sources and supports Richards et al., (2016), in the development of SMMs. Through an enhanced understanding of the athlete, the coach and the inter-disciplinary team in collaboration with the athlete consequently generated an individualised SMM. In the process, adopting a social-relational (Townsend et al., 2017), asset driven focus on what the athlete could do. The focus on the person instead of any disability appears to support Wareham et al., (2018), findings, which outline the two-way relationship between coach and athlete. Therefore, legitimising ways of thinking about disability within high-performance sports. In keeping with many views, consideration of the person as an individual was viewed as just a facet of good coaching.

In addition, the coaches reported little formal or relevant educational content within paracanoe or indeed, para-sport settings. What formal education was available was derived from able-bodied sources and did not meet the needs of the paracanoe coaches reflecting the view of Townsend et al., (2016) and Wareham et al., (2018). The formalised learning that was identified was provided from a deficit focus (Paul, 2010), focusing on a medical model of disability (Townsend, et al., 2017), by paracanoe Coaches 1, 2 and 3. This view supported the findings of Wareham et al., (2018), in a similar group of Australian Paralympic coaches who

identified comparable issues within training and education pathways. This impairment-specific perspective provided little practical application in how to develop SMMs. Therefore, the results of this study indicate the coaches are not receiving the educational support they require to develop individualised SMMs. Instead, they rely on experimentation, reflection and innovation as knowledge sources. Accordingly, the coaches relied on knowledge and experiences gathered during their careers as athletes, coaches of non-disabled and coaches of disabled athletes. Consequently, the coaches were dependent on comparing their experiences to that being observed, i.e., non-disabled to disabled athletes' techniques.

The coaches in adapting their technical knowledge derived from non-disabled athletes, initially, reconceptualised the deficit approach of the nature of the disability to a sport-specific setting and asset driven perspective. In effect, the coaches had to change the deficit driven model of performance, or what the athlete could *not* do, to an asset driven model of performance, or what the athlete *could* do as an initial step in evolving from a stable generic technical template to an athlete specific SMM. Such an approach is not without its challenges, as paracanoe coach one describes when referring to the deficit perspective: *"It doesn't define down to details; as an elite coach, you couldn't gain much from using that"* and continues to describe the application of the generic technical template into an SMM: *"it is now more trial and error and observations".* This trial, error and observation allowed the coach to refine and adapt existing templates and construct new MMS. In effect, an audit of the SMM against the witnessed reality, with the athlete and the identification of an SMMs accuracy and shortcomings in delivering the intended performance.

7.3.4 Superordinate Theme 2: Individualising the SMM. The second superordinate theme was made up of four sub-ordinate phenomena. These were: *1) Fixed generic SMM elements (coaching beliefs). 2) Comparison of technique (para-para) (ab-ab) (ab-para). 3) Individualised athlete SMM.* Finally, *4) Development of the SMM (coach-expert-athlete).*

Fixed generic SMM elements (coaching beliefs). All of the coaches reported having fixed coaching beliefs upon which their generic MMs were built. Unsurprisingly, these beliefs were linked to the formative experiences that the coaches were exposed to throughout their careers. Firstly, as athletes themselves, and secondly as a coach to other non-disabled canoe sprint and paracanoe athletes. Coach 3 describes: *"It's taken from the starting point you had from the able-bodied and possibly your own experience as an able-bodied athlete & taken it to where you have got to now".* The fixed beliefs were used as an observational tool by the coaches to identify the components of performance that were present or absent within the performance.

Through the use of these self-constructed tools, the coach was able to conceptualise how the athlete was solving the performance problem, and consequently individualise the SMM to the athlete. Coach 1 describes their process: *"Try to pick out non-negotiable key points within stroke that have absolutely to be in place. For example, you don't want the paddle blade to go over vertical".* While all of the coaches reported utilising fixed beliefs to guide their observational processes, these beliefs the coaches had developed appeared to be idiosyncratic. The fixed beliefs appeared linked to the coach's experiential journey and the elements they considered fixed within the generic MM. Therefore, any SMM was linked to the development of experience in line with Oliviera and colleagues (2014) and supporting the findings of Chapter six.

Comparison of technique (para-para-able-bodied). The coaches all reported obsessively searching for a SMM to help solve a movement problem through the comparison of other athletes' techniques. This comparison was informed through the assessment of world-leading non-disabled athletes (Olympic Canoe-sprint) and Paracanoe athletes, both intra and inter-group as described by Coach 3: "*I am constantly assessing technique, looking at able-bodied technique. If you look at look the French XXX (able-bodied athlete) look at YYYY, the*

German (Paracanoe), the 1000m guys, ZZZZ, great technique. But you know what, they are all different". This quote illustrates that through this comparative process the coaches were able to identify the fundamental elements of performance that their athletes were functionally capable of achieving. Further, the process aided critical thinking, knowledge generation and problem-solving in helping to identify areas of conceptual and technical development that were unique to the paracanoe athlete they worked with. However, this process wasn't always without its own problems as Coach 1 describes: *"You are down to gut instinct and looking at videos and copying good paddlers".* Such a position reflects the nature of the SMM as possibly more conceptually driven in line with Jarvelin & Wilson's (2003), view of how the user explains the system they observe as a whole, rather than being technically driven through component parts. In this case, the paracanoe coaches when comparing examples of individual athletes' techniques, return to a set of fundamental principles and concepts they recognise within the observation, rather than basic technical elements.

Individualised athlete SMM. Within parasport, the coaches recognised that individual athlete variance was higher and consequently the need to adapt and individualise the SMMs to the person was highly valued. The understanding of the person at the heart of the performance was considered critical by all of the coaches as Coach 3 describes: *"I have that template, but I am really aware that everyone's different and there are some key factors that need to be great but not everybody can get to all of those key factors",* illustrating the point that a unique model has to be created for each athlete, even if there are commonalities in technical components. Understanding and considering the person as an individual allowed the generic MM to be refined and a bespoke, individualised version of the SMM developed as Coach 1 describes:

> *"It's more individualised [to the person] rather than classification specific. I think things like length of levers has a massive impact as well, it's not disability*

specific. Different people in and within different classifications will have different limitations therefore you have to explore the individual functionality they are capable of".

A deeper understanding of, and, considering the individual needs of the paracanoe athlete, allowed the coaches to adapt their generic MMs of performance. Indeed, the adaption of the generic MM was considered essential by the coaches studied as evidenced by Coach 3 who described the need to individualise: "*All with a different disability, very different disabilities. Looking at how I could individually improve them".*

The desire of the coaches to create bespoke athlete SMMs allowed them to reject the overlaying of non-disabled MMs as described earlier. Instead, with experience, they were able to overcome the limitations of formal knowledge sources and balance their approaches against the passed down coaching craft highlighted by Chow and Knudson (2011). Hence, creating individualised SMMs.

Development of the SMM (coach-expert-athlete). All of the coaches interviewed reported valuing the use of expert knowledge in the development of the SMM, owing to the deficiencies in the coach's educational and experiential knowledge. The insight the experts brought within a specialist area such as anatomy or physiology was considered essential in the effective adaption of the SMM. Coach 3 describes this experience: *"He was taught [athlete] how he should use his abs how to use his movement. I had no idea how to do that, that was above me, the physio managed that".* The quote highlights the coach's need for supplementary expert knowledge. In addition, how the coach does not always have all of the answers and through empowering others with greater knowledge to lead the coaching intervention, athlete performance and the SMM was improved. Through the use of the expert (physiotherapist) leading the coaching process in this case, the coach was able to facilitate a bespoke solution for the athlete that was beyond the boundaries of their knowledge. Therefore, the SMM was

clarified, augmented and made more effective within the team through the practical application of specialist expertise as Coach 3 explains:

> *"The team around the athlete. So, the strength and conditioning coach, the physiologist if you have one. I have spoken to nutritionists and physio before, get them out see what they are seeing. Listen to what the athletes saying and collectively what is the solution to that".*

Through this collaborative process, the experts within the support team were encouraged to share their observations of athlete performance. Consequently, the experts offered interpretations of performance through the lens of their specialist knowledge. In this way, the SMM was further defined and refined within the team allowing alignment of effort in improving performance. Consequently through this process the coach's overcome the neglect of the multi-disciplinary team as identified by Alfano and Collins (2021). This demonstrates the value of expert contribution and improving the inter-disciplinarity team's influence within the coaching process.

Summary and discussion of individualising the SMM Superordinate Theme. The coaches interviewed recognised the individual nature of athletes. Both in general and paracanoe contexts. Accordingly, they considered the individualisation of their generic MMs to the bespoke needs of the athlete paramount within their coaching interventions. Therefore, within the paracanoe context, as the coaches gained experience, they were able to reject the overly of generic or able-bodied MMs and instead create bespoke SMMs individualised to the athlete. The use of experts including the athlete to supplement the coach's sources of knowledge was considered vital in helping the coach understand the individual as highlighted earlier. In effect, the athlete and expert become an integral part of the community of practice that develops the SMMs and is reflected in the individualised aspect of the process highlighted earlier. The integration of athletes into the coaching process and construction of the SMM support the

findings of Wareham et al., (2018) and further highlight the need for the social construction of meaning to make knowledge usable in overcoming unique coaching challenges.

Through the integration of the expert knowledge sources within the coaching team the coaches were able to enhance their understanding of how the individual athlete's disability/ability affected the performance. Hence creating a bespoke SMM. The athlete as a source of expert knowledge also supported the extensive use of questioning highlighted earlier to support observation, and in this way, the holistic view of the athlete was refined and the quality of the coach-athlete relationship improved (Jowett & Arthur, 2019). Utilising this process, the coaches' situational awareness and demands, (Smith & Hancock, 1994), were enhanced, consequently providing greater context about "what's going on" (Macquet & Stanton, 2014, p.725). In short, this allowed the coaches to create an in-depth understanding of the athlete and mitigate the limitations of observation highlighted earlier. Through the deeper individualised understanding an adaptable, richer, and context specific SMM was developed. Consequently, removing the contextual limitation of athlete variance issues of applying generic MMs in isolation (cf. Lees, 2010).

7.3.5 Superordinate Theme 3: Observation of the SMM. The third superordinate theme was made up of five sub-ordinate phenomena. These were: *1) Challenge of observation. 2) Observation strategy. 3) Objective measures of performance (technology). 4) Subjective measures of performance. And 5) Critical thinking/problem-solving.*

Challenge of observation. Despite their status within a World Class Programme and experience of paracanoe, observing athletes in real-time was at times challenging for the coaches interviewed. Reportedly, this was due to the speed of the forward paddle-stroke cycle that could reach 170 strokes per minute as described by Coach 3: *"The challenge comes when you have this great technique at 70 stroke rates and it goes to 100, 110, 115, 120 that's when it [observation] all goes out the window".* Such a quote highlights the challenge observation

poses to the coach in a real-world context and making accurate decisions in line with the findings of Lees (2010). While the observation of the technical elements of the generic MM was a challenge at high stroke rates for some coaches, conceptualising how the athlete was delivering the fundamentals of performance they observed within the SMM was also an issue. Coach 2: *"I find it hard to be really critical at that level, as I haven't got the experience. I haven't been there as an athlete at that 130, 140 strokes a minute".* The limitation of the coach's observational boundaries did appear to decrease with experience of paracanoe generically and through the increased understanding of the athlete, they worked with. Importantly, a considerable observational challenge may be experienced at least initially, for any coach transferring into paracanoe.

Observation strategy. In overcoming the challenge of observation, the coaches all reported developing bespoke observation strategies linked to their own generic MMs of performance as Coach 3 explains: *"I have these pictures, I have the set-up, lock the blade, essentially catch, dry phase, weight on blades, end of pull and exit. So basically, a stroke is broken down to six points".* Through this strategy, the coach was able to chunk down their observation into key phases to reduce the cognitive load and allow them to observe an element of the stroke at a high rate. To further reduce cognitive load and the coaches all reported continuing their observation process post-session as Coach 1 describes:

> *"Have a clear idea of what they need to work on, so you need to observe what they are doing. Look in slow motion, spend plenty of time to find out what's happening over a period of time not jumping to conclusions".*

Through the use of post-session observation, the coaches were able to more critically appraise the performance against the SMM. Therefore, more accurate feedback and agreed development of the SMM were able to be gathered. However, due to the time needed to review the observation post-session, the feedback was often delayed. The use of an observational

strategy supports the view of Lees (2010), in that observation within live sporting settings is hampered whereby feedback to or from the athlete may be limited. For example, such as the ability of the coach to enter the field of play or set within a high stakes sporting context and under time pressure.

Objective measures of performance (technology). The use of technology was considered critical by the coaches in helping to overcome the challenge of live observation as Coach 2 describes: *"I really struggle with being critical at that speed. That's what I have to use the video for".* Additionally, technology allowed variables that were not explicit within the SMM such as kayak hull lengths, paddle shafts, (McDonnell, Hume & Volker, 2010), or anthropometry of the athlete to be considered by the coaching team. However, due to the physical environment they coached in preventing live data visualisation, and the time needed to download data, any use of technology was often reviewed and analysed post-session and Coach 1 reported: *"Constantly, we are doing GPS stuff".* In this way, post-session technology was utilised by the coach to provide insight into how the interplay between the fixed elements they valued within their generic MM was being integrated into a unique technical performance by the athlete (Chow & Button, 2016). Consequently, coaching practice could be developed and applied to meet the unique needs of the athlete and the application of the bespoke SMM.

Subjective measures of performance. The coach's subjective measure of performance was operationalised through the interplay of coaching experience and athlete feedback in monitoring the SMM within the coaching session. Coach 1 comments: *"The first part would be understanding what people are doing".* The quote indicates how the coaches sought to understand how the athlete and the nature of their impairment were meeting the demands of the sport to create an individualised solution (Simon & Richards, 2022). However, in meeting unique athlete needs, understanding just what the athlete was doing, and consequently what

subjective measure to deploy, often needed collaboration and supplementation from the athlete and other experts. Coach 2 describes this:

> *"So, I would see myself as the engineer and the athlete needs to be feeling things, to me, for me the engineer, to help them make those changes or to speak to other people to help them make those changes".*

Accordingly, the subjective observation process initially employed by the coach were adapted and utilised by the athlete and support team as the basis for the in-session observation of the SMM (Lees, 2010). Importantly, in common with other sporting situations challenges remained for the coaches in that while the use of subjective observation was common (Holder & Winter, 2017), the accuracy of the observation was often questionable. Therefore, potentially impacting the coaching efficacy of any feedback (Giblin, Farrow, Reid, & Abernethy, 2015).

Critical thinking/problem-solving. In helping the coaches innovate bespoke athlete solutions and meet the challenge of paracanoe coaching, they unsurprisingly reported using multiple strategies and knowledge sources. Coach 2 describes utilising expert knowledge: *"Opens up critical thinking and thought and your reflection on that. It becomes really focused which is key".* In contrast, coach three describes their innovation of a profiling template to problem solve: *"And what I learned, whether pictures are right or not, I am likening it to something. I've got a zero point. I have got a place to start, I've got a basis, I can write notes next to it".*

Through this critical thinking process, the individual athlete SMM became constantly informed by an ongoing audit against fixed MM elements. Consequently, experimentation, reflection and collaboration could be enhanced which led to further innovation of the SMM within the coaching team. In this way, the technical elements of an SMM *(the what)* were supplemented and made useable by the psycho-social elements *(the how)* as each team member

integrates expertise to collaborate and socially construct a shared model (Richards et al., 2016; Stadifer & Bluedorn, 2003).

Summary and discussion of Superordinate Theme Three: Observation of the SMM.

Fixed beliefs allowed the coaches to develop individualised strategies to observe and understand how the athlete was solving the performance puzzle. However, variance could be problematic in the development of a SMM within a team where multiple coaches held competing technical models. This variance is similar to the findings of McDonnel, Volker and Hulme (2013), who reported similar differences in language and terminology in Olympic Sprint Kayak Coaches and Taylor, Werther & Culver (2014), in a parasport context.

In removing, the reported variance within the coaching teams SMM, clarity as to the team's non-negotiables of performance, definitions of these performance elements and phases was required to allow more effective collaboration against the SMM. In addition, as previously mentioned, the coaches actively sought out the opinions of the CoP to help make sense of, check, challenge, construct knowledge as a unified SMM (Stoszkowski & Collins, 2015) and gain a consensus of opinion. However, this in itself may lead to error if not properly considered in replacing an individual's heuristic bias, identified by Chapter five with the potential for a collective bias within the CoP.

The coaches highlighted the challenges associated with live observation when the complexity of the performance became challenging, for example at high stroke rates. In meeting this challenge idiosyncratic observational strategies were deployed by the coaches, based on the key elements of performance they valued. However, notwithstanding the earlier comments about individuality, caution should be employed when utilising observation strategies evolved from fixed beliefs.

Technology was reported as being highly valued by all of the coaches studied and allowed them to reduce cognitive load and gain insight into the application of elements of the

SMM by the athlete. However, this insight was often gathered post-session owing to challenges within the real-time visualisation of data within the sports context. The use of technology in this way also allowed the coaches to better understand their athlete, opposing Williams and Manley's stance (2014), who reported the dehumanising effect of technology when viewing athletes as data sets. The use of multiple information sources and the application of strategies, particularly post-session, allowed the coaches to problem solve. Consequently, SMMs could be constantly updated, refined and operationalised within the team.

7.3.6 Superordinate Theme 4: Leading the SMM. The fourth superordinate theme was made up of four sub-ordinate phenomena. These were: *1) Naturalistic decision-making. 2) Sense-making. 3) Pattern recognition. Finally, 4) Leadership.*

Naturalistic decision-making. In managing the real-world challenges imposed on their live observational process, the data showed all three coaches utilised naturalistic decision-making responding to clues, hunches and gut. This is reflected in statements by Coach 2: "*The body gives me many clues now at this level".* This quote refers to how coach two responded to shapes and patterns they valued through their experience (Klein, 2015), to make decisions in their real-world setting, whilst managing the complexity of the coaching session. However, the coaches were very aware of the boundaries of their expertise and while happy to go with their gut within the session, utilised technology to gather evidence and review their decisions post-session. Therefore, the coaches were able to contrast their observations and check and challenge the in-session observations and assumptions. The utilisation of NDM processes by all three coaches within real-time coaching allowed them to more quickly respond to their athletes by being less heavily on cognitive resources. Consequently, within real-time sports coaching, NDM may be more suited to situations that have less comprehensive information available and are time-pressured (Klein, 2008), such as the competitive environment. This study makes a new contribution to NDM research in sports. The body of current NDM research

is situated in nondisabled team sports and on the interaction between the athlete, the game and the coach, (Ashford et al., 2020; Richards 2012; 2016) and is situated in a tactical or strategic context. Consequently, this study offers a new contribution to Paralympic sport and insight into NDM within an individual sports context and coach decision-making.

Sense-Making. In making new knowledge and constructing meaning for themselves and those within the support team, the ability to sense-make (Weick, 1995), was considered important. Coach 1 states: *"Other coaches, other athletes, my own reflection, what has worked and what hasn't".* This quote indicates that the coaches analyse events retrospectively, connect dots and anticipate future actions in noticing information and making sense of the performance, supporting Macquet & Kargba's (2015), view of sense-making. Through this process the coaches were able to build conceptual frames to identify a performance vision they could work from Richards et al., (2009; 2016).

The use of sense-making appeared to have developed as a serendipitous by-product of having no paracanoe rule book, and a very close working relationship with the athlete and support team in developing the SMM as described by Coach 3: *"Having a physio in terms of having a disability like that, just someone saying he's too new to injury he doesn't know how to use his body like that yet".* This quote highlights how the coaches utilised a collaborative sense-making approach to utilise expert knowledge sources, (Duffy et al., 2013), that allowed the team to consider the fundamental question of what was happening and aligning thinking to generate a beta SMM (Richards et al., 2012; 2016)

Through this process knowledge was generated and made useable through the explicit integration of the athlete and experts with the support team utilised as a coaching resource to construct meaning and lead the sense-making process. Consequently, the use as sounding boards of athletes and experts in the observation process allowed the refined understanding of the SMM situational demands of the performance.

Pattern recognition. In working 'intuitively' the coaches all reported recognising and responding to familiar and typical patterns within the situation they faced. As Coach 3 described: *"you see the patterns",* and Coach 1: "*You should be able to join the pictures up a little bit and work out what is and what isn't important to the technical model",* both illustrating that the coaches recognised and worked from movement patterns stored in memory (Klein, 2015). Through the recognition of typical and familiar key patterns made by the athlete, the boat and the paddle, the coaches appeared able to match technical components of the observed SMM to those stored in memory. Consequently, the coaches were able to run mental simulations to decide on the direction of the coaching intervention. The use of pattern recognition in this way would appear to show similarities to the use of Klein's (2003; 2015) recognition primed decision-making (RPD; Klein, Calderwood & Clinton-Cirrocco, 1993), model within this sporting context where all three coaches reported matching cues and patterns within their observation of the athlete performance. Consequently, the coaches were able to recognise, match and connect dots to respond intuitively, by interpreting the cues to find solutions. The use of RPD in a Paralympic coaching and paracanoe context would expand the use of Klein's model into a new domain.

Leadership. In defining, refining and aligning behind a clear, individualised, performance vision or SMM, all three coaches recognised the importance and contribution of the wider athlete support team in the exchange of and generation of new knowledge to solve unique athlete coaching needs. In doing so the coaches recognised the contribution of the experts around them and at an applied level overcame the neglect of the multi-disciplinarity team within the wider sports coaching literature identified by Alfano and Collins (2021).

In developing a richer more individualised and effective SMM, sources of knowledge could be gathered, understood and operationalised. In supporting this collaborative process, the

coaches all reported having to fill a distinct leadership function to co-ordinate effort as Coach 2 describes:

> *"I see that as the team around that athlete is that something I have picked up from previous managerial experiences where everybody is part of your team and equal. So, I ask the question, there's lots of managerial skill I take to my coaching".*

However, to be effective within this leadership function, the coach had to accept they were not the font of all knowledge within all aspects of the SMM. Accordingly, they had to create psychologically safe environments that allowed those with greater expert knowledge to lead the coaching process when appropriate (Gosai et al., 2021). Coach 1: *"Check what other people are doing and constantly learn. What you view. You never ever get to a point that you are an expert, you always got to have to keep pushing and finding out more information"*, suggesting the coaches recognised the boundaries of their expertise and recognised the need for more experienced members of the team to lead specific areas of the coaching intervention and development of the SMM. Through the distribution of leadership, and the coach empowering leadership to the most appropriate expert to lead the development of the SMM, individualised elements of performance could be made more effective. Consequently, clarity of the performance vision and collaboration of the team increased. Therefore, if leadership is a distinct function of coaching within this context, then it should be considered important by coach educators.

Summary and discussion of Superordinate Theme Four: Leading the SMM. In solving real-world coaching problems and generating individualised SMMs, the coaches engaged with and utilised naturalistic decision-making behaviours. Consequently, within session, the coaches reported responding to familiar patterns and cues observed within the athlete's performance (Harvey, Lyle & Muir, 2015; Klein, 2008; Klein 2015). This suggests that a

recognition-primed decision-making strategy was utilised by the coaches (Kahneman & Klein, 2009; Klein, Calderwood & Clinton-Cirocco, 1986), possibly built upon the coaches' experience to fill in the unobservable gaps. The use of RPD in this way depends on suitable and accurate knowledge to fill the hiatus. Expanding from this point, the coaches anticipated possible errors in the technique given the observable context and current performance goal(s). When dealing with incomplete information or if coaches are less experienced such extrapolation may be prone to the heuristic biases as highlighted by Kahneman and Klein (2009). For example, this anticipation could lead to bias such as the illusion of control, representativeness or familiarity effect, as well as the influence of the athletes over the coach in prioritising outcome (wants) above observed needs. Or, when time-pressured and complex, utilising a fast and frugal heuristic to respond to the first useable, although not necessarily optimal element of technique they recognise.

Accordingly, the coaches were able to construct meaning through sense-making (Weick, 1995) and generate an SMM (Richards et al., 2012; 2016), they could work from. The integration of questioning of the athletes, their explicit integration in the CoPs, and use as co-participants and sounding boards in the observation process appeared vital to fully check and challenge, interpret and construct the coach's understanding of the situational demands of the performance. An example of collaborative sensemaking, (Duffy et al., 2013). The coach's ability to sense-make was often further refined through discussion with expert sources of knowledge and through utilising technology as discussed earlier (GPS, video etc). Coaching decision-making was consequently enhanced through the refined lines of questioning, developing the coach's knowledge and understanding of the individual athlete. This questioning process further defining and clarified the individualised vision of athlete performance the coaching team collaborated upon and their subsequent ability to create richer

templates and SMMs in the process. An approach that encouraged multiple information sources.

7.4 Summary of chapter and conclusion

This study examined a group of Paralympic coaches working within a World Class Programme with the support of inter-disciplinary teams. The research has identified several unique contributions related to how the coach's MMs are shared and made usable within those teams. Firstly, the study has shed light on how coaches working within paracanoe over time and with experience adapt generic templates to individualised SMMs. They do this through an interplay of sources of knowledge, individualising their SMM, observing the SMM and leadership of the SMM process. Within Paracanoe the research shows that a lack of formal education and knowledge sources generates the need for collaboration. This collaboration is a two-way knowledge generation process within the team. The experts provide an explicit mentor function that helps construct meaning, make knowledge useable and consequently construct a more robust and individualised SMM. In observing the SMM within live performances significant challenge is placed on the coach. While this challenge reportedly decreases with experience, it does highlight the need for mentoring support to any coach transferring into parasport. In meeting this coaching challenge, idiosyncratic observation strategies are developed by the coach based on the generic fixed elements of the SMM that they value. However, caution should be given if the use of non-disabled or fixed MMs of performance is being utilised to gather individualised SMM information.

7.4.1 Researcher Summary of Chapter. The research within this chapter has supported the development of bespoke SMMs to the athlete and in doing so, adds to the literature in individualising the SMM. In operationalising and innovating bespoke SMMs, collaboration is key to fuse distinct expert knowledge sources to clarify the components of the SMM. In clarifying and making SMM elements explicit, observation is improved. Importantly, in

clarifying and contextualising the SMM, distinct expert knowledge is important and care should be taken not to *water down* expert knowledge in an effort to remove working silos (i.e., sport medicine, technical coaches). Rather high-performance teams should consider permeable boundaries (Simon & Richards, 2022) to support the generation and innovation of domain expertise whilst allowing knowledge exchange and collaboration within the team. In facilitating the collaboration of experts the permeable boundaries, the coach fills a distinct leadership function. If it is accepted that leadership is part of a coaching, then leadership should be embedded in coach education at the earliest opportunity.

In operationalising observation, NDM paradigms appear more suited to support expert and experienced coaches. However, empirically and as a personal observation, it would appear that even the most experienced coach if met with a new athlete in a new environmental context may be susceptible to heuristic decision making as their expertise becomes fractionated (Klein, 2015). Accordingly fractionated expertise may appear to *bridge* heuristic and NDM in the real-world and would be worthy of further research. The following chapter will expand further on this body of work by exploring how SMMs are individualised and applied within the paracanoe context. The chapter's specific phase under investigation is the 2018-2019 years of the Olympic and Paralympic preparation cycle for Tokyo 2020. The chapter examines the differences in the Paralympic and Olympic Programme coaching team's SMMs, terminology and definitions of phrases. These differences will be examined within the acceleration phase at the start of the race, which is a vital aspect of successful race performance.

CHAPTER EIGHT: A CASE STUDY: INVESTIGATING COGNITIVE OBSERVATIONAL DIFFICULTIES IN ELITE COACHES USING AN APPLIED COGNITIVE TASK ANALYSIS

8.1 Introduction

Preceding chapters have found that the coaches studied, construct and adapt their individual SMMs based on fundamental principles of performance that they value. SMMs are constructed through coaching experience, experimentation and a repertoire of knowledge developed within related domains (e.g., physiology, anatomy), as evidenced in Chapters six and seven. For coaches who work and collaborate within an inter-disciplinary team a clearly defined SMM would improve the effectiveness of the team. Through the shared understanding of the performance vision, an athletes' SMM can be further individualised through the social construction of knowledge highlighted in Chapters six and seven.

However, Paralympic sport presents many additional challenges in which coaches may be further challenged to adapt generic MMs created from their previous experiences to the individual athlete they are working with (Taylor et al., 2015; Tweedy & Vanlandewijck 2011; Tweedy, Beckman, & Connick 2014). For example, as previously described in Chapter seven, coaches transferring from non-disabled sports, or from within different Paralympic sports have developed a MM/SMMs based on the multisegmented motion patterns of performance they value (Gløersen, Myklebust, Hallén & Federolf, 2018). Therefore, coaches may look for technical proficiency that cannot be applied, (or at least the coaches think cannot) because of technical performance limitations caused by factors, such as impairment within the paracanoe context or anthropometry within non-disabled populations. In effect, knowledge of techniques built from non-disabled athletes is useless, unless the parts of the

performance can be sequenced and adapted into an individualised SMM, as highlighted in Chapters six and seven.

Within the context of this chapter, a case study example will be used and set within a specific time frame of Olympic and Paralympic preparation. This chapter's specific phase under investigation is the 2018-2019 years of the Olympic and Paralympic preparation cycle for Tokyo 2020. During this time the performance questions the coaches were currently involved in answering and exploring centred on developing a deeper understanding of the coach's SMM of the acceleration phase of sprint canoeing. In layman's terms, the acceleration phase of sprint canoeing can be described as encompassing the start process, moving from stationary and transitioning through to the race pace. However, considerable variation was evident within the coaching and inter-disciplinary support team in agreeing on the distance of the acceleration phase (described between four and 100 meters), and the principal technical elements of performance that allow an athlete to break inertia and accelerate to their maximal velocity. To address this challenge, the creation of a alpha SMM (Richards et al., 2016), specific to the race start was identified as a focus. The SMM would integrate the inter-disciplinary lens of all support staff, focusing on establishing an SMM that the team could agree, define, and align behind. Addressing this real-world problem was also part of this thesis journey and provided additional insight into the understanding and construction of SMM in elite sports, integrating and applying the findings of Chapters five, six and seven. Identifying the inter-disciplinary SMM for the race start could provide a performance advantage in the lead-up to the 2020 Tokyo Games if the collaboration of the team could be enhanced by a deeper understanding of the SMM relating to the acceleration phase and the principal components of performance. British Canoeing Paracanoe already possessed generic templates such as the What It Takes to Win (WITTW), deterministic model (Hay & Reid, 1988; Figure 8.1). See Figure 8.1 below.

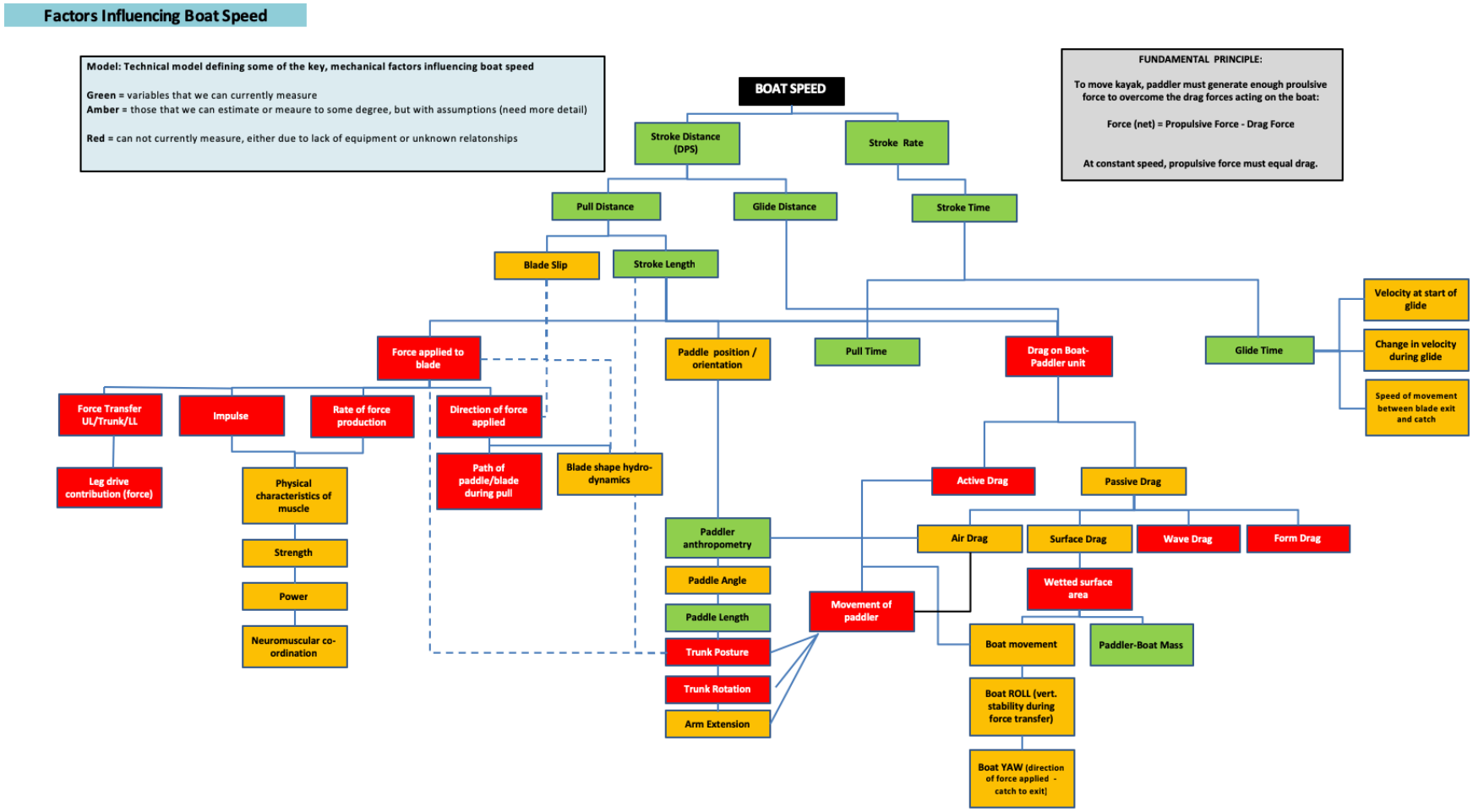

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Figure 8.1. WITTW Paracanoe Deterministic Model

Figure 8.1 was developed by the British Canoeing Paracanoe team to identify the component factors that determined the performance of paracanoe. This paracanoe-specific model was adapted from Wainwright, Cooke, and Lowes (2014), Deterministic Model of Sprint Kayaking. As such the model allowed the identification and understanding of generic WITTW components in line with predicted gold medal performance times at the Tokyo 2020 Games.

The WITTW fulfils the needs of a generic template for Olympic Sprint Kayaking. However, the WITTW is generic across events and athletes and limited guidance was provided on how to apply the model as a coaching resource. Consequently, the WITTW fails to provide an athlete-specific model that addresses the bespoke performance needs of a Paralympic athlete as presented in Chapter seven. The impact of the rigidity of the WITTW template, overlaid onto the Paralympic athlete as discussed in Chapter two, promotes a cut-and-paste approach to coaching and misalignment of individualisation of the coaching process and therefore is limited in its use. Work by Simon and Richards (2022), outlines that a one size fits all approach does not work in Paralympic sport owing to the bespoke nature of athlete impairments and consequential variance in a Paralympic athlete's performance needs. Furthermore, Simon and Richards (2022), also support the concerns of Lees (2010), in that the individual coaches' interpretation of technique varies. Consequently, a lack of flexibility and variation in the generic templates such as the WITTW, result in it being too rigid to be applied to an individual athlete's SMM and in the Paralympic athlete case, where coaching needs to be tailored to the limitation of disability as well as the individual characteristics. Accordingly, the WITTW fails to consider the inter-disciplinary lens of specialists, which is essential in elite sports to properly identify contextual and situational variables of performance (Martin et, al., 2019).

Supporting the stance of Simon and Richards (2022) and Lees (2010), through empirical observation of the coaches, it became clear that the understanding of how one deterministic level within the WITTW could impact positively or negatively on another level was often misunderstood. Consequently, the coaches did not know how the levels of the deterministic WITTW are interconnected, and what needed to be addressed within the coaching session to improve performance (Lees, 2010). Understandably, this lack of understanding of the athlete, in the context of the performance setting, can lead to a high level of challenge and complexity for the coaches in understanding the interrelated nature of the parts of the observed performance. The solution to the complex performance problem would be to develop athlete specific SMMs, which are constructed through an inter-disciplinary sport science and coaching lens.

However, in moving away from the rigidity of the deterministic model of performance (driven by non-disabled coaching philosophy and the National Governing Body coaching resource), the Paralympic coach frequently lacks the bespoke knowledge and principles of a technique to effect technical change for the Paralympic athlete. The result of this is reflected in pedagogical experimentation (c.f. Chapter six & seven) by the Paralympic coach to find the solutions, or more simply 'adaptive learning. This chapter, therefore, aims to enhance the understanding of what is needed by Paralympic coaches during this 'adaptive learning' to effectively integrate knowledge and experience from generic technical models It will also refine and adapt this understanding in the context of the bespoke needs of the Paralympic athlete.

Therefore, in answering the real-world performance questions, this chapter explores the challenge of creating an SMM in the Paralympic sport of Paracanoe. More specifically, this chapter explores what are the knowledge and principal components of the performance specific to the start phase of the race and how coaches and performance specialists who

collaborate within a World Class Programme have derived their athlete specific SMM for performance. This chapter identifies the commonalities or idiosyncrasies within the SMMs of all performance specialists and what strategies they employ to overcome challenging aspects of observation within these templates to improve the technical efficiency of their athletes.

The focus of this chapter will be to explore SMMs within the paracanoe context. The chapter examines the differences in the Paralympic and Olympic Programme coaching team's SMMs, terminology and definitions of phrases. These differences will be examined within the acceleration phase at the start of the race, which is a vital aspect of successful race performance. Consequently, within this chapter, RQ 3 will be addressed which focuses on real-time observation and how this informs individual feedback. When coaching in real-time does a high-performance coach in paddle sport utilise real-time observations or is there an adaptation of predetermined and established SMMs generated by experience? In addition, the chapter will examine RQ 2 by examining how the integration of coaches' technical observation is unified into a sport specific SMM to improve individualised athlete performance. To address these questions the chapter will firstly, present the research methodology and procedures. Results are then interpreted before finally being discussed.

8.2 Method

8.2.1. Research design. This research was conducted in the lead-in to the Tokyo Olympic and Paralympic Games. Specifically, data was collected during the European Championship, in Belgrade (May 2018) and ran to the original date of the Tokyo Olympic / Paralympic Games (August 2020) and lasted 26 months. Crucially within the research period, COVID-19 presented a collaboration challenge. The research was completed through lockdown periods remotely with collaboration issues solved through virtual and remote working with PowerPoint used as a central data collection tool (Appendix 8.1). The evolution of the SMM of the acceleration phase evolved over these 26 months, with coaches and inter-disciplinary

specialists working collectively in groups within team meetings but also individually at times due to the constraints of Government COVID restrictions in force over that period.

The research centred on informing a performance question the coaching team and support staff had identified to develop insight into the acceleration phase for the start process of the race. A case study integrating Applied Cognitive Task Analysis (Militello & Hutton 1998), was used to explore the observation and analysis strategies of coaches within the start or acceleration phase of sprint kayaking. ACTA required the cognitions in relation to the start phase of the race of the coaches to be captured. ACTA was also innovatively used to capture the expertise of the inter-disciplinary support team to; 1) explore the similarity of task diagrams with coaches; and 2) explore cognitive skills through knowledge audit to inform continuous coach development.

8.2.2 Participants. Eight coaches were identified for this investigation. Olympic n=3; Paralympic n=3 Inter-disciplinary specialist (strength & conditioning coach & physiotherapist n=2). Participants were one female and five male Olympic and Paralympic Sprint Coaches and two male inter-disciplinary specialists. To avoid deductive disclosure all participants reflecting their role within the development of athlete performance have been referred to as a coach. Steps were taken to ensure the anonymity of the coaches involved in the study. For example, owing to the specialist nature and correspondingly low number of inter-disciplinary specialist staff (i.e., Strength Coach, Physiotherapist), involved within the coaching team examined, all participants have been assigned a coach number rather than be identified by specialism. Coaches have been assigned a number at random from one to eight and steps have also been taken to avoid deductive disclosure. The coaches were based in the United Kingdom and had been coaching between five and 25 years of coaching experience (M_{years} = 11.8 years) and with an age range between 32 and 50 years old (M_{age} = 39 years). The inclusion criteria included: 1) all participants were coaches employed by British

Canoeing World Class Programme; 2) Coaches had engaged with at least one Olympic/Paralympic cycle as part of a coaching team; 3) all participants held a recognised coaching award or professional qualification for a minimum of five years at level three UKCC. In addition, individuals were categorised as experts and novices. Based on single or multiple Olympic/Paralympic cycles they had coached within.

Proficiency scaling (Hambrick & Hoffman, 2016), was utilised to capture the comparison of novice–expert differences required for ACTA. Further, proficiency scaling identified three coaches within the participant cohort, who were considered an expert in the canoe sprint start process. The three experts were classified as 'master experts' and were defined as coaches who have experience within two or more Olympics/Paralympics cycles. With the single term 'experts' being used to classify less experienced coaches who had less experience and experience of one Olympic/Paralympic cycle (synonymous with the novice for the purpose of ACTA). The demographic data of participants can be found in Table 8.1

Table 8.1: Participant Experience and Qualification

Coach	World Class Category	Highest Qualification	Years of World Class Coaching Experience	Olympic or Paralympic Cycles
Coach 1	Olympic	UKCC Level 3	10	2
Coach 2	Paralympic	UKCC Level 3	15	1
Coach 3	Olympic	UKCC Level 3	17	3
Coach 4	Olympic	UKCC Level 3	25	6
Coach 5	Paralympic	UKCC Level 3	7	1
Coach 6	Paralympic	UKCC Level 3	8	2
Inter-Disciplinary Coach 7	Paralympic	Specialist Expert	8	1
Inter-Disciplinary Coach 8	Paralympic	Specialist Expert	5	1

8.2.3 Equipment. Data were recorded using a digital Dictaphone and stored electronically in an mp3 file format in a secure encrypted external hard drive. In line with normal coaching practice within the real-world paracanoe context, the researcher's iPhone was used to capture footage of an athlete performing a start phase. The video was played back through the iPhone on a Phillips 36-inch TV monitor using Quick Time Player software.

8.2.4 Procedure. This study was carried out with the approval of the university's ethics committee, and informed consent from (Appendix 8.2) all participants were provided before data collection.

ACTA Process. The ACTA was conducted following the guidance of Hutton & Militello (1998) and consisted of four steps (Crandall, Klein & Hoffman, 2006; see Chapter four for extended detail). Step one involved a task diagram and interview, step two, a knowledge audit, step three a simulation interview and finally in step four, a cognitive demands table was created. The ACTA was conducted in the build-up to the 2018 European Championships (Year two of the 2020 Olympic / Paralympic Cycle) and was carried out between training sessions within the World Class programme to offer the convenience of location. The Head Coaches' office was utilised to conduct the interviews and simulations as a quiet and private space. Steps one, two and three lasted approximately one hour per stage. Each stage of the ACTA process is outlined below.

Step 1 – Task Diagram. A discussion on the global race phases of a 200m race was initially verbally discussed to familiarise participants with the process before the acceleration phase was explored through the task diagram. Participants were asked to construct a task diagram in line with the procedures described by Militello and Hutton (1998), in less than six but more than four, stages representing the process they go through when observing and analysing in sprint kayak. The diagrams provided a broad overview of the acceleration phase of the race. They illustrated the key areas of the performance phase for the start and outlined

what the coaches considered important, the difficult cognitive elements, why those aspects are difficult (Kahneman & Klein 2009), how the coach addressed these challenges, the cues and strategies and anticipated common errors. Table 8.2 outlines the process and prompts used within stage one of the ACTA process. The task diagram for all coaches was individually analysed and then unified into one diagram to represent the SMM of the race start phase. The unified task diagram (see Fig 8.6 on page 214,) was shown to the coaches who had the opportunity to provide further clarification, insight and questions as to whether it represented their original diagram.

Table 8.2 - ACTA Stage 1 Task Diagram

	Question	Guide	Prompts	Time	Notes
ACTA Criteria	**Stage 1: Task Diagram**				
Past and future	When observing do you know exactly what is happening technically and where the performance is headed?	Past and Future Problem solving Heading off problems	What does the athlete need? Why does the technique look like that?	10	How did the technique develop? Where is the performance headed and what is needed?
Big Picture	What are the important elements in observing and analysing in sprint kayak?	Key elements Context Big Picture Keeping track	How do the components of technique fit together? What is important?	10	What do they prioritise? Definitions and language
	Can you break this task down into more than 3, but less than 6 steps?	What are the key elements?	Draw it? Phases	10	Indicate with arrows the order of steps
	Of the steps, you have just identified which require difficult cognitive skills?	What are they? Situational demands	Highlight on diagram Articulate and field notes from interview	10	

Step 2: Knowledge Audit. Step two of the ACTA process specifically focused on the initial start of the race (a deep dive into one sub-task of step one). A knowledge audit for step two was constructed using ACTA probes (Militello & Hutton's1998; see Table 4.1 in Chapter four).

The ACTA knowledge audit prompts can be found below in Table 8.3. The knowledge audit allowed the coaches to further explore one sub-task of one aspect presented in the overview of the task diagram, the race start. Probes and questions (Table 8.4), were utilised to elicit examples of domain-specific knowledge and skills related to the start phase. This included aspects of expertise, cues and strategies and difficulties identified by the coach relating to the athlete executing the race start. Owing to the nature of the ACTA being performed within the naturalistic setting of high-performance sport, the method of ACTA was integrated into the normal pedagogical mechanisms of high-performance coaching (Richards et al., 2012).

Integration of CTA approaches, and hence ACTA, into training settings has been identified as acceptable (Hoffman & Militello, 2009). To enable a natural engagement with step two of ACTA, detailed field notes (Appendix 8.3 a, b, c, d, e, f) were captured by the head coach in line with normal pedagogical practice and later analysed. The notes were also transcribed into PowerPoint and shared with the management as part of the monitoring of team discussions (Appendix 8.1).

Table 8.3: ACTA Knowledge Audit Prompts

ACTA Prompt for Acceleration Phase	***In relation to the type of task highlighted….***	***Prompts***	***Use Task Diagram***	***Area of Interest***
The acceleration phase (ACTA: Big Picture)	Following on form the last session we had, this session will focus only on the start phase of the race. Can you describe in high-level terms this phase?	What is the first part of the acceleration phase? How long does it last? What comes next?	Situational Assessment Situational Understanding	How do they build and review their established MMs
Phase of Start – Propel/Project (ACTA Noticing; Improvising; Opportunities; Self-monitoring; Anomalies; Equipment: Difficulties)	You mentioned the first stroke is important, can you tell me more about that part?	What is the purpose of this phase? What are the important elements of performance? When does the phase end? What does 'correct' look like?	Noticing: What jumps out? Improvising: Can you think of a time you've improvised? Opportunities: How do you take opportunities to do things better? Self-Monitoring: How aware of yourself are you in the process? Anomalies: How do you recognise unusual elements? Equipment: Have you been led astray by equipment? Difficulties: What are the difficulties?	What is their area of focus? What are they observing within the phase? What is important within the MM?
Phase of Start – Rhythm (ACTA Noticing; Improvising;	You mentioned building the stroke was important,	What is the purpose of this phase? When does the phase start and end?	Noticing: What jumps out?	How do they recognise the start/end of the phase?

Opportunities; Self-monitoring; Anomalies; Equipment: Difficulties)	can you tell me more about that part?	What does 'correct' look like?	Improvising: Can you think of a time you've improvised? Opportunities: How do you take opportunities to do things better? Self-Monitoring: How aware of yourself are you in the process? Anomalies: How do you recognise unusual elements? Equipment: Have you been led astray by equipment? Difficulties: What are the difficulties?	How have they constructed the phase elements of the MM? What are the principal components of performance for this phase?
Phase of Start – Rate (ACTA Noticing; Improvising; Opportunities; Self-monitoring; Anomalies; Equipment: Difficulties)	You mentioned increasing the stroke rate was important, can you tell me more about that part?	What is the purpose of this phase? What is the difference between this phase and the last? What does 'correct' look like?	Noticing: What jumps out? Improvising: Can you think of a time you've improvised? Opportunities: How do you take opportunities to do things better? Self-Monitoring: How aware of yourself are you in the process? Anomalies: How do you recognise unusual elements?	How do they recognise the start/end of the phase? What are the principal components of performance for this phase? What are their observational strategies?

			Equipment: Have you been led astray equipment? Difficulties: What are the difficulties?	
Phase of Start – Distance per Stroke (ACTA Noticing; Improvising; Opportunities; Self-monitoring; Anomalies; Equipment: Difficulties)	You mentioned lengthening the stroke was important, can you tell me more about that part?	What is the purpose of this phase? What are the important elements of performance? When does the phase end? What does 'correct' look like?	Noticing: What jumps out? Improvising: Can you think of a time you've improvised? Opportunities: How do you take opportunities to do things better? Self-Monitoring: How aware of yourself are you in the process? Anomalies: How do you recognise unusual elements? Equipment: Have you been led astray by equipment? Difficulties: What are the difficulties?	How do they know when this phase is over/? What does success depend upon? What is difficult? What are the common errors?

Probes and questions (Table 8.3), were utilised to elicit examples of domain-specific knowledge and skills related to the race start phase. This included aspects of expertise, cues and strategies and difficulties identified by the coach relating to the athlete executing the race start.

Step 3: A Simulation Interview Using Video (Evidence of Impact of research).

Following the knowledge audit, a simulation interview was conducted. The simulation interview allowed a deeper dive into situational assessment, errors, and biases to explore the difference between master experts, experts and inter-disciplinary specialists for the specific phase of the race start. As part of the interview, participants were shown a video (12 seconds in duration). The video presented a challenging scenario relating to the 'start of the race' phase for a Paralympic 200m Kayak race (training context at the national centre). The video recording was of a known GB paracanoe athlete completing an acceleration phase. The video would enable comparison and examination of the observational processes of the coaches and multi-disciplinary specialists (Militello & Hutton, 1998). The interview focused more specifically on the coach's and inter-disciplinary specialist cognitions within the coaching process and probed for definitions of technique and phase, technical templates, the flexibility of SMMs, areas of high cognitive load, uncertainty and actions. Figure 8.2 illustrates a still image at the start of the video. See Appendix 8.4 for video footage.

Figure 8.2 Start of the video clip.

The coaches were encouraged to interact with the video as they would within their normal coaching practice within athlete debriefs, (slow it down, speed it up), when viewing the recording. Using the questions and prompts in the simulation interview (see Table 8.4) participants were asked to identify; 1) 'the difficult cognitive skills within observation'; 2) 'why it was difficult';3) 'common coaching errors': and 4) 'cues and strategies'. A reference was made to their task diagram (step one) to help facilitate and probe areas of interest. The interviews allowed key information to be elicited and for experiences to be explored in great depth within context. This information was recorded using a Dictaphone as detailed in 8.2.3.

Table 8.4 Simulation Interview

Area of Interest	Focus	Examining Decision- Making	Difficulties
General focus for all phases	What are the important elements in observing and analysing in sprint kayak? (Big Picture Situation awareness)	What are the key elements? Video recall (Richards, et al 2012) What do they prioritise? Definitions and language Indicate with arrows the order of steps	Of the steps, you have just identified which require difficult cognitive skills? Highlight on diagram Articulate and field notes from interview What are they? Situational demands
Propel / Project Overcoming Inertia from stationary to increase velocity	What are the important technical elements and key phases	Noticing Meaningful patterns	Key Cues
Rhythm Increasing Pattern of Paddle Stroke Cycle	What are the indicators of a successful acceleration?	Deviation from the norm	How do you detect anomalies or know when something is amiss?
Rate Frequency of Paddle Stroke Cycle	How do you adjust your observation for the increase in stroke rate?	How do you observe in exception to the norm situations? What tricks of the trade do you use?	How do you self-monitor the effectiveness of your observation?
Distance Per Stroke Distance Travelled with Each Paddle Stroke	What are the common errors you see in others coaches observation process?	What are the observational pitfalls?	How do you rely on your experience?

Step Four - Cognitive Demands Table. The final step in the ACTA process is the production of a cognitive demands table through the process of merging and synthesising the findings of ACTA steps one to three. The cognitive demands table provided a format where the cognitive aspects and decision-making process for an individual, relating to the 'start phase' of the 200m event can be identified. The table can be used to not only inform the current performance context and preparation for the Olympic and Paralympic Games but can also inform coach education and Continual Professional Development (CPD) for inter-disciplinary support staff.

8.2.5 Data analysis. Data was analysed for each of the ACTA stages. Single cases were first examined before the data was combined to produce a specialist knowledge audit. Proficiency scaling (Hambrick & Hoffman, 2016), was then used to narrow the focus of research to the three coaches who are experts in Olympic and Paralympic acceleration phases. While all participants are considered experts within the 200m canoe Sprint race discipline, three coaches were identified as more proficient. The results and analysis will focus on the three experts as the most proficient performers in line with ACTA methodology.

8.3 Results and analysis

Results are presented in line with the methodological steps, enabling a progressive layering of findings to construct a knowledge audit table. Findings from the task diagrams of the eight participants are presented first (ACTA step one). A deep dive is then conducted on the specific acceleration phase of the event. Both cognitive aspects and decision-making aspects for the acceleration phase of the race are captured through the knowledge audit (step two) and the simulation interview (step three). In the final part of this section, the accumulation of findings is presented in a cognitive demands table, integrating the synthesis of steps one to three.

8.3.1 Task diagram. In line with the ACTA process, all participants constructed a task diagram as outlined in step one of the ACTA method. All of the coaches verbalised their thoughts and contextualised their thinking by utilising Think Aloud Problem Solving (TAPs; See Chapter 4; Richards et al., 2012), to construct an ACTA task diagram representing their conceptual understanding of the 200m race. The full Olympic and Paralympic 200m race distance was initially discussed with each individual to set the context. Participants were then encouraged to focus in more depth upon the acceleration or start phase of the race and were guided to dive more deeply into the start phase and produce a diagram of the strategic vision

(MM) for the 200m race, which they normally utilised to coach an athlete for the race start phase. Figures 8.3, 8.4 and 8.5 outline three examples of ACTA task diagrams that were produced for a Paralympic Coach, Olympic Coach and Inter-Disciplinary specialist staff member respectively (Coach numbers withheld to avoid deductive disclosure).

Task Diagram Example 1: **Olympic Coach.** Figure 8.3 on page 205, shows an example of a task diagram from an Olympic Coach's perspective. The figure consists of four stages that encapsulate the SMM of an Olympic coach in describing the acceleration phase. The first element of the diagram highlights the interplay of psychological and physiological focus immediately preceding the start which they labelled as the "*ready phase".* The ready phase was a common language among the coaches studied. However, the term did have a bespoke meaning for each coach. In this example, it related to the competition start process and preceded the actual acceleration phase beginning. At this stage of the acceleration phase, the coach commented that the focus of athlete attention is on the start process, whilst simultaneously preparing to generate kinetic energy as a "*coiled spring"* to express force and begin the acceleration phase. The Coach used the term "*coiled spring"* within their description. The meaning was idiosyncratic to the coach, however, the word did describe a commonly held principle within the coaching team, which were studied in this investigation. Although it was not an established shared common language as outlined by Richards et al., (2012), working with elite coaches, the concept indicated the phase immediately preceded the start bucket (the device used to hold kayaks steady at the start line) and the reaction required to respond to the bucket dropping and the athlete responding before their competitors. The competition start process was a concept highlighted by other coaches, although the term 'coil spring' was unique to this coach.

In the second stage of the diagram, the coaches referred to the "*set*" element and described the athlete's decision-making process to manage environmental factors, (head/tail

wind etc). Coaches outlined that such a process would be managed through the tactical choice of stroke application. Set was part of the shared common language of the group. This element also illustrates the SMM of how the athlete will break the inertia, to accelerate the boat through the expression of force, whilst minimising the loss of force. Or as Coach 2 describes *"minimising power leakage*" through instability within their kinetic chain. Coach 1 described this as *"dampening"* (c.f. Appendix 8.3) the stroke. Interestingly, within this stage was the descriptor of the "*hidden issues"* which was outlined by the coach. Further exploration of the "*hidden issues"* resulted in multiple interpretations of physiological, technical, physiological or strategic errors. For example, Coach 1 within the third element, describes how within the first four to six strokes, the intent of the athlete should be on a smooth stroke, using the words "*don't splash".* This indicated a smooth and effective transfer of force to the water to the coaches. The SMM within this element for the coach appears to describe a compact body position continuing to express force within the first twenty meters. The athlete then transitions into a more upright posture as they increased the stroke rate over the first 75m. Within the fourth element, the emphasis for the coach shifted to how the athlete strategically managed their speed against their race plan as the athlete "*settles'* the boat into their "*race pace*" which allows the athlete to maximise the distance travelled in each stroke. The use of the terms *"settles"* by the coach indicates an effective application of the technique to transmit force to the water with minimal energy lost through the component of "*dampening"* referred to by Coach 1. Within this phase, the coaches observed for "*running*" or lack of surging of the boat that indicated to them effective speed management. The term smooth running for the coach indicated stroke efficiency and was an important factor because the coach knew that effective power transfer from the body via the paddle into the boat was happening.

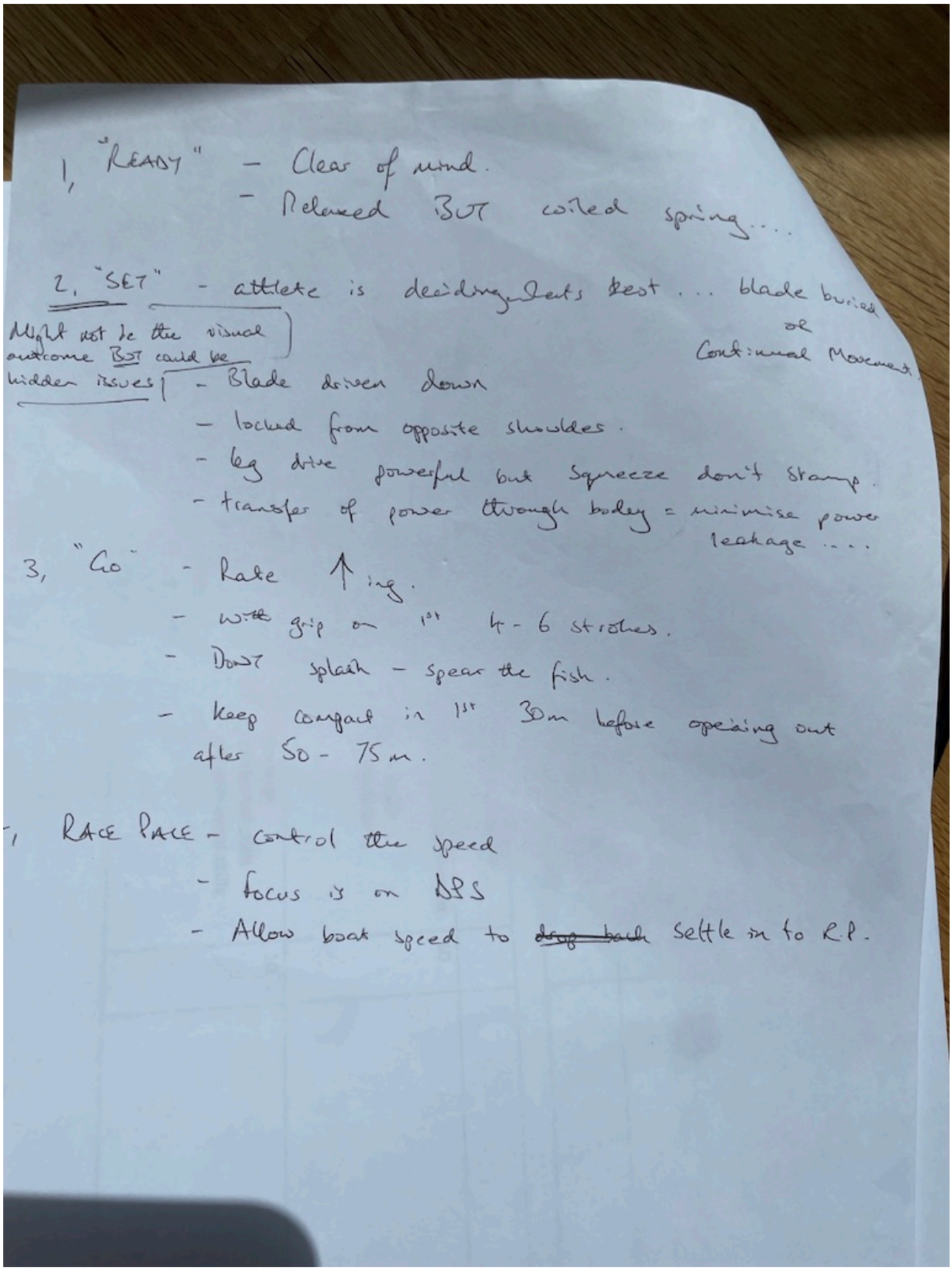

Figure 8.3 Task Diagram Example 1 (Olympic Coach)

Figure 8.4 Task Diagram Example 2: Paralympic Coach. Figure 8.4 shows an example of a task diagram from a Paralympic perspective. The diagram consists of five stages that encapsulate the SMM of a Paralympic coach in describing the acceleration phase. What was of interest was the flow of thoughts and how they were represented on the paper. Instead of a linear listing, Coach 2, mapped the process by illustrating links between blocks of text. The integration of overlapping performance factors in itself could be the representation of a more flexible and adaptable MM that the coach was articulating.

The first episode of the diagram presents the importance of creating a stable platform from which to express force explosively to break inertia and propel the boat. In creating stability to express force, Coach 2 described an important element of creating stability as the interplay between "*the athlete and the boat, through bespoke equipment modifications"* that allowed the transfer of force by mitigating the effect of an impairment. The second element describes "*locking the blade".* In effect, this 'lock' allows the transfer of force generated by the major muscle groups to be transferred to the water. Coach 2 observed for a slip of the blade through the water, which highlighted an anomaly that would guide them to use a more systematic observation strategy as a trick of the trade. Thirdly Coach 2 described the linking of strokes while moving from a high-force, low-velocity application to a lower-force, higher-velocity interplay through "*building a rhythm".* Within this example, 'rhythm' represented a coordinated and effective stroke sequence.

These three elements were described as being coordinated when they happened sequentially within the first four strokes of the race. In a fourth stage, the application of force and rate of paddle stroke is manipulated to effectively "*go through the gears"* and continue to accelerate the boat. The fifth stage was the ability of the athlete to subtlety modify the weighting and timing of the four elements described to consistently deliver an effective start in a differing race or environmental conditions.

Figure 8.5 Task Diagram Example 3: Inter-Disciplinary Specialist. Figure 8.5 shows an example of a task diagram from an inter-disciplinary perspective (Coach 3), that consists of four stages, encapsulating the SMM in describing the acceleration phase. Within the first episode, Coach 3 describes observing "*for the same things"* the technical coaches value with their SMM. However, the technical elements are observed through the lens of inter-disciplinary performance through the athlete's body. Coach 3 described observing the athlete, and then the technique to audit a "*balanced"* or "*smooth"* MM that represents an individualised SMM or "their normal". Interestingly, Coach 3 was cognitively challenged within the first four strokes of the acceleration sequence. As a trick of the trade a coping strategy to deal with this they began applying their MM from the fourth stroke or so (Appendix 8.3). Analysis indicated that all coaches shared a SMM of the race start although the technical coaches have more specific detail to match their domain expertise for the first four-stroke phase. Within the second element of the diagram, the pattern of the "*athlete, paddle, boat, athlete"* was continually audited to understand how the athlete was applying force. Coach 3 audited the performance to consider how *"off water"* (e.g., gym training) interventions could be designed to support the coaches and develop a beta SMM. Within the third element, there is an observational emphasis on the *"quality"* of the entire stroke phase. Within this example, the SMM represented a *"balanced"* representation of performance through a physiology and body position perspective. Coach 3 again described an observation process of "*refer back to their normal"* as a trick of the trade in relating on-water observation they were less familiar with to an off-water context they were more familiar with (i.e., gym), to spot any anomalies. The fourth element Coach 3 described as a more holistic process within their observation process. Within this example, Coach 3 described being cognitively challenged to effectively observe against an SMM as the athlete approached maximal stroke rates of up to 170 strokes per minute.

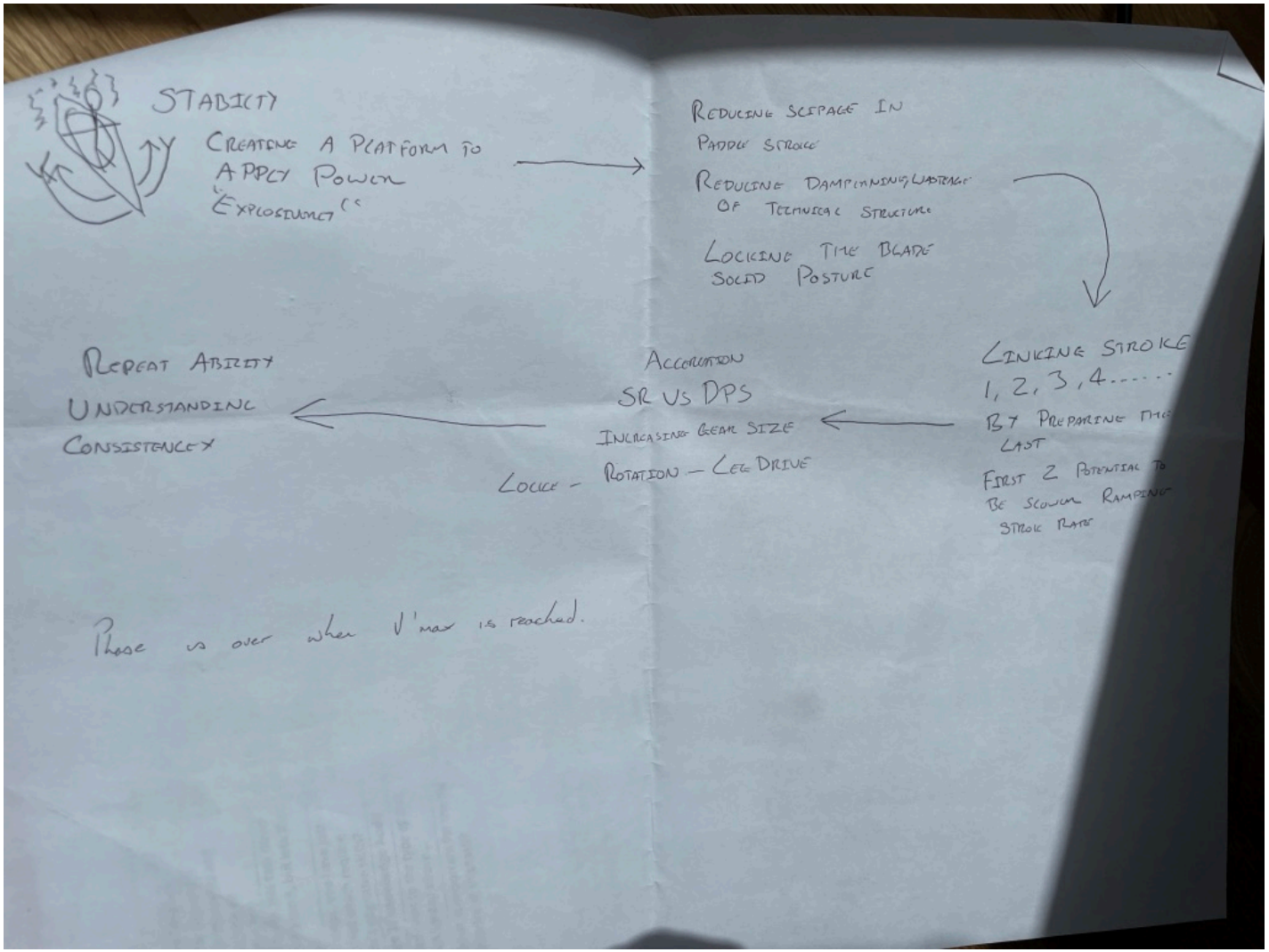

Figure 8.4 Task Diagram Example 2 (Paralympic Coach)

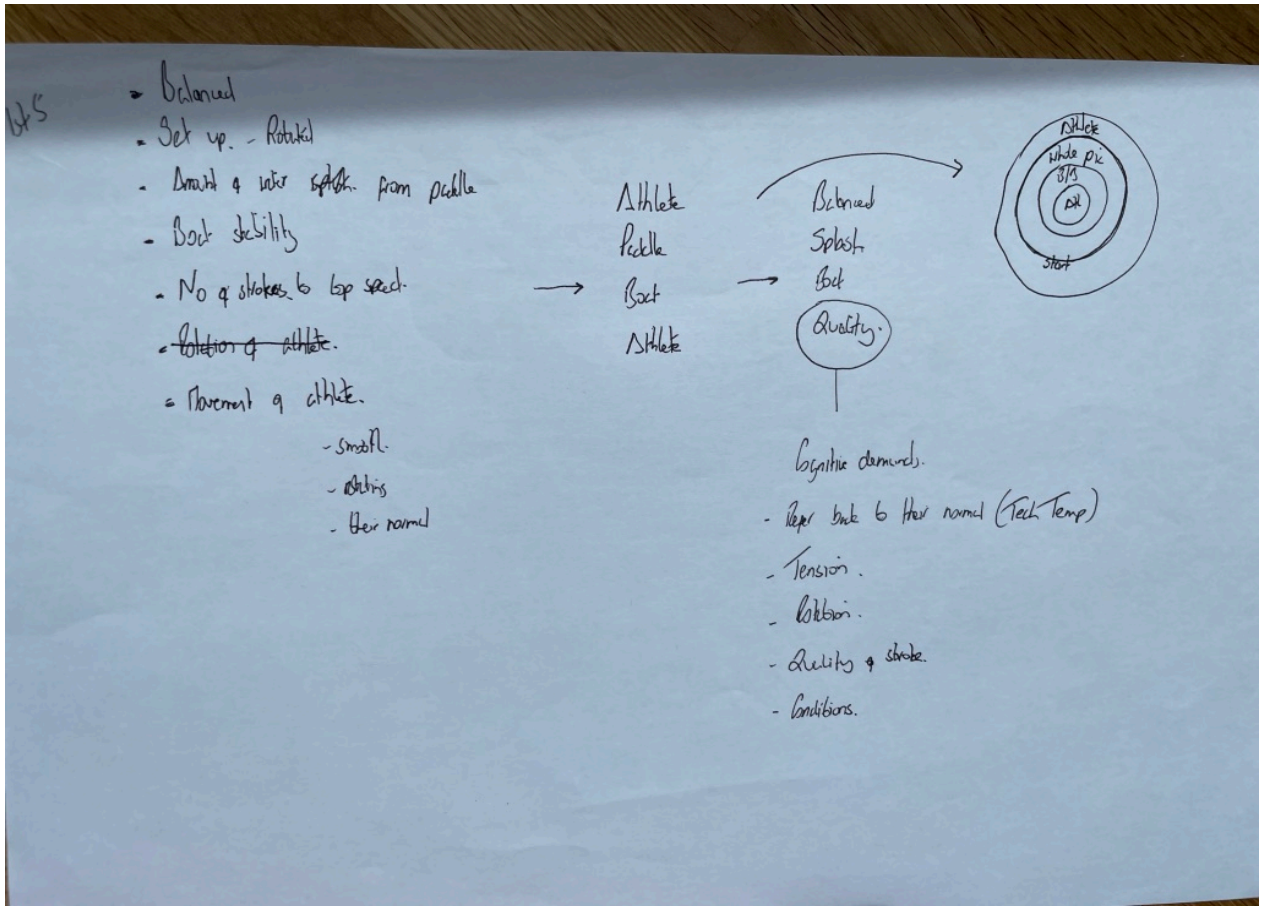

Figure 8.5 Task Diagram Example 3 (Inter-Disciplinary Coach)

Summary of Step 1. Each task diagram allowed comparison against the other coaches within the team. The individual task diagrams analysis identified commonalities within the SMM, such as the application of force by the athlete to accelerate the kayak. The comparison identified the common features the coaches valued. For example, the importance of the athlete to break inertia and 'propel' the boat to start the acceleration process, and common language such as 'distance per stroke' to apply force. However, while there was agreement on the principal components of the acceleration phase, the language used to describe the detail of these elements was often highly idiosyncratic. For example. in describing the key principle of the athlete breaking inertia the coaches described this as, "*coiled spring"* (Olympic Coach) "*tension"* (Inter-Disciplinary Specialist), or "*explosive"* (Paralympic Coach).

A domain-specific interpretation of the SMM by the coaches was evident. This is reflected in the statement by the Olympic coaches who sought to coach the athlete to an idealised technical model in the application of force application and consequently coached the athlete towards this model (move the athlete towards the model). This is illustrated in the more descriptive process outlined by the Olympic coach (i.e., do this) as opposed to the more principally driven Paralympic coach diagram (i.e., apply these principles).

Accordingly, Paralympic coaches sought to innovate a more bespoke athlete-specific model and coached the athlete to apply force in a way that was most effective for them (move the model towards the athlete). Inter-disciplinary specialists sought to develop specific biomechanical positions that allowed the athlete to express force. This could be owing to their knowledge of specialist sports science areas. Therefore, the athlete's ability to generate force was prioritised over the technical application (develop the component to be applied in a model).

At the end of step one, a unified task diagram was constructed to integrate all participants' SMM and is presented in Figure 8.6 (see Fig 8.6 below). The unified model consists of four episodes which are 'Propel/Project, Rhythm, Rate, Distance per Stroke'. Each episode is a prerequisite for the next, and therefore outlines a progressive chain, laying the strategic heading for the next layer of detail relating to the content.

While the participants attempted to describe the difficult cognitive elements within the task diagram, they instead often described the process they went through. This may suggest that the process itself is utilised as a strategy that each coach employs to manage the difficult cognitive elements of observation. It also could be suggested that when the coach is managing complexity, they separate the challenge into 'chunks' as outlined by Richards et al., (2012). In doing so the complexity can be rebuilt, utilising a 'top-down' and 'bottom-up' cognitive process to produce the desired outcome (Richards et al., 2016). It is also possible that the episodes of the task diagram for step one are related metacognitive process which the coach did not articulate but would be explored in step two. Once the unified task diagram was complete (Figure 8.6), it was presented to the participants for agreement as a form of member check and to ensure it represented their individual task diagrams.

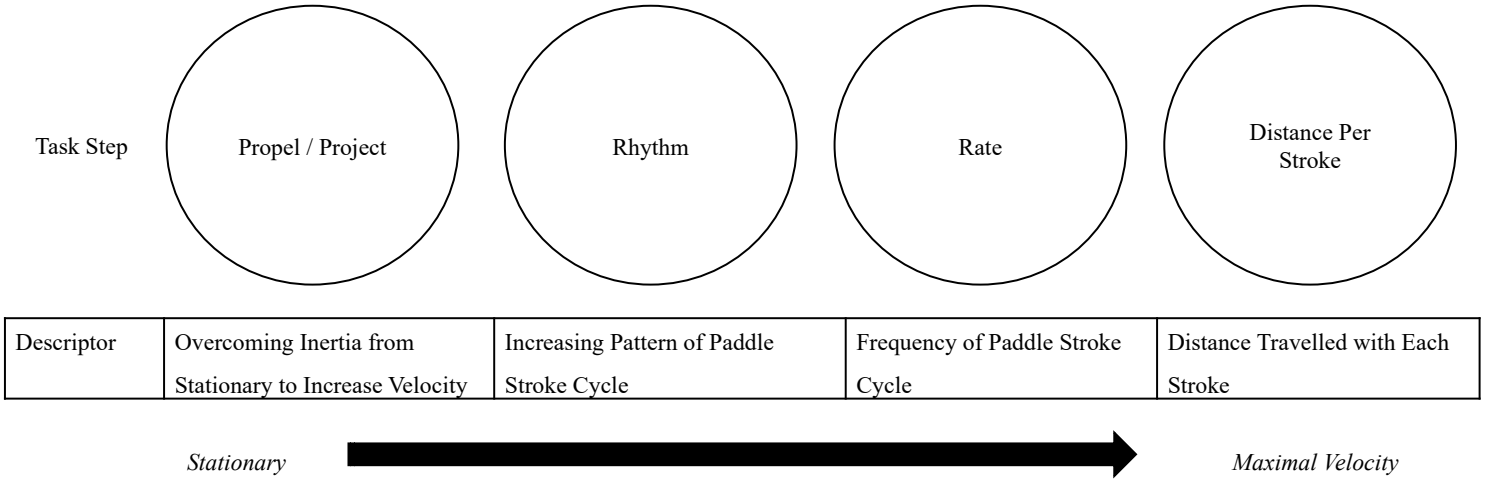

Figure 8.6 ACTA Task Diagram – Four-Phase Acceleration Process

8.3.2 Step 2 Knowledge Audit Results. While the unified task diagram (see Figure 8.6) was broad, all of the coaches were in agreement with each element of the diagram and that it represented a general and broad overview of the SMM of performance across Olympic, Paralympic and inter-disciplinary support teams, (Physiotherapists, Strength & Conditioning etc.,) that they worked from. The coaches verbally articulated the sub-division of the acceleration phase into the sections as represented within the unified task diagram (Figure 8.6). These sections represented the initial set-up of the athlete at the start of the race, the overcoming of inertia, the increase in force application, the development of stroke rate and the connection and transfer of force to the water of each stroke. As outlined in the methodology, this was captured through field notes (Appendix 8.3) and team PowerPoints (naturalist focus group; Appendix 8.1) which integrated the ACTA process into the natural structure of performance sport (see Richards et al., 2012). These mechanisms recorded the discussion for later development by the group (Appendix 8.1). Utilising the emergent themes which identified the sub-phases within the task diagrams (Propel, Rhythm, Rate and Distance Per Stroke in stage 1), a detailed account of each phase was captured to construct a knowledge audit of the race start. The following paragraphs capture the detail of these sub-phases in relation to cognitive demands and decision-making processes. The following section, therefore, captures the reflections of all three participants using these headings for clarity to the reader. The headings outline the detail of each phase (identified in stage one) and how the coaches and inter-disciplinary specialist engaged with the process to create knowledge audit (Step 2; ACTA). The section explores this in the context of research to provide a detailed evidence-based and informed account of each phase of the race start.

8.3.3. Propel. The coaches all reported looking for patterns of body, boat and blade supporting the work by Ferrero (2006). This was reflected in the task diagrams and in comments from Coach 1 who stated, "*power is transferred through the whole body"* and was

further supported by Coach 2 and the inter-disciplinary specialist with their comments of *"explosive"* and building the rate of force development, (Appendix 8.3 field note; Appendix 8.1, PowerPoint). Such quotes indicated that these factors were built into the coach's own MM of the stroke cycle, in effect allowing the coach to self-select the area of performance to attend to, based upon the coach's perception of importance (Rabb & Johnson 2007). This selected attention bore relation to the bounded rationality described by Simon (1955), built upon the coach's experiences and view of the world. Before the 'start' or beginning of the acceleration phase, the coaches reported confidence in having a thorough knowledge of the initial set-up (or ready position) of the athlete. This confidence was derived through an in-depth understanding of the athlete they were working with, and the technical element and SMM they were trying to achieve. For example, the inter-disciplinary specialist's description of the athletes as "*normal".* However, as soon as the athlete moved from "*set up"* to initiating the acceleration and started to propel themselves forward to overcome inertia, the accelerating stroke rate increased the complexity of the observation. Coach 1 and Coach 2 reported considerable challenges in visually attending to all aspects of the stroke cycle beyond the first few strokes as the rate increased. This was evidenced in Coach 1 stating "*it's guesswork"* and Coach 2 supporting this with "*you need to review the data to understand what happened*". In addition, the coaches were also challenged to identify just how the athlete produced force, or indeed where torque was lost. It appears from the findings that the coaches used a strategy to overcome this. The coaches employed a strategy that tactically observed for a smooth application of force, which they associated with the effective delivery of technique. For example, Coach 1 described the smooth application of force as the athlete *"clawing the water."* As a further trick of the trade strategy to reduce the cognitive load, the coaches described attending to just one aspect of the performance in action (i.e., hand position). The inter-disciplinary specialist referred to this in their observation of body

position. When needed, reduction in observational difficulty was supplemented through having to utilise technology to provide additional data and expert sources, to contrast and compare observations. For example, all of the participants used GPS and video to support the observations on the water post-effort and post-session. In addition, coaches were reliant on athlete priming and feedback strategies to help them better perceive the athlete's intention and action (Chow et al., 2016; Davids, Button & Bennett, 2008).

8.3.4. Rhythm. As the athlete moved through the propel phase identified in the unified task diagram (Figure 8.6), and the stroke rate increased, the coaches studied utilised a gradual increase in rhythm and associated patterns to observe the performance. The observation of patterns in turn appeared to affect the bounded rationality of the coach (Kahneman & Klein 2009), which diminished as the speed of the stroke cycle increased. Consequently, the small world environment (c.f. Kahneman & Klein 2009) and coach's confidence in their observation decreased. For example, Coach 1 description of "*guesswork*" as stroke rates approached 170spm (stroke per minute). Observation at a high stroke rate presented a cognitive difficulty and challenge to the coaches and in particular, the inter-disciplinary expert. This may explain why the coaches studied in Chapter five defaulted to a heuristic decision-making strategy.

To mitigate the observational challenge, Coach 2 reported spending many hours in informal learning to reinforce their SMM. Coach 1 commented on the value of other Olympic coaches' "*opinions and expert models"* for non-disabled disciplines. In contrast Coach 2 commented on how they *"valued and searched wider for expert knowledge from out of the sport" (*physiology, biomechanics etc), to construct and refine stable templates of performance. However, the reliance on experts in itself could lead to a pitfall of heuristics in that the coach may be observing performance based on what they or the expert value as

opposed to what they are observing. For example, the direct replication of expert practice overlaid on to an athlete as described in Chapter five.

The rhythm for the coaches represented an increase in the rate of force development via the smooth and effective transmission of force from the athlete to the water via the paddle blade as evidenced by the inter-disciplinary specialist. It was agreed by all coaches that a smooth rhythm was a key indicator of success and one that allowed them to reduce the observational complexity of analysing the plethora of parts contributing to performance in action. In short making an educated guess that the technique was either effective or ineffective, in a similar fashion to the adventure-sport coaches studied in Chapter two. In addition pattern recognition (Klein, 2015; Oliviera et al., 2014), appeared to play a part in the observation and was utilised by the coaches presumably as a way of again reducing the cognitive load (e.g., is this the picture and pattern that I'm expecting?). However, the use of technology and slow-motion video were habitually utilised often between efforts to help the coach slow down the performance and analyse (See ACTA stage 3). The use of technology was more apparent within the Paralympic coach cohort. It is suggested that this was owing to the need to help gather information due to the lack of formal education and the bespoke nature of technique within a Paralympic population (Simon & Richards, 2022).

These results are similar to the findings of Tweedy and colleagues (Connick, Beckman, & Tweedy 2017; Tweedy, Beckman, & Connick 2014; Tweedy & Vanlandewijck, 2011) within Paralympic sport and McDonnell, Hume & Volker (2012) and Wainright, Cooke & Low (2014), within sprint canoe. There was a lack of consensus and agreement of technical definitions, key phases or importance of elements of performance amongst the coaches. The lack of consensus supports recommendations from previous chapters on the alignment of language and performance determinants in developing an SMM. In addition, these findings show that a lack of agreement creates MMs unique to the coach, driven by the

lack of formal education highlighted by Taylor (2015) and warned against by Lees, (2010). Coach 2 described this lack of consensus on SMMs of performance in some instances creating issues when the coaches collaborated and made communication between them at times difficult. Often communication was built on an individual coach's implicit understanding of technique, which appeared to be superficially explored at best, and therefore created difficulty in making SMMs explicit between coaches. Crucially while Coaches 1 and 2 felt they *"knew"* what to observe, they struggled to verbalise their observational process within the ACTA interview stages. This cognitive challenge was especially noticeable among inter-disciplinary specialist who reflected on how they initially "*had little experience"* of or had recently transferred from Olympic to Paralympic sport, (c.f. Taylor 2015)".

Coach 2 and the inter-disciplinary specialist in developing knowledge, used similar terms for phases or components of performance. As such, they described "*seeking each other"* to compare observations. This may go some way to explaining why coaches view of 'expertise' is defined and held within the community, (Stoszkowski and Collins 2016). However, the value the coach places on the *expert* may be driven by familiarity or affect heuristics, as discussed in Chapter five and not by any accepted definition of expertise per se, although this requires further research.

8.3.5. Rate. As the velocity of the athlete within the acceleration phase increased, so did the rate of force development in line with Newtonian physics. Coach 2 described this, "*as the cyclical rate of the application of force that the athlete applied with each paddle stroke increases".* All of the participants described the cognitive challenge placed on them by the increase in stroke rate. Coach 1 described being challenged beyond 20 strokes, Coach 2 beyond 40 strokes and Coach 3 beyond four strokes. All coaches generally accepted that the stroke rate (SR) increased proportionally with velocity. However, there was disagreement as

to the optimal rate that athletes should achieve, or at what distance from the start the rates increased, reflecting the previously mentioned lack of consensus around technique.

However, it was generally accepted by the coaches that the rate at which force is applied in the first four strokes was slower, intended to break inertia and linked to the propel phase of acceleration and as the velocity increased the athlete needed to *"go through the gears"* as described by Coach 1 (Figure 8.3). This rate increased up to the point at which maximum velocity was reached. However, there was disagreement as to when the athlete reached maximum velocity. For example, Coach 2 stated the distance as "*around 40 meters",* and Coach 1 up to "*75 meters".* The SR, which for the fastest athletes may reach 170 strokes per minute, offered a significant challenge for all of the coaches to observe in action and presented a high cognitive load. Coach 1 and 2 resorted to offering the athlete non-specific and general holistic feedback within the coaching interaction. The inter-disciplinary specialist at this point reported they were unable to offer more detailed specific technical input until after consulting video or GPS and discussing with the technical coach or athlete to understand intent and make sense of the performance (Weick, 1988).

The stable generic SMMs based upon the coach's own experiences and WITTW acted as an anchor to guide observation and as a return point if the cognitive load became too much. The use of individualised SMMs became more apparent as the coach sought to challenge their observation and understanding of how individual athletes delivered optimal performance SMMs for individual athletes were developed and refined with the use of technology, (video, GPs etc,) to help the coaches slow down and repeat, compare and contrast observations as an individual and as part of a Community of Practice. Thus, individual SMMs could then be derived and applied. Collaboration also had the effect of developing trust and enhancing the coach-athlete relationship in line with the findings of Alexander and colleagues (Alexander, Bloom & Taylor, 2020).

8.3.6 Distance Per Stroke. The coaches all reported that critical to the delivery of performance within the acceleration phase was the efficient transmission of force to the water and the consequent distance per stroke (DPS) that could be travelled. For example, Coach 1 described this efficiency as the "*athlete settling into race pace"* (Figure 8.3). This performance component area allowed the coaches to critically appraise their observations with their stable SMMs. Coach 2 described this process as *"contrasting the athlete's performance supported by technology",* an example of metacognitive skills and auditing Carson & Collins, 2011; 2016). In addition, as identified in Chapters six and seven, all of the coaches utilised athlete questioning to aid their understanding of the athlete's performance. For example, Coach 3 reported needing to understand how the "*cognitive demands on the athlete affected their performance*" (Figure 8.5), to create meaning. Subsequently, they were able to experiment with and create the SMMs that then drove individualised coaching delivery, or as Coach 3 simply describes, "*finding the athletes normal"* (Figure 8.5).

The development of the coach-athlete relationship became key in the coach's ability to better understand the athlete and consequently their performance. Through this process, coaches were able to better understand how the athlete was creating a performance outcome when the observation process was difficult. As an example, when generic templates such as WITTW became limited, or in a Paralympic context of performance were absent. Through an experimentation process that involved and empowered the athlete to support sense-making (Weick, 1988), coach and athlete collaborated in interpreting the outcome. The ability to observe DPS was considered to be little more than "*guesswork"* (Coach 1), within the performance and had to be examined in retrospect with GPS to unpick the technique and create meaning. However, as a tactic to manage the guesswork, the coach identified looking for body, boat and blade patterns again reminiscent of recognition-primed decision-making (Kahneman & Klein, 2009; Klein, Calderwood & Clinton-Cirocco, 1986), that where were

indicative of a good DPS, such as a smooth-running boat, strong body positions and paddle blade angles.

To make the observation useable as discussed earlier, coaches highlighted that the performance was then compared and supplemented with athlete feedback, video and GPS information to identify where within the performance the target DPS was being achieved. In effect again auditing the generic template against the SMM was indicative of a refined metacognitive strategy within the coaches. The data derived from technology was also supplemented when needed with coaching team opinion, specialist advice and use of the community of practice the coach had developed as described by Coach 2 and the inter-disciplinary specialist. This collaboration allowed the coach to scaffold knowledge and construct meaning (Jones & Wallace, 2005) created a knowledge exchange mechanism that provided insight into the performance and crucially uwhat the performance depended upon to optimally effect that change.

Summary of Step 2: Step two presented the results of the individual participant's knowledge audit through the unified task diagram (Fig 8. 6). Specifically, a 'deep dive' was undertaken to explore each of the elements of the task diagram (Propel, Rhythm, Rate and Distance per Stroke), with each participant. The coaches described auditing SMMs against the individual athlete, the nature of disability and equipment limitations suggesting flexibility, adaptability and creativity to create an SMM of performance. Each individual experienced cognitive challenges in articulating an actual athlete's performance when responding to the questions in Table 8.4 as part of the knowledge audit. This would suggest the performance team experienced difficulties when verbally auditing in real-time at the start of the race, against their SMMs. The level of challenge varied based on their previous experiences, the depth of those experiences and the coaching repertoire.

8.3.7 Simulation Interviews. The simulation interview was based on the presentation of a challenging scenario as outlined in the methodology using video. The coaches were presented with a twelve-second video recording of a known paracanoe athlete completing twenty strokes of the acceleration phase to examine, compare and contrast the observational processes of the coaches (Militello & Hutton, 1998). As outlined in step two, field notes captured the coaches' comments (Appendix 8.2) and PowerPoints (Appendix 8.3), captured the discussions of the simulation interviews to synthesise knowledge collated from coaches. These methods matched the natural dynamics of high-performance environments. Work by Richards et al., (2012) highlights the importance of CTA as a robust and valid group of methods which can be used to capture the real-world decision-making of elite coaches during world cup preparation. The interview focused more specifically on the coach's cognitions within the coaching process.

The interviews revealed that all of the coaches reported challenges when observing the acceleration process in several areas. For example, Coach 3 describes their observation as the athlete moved from stationary and as the stroke rate increased, *"the key technical phases that the stroke was comprised of in effect blurred into one"* at 0:08 secs of the video or eight strokes (Appendix 8.3; Field notes). This blurring recognised that the coaches had cognitive difficulty in separating key 'data' or decision points that their MM was constructed upon as stroke rates increased past 120spm (0:12 secs of video), as reported by Coach 1 (Appendix 8.3: Field notes). In helping to manage this cognitive challenge Coach 2 described their "*obsessive use of technology*" that was often utilised in collaboration with the athlete or CoP if available to audit the performance post-event. This meta-reflection would appear to support the auditing element of PJDM (Martindale & Collins, 2012), as the preconception of the SMM held in memory against the actual performance observed. SMMs were constantly compared and contrasted against the video including still and slow-motion playback.

Auditing within and post-session presumably allowed in-action and on-action reflection (Schön, 1983), and metacognition, (Collins & Collins, 2013). This was reported by the coaches as a crucial strategy to overcome difficulties, allow them to gather more information, challenge their thinking and clarify their observations and perception.

However, an interesting observation would be that within the real-world coaching context the use of technology and video specifically may cause Parallax Error (Hirshfeld, 2001). Simply put, if you are trying to measure the same thing from different angles, there will be a different perspective for the observer. Parallax error is the difference in measurements that will be observed by the coaches videoing their athletes from differing distances and reference points or the athletes taking differing lines down the regatta course relative to the coach. The athlete within the picture may not change but the perspective and measurement will. Parallax error may additionally increase the susceptibility to heuristic bias, within the coach and team of coaches, especially if the coach intra-session utilises video playback for a simplistic and quick confirmation of feedback. Therefore, the coaches were cognitively challenged in their decision-making as to what technical element to prioritise and act upon within the coaching intervention and feedback to the athlete. Coach 2 and 3 also reported a challenge in making a direct left-right comparison of technique as the coaching environment forced them to observe side-on to the athlete, obscuring the view (0;00 -0:12 secs of video; Appendix 8.3; Field Notes).

The data gathered from the simulation interviews revealed ten difficult cognitive skills that the coaches reported when observing in practice. These were: 1) The challenge of separating stroke phase and cycle at an increasing stroke rate; 2) Deciding which interrelated element of performance to act upon; 3) Communicating feedback to/from athletes; 4) Comparison of the entire stroke cycle left to right; 5) The visual speed of the stroke; 6) Interpreting data in live sessions; 7) Quantifying distance travelled per stroke in real-time; 8)

Adapting individualised SMMs in real-time; 9) Adapting Stable Generic Templates; 10) Selecting a pedagogical approach to coach the SMM. A summary of the additional information provided through the simulation interview for each sub-phase is captured below which integrates these key factors under the categories as outlined in Stage 2.

Propel. The propel phase represented the athlete moving from stationary into the initial stage of acceleration (0:00- 0:04 secs within the video). The rate at which the stroke cycle increased presented a challenge to the coach's observation. The inter-disciplinary specialist reported this challenge beginning at the fourth stroke (0:04 sec on video; 60 spm), while Paralympic coaches reported challenges beyond 20 strokes (0:12 sec on video; 120+ spm) and Olympic coaches beyond 40 strokes (170spm) (Figures 8.3; 8.4; 8.5). The coaches reported the challenge was compounded by the distance of the observation to the athlete, the position of the observation relative to the athlete and what information was known about the athlete.

Rhythm. The rhythmical increase in stroke rate as the athlete accelerated was associated with a successful acceleration phase and was reported to occur from 0:04 secs in the video. The coaches' strategy in observing a rhythmical increase of rate, or "*going through the gears"* (Coach 1), particularly at higher velocities (i.e., beyond 120+ strokes per minute (spm)). appeared linked to the recognition of key patterns within the performance that the coach could recognise and pick out within the stroke cycle.

Rate. As the rate increased and the level of cognitive challenge experienced by the coach to decipher the 'blurring' of the stroke cycle was observed. For example, the blurring for the inter-disciplinary specialist occurred beyond 0:08 secs on the video. In managing the blurring all of the participants again defaulted to a pattern recognition strategy of picking out a key technical position within the stroke sequence. For example, key technical points included a 90-degree flexion of the elbow joint for Coach 1, or the recovery hand at a height

relative to the athlete's ear for Coach 2. For expert coaches, the cognitive ability to observe a key technical position at an SR, was limited to one position (0:08 sec; (120spm) on video) while master experts were able to pick out two or more key positions. The key technical positions that created a pattern were linked to the SMM the coach had previously constructed from experience and therefore had the risk of heuristic bias as described in Chapter five associated with such strategies. However, the coaches did acknowledge and recognise the risk of heuristic decision-making by acknowledging and referencing their own biases and utilised technology post-session along with peer review to help audit their observations.

Distance Per Stroke. As the athlete neared their maximal SR of up to 170 spm and settled into their mean velocity through the acceleration phase, the coaches reported that distance per stroke (DPS) was a primary performance factor they observed (Coach 1; Coach 2). However, it was impossible for them to accurately gauge the exact distance travelled through their observations (Appendix 8.3; Field Notes). A further challenge was placed on the coaches through wind direction, (head, cross tails winds) and the temperature of the water that directly affected the DPS and the coaches' ability to effectively observe for this component (Appendix 8.3; Field Notes). As a strategy, the coaches had developed various tactics within the session that gave clues to the DPS such as the angle of the paddle shaft (Coach 2) relative to the water at the *"lock" (*Coach one) phase that signalled an effective transfer of force to the water. Additionally, the pattern of the athlete's body within the stroke sequence (Coach 3) helped identify the effective transfer of force to the paddle (0:04 sec on video) with excessive movements indicate of an energy leak (0:10 sec on video; Coach 2). Further, the coaches observed a "*smooth run of the kayak"* in the water that identified to them the boat was not surging or pitching and therefore DPS was likely to be within a specified bandwidth (0:10 – 0:12 sec on video, Coach 1). However, true clarity on DPS was only

available to the coach and athlete post-session once GPS data had been downloaded and visualised to review against the planned session outcomes (Coach 2).

Step 3 has presented an overview of the simulation interview stage of the ACTA. The simulation interviews revealed the difficult cognitive demands of the Olympic, Paralympic and Inter-disciplinary specialist's observation of the acceleration phase. An important part of the video simulation resulted in the identification of decision points for the identification of each Project, Rhythm, Rate and DPS sub-phases of the acceleration phase. The cognitive challenges were presented using the Project, Rhythm, Rate, and DPS headings with examples of ten difficult cognitive skills within the acceleration phase. The difficult cognitive elements will be presented in the next section.

8.3.8 Cognitive Demands Table. The cognitive demands table presents (see Table 8.5,) the information from the difficult cognitive elements identified through the four ACTA techniques and has used 'Difficult Elements', 'Why Difficult', 'Common Errors', and 'Cues & Strategies' as headings. The table was constructed by integrating Stages 1, 2 and 3 outlined above. The data identified ten cognitively challenging elements when observing athletes in real time. These were; 1) Separating stroke phase and cycle at an increasing rate; 2) Deciding what to act upon; 3) Communicating feedback to/from athlete; 4) Comparing left / right elements of the stroke cycle; observing the entire stroke cycle; 5) Speed of stroke; 6) Interpreting data; 7) Quantifying distance travelled per stroke; 8) Adapting the individualised Mental Model; 9) Adapting Stable Generic Templates; 10) Pedagogical Components. Table 8.5 on presented the cognitive demands that represented the greatest challenge to the coaches when observing athletes in real time. The cognitive demands will be unpacked further in the discussion of findings section.

Table 8.5 Cognitive Demands Table

Step	**Decision Points**	**Assessment (Difficult Elements)**	**Assessment (Difficult Skills)**	**Action Step (Cues & Strategies)**	**Potential Errors**
Propel	Set-Up Breaking inertia First four Strokes	Interrelated performance factors,	Prioritising components for the greatest effect, Adapting Individualised SMMs	Trail & Error, CoP/Expert Opinion, Athlete involvement Measuring & monitoring Education around athlete disability/physiology, Coach – athlete relationship	Focus on the wrong area, Guesswork, Lack of knowledge, Failing to individualise, Lack of progression
	Breaking inertia to end of the fourth stroke	Deciding what to act upon	Multiple interrelated performance component elements	Metacognition, CoP support and comparison, Clarity on the area of focus, Check and challenge DM Experimentation	Incorrect feedback, Attention on lees relevant factor, Heuristic bias
Rhythm	Fourth to twentieth stroke	Comparing left / right elements of stroke cycle	Coach position, Distance to athlete, High stroke rate	Flags & Markers Multiple angle comparison	Phase or portion of stroke obscured
	Tenth to twentieth stroke	Observing entire stroke cycle	Left to right observation, Speed of observation,	Obscured view, Athlete tactical differences	Coach positioning relative to athlete, Understanding athlete intent
Rate	Tenth to twentieth stroke	Separating stroke phase and cycle at increasing rate	Distance to athlete Obscured body segments, Athlete moving relative to coach	Athlete intrinsic Feedback External Internal attentional focus Use of technology	Obscured view, Miss key information,
	Twentieth stroke onwards	Speed of stroke	Becomes too fast to observe, Athlete moving away from you Left/Right Comparison difficult	Technology Slow motion Athlete feedback Observe patterns Observe boat outcome	Can become guesswork Blurring of pattern

		Communicating feedback to/from athlete	Interpretation and misunderstanding	Common language and definitions Established SMM	Generic technical template or SMM error
DPS	Throughout the acceleration phase	Quantifying distance travelled per stroke	Technology needed, Differing environment, (i.e., wind, water)	Expert help, Standardised data collection Technology	Delayed interpretation, Miscalibration of GPS device
	Key transitions between acceleration phases (Propel, Rhythm, Rate, DPS)	Interpreting Data	Can tell you what happened but not why Fluctuating collection conditions	Expert help, Standardised collection, Comparison against multiple data points,	Miscalibration of interpretation, Not comparing like for like,
	Key transitions between acceleration phases (Propel, Rhythm, Rate, DPS)	Pedagogical Component	Developing skill at velocity, Technical refinements to engrained skills	Expert sources of knowledge Relevant coach education Athlete involvement within the coaching process	Overreliance on pedagogical approach, Failure to individualise coaching/SMM Ineffective athlete development
	Holistic within the acceleration phase (Propel, Rhythm, Rate, DPS)	Adapting Stable Generic Templates to bespoke SMMs	Able – Para comparison, Para – Able Comparison. Para – Para Comparison,	CoP Expert information, Education on disability Metacognition, Effective coach athlete relationship, Athlete leads process Common language and definitions	Incorrect feedback, Failing to individualise, Damage to coach athlete relationship, Failure to adapt MM

Table 8.5 presents the ten cognitively difficult skills identified within the first three stages of the ACTA about the sub-phases of the acceleration phase of sprint kayaking. The table highlights the decision points of the subphase and the difficult skill and elements the coaches reported facing within their observations. The propel phase represented the point at which the athlete became 'ready' to accelerate and lasted through the initial start process up to the fourth stroke. Within this phase, inter-related performance factors and consequently deciding and prioritising what to act upon cognitively challenged the coaches. The cues and strategies the coaches had developed to overcome the difficult skills and elements included collaboration and the involvement of the athlete within the decision-making process. Common errors within this phase included a failure to individualise with feedback based on generic SMMs.

The Rhythm phase started from the fourth stroke through to the twentieth and allowed the coach to observe the whole stroke cycle. The speed of the stroke cycle started to present a challenge to observation within this phase and as a coping tactic coaches observed for positional flags and markers, such as elbow position. Potential errors within this phase included the potential to miss key phases of the stroke cycle. The rate phase lasted from the tenth stroke and was open-ended throughout the performance. The visual blurring of the stroke within this phase presented an observational challenge with the coaches reporting difficulty in separating out key positions within the stroke cycle. As a tactic, coaches utilised video and slowed down video replays inter-session to allow them to observe the performance at a more manageable speed. The coaches reported potential SMM error within this phase. Finally, the DPS phase was present throughout the acceleration and represented the key transitions between phases and the rate of force development. Coaches reported cognitive challenges with the comparisons of athlete technique within this phase and relied on collaboration to help them make sense of and compare techniques. Consequently, a potential

error within the DPS phase related to the lack of individualisation or the development of a bespoke SMM. The difficult skills within the cognitive demands table provide the basis for the discussion of findings in the next section.

8.3.9 Summary of the results section. The results section presented individual participants' task diagrams at step one. These diagrams were then combined into a unified task diagram ACTA Unified Task Diagram that identified a Four Phase Acceleration Process. The Four Phase Acceleration Process was explored within the Knowledge Audit at step two, which provided a deep dive into the coach's understanding of Propel, Rhythm, Rate and Distance per Stroke phases. In step three a simulation interview provided a challenging scenario to the participants through the use of a video of an athlete performing an acceleration phase. Finally, within the results section steps one, two and three were analysed to compile a cognitive demands table that identified ten difficult cognitive elements of observation relating to the acceleration phase of sprint canoeing. The findings of the results, implications and impact on professional practice and coach education will be discussed within the next section.

8.4 Discussion of findings

The discussion of findings will be presented in three parts. 1) The interpretation of the results and findings; 2) The impact on professional practice and; 3) The implications for coach education.

8.4.1. Interpretation of the results and findings. Although several aspects of interest will be considered within this discussion, three key aspects emerged and stood out from the analysis of the results. These were; 1) Similarities in the SMM of the Participants; 2) The cognitive similarities and challenges among the participants; 3) How the participants solved the cognitive challenge.

Similarities in the SMM of the Participants. The ACTA process identified similarities within the participant's SMM within the task diagram and knowledge audit steps. The similarities were further probed within the simulation interviews and a similar cluster of cognitive skills was identified. For example, within the knowledge audit the participants within the propel phase all identified that the breaking of inertia was the key element of the phase. There was also a similarity in that the coaches defined this phase as lasting from the 'ready position, through the first movement of the athlete until the fourth stroke. However, the simulation interviews revealed that in observing within this phase, the Olympic coaches valued a 'textbook ideal' while in contrast the Paralympic Coach was less focussed on a textbook ideal and instead valued a more unique but effective solution. The interdisciplinary coach observed for key positions they recognised from gym exercises that indicated the athlete was effectively expressing force to the water. Again, within the propel phase, the participants all reported difficulty in prioritising which technical element of performance to focus upon. Tactics to overcome this challenge involved comparison of the observation within their CoP, measurement where possible and education to support the understanding of the athlete's SMM.

Within the rhythm phase within the knowledge audit step, the participants reported similarities in their use of a rhythmical increase in SR to indicate effective power transfer and an increase in boat velocity. There was again similarity in where this phase started at four strokes. However, in probing further within the simulation interviews there was some disagreement in where the phase finished with Olympic and Paralympic coaches observing this element at up to 20 strokes, while the Inter-disciplinary coach reported this phase ended at ten strokes. Another similarity within the Rhythm phase explored within the simulation interview was the difficulty in comparing left to right strokes. The coaches had developed

similar tactics in inferring a left/right judgement of an effective stroke by observing for key joint positions (elbow, wrist etc).

Within the rate phase, the participants within the knowledge audit step reported a similar challenge to their observation in that as the SR increased, their ability to critically observe lessened. However, the speed at which this challenge affected the coach's observation differed with the inter-disciplinary coach reporting "*guesswork"* from beyond 10 strokes and an SR of 120spm +, while the Olympic and Paralympic perhaps linked to their more comprehensive technical experience were challenged beyond 20 strokes or 170spm. Within the simulation interviews the coaches described that at these rates, they reported challenges in effectively separating key elements of the stroke cycle. As a tactic to help manage this cognitive load the coaches all resorted to technology to help them review and slow the performance within the session.

Within the DPS phase, within the knowledge audit step, the coaches all reported challenges in effectively observing and auditing the distance travelled with each paddle stroke, and consequently just how effective the athlete was in moving the boat. The participants all described looking for a smooth 'run' of the boat across the water within this phase, with surging or bobbing indicating to them an ineffective transfer of force. However, through the simulation interviews, there was a difference in how the coaches conceptualised an effective force transfer. The Olympic coaches again described technique against an ideal, while the Paralympic and Inter-disciplinary coaches observed for a more holistic connection of athletes to their boat.

In discussing the findings, the original nature of this research should be noted. The SMM has not been explored in sprint-canoe, or in a comparison of Olympic, Paralympic and inter-disciplinary coaches, all working within a high-performance setting to develop the technical skills of athletes. In addition, this is the first time ACTA has been used as a

methodology to explore the above. Therefore, limited research can be called upon for comparison. The following section will discuss the informing on professional practice and the applied impact of the research.

8.4.2. Informing professional practice and impact: The applied application of ACTA: evolution of the acceleration phase. The evidence and applied learning that was derived from the ACTA research were profound and supported the British Canoeing Paralympic Team to readdress their WITTW and understanding of the acceleration phase. While not the only factor the applied impact of this research directly contributed to Paralympic Medals at Tokyo 2020. As examples within the Women's KL3 classification within the life of this research the GBR team took the World record of 51.02 secs, held by Sweden in 2018 to 49.58 in 2021. Further. in KL2, GBR reduced the World record from 48.56 to 47.47 in 2020. Both of these margins are attributable to an improved acceleration phase. This knowledge innovation and transfer were, innovated, experimented with, refined and deployed over the Paralympic cycle following the timeline below.

2018 Season. Paralympic coaches and multi-disciplinary staff are empowered to define and agree on key technical stroke phases within the acceleration phase (Gløersen, et al., 2018) and align and define the language used to describe these key phases. Subsequently, agreeing on what psycho-motor performance elements actually depend upon and how hierarchical levels of the WITTW deterministic model they used at that point could be better explained within a SMM (Appendix 8.1). Consequently, the WITTW went through a series of iterations with the goal of developing a beta SMM that better-explained performance phenomena and could be used by the coaches to individualise coaching to a Paralympic athlete (Appendix8.1; PowerPoint).

2019 Season. The evolved SMM developed through the 2018 season was developed of circa, 20 iterations (Appendix 8.1: PowerPoint) and subjected to international competition.

This process further evolved the beta SMM to include the psycho-social (Richards et al., 2016), components of the SMM. Consequently, individual athletes' preparation and race plan strategies could be devised to support the successful execution of individual athlete performance strategies within a race.

2020 Season. Although disrupted by the COVID-19 global pandemic, the team took the opportunity to continue the evolution of the SMM. The postponement of the Tokyo Games was re-purposed by the team and allowed the opportunity to develop each athlete against their individualised SMM and continue to work towards their agreed performance goals. Lockdown also allowed the staff team to develop specialist sub-groups based on their expertise that had the goal of innovating new intellectual knowledge within the acceleration phase. This knowledge was then reintegrated into the coaching team, exchanged and made useable to enhance the beta SMM and further improve the WITTW and individualised athlete performance. The final beta SMM developed within this process can be found at Appendix 8.1.

2021 Season. Coaches, support team and staff all had clarity of individualised SMMs, commonality of language and athlete goals. The GB Paracanoe team were the only nation to secure 100% of available Tokyo 2020 athlete qualification quota allocations. At Tokyo 2020 the team of eight athletes secured seven medals, (three gold, one silver and three bronze), set four World records and finished top of the Paralympic Medal Table (Appendix 8.5).
While Tokyo's success and medals were the ultimate objectives within the applied impact of this research there has also been a profound effect on coach learning education and practice associated with this research. The collaboration of the coaching team involved in the research and effective collaboration has greatly developed along with clarity of the SMM the team contribute to. While set in an elite environment there are implications for canoeing and wider sports coaching that will be discussed in the next section.

8.4.3 Implications for coach education. Through the insight gathered with this research, the cognitions within the observation for canoe coaching have been explored. The Cognitive Demands Table (Table 8.6), can help inform our understanding of coaching within this domain and offer suggestions for other sports in what skills coach education should develop within their coaching workforce. Specifically, within the research context presented the insights inform a pedagogical approach to coaching the acceleration phase of a canoe-sprint race start. The key facts are summarised from the Cognitive Demands Table (Table 8.6) and the difficult skills identified by the coaches in relation to their observation and analysis of sprint kayaking are now discussed as a narrative.

Speed of cycle. The simulation interview shows that the coaches find the physical act of observing the speed of the stroke cycle a challenge, although the level of challenge varied from coach to coach and was dependent on experience. The observation was often compounded by the coach's preference for position and distance relative to the athlete. This may further compromise the observation and individual coach's perception by obscuring a principal element of performance. For example, leg drive below an enclosed cockpit, or a direct left-to-right audit. This has the potential to lead to the coach missing key information as they are challenged at different stroke speeds and observing from differing positions, then logically their perception of performance will differ. As a strategy to overcome this issue, the coaches utilised technology such as video or GPS that could be reviewed post-trial. They also valued the use of pre-set intrinsic athlete feedback loops to provide situational awareness of the athlete's perception of performance and the intended and actual outcome of the phase. The ability of the coaches to effectively communicate, collaborate and develop a SMM of performance may be adversely affected by the level of challenge and effective observation.

***Deciding what to act upon*.** The coaches identified that the decision upon which performance component to act upon within both the observation, their extrinsic athlete

feedback and their choice of pedagogical approach to be a challenge. Although this varied in nature from coach to coach. They highlighted that identifying the key performance component from the multiple interrelated options and the ability to prioritise is particularly difficult. This highlights the limitations of generic MMs perhaps derived from deterministic models and the need for flexibility and adaptability in constructing athlete specific SMMs. The need to develop meaning through an expert CoP was a resource all the coaches valued. However, the coaches were sceptical and sought out and compared multiple opinions. The ability of the coach to utilise reflection and compare multiple trials through video etc, to provide clarity of the performance area they had prioritised was key within their decision-making process. It was also accepted that the initial decision or course of action may not necessarily be correct and experimentation was also considered a vital strategic decision-making process. The ability to then revisit the decision and subsequent course of action was a key factor in developing individualised SMMs.

***Communication feedback*.** The challenge of giving accurate feedback that was understood and acknowledged from coach to athlete and athlete to coach was also considered at times difficult. This often led to miscommunication and errors in interpretation. To overcome this challenge the coaches accepted that clarity of language was required. While coaches strategically sought clarity of language within the staff team, they often defaulted to a bespoke language while individualising to athletes. Paradoxically, however, this often led to confusion when athletes worked across groups or when communicating with other staff members as there were multiple definitions for the same thing. Interestingly it could also be inferred that the lack of terminology and definitions could limit the coaches' collaboration and understanding of the athlete and therefore the ability of the team to develop individualised SMMs. In overcoming the feedback challenge the development of the coach-athlete relationship became key in the coach's ability to better understand the athlete and

consequently their performance through an empowerment process and actively involving the athlete with the coaching interaction. Through this process, coaches were able to better understand how the athlete was creating a performance outcome and individualise the MM when the observation process was difficult.

Left / Right comparison. The coaches often reported difficulty in positioning themselves in an effective space relative to the athlete to observe both left and right sides and therefore the ability to observe all elements of the stroke cycle. This however may be more due to a physical constraint that challenges and creates cognitive load as the coach is effectively blind to one side of the athlete. Therefore, potential errors can occur as the coaches often reported filling in the blanks with assumptions. To aid this the coaches reported comparing what they could see, (i.e., paddle blade heights at most vertical points; wrist position at key points), that would suggest the stroke phase is equal/unequal. However, it was accepted that this was not without risk and was contrasted with athlete feedback and utilised as a guide only unless it could be quantified at a later point (i.e., GPS trace).

Speed of stroke. While the coaches opinion differed over exactly when the speed of the stroke cycle adversely affected their observation, (range 4-20 strokes), they all conceded the stroke rate became too fast to observe as the athlete approached maximal velocity. However, they all agreed that at a maximal rate of 170spm, the observation became little more than guesswork at that moment, and technology was vital in slowing the performance down to its principal parts. As a strategy to improve collaboration between the team of coach's agreement on when stroke rates within the different phases of acceleration become less reliable could be utilised by the coaches to align SMMs.

Interpreting data. Although the use of technology to provide quantifiable data sources was considered vital, it was often operationally difficult to interpret and analyse. This was reported to be due to educational, environmental and non-standardised collection or

recording issues that often led to the coaches not comparing like for like. In addition, coaches reported identifying a performance area (i.e., left/right imbalance), but not knowing the cause and therefore needing to contrast this with the CoP to reach a decision.

Quantifying distance per stroke. The amount of propulsive force that the athlete could transfer into the water was a key determinant of performance. However, it was considered to be impossible to measure visually, the distance travelled with each stroke and the coaches were reliant on GPS technology post-session to provide observational data. However, there were strategies that the coaches utilised to infer an effective transfer of force such as the shape or form of the athlete, the smooth run of the boat, (no excessive movement) and an effective lock of the paddle blade onto the water.

The generic SMM. The coaches reported working from and coming back to a stable generic MM as a reference point. Individual coach generic templates were constructed from previous experience as an athlete and/or as a coach across Olympic and Paralympic sports. The coaches were aware of applying these MMs out of context but needed them as a starting point to explore away from in developing an individualised solution The involvement of the athlete in the coaching process was considered key as a strategy to quantify the effective impact of the template that was applied. Therefore, providing the basis for feedback and development of the MM into an athlete-specific model.

***Adapting the SMM*.** The ability to individualise coaching delivery was highly valued by the coaches and considered a hallmark of an effective coach. The potential to prioritise a less important component area through a lack of knowledge was considered a key challenge the coaches needed to overcome. In adapting established SMMs to the individual athlete the coaches needed to experiment, innovate and supplement knowledge with expert opinion. The coach-athlete relationship and utilising the athlete's specific understanding of themselves and their assets were also important strategies in creating effective athlete models. In addition, the

CoP was again highly valued in supporting or providing an alternative perspective and helped to establish a SMM of performance when the coaches and support team discussed individual athletes.

Pedagogical component. The technical refinement of engrained skills, often at high velocity and stroke rate was a distinct cognitive challenge for the coaches. There appeared to be an overreliance by each coach on a favoured, tried and tested pedagogical approach when the coaching complexity became difficult to manage. Presumably, this may be a coping strategy as the coach's observation is challenged, they default to a tried and tested pedagogical method to reduce and manage cognitive load. The over-reliance on a pedagogical approach may lead to errors in the ability to effectively individualise coaching delivery. Consequently, failing to effectively develop the technique the coach is attempting to refine. In addition, this may lead to miscommunication or disagreement by the team of coaches in identifying the part of the performance to affect, and decision-making around how to go about developing the technical skills of the athlete.

8.5 Summary of chapter and conclusions

Within this chapter, the ACTA-informed research has identified a similarity in the SMM across multiple experts. However, how the SMM is interpreted and applied is dependent on the expertise of the coach. Logically, a greater diversity of expertise would therefore create a richer and more complete SMM to support individual athlete performance. As a result of understanding how the SMM is operationalised, this chapter has been able to provide a Cognitive Demands Table (Table 8.6), that shows how coaches and inter-disciplinary specialists overcome coaching challenges through the use of strategies and tactics.

Therefore, the chapter provides original guidance that is bespoke and unique to the high-performance coaching community. However, the insights can also be interpreted to

inform coach educators and developers. The chapter has also informed how learning captured within the high-performance community can be used to inform professional development within the education of pathway coaches and allied inter-disciplinary professionals as outlined in section 8.4.3. The Task Diagrams, Knowledge Audit, and Cognitive Demands Table can be used to inform coach education within canoeing. The key phases within the acceleration phase of propel, rhythm, rate and DPS, can also be used to structure the learning of developing coaches and inter-disciplinary specialities within sprint-canoeing.

8.5.1 Researcher perceptions of chapter. The insights gained through this study directly addressed real-world coaching and performance challenges by defining components of performance and allowing coaches, athletes and interdisciplinary teams to align against a unified SMM. The Unified Task Diagram and Cognitive Demands Table, at an applied level was adopted by the team and used as an organic basis for collaboration. Through this organic process, the beta SMM was further refined, knowledge exchanged, created and made useable through permeable boundaries of expertise, and utilised by the team as an applied tool in normal working practice through the Tokyo cycle (2018-2012).

In doing so, as highlighted earlier the applied impact of this research has contributed to eight Paralympic medals at the Tokyo Games and 52 Individual World Championship, European Championship and World Cup medals across the Tokyo cycle. These medal outcomes were derived through the coaches and inter-disciplinary specialists within this research and wider thesis. Their contribution to the SMM and their continued professional development was instrumental in the team's success as they continued to implement new ways of working that originated in this study. These practices continue to be implemented and refined today, as a way of working within the team and throughout the high-performance community as team members have moved into leadership positions. The final section Chapter nine will review the whole thesis in the context of the research questions.

CHAPTER NINE: FROM REASEARCH TO COALFACE (THEORY TO TOKYO)

9.1 Introduction

This thesis was constructed with the purpose of exploring the development of naturalistic observational strategies [of athlete performance] of the coach in real-time and how this process informs the development of a SMM. Additionally, through the dual lens of a researcher and Head Coach, answering the thesis aim helped support professional effectiveness, through the identification of original knowledge that contributed to Olympic and Paralympic medal success. Specifically, knowledge gained through this research journey supported the decision-making in the use of real-time feedback of high-level paddle-sport coaches in Olympic and Paralympic Sport. In addition, the insights provided through this research, made an original contribution to knowledge that supported management processes, that allowed the construction of SMMs within expert teams to be personalised to athletes. This chapter brings together the findings of the thesis in answering the RQs and discusses the contribution to knowledge.

In meeting the research aim, the thesis sequentially examined the observational process of a holistic group of adventure, performance, and Paralympic high-level coaches in Chapter five. Subsequently, in Chapter six, the focus of research narrowed to explore through a TA methodology, high-level coaches working in para-sport in both adventure & performance domains. Within Chapter seven, the focus again narrowed to examine via an IPA approach, World Class Paralympic coaches and explore the individualisation of the SMM. With the final research study, Chapter eight explored the cognitive process of Olympic and Paralympic coaches via ACTA. In meeting the research aim, this thesis makes a unique contribution to both professional practice and academic knowledge. In addition, the thesis extends the body of research, in the area of technical SMMs for individual sports, variance

within Olympic and Paralympic athlete individualisation and knowledge exchange in generating bespoke solutions. These contributions are explored fully in section 9.5.

In collating the findings within this thesis, the chapter will firstly explore the research question in relation to the findings, by presenting and summarising the main themes. From there, the chapter will explore the findings in relation to applied practice set within the Tokyo Olympic and Paralympic cycle. Subsequently, the contribution to knowledge and professional practice will be explored and the unique contribution outlined before the limitations of the research are acknowledged. The recommendations for future research are then presented. Finally, the chapter and thesis are summarised.

9.2 Collating and summarising the findings

Within previous chapters this thesis has presented multiple findings that are important for the sports coaching, canoeing and Paralympic domains. The findings firstly extend the work of Richards et al., (2009; 2012), who researched SMMs within team sports through a tactical or strategic lens. The findings of Chapters five, six, seven and eight illustrate how the SMM can be developed and utilised at an individual athlete level to identify technical (psycho-motor – psycho-social) needs within an individual sport. Secondly, the findings add to the paucity of research within Paralympic sport coaching and evidence that SMMs cannot be transferred from Olympic to Paralympic Sport, producing not only a contribution of knowledge to these environments, but potentially shaping coach education across the coaching pathway in Paralympic and Olympic sport. The thesis has demonstrated that the overlay of a generic template derived from coach education based on Olympic SMMs is ineffective due to variance of Paralympic athlete needs as discussed in Chapter two. A key focus which as not be highlighted in previous research and was highlighted in; *Individualising Coaching Within Olympic and Paralympic Worlds: An Applied Perspective.*

(Simon & Richards, 2022). Thirdly, this work is unique in that it is the first time that the researcher has held a dual lens of being a Head Coach within the same sport of both an Olympic and Paralympic team in considering the SMM and the technical models of observation they create. To summarise the findings throughout the evolution of the research journey, the following three main contributions to knowledge will be discussed. These are, firstly, observation within coaching is cognitively challenging. Secondly, the personalisation of the SMM and coaching. Thirdly, knowledge creation and exchange.

Observation within coaching is cognitively challenging. This thesis has demonstrated that individualising observation within the coaching process presents a cognitive challenge to coaches. The findings of this research add to the literature in understanding how the level of cognitive challenge is reduced. Understanding how to reduce this challenge extends work by Holder and Winter (2017), in how more effective decisions can be made by the coach, through an enhanced understanding of the SMM. Insights gained within this thesis help to understand observation within the sporting context by making SMMs explicit and understanding associated decision-making, for example, the Unified Task Diagram in Chapter eight. Accordingly, the thesis goes some way in addressing criticism of the observation process within sports-coaching (Lees, 2010), due to the inability of the observer to account for *invisible* factors such as cognition, intention, or perception of the athlete (Gillham, 2009; Holder & Winter, 2017; Martin, Winter & Holder, 2019).

In adding to the literature, the thesis showed that the coaches studied within this thesis manage observational complexity through experience and the support of experts to develop, augment and create knowledge. A knowledge exchange process between the coach, expert, and athlete, helps to inform a deep understanding of the athlete, which informs the SMM, beyond the technical expertise of the coach. When observing in real time, coaches exhibit naturalistic decision-making behaviours to help them navigate the complexity of coaching in the real

world. This is the first time within the NDM research that observation within sports coaching has been identified and makes an original contribution to the body of knowledge in this area. Additionally, while well researched from an athlete perspective this work adds to the existing literature that is dominated through an athlete lens, by considering NDM behaviours from an observation in coaching perspective. Chapter five has shown that lesser experienced coaches may default to heuristic decision-making to manage cognitive complexity which results in them overlaying generic templates upon the athlete. However, as the coach develops domain and context-specific experience, they are more able to recognise the boundaries of their expertise and utilise naturalistic decision-making behaviours. This work contributes to the body of knowledge within the NDM (Demir & McNeese 2015; Klein 2015), research in several important ways. It is the first time NDM has been studied in Canoeing, Olympic and Paralympic sport. It is also the first time NDM behaviours have been identified within the observation process of sport coaching. In addition, the findings support Kahneman and Klein (2009), in the utilisation of fractionated expertise as the coach moves form novice to expert in the management of the observation process within coaching.

The personalisation of the SMM and coaching. While the concept of individualisation is accepted within the sports coaching literature, this thesis has shown that Paralympic Sport requires a deeper application of individualisation to personalise the coaching intervention. The insights gained from within this research evidence that Paralympic Sport is elite, and as such it deserves its own SMM. The understanding of personalisation of the SMM to the Paralympic athlete, are at least initially nebulous and often modelled on Olympic education experiences. This research extends the work of Fairhurst, Bloom & Harvey (2017) and Wareham et al., (2017), in understanding the needs of coaches transferring into this world. More simply, while coach education and technical models derived in Olympic sport may have common principles, the variance of the Paralympic

athlete requires a bespoke SMM. In developing the bespoke SMM that coaches work from, expert knowledge is required to augment, supplement, and apply coaching knowledge. In personalising the athlete's SMM, coaches initially are guided by previously constructed generic SMMs of performance developed through experience such as the examples of the overlay of an Olympic SMM to a Paralympic athlete in Chapters six and seven. These generic SMMs are adapted and individualised to the athletes, through a process of experimentation and reflection and modified into an SMM. However, not all SMMs can be adapted owing to the greater variance of the individual athlete within the Paralympic setting. Indeed, some SMMs may need to be developed with no rule book due to this variance. For example, the unique impairment on the athlete of a spinal cord lesion. In meeting this bespoke variance need, individualisation of the SMM was further developed through supplementary expert knowledge into a personalisation of the SMM to the athlete.

Knowledge creation and exchange. The findings of this thesis contribute to the paucity of research within Paralympic sport in several distinct ways and extend the work of Purdue & Howe (2012) and Ritchey (2013), in better understanding Paralympic coaches' educational needs. In supporting the personalisation of coaching, a knowledge exchange process is needed to augment and supplement the depth of the SMM through expert sources of knowledge that should include the athlete voice. These insights are important and again extends the work of Fairhurst et al., (2017) and Wareham et al., (2017), in identifying challenges to a coach transferring into Paralympic sport. In doing so, this thesis offers an original contribution to the literature by identifying that knowledge exchange within para-sport is driven through informal learning such as experimentation. Knowledge is made useable via the two-way knowledge exchange identified in Chapters six and seven in context, through community of practice and experts. In generating new knowledge, experts provide

an explicit mentor function that helps construct meaning, make knowledge useable and consequently construct a more robust and individualised SMM.

The importance of informal learning within Paralympic sport evidenced a shortfall in formal learning that reflects and supports the findings of Wareham and colleagues. Accordingly, the thesis offers original insights to support formal para-sport coach education and mentoring regarding the SMM. Through this knowledge exchange process, coaches are able to modify existing SMMs to the needs of the athlete. If no established SMM exists or is not able to be adapted to the athlete coaches must create novel SMMs that satisfy the athlete's need. In understanding how this process is operationalised through the utilisation of a CoP and mentors, to augment knowledge and sense-make within context of this thesis again makes an original contribution to the SMM literature. Extending the work of Richards et al., (2009: 2012; 2016). Findings show how within an individual sport, the SMM is adapted and refined through a continuous reflective cycle, that updates and audits the SMM against athlete needs. Lastly, the thesis offers an extension of the SMM literature in how to operationalise the SMM. The findings of Chapters five, six, seven and eight show that in order to create the conditions that encourage the contribution of the wider athlete support team's expertise, the coaches must fulfil a distinct leadership function. Through this leadership, athlete needs and contributary performance components are able to be identified, defined and aligned, to coordinate the task of developing an individualised SMM.

9.3 Addressing the research objectives

In addressing the aim of this thesis, it is important to revisit the RQs outlined in Chapter one. Specific Chapters have outlined in detail the RQ findings, so only a brief overview is provided here. The following section will outline how the RQs have been answered within the context of this thesis.

9.3.1. Research Question 1. How do elite high-performance coaches working in paddle-sports observe and analyse the performance of their athletes in a naturalistic setting? The findings of Chapters five, six, seven and eight reveal that coaches utilise naturalistic decision-making processes to manage the complexity of coaching and that these processes are linked to experience. Less experienced coaches' default to heuristic decision-making to manage the complexity of observation. Heuristic decision-making was reflected in coaches observing for generic SMMs within the observation and then overlaying them against the athlete. In addition, heuristic decision-making is more prevalent in less experienced coaches. A more experienced coach can recognise the boundary of their expertise and utilise NDM. Domain experts appear to recognise the boundaries of their expertise and are less susceptible to heuristic decision-making supporting the fractionated expertise notion put forward by Klein (2015). As the coach becomes more experienced, they utilise pattern recognition and naturalistic process. For example, the descriptions within Chapters seven and eight of how the participants observed intuitively when facing a considerable cognitive challenge, when observing performance, such as high stroke rates. Consequently, the coaches often responded naturalistically to incomplete information driven by their perception of performance.

9.3.2. Research Question 2. How do elite high-performance coaches develop mental models of performance and integrate naturalistic in-action observations within their decision-making process? Chapters five, six, seven and eight showed that coaches worked from a generic SMM of performance, based on their experiences. Accordingly, the coaches observed for components of performance they valued, driven by their experiences. The complexity of real-world observation and associated cognitive challenges required coaches to utilise naturalistic decision-making behaviours to manage their observation process. Less experienced coaches defaulted to a heuristic decision-making approach. More experienced coaches utilised pattern recognition through recognition-primed decision-making to observe.

The naturalistic decision-making process within coaching observation is informed through reflection, meta-cognition and seeking out knowledge sources to support the creation of a bespoke SMM. The SMM is constantly adapted and updated through a greater understanding of the athlete, which in turn helped reduce the cognitive load on the coach and informed the observation process.

9.3.3. Research Question 3. When coaching in real time does a high-performance coach in paddle-sport utilise real-time observations to inform coaching feedback and individualise their practice, or is there an adaptation of predetermined established (Mental Model) models generated by experience? The results of this thesis evidence that coaches utilise a range of tactics to inform coaching feedback in real-time to individualise their practice. Less experienced coaches worked from generic SMMs of performance (at least initially) and fed back to the athlete against these SMMs. However, as the coach developed domain, athlete, and contextual experience, they were more able to navigate and explore away from generic templates to personalise their SMMs individualise their coaching feedback.

9.3.4. Research Question 4. Can the integration of a coach's technical observation and knowledge of performance determinants (e.g., athlete, environment) be unified into a sports-specific shared mental model which can be understood as a Shared Mental Model and adapted by a team of coaches collaborating to improve individualised athlete performance in paddle-sport? The results of this thesis at both a theoretical and applied level demonstrate that a coach's technical observation beliefs, can be shared, understood and made usable by a team to collaborate through an SMM. The SMM allows the team of coaches to define, align and coordinate around individual athlete performance needs. Knowledge exchange within the team allows a deeper, richer, and more informed SMM to be created for the bespoke needs of the athlete. The continuous knowledge exchange allows the adaption of the SMM to occur and beta SMMs (Richards et al., 2016), to be developed. Leadership and

cultural development skills are required to maximise the beta SMM process. In addressing the RQ's above the following section will discuss how the findings have contributed to knowledge and critically for the author, applied to professional practice.

9.4 Contribution to knowledge and professional practice

This thesis makes five contributions to the development of academic knowledge. In addition, owing to the applied nature of the thesis, the thesis also contributes to the development of new professional knowledge and practice. These findings have been consolidated into five themes and are presented below, before the thesis contribution to professional practice is discussed.

Individualisation and personalisation of the SMM. Firstly, the finding of chapters five, six, seven and eight have added to the research on the use of and individualisation of the SMMs in Paralympic and Olympic sport (RQ 2, 3 & 4). The results revealed that the coaches worked from a set of fundamental principles they could explore from and return to, in developing a bespoke SMM for the athlete. The coaches valued experimentation and experience to guide the development of the SMM, perhaps relating to the lack of formal knowledge. As a solution to overcome the limitation of formal knowledge and coach education, informal knowledge exchange and creation were highly valued and helped overcome the problem of having no athlete-specific 'rule-book'. Therefore, expert sources were utilised to augment and contextualise the coach's knowledge and, in the process develop a richer SMM (RQ 2). Chapter seven has made several new contributions to knowledge in understanding how coaches working within paracanoe over time and with experience, adapt generic templates to individualised SMMs (RQ 2, 3 & 4). They do this through an interplay of sources of knowledge, individualising their SMM, observing the SMM and leadership of the SMM process.

Observation within coaching. Secondly, the insights provided within this process have added to the observational research within canoeing, Paralympic and Olympic coaching (RQs 1, 2 & 4). Through the knowledge audit and task diagram stages of the ACTA it was shown that coaches faced a considerable cognitive challenge when observing performance and that the coaches often respond to incomplete information driven by their perception of performance. The more experienced coaches recognised this observational shortfall (c.f. Fractionated Expertise; Klein, 2015) and utilised support networks and technology to aid the post hoc rationalistic decision-making process to check and challenge their initial observations.

ACTA within sport. Thirdly, to the best of the author's knowledge, this is the first time an ACTA has been utilised to research canoeing and Paralympic sport. Chapter eight presents original research within Paralympic sport and the application of an ACTA process to explore observational processes within sports coaching (RQ1). Demonstrating the applied nature of the doctorate and exploring common elements of performance and cognitive difficulties within the ACTA, the generic MM was reconsidered into a shared version that supported Olympic and Paralympic success (RQ 2, 3 &4). In effect, the learning from all studies was applied to create a unified SMM. In doing so, an effective CoP aligned around the SMM, that removed individual coach idiosyncrasies, improved communication through common definitions and terminology. This process facilitated the social construction of a fit-for-purpose SMM within the whole coaching team (RQ 4). The key phases identified through the Task Diagram within the acceleration phase of propel, rhythm, rate and DPS, can be used to structure the learning of developing coaches and inter-disciplinary specialities within sprint-canoeing (RQ 2 &3).

Coach education. Fourthly, there have been multiple findings within each study that will inform coach educators and designers of pedagogical content. These results have implications for coach educators and designers of pedagogues in that para-coach education

should be made domain specific. More simply education and **S**MMs cannot just be transferred from able-bodied resources (RQ 2, 3 & 4). Therefore, the chapter provides original guidance that is bespoke and unique to the high-performance coaching community. However, the insights can also be interpreted to inform coach educators and developers. The chapter has also informed how learning captured within the high-performance community can be used to inform professional development within the education of pathway coaches and allied inter-disciplinary professionals such as strength & conditioning, physiotherapists, psychologists etc, as outlined in section 8.4.3. (RQ 3 &4). The Task Diagrams, Knowledge Audit, and Cognitive Demands Table within Chapter eight can be used to inform coach education within sprint canoe.

Coach development and mentoring. Finally, the findings supporting informal learning, CoP's and mentors will help inform the effectiveness of coach development and mentoring. Further, the use of CoP's and mentors to assist para coaches should be considered to contextualise knowledge, adapt SMMs to the individual athlete and support isolated coaches (RQ 2, 3 &4). Within Paracanoe the research shows that a lack of formal education and knowledge sources generates the need for collaboration. This collaboration is a two-way knowledge-generation process within the team. Experts provide an explicit mentor function that helps construct meaning, make knowledge useable and consequently construct a more robust and individualised SMM. It does highlight the need for mentoring support to any coach transferring into parasport. Therefore, coaches require distinct support in contextualising and sensemaking of coach education content which has implications for coach development.

9.4.1 Contextualising the findings in relation to professional practice. The following sections will consider how the findings of this research have linked to the development of professional knowledge, professional practice and academic understanding. Through the

insights gained through the evidence of research studies within this thesis, the following real-world outcomes have been realised. A greater clarity and awareness of the cognitive demands of observation within the coaching process has informed SMM and observational strategies. This has been achieved through the participants enhanced understanding of the component parts of the SMM augmented by expert knowledge (RQ 1). When utilising an observational strategy, the potential for heuristic bias is understood. For example, overlaying Olympic MMs onto Paralympic athletes when cognitively challenged. The findings of the research identified that coaches in principle, use heuristic decision-making within their observation process to manage the complexity of observation within the coaching process (RQ 1 & 3). The data supports the wants versus needs paradox of Barnston (2014), with the data finding that less experienced coaches may bias their decisions around athlete 'wants' as opposed to needs. The wants versus needs paradox appeared to create a force-multiplier of overlapping heuristics such as miss-calibration and would illustrate a misunderstanding of individualised coaching. In addition, heuristic decision-making is more prevalent in less experienced coaches. Domain experts appear to recognise the boundaries of their expertise and are less susceptible to heuristic decision-making supporting the fractionated expertise notion put forward by Klein (2015). Consequently, technology, expert check and challenge and a richer understanding of the performance observed, (such as the acceleration phase in Chapter eight) have helped to mitigate the negative impact of heuristics on observation (RQ 1, 2 & 4). For example, the check and challenge of experts with the wider coaching team.

A deeper understanding of individualisation and the personalisation of coaching has allowed the development of more bespoke SMMs, as the athlete needs are identified and clarified through knowledge exchange with the coaching team (RQs 2, 3, & 4). The augmentation of knowledge that generates a richer understanding of the athlete, has also facilitated the development of asset-driven philosophies of what the athlete can do. The

impact of asset driven philosophies has contributed to the personalisation of the SMM in the development of bespoke SMMs that more accurately meet individual athlete needs. (RQ 3 & 4). The insight gained within the Paralympic domain has crossed back from Paralympic to Olympic sport. More simply, the enhanced understanding of the personalisation of the coaching process has allowed all athletes SMMs to be considered and adapted on an individual basis. In doing so, more effective coach-athlete and support team relationships have formed, that have had a cultural impact on performance that underpins the creation of beta SMMs (RQ 4). A key component of leadership, for example, is the removal of the interdisciplinarity team expert silos, that have contributed to the development of the SMM and allowed knowledge transfer within the team as detailed in Chapters six, seven and eight. Through this process the coaching and support team have aligned with clarity of role and responsibility around an SMM and its evolution (RQ 4). For example, the coaches within Chapter seven recognising the contribution of the expert knowledge of the physiotherapist and empowering them to lead the SMM adaption process. Consequently, through this collaboration, tailored performance plans have been created for each athlete to develop individualised performance processes.

The need for knowledge exchange through the contribution of experts and informal sources of learning, has developed leadership and management skills to empower others in transformational, autonomous, interconnected environments (RQ 2, 3 & 4). For Example, developing a shared understanding of SMMs and the need for the most appropriate expert within the team to lead and drive the experimentation and collaborative process. Further, the importance of a culture that allows transformational leadership has been understood from a much richer and more applied perspective. Through these processes, the performance outcome of the athlete and team have improved, culminating in success at the Tokyo

Olympic and Paralympic Games. The impact of performance will be discussed further within the professional contribution of the thesis, which is discussed next.

9.4.2 Personal development and professional contribution. There have been a number of key insights that have been created, that have provided Great Britain athletes a performance advantage. The applied impact of this research has contributed to one Olympic medal and Olympic Record, seven Paralympic medals and four World Records at the Tokyo Games. In addition, 57 Individual World Championship, European Championship and World Cup medals across the Tokyo cycle have been won. Supporting anecdotal evidence from the research, directly contributing to table-topping performance at Tokyo 2020 can be found at Appendix8.5. As examples within the Women's KL3 classification within the life of this research, the GBR team took the World record of 51.02 secs, held by Sweden in 2018, to 49.58 in 2021 (2.8%). Further, in KL2, GBR reduced the World record from 48.56 in 2018, to 47.47 in 2021 (2.3%).

In addition, the applied findings of this thesis have contributed to the development of working practice and processes in Canoe-Sprint, Paracanoe, the English Institute of Sport, UK Sport, the British Paralympic Association, and the British Olympic Association to name a few. Within Paracanoe specifically, the research findings directly contributed to the development and embedding of a performance culture and leadership philosophy. The concept of the SMM was understood and accepted at the coaching coalface, as were the working practices of identifying and aligning behind a performance vision. In addition, the exchange of knowledge that this research supported, allowed the participants to better understand and conceptualise their SMMs of performance. Consequentially, the observation process of the coach was enhanced, and cognitive complexity was reduced. Critically, from 2018-2021, the research contributed to 57 individual World Championship, European Championship and World Cup medals. In addition, one Olympic medal, Olympic Record and

seven Paralympic medals and four World records are attributed to the applied contribution of knowledge from this research. This applied knowledge has been adopted initially by the Paracanoe team and as success was recognised, the wider UK high-performance community.

9.5 Limitations of research

This section discusses the limitations of the research and reflective changes at the conclusion of this phase of the learning journey.

Paralympic and Olympic contexts. While there is an abundance or research within Olympic populations, the comparative paucity of research within Paralympic sport, has been a limitation. The challenge has therefore been examining through a dual-lens, differences in coaching within Olympic and Paralympic sprint canoeing and observation within coaching. Within much of the subject area the lack of research examining Olympic and Paralympic coaching and SMM differences within the same sport has limited the cross-discipline comparison and transfer of concepts to inform the scope and nature of the thesis. However, through the course of the research journey, the lack of comparable research allowed a deeper critical appraisal of RQ to emerge, with a more targeted real-world application of learning.

Complex individual environments. The complexity and of the research environment and the variance of the nature impairment of the Paralympic athlete has been a further limitation. The range and scope of athletes across and within sport classifications has an extremely limited theoretical research base upon which to call, with most literature being overlayed form Olympic sprint-canoe disciplines. The challenge is therefore dealing with a high volume of complex information which is continually changing, from multiple sources and is needing to be packaged to support the bespoke to the athlete.

Detangling Olympic and Paralympic generic MMs. There is a need to separate Olympic and Paralympic coaching observational and SMMs to inform distinct knowledge

and educational needs, whilst still learning from each other. The paucity of research within Paralympic sports and associated support team professions in relation to coaching observation and the individualisation of the SMM, is extremely limited.

SMMs within individual sport. The current SMM research within sport has been focussed on team sports and the application of strategy or tactics. Therefore, a limitation is that more research is needed to explore SMMs of individual athletes' technical needs, within Olympic and Paralympic disciplines which as identified in this thesis. Addressing both of these issues in one thesis is not possible. The focus of future research needs to drill down into how SMMs shapes personalised feedback in Olympic and Paralympic Sport. In addition, how SMMs can inform leadership to align inter-disciplinary team's expert feedback and provide a clear directional journey for the athlete. Further, within sprint-canoe, the SMM needs to be examined for all aspect of the race to support observation and consequently identify athlete performance requirements (e.g., all phases of the 200m race). Within this thesis it has not been possible to consider this full process for all race events and classifications, for both Olympic and Paralympic disciplines.

COVID and the Global Pandemic. The timeline of this course of research meant that it was set within the COVID-19 pandemic. This had both positive and negative implications, that limited the collaboration of the application of theoretical learning, in the development of the SMM in the run-up to the Tokyo Olympic and Paralympic Games. The development of the cognitive demands table phase of Chapter eight, ACTA methodology was set within lockdown which made collaboration and communication difficult. While now commonplace, coaches, support staff and athletes had to find new virtual ways of continuing to develop performance and associated better? SMMs.

In considering the theoretical, professional contribution and limitations of this thesis, a number of recommendations for future research emerge. These are now considered in the next section.

9.6 Recommendations for future research.

The following section presents recommendations for future research related to the research perspective and the scope of future direction. As discussed above and outlined within the course of this thesis, the research findings have many novel implications for observation, and coaching practice. These are outlined below.

Individualisation and personalisation of the SMM. At an individual athlete level there is considerable scope for future research in exploring psycho-motor and psycho-social elements (Richards et. al., 2016), to individualise and personalise the SMM around asset driven philosophies of what an athlete could do. Accordingly, the definition, nature and scope of individualisation and personalisation of the SMM to the athlete, requires further research. Paralympic sport is elite and therefore deserves its own dedicated coaching research. In addition, the individualisation of the SMM has a wide scope across team, individual Olympic, Paralympic and Professional sport for future research directions. Further, while this thesis has examined elite coaches, the examination of coaches along their development journey or working at alternative levels of the talent pathway is worthy of future consideration.

The Development of the SMM from a support team perspective. In further understanding how to coordinate and collaborate around an SMM, the support team's perspective should be explored. Through this view, the SMM's development and associated requirements from a non-technical coaching lens would help to further align coaching teams around performance visions, improve collaboration and generation of new knowledge. While

this thesis has explored knowledge exchange within Paracanoe, there is considerable scope to explore further within Olympic disciplines and across sport. Additionally, there is future scope to examine how, in the absence of an established SMM (for example in action sports) the support teams contribute to the innovation knowledge and how this is then made useable via the two-way knowledge exchange identified in Chapters six and seven. In generating new knowledge, experts provide an explicit mentor function that helps construct meaning, make knowledge useable and consequently is also worthy of future consideration.

The Athlete's contribution to the SMM. Closely related to the point above, the athlete's role and voice in the development of the SMM would be a worthy addition to the literature and application of knowledge. In support of the **S**MM personalisation process, the coaches utilised a CoP to augment and apply knowledge in creating bespoke **S**MMs, of which the athlete was a critical component. More simply, the athlete is an expert on themselves and therefore, understanding how the athlete could be more directly involved in the development of the SMM to form an explicit knowledge source would be merited. Through the utilisation of the athlete within the SMM, understanding the personalisation of their coach's observation and indeed all coaching process would be a rich source of future research.

Leadership within coaching. The research presented within this thesis has detailed how leading the team in defining and aligning around a clear performance vision (SMM) has enhanced coach-athlete and support team relationships and effectiveness. Accordingly, permeable boundaries have helped remove interdisciplinarity team expert silos and allowed knowledge transfer within the team. Through this process, the coaching and support team have aligned with clarity of role and responsibility around an SMM and its evolution. The need for knowledge exchange through the co-ordinated contribution of experts and informal sources of learning, has developed leadership and management skills to empower others in

transformational, autonomous, interconnected environments. Therefore, if leadership is accepted as a distinct function of coaching, it would be worthy of future research.

9.7 Summary of the Thesis

The insights gathered within the lifetime of this thesis has made a distinct contribution to knowledge in Olympic and Paralympic sprint-canoeing and is a unique piece of work. In extending knowledge, the thesis has addressed some of the limitations of research and challenges to extend academic knowledge. At an applied level the professional knowledge gained has helped deliver Team GB and Paralympics GB ambitions at the Tokyo Olympic and Paralympic Games and created a legacy within the sprint-canoe of co-ordinating and aligning the athlete coaching and support teams around personalised SMMs. In addition, the learning journey has stimulated personal post-doctorate research interests in further understanding the personalisation of the SMM, leadership and implications for coach education and mentoring.

In summary, this thesis has been constructed over nine chapters and has spanned eight years and two Olympic and Paralympic cycles. It has been a fascinating learning journey that has underpinned personal, Team GB and Paralympics GB success. It is understood that a significant amount of work is still required to further extend academic and research knowledge. However, the thesis has informed the coaching and observation process, developed our understanding of the SMM within individual sport and won medals at the Tokyo Olympic and Paralympic Games. To conclude, this thesis is the first step in examining how SMMs are used in an individual sport to enhance real-time observation and feedback. In so doing, coaching is personalised through the integration of multiple experts' knowledge, to co-create a rich learning environment for sprint-canoe (Olympic & Paralympic) where expert feedback is co-ordinated and personalised.

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