Developing decision making capability in adventure sport professionals: exploring epistemological foundations and implications for leader education in caving

by

Martin Barry

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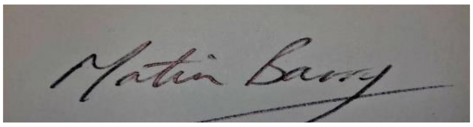
Signature of Candidate 

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Abstract

The overall aim of this thesis was to explore the subtle yet complex relationships between the values and beliefs of the adventure sports professional, and their judgment and decision making behaviours. It investigated how the training of decision making across a range of adventure sport domains may be developed. A series of studies (Chapters 3, 5 and 6) were undertaken to help identify and establish how the epistemological position of the adventure sport professional informs subsequent decision making chains which underpin their practice in-action. Chapter 3 centered on the activity domains of caving, multi-pitch rock climbing and winter mountaineering, but evolved in Chapters 4 and 5 towards a specific focus on vertical and extended horizontal caving. This evolution was in response to the absence of literature and research on the judgement and decision making requirements of the adventure sport professional in this accentuated underground environment. A pragmatic research philosophy led to a multi-method approach utilising a series of interviews and observations, and a variety of analysis techniques across the different studies. The key findings from Chapters 3, 4 and 5 revealed specific epistemological positions orientated to the development of client agency, independent performance, and positive adventure. These positions were seen to support a coherent leadership and learning framework on which to base shared decision making processes that were appropriate to the environments in which they were situated. Chapter 6 compared the PJDM processes of expert caving instructors to novice cave leaders in order to inform the development of improved practice and training resources. In Chapter 7, resources were created which were validated utilising an assembled panel of outdoor sector experts. Research throughout Chapters 3,4,5 and 6 identified that the technical and rational focus of training and assessment at National Governing Body level within the activity domains investigated was of a high standard. However, the support and development offered for progression in decision making was conspicuous by its absence, especially within caving training and leadership. A recommendation arising from the findings of the thesis was a rebalancing of the education of this group, with an increased focus and weighting on the training and assessment of decision making, rather than solely on technical competencies. Adopting this recommendation will support a graduated shift from proceduralised methods to one which focuses on blended expertise in-context, in consideration that sound judgment and decision making are at the crux of many professions, not least of all within adventure sport practice.

Although the findings correlate with aspects of research conducted within other adventure sports domains such as paddlesport, the investigations add significantly to the literature base of leadership and decision making within multi-pitch rock climbing and winter mountaineering, and uniquely, to the domain of vertical and extended horizontal caving. A bespoke epistemological chain for high level cavers was conceptualised, which when allied to a novel judgment and knowledge framework, informed the development of a training resource package designed to enhance decision making expertise. This work has impact, significance for practice and offers progression in the development of professional judgement and decision making capability. It is original, provides a contribution to knowledge and offers functional transfer across a range of activity domains.

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Barry, M, Collins, L, & Grecic, D. (2023). Differences in epistemological beliefs in a group of high level UK based Caving, Winter mountaineering and Rock climbing instructors. *Journal of Adventure Education and Outdoor Learning.*

Professional magazine articles

Barry, M & Ensoll, R. (2016). Searching for serendipity in outdoor education. *Horizon*s 75 (Autumn).

Barry, M. (2017). FACETS and the heuristic traps of the experienced outdoor professional undertaking a classic challenge. *Horizons,* 77 (Spring).

Barry, M. (2018). Thoughts on mastery, uncertainty, agency and authenticity within outdoor learning. *Horizons,* 81 (Spring).

Barry, M. (2022). The 4-3-2 of leadership and learning. *Horizons,* 97 (Spring|).

Barry, M. (2022). "The answer my friend, is dancing in the wind." *Horizons,* 99 (Autumn).

Conferences / knowledge exchange

January 2018 – Inaugural Adventure Sports Coaching Conference (ASSC). Presentation and discussion critically explaining the aims and objectives of the thesis and implications to practice. Play y Brenin, UK.

July 2019 – Presentation of epistemologically based research to peers on similar doctoral journeys - critical discussion on implications and limitations of the data collection occurring in authentic settings. University of Cumbria, UK.

January 2022 – *"PJDM and working for the Outward Bound Trust".* Full staff training event for 80+ delegates; presentation and workshops. Outward Bound, Penrith, UK.

List of abbreviations used within the thesis

AALA Adventure Activities Licensing Authority

ACTA Applied Cognitive Task Analysis

AS Adventure Sports

ASC Adventure Sports Coach

ASP Adventure Sports Professional

BASI British Association of Snowsports Instructors

BC British Canoeing

BCA British Caving Association

CA Cognitive Apprenticeship

CDM Classical Decision Making

CrDM Critical Decision Method (within the field of ACTA)

CIC Caving Instructor Certificate

CLAP Communication, Line of sight, Avoidance and Position of most use (acronym)

CPD Continuing Professional Development

CoP Community of Practice

EC Epistemological Chain

EP Epistemological Position

IOL Institute for Outdoor Learning

IPA Interpretative Phenomenological Analysis

MIA Mountain Instructor Award (replaced by MCI in April 2019)

MCI Mountaineering and Climbing Instructor (formerly MIA)

MIC Mountain Instructor Certificate (replaced by WMCI in April 2019)

MT Mountain Training

NDM Naturalistic Decision Making

NGB National Governing Body (e.g. Mountain Training)

PJDM Professional Judgement and Decision Making

PLOW Previous weather, Local knowledge, Observations, Weather forecasts (acronym)

SRT Single Rope Technique

WMCI Winter Mountaineering and Climbing Instructor (formerly MIC)

Glossary of Caving Terms

Duck - Refers to part of a cave passage which is largely filled with water with limited air space between the water and rock above. Often requires the caver to fully submerge themselves in the water to proceed.

Pull-through caving - Refers to the practice of descending vertical caves whilst retrieving the rope, adding significantly to the commitment factor given there is no means of upwards escape.

Rigging and derigging - Refers to the term of tying rope into anchors within the cave to facilitate progression. Some anchors may be natural (such as strong rock features), but the majority are 'artificial' pre-placed metal anchor bolts which have been drilled and glued into place and facilitate rapid rigging of rope for others to follow. Derigging is the reverse process but requires skill to maintain safety whilst undoing anchors and repacking rope back into bags for ease of transport.

SRT - Single Rope Technique refers to the practice of ascending and descending vertical pitches within caving systems. On SRT trips only one person can be on one rope at a time given that rope is fully loaded -presents difficulties in the safe supervision and coaching of clients.

Sump - A section of cave passage which is completely filled with water. Some sumps are free-divable by breath holding, others require diving equipment. 'Sumped off' refers to the situation when an air-filled passage becomes completely flooded.

Chapter 1 – Introduction

1.1 Preface

The primary aim of this thesis is to investigate the subtle yet complex relationships between the values and beliefs of the Adventure Sports Professional (ASP) and their subsequent judgment and decision making behaviours and actions. The principal aim of this chapter is to offer an overview of the thesis and a background to the work. It clarifies terms, sets the scene, and justifies the research direction.

1.2 Thesis Overview and Background to the Research

The links between an individual's beliefs and values, and how they relate to their coaching or leading behaviours is referred to as the epistemological chain (EC) (Grecic & Collins, 2013). The EC is conceptualised as connected and interacting decisions which are made based on deeply held personal beliefs about learning and the acquisition of knowledge. The decisions made will be evident in the planning stages, in how the learning environments are created and managed, and how the behaviours used in-action support learner pedagogy and welfare.

It is conceived that a professional's philosophical position derived from life experiences and views of knowledge, supports and scaffolds a complex and synergised decision making process which is referred to as Professional Judgement and Decision Making (PJDM) (Crowther, Collins & Holder, 2018, Martindale & Collins, 2012). PJDM is conceptualised as a dual decision making process in which classical decision making (CDM) and naturalistic decision making (NDM) work together (Shea et al., 2016). The proportion, weighting or extent to which each aspect is 'nested' depends on the context and situation of the decision. The CDM aspect of the process is deliberate and logical whereas the NDM approach enables decisions to be made in shorter timeframes with less, poorer quality or unverified information. Although some of the decisions made by successful and safe ASPs may be considered tacit or categorised as intuitive, their decisions must be based on some sort of personal philosophical principle or deeply held belief which may be termed an epistemological position (EP) or stance (Collins, Collins & Grecic, 2015). This personal epistemological position stems from the branch of philosophy which is concerned with the scope and nature of knowledge and how the individual values and perceives it. Consequently, the EP becomes a fundamental factor when interpreting and understanding how knowledge is acquired (or not), how it may be utilised and synthesised, and how it is likely to impact and shape coaching processes and leadership interactions. Accordingly, an understanding of epistemology is essential because it is fundamental to how we think and arrive at decisions. Without being able to understand how we acquire and develop knowledge it becomes difficult to maintain a coherent path on which to base thinking. Exploring epistemological positions and assumptions helps determine the issue of whether knowledge can be acquired, or if it is something that must be experienced and created (Cushion, 2010). Although ASPs may not necessarily articulate clear beliefs about epistemology, their practice is consistently supported by basic and unquestioned beliefs about learning which become evident within their leading and general session management philosophy (Light, 2008). To this end, Cushion (2010) proposed that "*all coaching is based upon some theory about how we learn*" (p.51).

There is a growing body of work which has investigated how the epistemological position underpins PJDM in-action (for example Christian, Berry & Kearney; 2017, Collins, Collins & Abraham, 2015). However, this presents as an under- researched area when compared to the quantity of PJDM studies across other fields. For example, in mainstream sport domains (Martindale & Collins, 2005; Smith, McEwan, Tod & Martindale, 2019). With specific reference to the field of sports psychology, Burton and Raedeke (2008) describe that a comprehension of the epistemological position supports coaches in remaining faithful to their ethics and values while processing the multiple choices and decisions that need to be made. More research is available across classroom-based teaching (Howard, McGee, Schwartz, & Purcell, 2000), business (Velu & Stiles, 2013), military operation (Gresser, 2014) and medical contexts (Li & Chapman, 2020), for example.

Further, most of the adventure participation-based investigations have been grounded in the paddlesport domain due to researcher access (for example, Collins & Collins, 2013) and therefore this thesis seeks to explore the epistemological stance and PJDM relationships across other AS domains which to this point have not been investigated in any depth. Within this thesis they are winter mountaineering, multi-pitch rock climbing and vertical and extended horizontal caving, which have been made possible by author access. Notably and similar to the paddlesport studies, the research investigates how EC – PJDM relationships are operationalised in environments which are typically consequential and therefore involve the components of both pedagogy and welfare needs. For clarity, the role and remit of the ASP is characterised by operation in natural settings that typically entail extended timeframes. The decision making requirement is exercised in environments which are consequential, namely that they clearly have the potential to cause physical and emotional harm (Brymer & Schweitzer, 2013).

Across the thesis, a methodology which draws from the field of phenomenology has been chosen as it recognises the personal and philosophical nature of the thesis context and is one which may help to make sense of the underlying structures and interpretations which support the decision making processes of the ASPs sampled. The very nature of PJDM in consequential, natural environments involves a range of social and technical factors, and therefore, to fully understand the practices of these professionals, field observations and in-situ conversations were employed in addition to more formal methods of data capture, yet an interpretive lens was maintained throughout. The research philosophy for the thesis was also driven by a sense of purpose and function, namely that a thesis such as this should offer practical, applied outcomes and beneficial applications for the consumers of such research.

Giacobbi, Poczwardowski and Hager (2005) recognise that a pragmatic approach to research identifies and promotes new practice knowledge, without which the separations between theory and practice in the minds of the ASP will continue to grow. Or, as Bryant (2009) considers succinctly, good (pragmatic) research is useful because it makes a difference, which is the intention here.

One main distinction in the research context of AS compared to investigations within mainstream sports (rugby, athletics, golf, for example) relates directly to the professional environment of operation of the ASP. In traditional sport, deficiencies in decision making may relate to rankings or the colour of medals awarded in competition, and within class-based teaching, such deficiencies may manifest themselves in the quality of taught provision, student achievement, or in group management issues. Without underplaying the importance of decision making in such domains, inadequacies in PJDM in adventurous settings are capable of generating serious physical harm and emotional trauma, where feedback on performance can be immediate and stark. In short, PJDM ‘looks different’ when applied to mainstream sports or to adventure based sports. In domains where decision making training is vital, for example in emergency services, surgery and aircraft flight training, significant time and resources are allocated to the development and improvement of PJDM skills in realistic contexts (Millitello & Klein, 2013). However, due to exigencies of time and course costs, rarely is the enhancement of PJDM included within training elements for the ASP, yet consistent to work within the emergency services and flight operation, engagement with adventure sports provide an opportunity for serious harm when decision making quality is inadequate.

The research objectives of the thesis are underscored by the comprehension that qualifications schemes operated by the National Governing Bodies (NGB) of outdoor activities (which the ASP must access for certification) is facilitated through the acquisition of procedural or 'how to' knowledge and increasing technical competencies (Collins & Collins, 2012). Consequently, high-level outdoor practice becomes established as the transmission of such procedural knowledge and enhanced technical skills, delivered through discrete training and assessment modules. Despite this process producing 'successful' candidates with what Schön (1983) would term technical-rational capability, there is scant training across the NGB schemes which specifically seeks to develop expertise in PJDM. Candidates are trained and assessed in the 'what and when?' aspects of their given role, but much less so in the 'why or how?' considerations. This is reflected in the statistics and reports which show that incidents concerning led groups that have involved near misses, injury or fatality have rarely been as a result of technical deficiency but more to poor judgment and decision making ability on the part of the ASP (Brookes, 2011; Allen, 2019).

Notably, background reading for the thesis revealed that there is no current caving research available in relation to leader behaviours and PJDM underground, and how it relates to decision making performance in the consequential working environment of the cave professional. It appears that knowledge transfer in this domain is based on exposure to limited training course delivery (typically two days), and an informalised process of accumulating a set amount of caving journeys where knowledge may (or may not) be transferred from experienced colleagues or through informal reflection on experience. There is a similar pattern of course delivery within the mountaineering and rock climbing certification schemes, but the inescapable nature of the terrain in which caving professionals operate and the tasks that must be managed in subterranean environments, warrants further and specific exploration of the EC – PJDM connections. Therefore, the initial research aims and objectives of the thesis were modified to accommodate the opportunity for research in this untapped domain.

Within the scope of the thesis, caving refers to professional leadership with small groups or individuals that involves vertical and horizontal progress in an environment where access to assistance or rescue may be extremely difficult should it be required. It is a setting where the 'weight' of decision making may be considered to be significantly high. Although a clearer understanding of how the epistemological position underpins and operationalises PJDM within a broader range of AS is required, the specific focal point of the thesis explores how such PJDM capability may be enhanced and developed within extended horizontal and vertical caving leadership.

1.2.1 Initial introduction of terms

In recent work (Collins & Collins, 2016; Christian, Berry & Kearney, 2017), the outdoor professional has been defined as the Adventure Sports Coach (ASC) which goes some way to clarifying the roles of instructor, coach, guide and tutor which appear to be casually and unhelpfully interchangeable. Within the scope of this thesis, the term utilised is Adventure Sports Professional (ASP). This is in order to avoid conflation of terms and because seldom did any of the participants involved in the research set out to specifically provide a service of coaching, enhancement of performance or of skill development. That said, coaching and skill development moments were observed within all mountaineering, rock climbing and caving episodes, but they were never planned nor stated as specific aims. Skill based coaching occurred when required to ensure caving and mountaineering journeys could continue, or to improve factors of safety and efficiency in rock climbing, but the coaching role was minimised in comparison to actions and decisions relevant to activity leadership or progression. Terminology within AS participation is routinely ambiguous and transposable, and therefore a thorough justification of terms is incorporated within Chapter 2.

The following section offers an overview of the structure of the thesis, followed by the research aims and objectives of the thesis. The final part is a short personal narrative to aid in situating the work and to offer an insight into the author's background.

1.3 Thesis Structure

Following this chapter's introduction, Chapter 2 serves as both literature review and discussion of the demands and requirements of an approach which advocates PJDM; one which supplements and subsumes elements of what may be termed proceduralised practice. The chapter clarifies terms and makes a case for the 'adventure sports professional.' It discusses the demands made on the aspiring ASP with reference to the interactions between decision making, risk management, skilful technical independence and pedagogic expertise. Chapter 3 explores the differences in epistemological beliefs across the domains of rock climbing, winter mountaineering and caving. Utilising the interviewing process of Interpretive Phenomenological Analysis (IPA), session observations, field notes and in-situ conversations, the chapter investigates the connections between cognition, experience and beliefs in the consequential working environments of the ASP. The primary focus of Chapter 4 is to further investigate the EC and PJDM processes in the specific area of vertical and extended cave systems, owing to the almost complete lack of literature in this under researched and accentuated AS domain. This is accomplished by further analysis of the data from the range of interviews and observations of authentic, full duration caving sessions completed in Chapter 3.

Chapter 5 digs deeper and continues to address the research objectives of the thesis by further exploring the PJDM processes and the epistemological chain of the ASP utilising the critical decision protocol (CrDM) within Applied Cognitive Task Analysis. Notably, it is investigated in the context of real and experienced situations that have been considered challenging and complex by the participants. Chapter 6 considers how the knowledge derived from the exploration of critical incidents discussed in Chapter 5 may support practice as a result of creating improved training experiences for those in coach or leader education, specifically here relating to cave leadership and PJDM development. This is facilitated through extended interviews of novice cave leaders to compare their practice to those of expert cavers. It is worth noting that the work of Chapter 5 and 6 evolved as the thesis progressed and unfolded. Chapter 7 selects and develops applied training materials designed to enhance PJDM learning and the development of expertise in the caving context, utilising feedback from an assembled expert panel. In Chapter 8, conclusions are drawn with a particular emphasis on contributions to the PJDM literature base within AS practice, the creation of new and applied training resources, and the unique contribution the thesis has made to comprehending PJDM across a greater range of AS, but specifically within caving.

1.3.1 Participants within the thesis

The research of the thesis evolved in response to findings, which is considered as a positive adaptation as the body of work grew and new knowledge emerged, reflecting good research practice. For clarity, a summary table of participants who were involved within the investigations of each chapter is offered.

Table 1. Thesis participants

Chapter	**Number of participants**	**Detail of experience / qualification stage**
Chapter 3	9 (10)	Very experienced and qualified to the highest level of available award. Considered as experts in their adventure sport activity. 3 multi-pitch rock climbing instructors (MCI), 3 caving instructors (CIC), 3 winter mountaineers (WMCI). In addition, one similarly experienced participant utilised for the pilot study.
Chapter 5	3	3 caving instructors (CIC). Considered as expert; no involvement in the work of Chapter 3.
Chapter 6	4	Trainee cave leaders, all of whom have recently completed their initial training course. No higher level awards in other adventure sport disciplines.
Chapter 7	7(8)	These participants formed an expert review panel. All very experienced and holding high level qualifications in their respective adventure sport activities. In addition, one similarly experienced participant utilised for the pilot study.
Total	23 (25)	

1.4 Aims and Objectives of the Thesis

The objectives of the thesis act as a structure to the programme of work, offer context for the reader and are listed below.

1. Appraise and analyse the PJDM requirements of the trainee ASP by conducting a thorough literature review and appraisal of trends within the outdoor sector.
2. Explore how the epistemological position of the ASP supports PJDM across a broader range of adventure sports domains through contextually authentic field research.
3. Examine and evaluate how expert ASPs make decisions in balancing session objectives and client welfare.
4. Investigate the specific decision making contexts of the high level ASP in authentic caving environments.
5. Compare and evaluate the practice of novice and expert professional cavers in relation to their EC and PJDM.
6. Conceptualise and create an applied resource, developed from the findings of the thesis which enhances PJDM within adventurous activity provision, specifically associated to caving leadership.

1.5 A Personal Narrative

This personal narrative offers a principally autobiographical account of the influences and experiences which have shaped the author's professional practice and engagement with adventurous outdoor activities. Such a narrative is deemed a valid form of data collection (Rinehart, 2005) in view of the research context and background to the thesis which considers how the epistemological stances of the author and participants directly influence how they engage with adventurous activities as a result of the way in which their lives have been lived. This aspect can be seen to depict greater significance when reflecting on behaviours, experiences and actions which are deemed to have considerable components of risk (West & Allin, 2010). The personal narrative also serves as a useful and valid alternative to the positivist methods found within socially based research (Adams, Jones & Ellis, 2015), but there are numerous interpretive forms, and therefore limitations, to such a narrative approach (Pryle & Palmer, 2013). Critical friend analysis was utilised to maintain a more detached overview (Costa & Kallick, 1993) but such that the background story which is important in the setting of the thesis is retained as it provides the reader with the contextual frame of the research origins. It offers insight into the personal beliefs and values which were instrumental in shaping the author's epistemological position. It is consciously written in a way which minimises theoretical support in the first section in order to add authenticity and legitimacy to a personal account (Silverman, 2013) but increasingly draws in appropriate literature in the latter parts.

1.5.1 The semi-nomadic kid and the beginnings of adventures

As a youngster my parents moved house every few years, which resulted in changing schools regularly. Getting through the first few weeks of the inevitable fights and testing out of 'the new kid' saw me searching each time I moved for some sort of anchor and purpose. I was a fit and capable young lad and enjoyed keeping fit but otherwise did not really know what I wanted to do with either my spare time or life in general. Entering a new school at the start of Year 11 was typically testing, but as the academic year drew to a close in the summer term, an activities week was organised which included the option of a five-day course of outdoor pursuits in the Lake District. The time period here relates to 1981 which significantly pre-dates the formation of the Adventure Activities Licensing Authority (AALA).

The activity week was enjoyable, memorable, and important for many reasons. It provided me with an unerring sense of positivity about being outdoors but importantly presented me with numerous experiences on which I could later reflect and use as a rudimentary foundation for my own professional practice. The week introduced me to what I now understand to be the use of risk for learning and personal development, although in hindsight it was rarely managed appropriately. For example, after a day of sunny mountain walking on Scafell, it was agreed we should finish off with an invigorating swim in Wastwater, which is the deepest and coldest of all the lakes in the National Park. On the shore it was somehow decided that the teacher plus me and a group of five others would swim across the lake and back, the rest to remain onshore and splash about in the shallows. Apart from exhibiting a moderately enthusiastic attitude, I was not sure why I had been selected for this 'adventure' given that at the time, I was not a particularly strong swimmer and had what I considered to be a reasonable trepidation to cold, deep water. Nevertheless, our group set off across the lake wearing just swimming shorts, bound for the far shore well over half a mile away. At some point, the teacher declared that he was unable to complete the swim and therefore we should carry on and that he would see us later, back on shore. I cannot understand my drive to continue with the swim, only that I had a sense of determination to complete whatever task I embarked upon. Sometime later I sat, shivering, alone and utterly exhausted on a jagged rock on the far shore; alone given that unbeknown to me, all the other boys had turned back at some point after the teacher did.

The walk back around the lake would be impossible in bare feet due to sharp rocks, so there was no realistic option but to re-enter the cold, dark water and attempt the swim back. The return journey was difficult. I felt vulnerable, isolated and so far from assistance should it be necessary. I was lauded for being the only one to complete the challenge, but in retrospect, I could have easily become too exhausted to swim, as at various points I had needed to stop and tread water to recompose myself prior to continuing. I have such fond memories of the course, but the abject lack of risk management and judgment ability is alarming in retrospect. Although there were no incidents, the establishment of the AALA in 1995 was necessary to ensure safer practice and improved risk management.

As a 16-year-old I was really into judo and although I found it to be challenging and frequently injurious, whenever I had needed medical support or a break during training, it was always available, guaranteed and within the confines of a relatively warm and secure building. However, when mountain walking, caving, climbing or kayaking, it was apparent should assistance be required, it was neither certain nor swift and therefore it was necessary to develop a mindset of independence and in managing safety through one's own actions. It soon became apparent that outdoor activities inherently carried greater risk of serious injury than traditional or more mainstream sports, but evidently that risks were proportional to skills, fitness and the decisions made whilst participating within them. In learning at an early stage within my paddlesport development to 'Eskimo roll' my kayak on whitewater rivers, I noticed that I did not receive the bangs, bumps and bruises of my friends who could not yet roll, and who therefore swam down some rapids before spluttering ashore. My skill in rolling the kayak significantly lessened the likelihood of injury through swimming in rivers, but because of the development of this skill, I then attempted harder sections of whitewater in which the likelihood of swimming increased once more, until eventually I began to match my proficiencies against the challenge more closely.

A recent and arguably more notable example of risk being proportional to skill can be found in considering Alex Honnold's solo climb of El Capitan in 2017. In understanding risk through a severity versus likelihood lens, the consequences for anyone falling from height are undoubtedly the same. However, the prospect of it occurring to a climber as dedicated, physically skilled, and psychologically prepared as Honnold becomes significantly diminished, as evidenced by his successful completion of the climb (Bates, 2019). In my own adventures, rarely did I feel that risks were purposefully sought, but as with Honnold, they were necessarily managed as a requirement of travelling through the natural environments in which they were situated, one where the lack of immediate outside assistance and isolation was appealing.

As an 18-year-old I really enjoyed climbing, along with three friends. As a close-knit band we considered that we were increasingly matching our developing skills and capabilities to more difficult objectives, culminating in successful month-long mountaineering visits to the Alps. At some point on one of these Alpine trips, we generated a tacit understanding that our lives were in one another's hands and that we would tolerate the chance of sustaining serious harm to help one another, should it be necessary. This 'brotherhood' and acceptance of risk which was necessary for us to climb in such beautiful mountains, increasingly supported a positive view of adventure in natural environments and a stark counterpoint to the mainstream sports which I had been brought up on.

1.5.2 The Personal Value of Reading

The Alpine expeditions generated what I now understand as a community of practice (Lave & Wenger, 2002). They offered the time to read and think, and discuss matters which were somewhat philosophical in nature, often about the purpose behind our excursions to the mountains or in attempting to ascend difficult mountains and rock climbs. Reading Lionel Terray's book 'Conquistadors of the Useless' (1963) was both influential and intriguing and formed one of the main drivers for my choosing to study outdoor education.

Following the four years of my teaching degree, I initially taught at a run-down secondary school on the outskirts of Burnley. It was not for me, and I resolved to become established professionally in the outdoor sector as soon as I could. This desire to become skilful and experienced enough to complete the certifications across a range of AS domains ultimately facilitated the research of this thesis as I had ease of access to professional colleagues a result of networks developed over 20 years of practice. However, the personal skills necessary to conduct field research on steep snowy mountains, vertical rock faces and within deep caves were particularly advantageous.

The comprehension of decision making within complex outdoor environments highlighted with my climbing friends in the Alps remained intriguing, further fueled by reading Tejada-Flores' book entitled 'The Games Climbers Play' (1978). However, the work of Storry (2003) proved very formative as I progressed in my own outdoor teaching career, illustrating what he defined as four main factors that underpin adventure-based participation.

Storry's (2003) factors in brief were Deep play (total immersion in the activity, perhaps to the exclusion of all else and where a state of flow (Csikszentmihalyi, 1990) may be achieved), Personal achievement (trying one's best either against personal goals or in competition against others), Social bonding (being in the outdoors for social contact and company) and Nature connection (being outdoors principally to enjoy nature). He suggested that there may be some overlap of factors but the reason for participation centres at least initially on one main element but that it will vary according to context and also experience. Unease within a group can often be related back to incongruence or lack of spoken agreement of the factors which underpin session aims or outcomes. Considering Storry's factors highlighted the value of reading in understanding human interaction, in this example, the correlation to aspects of social theory (Bandura, 1977).

In becoming more experienced and skilful, I was increasingly at ease with solitary outdoor experiences of sea kayaking, caving and mountaineering. I desired a feeling of competence and self-efficacy by managing any problems that may come my way and this balancing of risks against available benefits felt worthwhile. I wanted to rely on my wits rather than to have support in place and this feeling has only intensified in a world full of technical support and access to assistance which correlates to the concept of 'edgework' (Lyng, 2017). I had noted that in regard to any outdoor based activity and in particular with mountain running, it was rare to come back from an hour or two on the fells in anything other than a better mood or mental state than the one you started with. This is borne out by Nettleton (2013) who explored the high levels of self-esteem and mental resilience found within most fell runners. She discusses the positive phenomena of solo fell running as a form of self-efficacy which generates high levels of what she purposefully and provocatively termed 'existential capital.'

From my school experiences of playing rugby and football which were constrained by rules, regulations and referees, I began to notice the tension of those rules and regulations within adventurous outdoor activities and could not quite resolve my own feelings towards their necessity or otherwise. However, in 2016 I attempted and completed a long-distance mountain running challenge known as the Bob Graham Round (BGR), which necessitated pacers and support over the 24-hour period of its duration as part of the verification of completion (in other words, the rules). The following winter I decided to make another attempt but this time solo and with no support in place. This was in order to eliminate any conventions associated with participation as I felt that such regulation in outdoor activities was, for me, misplaced as it essentially managed out the 'risky rewards' (Barry, 2017) of the commitment. The solo winter round felt much more aligned to my own views of adventure and risk management and was significantly more rewarding and enjoyable.

The perceptions of risk in outdoor activities have been a perpetual source of debate, not least of all for someone who does not enter outdoor adventurous environments to court risk, rather than one who manages it in pursuit of the anticipated positive outcomes. The greater good, as Zuckerman (1991) termed it. Even as younger man I became aware of the complexities surrounding risk. Although I had lost a number of friends and colleagues through accidents while kayaking, mountaineering or by avalanche, more had passed away through road traffic incidents, suicide or by natural causes. I knew that adventure sports in general were less likely to cause injury than traditional sports per participation rate (Brymer & Feletti, 2020) but I was also conscious that being hurt whilst deep in a cave was likely to offer a different outcome to being injured on a judo mat, for example.

I was becoming increasingly aware that any behaviour which involved engagement with risk was associated with an increased chance of sustaining an injury, but actually less so in the case of highly skilled individuals or in the case of activities which necessarily demand high levels of skill, where the trend tends to be reversed (Turner, McClure, & Pirozzo, 2004). In this regard, I began to understand the subtle yet strong relationships between a range of factors and aspects which could be termed impactful decision making, or PJDM.

1.5.3 Starting the writing process

Between 1997 and 2010, I wrote at a very pedestrian rate for professional magazines and NGB publications, but more recently the pace quickened. The writing was in the belief that my lived experiences had something to offer aspiring ASPs and to promote academic debate. In 2014, I wrote for the professional journal of the British Association of Snowsport Instructors (BASI) and discussed the learning style preference research of Honey and Mumford (1992). This was in the understanding that the work had fared poorly under academic scrutiny yet continued to be used unchecked on BASI skier training courses. Following this publication, I was asked to present at the National Coaching Conference of British Canoeing (BC) in November 2015 to offer guidance on the coaching and leadership models which had or had not 'stood the test of time.' I presented evidence and literature such that the conference delegates could form their own views on the information presented clearly to them, offering my informed opinion should they request it.

The BC Conference presentation and BASI journal submission began to 'light the research fire' but to this point the efforts had been centered on some arguably outdated learning theories. New and emerging questions centered on how the underpinning beliefs and values (i.e., epistemology) of outdoor professionals were operationalised by their processes of PJDM. Specifically, I was increasingly interested in how aspiring ASPs were trained to manage risks in adventurous environments while delivering pedagogically beneficial experiences that could be harnessed for the purposes of learning.

Across 2016, 2017 and 2018, I wrote three articles for 'Horizons' which is the professional magazine of the Institute for Outdoor Learning (IOL). The first article focused on the perils of overplanning adventure, the second on judgment in demanding environments and the final article explored the role of agency and autonomy in decision making. Following the publication of the articles, I felt in a stronger position to commence a period of study and commit to the work which culminates in this thesis.

1.6 Research Philosophy

This is probably best expressed in the phrase 'the more you know, the more you realise how much there is to learn.' The journey of the author from experienced practitioner to university lecturer to doctoral candidate has facilitated the development and growth of an epistemological stance, or position. From one which considered knowledge to be neutral and perhaps value free (arguably positivist) towards a view that knowledge can be subjective, specific in terms of context and time, and may contain multiple interpretations (arguably interpretive). One of my personality traits could be described as pragmatic (do what works, avoid doing what does not), and in this context pragmatism as a research paradigm is located between the two, and is what it does (Denscombe, 2010). As a qualitative research method, it identifies that knowledge may be provisional and recognises that dualisms or binaries are neither helpful nor welcome (i.e., objective versus subjective, yes versus no). It may be posited that the quest to find 'truth' would be an unending and valueless exercise, given that research established on this philosophical position is provisional in terms of time, context and culture (Foucault, 2002). In short, my research philosophy is founded on constructive interpretivism in the understanding that as data and information are analysed, knowledge is constructed. Although valued in specific timeframes and contexts, this knowledge and understanding should act as a body of work to be built upon, developed and refined.

The next chapter serves as both literature review and initial discussion of the demands, capabilities and experiences required of the aspirant ASP, in order to help clarify the field of operation in which the studies are situated. Given the access and experience of the author, these demands and requirements are initially considered within a Higher Education (HE) context, as the learning and certification gained through an adventure-based degree exists as one of the primary routes to becoming established professionally within the outdoor sector. The chapter further clarifies terms and makes a case for the ASP and discusses the pressures faced when managing the demands associated with decision making, risk management, skilful technical independence and pedagogic expertise (Collins & Collins, 2013).

Chapter 2 –The Adventure Sports Professional and the case for Professional Judgment and Decision Making

2.1 Preface

The aim of this chapter is to conduct a literature review and discussion of the context of adventure sports (AS) and highlight the demands and requirements of an approach which advocates PJDM, one which supplements and subsumes elements of proceduralised practice. It develops the concept of the epistemological chain, namely how the beliefs and values of the outdoor professional link to their practice, actions and behaviours. Importantly, the chapter clarifies terms and makes a case for the 'adventure sport professional.' It discusses the demands made on the aspiring ASP with reference to the interactions between decision making, risk management, skilful technical independence and pedagogic expertise. The chapter offers avenues of exploration to enhance the training and development of aspiring ASPs, noting that planned enhancement of PJDM expertise is largely conspicuous by its absence across training programmes at a time when participation in adventurous activities continues to increase (Aadland, Noer & Vikene, 2016).

2.2 Introduction

The PJDM literature is plentiful within the fields of sports coaching and sports psychology (Abraham & Collins, 2011; Connaughton, Hanton, & Jones, 2007; Martindale & Collins, 2007), with a growing body of work specifically associated with decision making in AS (Boyes, Potter, Andkjaer & Lindner, 2019; Carson, Davies, & Collins, 2020 and Collins & Collins, 2017). Recent AS research has been mainly focused on paddlesport, mountaineering and to some extent rock climbing, but there is a complete paucity of literature related to the adventure activity of caving. Writing is available on cave geology (Bell, 1996) and technique (Marbach & Tourte, 2002), but there is little about decision making and leadership within the cave environment. The lack of writing on PJDM in this domain presents a notable gap in research and therefore presents a significant opportunity for original inquiry and in offering applied recommendations for professional caver development within the UK.

Adventure recreation such as rock climbing, mountaineering, white water and sea kayaking, has become a growing global phenomenon (Wolf-Watz, 2011). The increased popularity of many aspects of adventure activities has led to a growth in the demand for qualified ASPs to supervise, coach and lead these adventure activities (Eastabrook & Collins, 2021). With this demand for ASPs has also come a demand for domain specific and more targeted research into effective practice and ASP development (Collins & Carson, 2021), especially focused on decision making and how it is underpinned by beliefs and values.

In the UK, a range of different developmental routes facilitate the training and education of ASPs. These include undergraduate and postgraduate degrees, Level 3,4 and 5 apprenticeship programmes that typically take several years to complete, and NGB training and awards courses that are generally shorter and more technically focused programmes. Increasingly, early career ASPs hold a combination of these qualifications and awards. The initial stages and accreditations of these programmes, in common with many coach and leadership programmes across all sports, are characterised by proceduralised practice and competency-based methods of evaluation (Collins et al., 2014). Problematically, these approaches rarely suit the adventure settings which are characterised by interacting, multidimensional factors that are continually changing, and may contain such a range of unknown factors that they may be referred to as hyper-dynamic environments (Simon, Collins & Collins, 2017). Adventurous factors may be unpredictable, volatile, variable and potentially ambiguous as they relate to risks, hazards or obstacles (Pickett & Reid, 2022). Obvious examples can be found in whitewater kayaking, back country skiing and especially sea kayaking, where conditions may change significantly and become more difficult within short timeframes.

Proceduralised methods fail to engender and develop the essential adaptability identified by both Tozer, Fazey and Fazey (2007), and Mees, Sinfield, Collins and Collins (2020) as essential requirements for the ASP. Positively, in the higher levels of the ASPs development (for example post-graduate and some of the higher levels of NGB certification), methods are employed that do engender adaptive expertise and the associated criticality, judgement and reflective skills required (Collins & Collins, 2016). However, by this point, significant anecdotal and professional experience suggests the ASPs practices may have become engrained and their professional philosophies, tacitly endorsed via certification, become less receptive to evolution. The transition from ‘routinised’ to adaptable practice becomes challenging for both the learner, trainer and educator. This is a particular challenge when the ASP moves from engineered and managed environments with inherently less risk, to dynamic natural environments (Simon et al., 2017) and the greater risks associated with authentically adventurous settings (Barry, 2015;

Collins & Carson, 2021). There is a clear need to understand how ASPs might best develop through this transition.

Both Tozer et al. (2007) and Mees et al. (2020) conclude that it is essential to comprehend how the progression from routine to adaptive expert can be facilitated. This position is shared. The hyper-dynamic nature of working in authentic adventurous environments is ever present (Christian, Berry & Kearney, 2017) along with the risk, and it is suggested that adaptability and flexibility may be better facilitated throughout the developmental process, with a clear focus on developing adaptive expertise (Hatano & Inagaki, 1986) from the outset. Adaptive expertise requires the ASPs to make effective judgements and decisions based on a comprehension of the situational demands by selecting from a range of appropriate options (Collins & Collins, 2019b). Consequently, it is contended that along with adaptive expertise, decision making and judgment making skills are integrated early in the development of ASPs. Utilising the context of Higher Education (HE), this chapter considers how this might be achieved. The intention is to focus on how the development and education of ASPs may be framed and designed whilst contributing to the adventure sport literature base.

2.3 HE Provision in the UK

At the time of writing, there are 30 undergraduate degree providers in the United Kingdom offering 63 outdoor-based courses (UCAS, 2022). These programmes offer education to aspiring ASPs, fulfilling the roles of outdoor coaches, leaders and educators. The extent and range of undergraduate provision are prone to fluctuations in market supply, demand and demographic factors. The issue is not new, noting that Barnes (2002) hinted at the longevity and nature of the issues shaping outdoor and adventure course provision, given that at the time of writing, university course provision is once again in decline.

Demand and uptake have also been affected by changes in the degree course fees for HE in the UK, including a decreasing demographic (Office for National Statistics, 2018), the financial pressures of running an effective outdoor degree programme and a growth in sector-based training in the form of apprenticeships and 'fast-track' instructor training programmes. The latter utilises NGB qualifications as the basis.

In the UK, students typically enter an undergraduate degree course between 18 and 20 years old, directly from school or Further Education. These learners will have been exposed to a range of pedagogic and leadership theories derived from non-adventurous contexts and commonly have limited exposure to authentic, adventurous experiences (Barry, 2015; Christian et al., 2017). In the last few years, outdoor activity provision in the UK has witnessed a shift from AS taking place in natural environments towards site-based activities in manufactured or engineered locations, such as climbing walls, ropes courses, artificial cave systems and white-water sites (examples in the UK include Zip World, Go Ape, Lee Valley Whitewater Centre and Tree Top Treks) and managed environments (such as the whitewater facilities at Canolfan Tryweryn, in North Wales). Consequently, the experiences of HE undergraduate students will show a greater tendency to have been established in a combination of both natural and site-based activities.

This general shift away from natural environments is linked to both the 'sportification' (Crum, 1991) and 'commodification' of adventure (Loynes, 1998; Brown 2008), where the fiscal demands of austerity in the UK and a risk averse culture base (Furedi, 2007) has driven a greater emphasis to be placed on risk management procedures. This is commonly operationalised through the engineering out of natural variations and facilitating security via proceduralised practice rather than judgement. Notably, this change has had two effects. First, the student's prior experience of AS has been reduced to the role of a 'passenger' (Brown, 2008; Humberstone & Stan, 2012) in contextually poor environments (Brown & Beames, 2017). Second, the mental model of professional practice is equally contextually poor where the sophistication of being an autonomous professional capable of making judgements and decisions in context is replaced with one of an accountable practitioner capable of following procedure. This latter point presents an existential threat to professional practice and adventure-based outdoor degrees, and to the value of outdoor learning more broadly.

It can be seen that a significant number of aspirant ASPs undertaking an outdoor based degree move rapidly from the passenger role via participant to pilot (Humberstone & Stan, 2012). Consequently, the students' mental model of adventure sport is possibly more akin to a traditional sport conducted outdoors or an adventure-themed activity in which risk is mitigated via procedure and engineering rather than being recognised, responded to, harnessed or exploited for learning (Collins & Collins, 2016). The requirement for enhanced PJDM in natural environments does not change, but the accrual of experiences which support the gaining of adaptive expertise become subjugated by the managed environments in which significant proportions of practice occur. Crucially, lower adaptability is required in such manufactured or managed settings and the important process of reflection on experience cannot occur if the experiences are constrained or subdued.

2.4 Clarifying Terms

Applying terminology within the scope of coaching and leadership in AS domains is problematic for two main reasons. The first is due to the widespread use of interchangeable terms as they relate to the role of the ASPs in operation (instructor, leader, guide, coach). The second is that coaching and leadership are considered to be synergetic in adventurous contexts (Tozer et al., 2007). For example, in the sports of cricket or hockey, leadership, as is conceived in adventure, is rarely necessary for successful and safe coaching, nor does the coaching require management outside of the constrained environments of pitches and fields, or the regulatory constraints linked to the rules associated with participation (Crowther et al., 2018). The terminology used in such sports is typically one of 'coach' rather than those used within AS which maintain implications of leadership within the educative process (Priest & Gass, 2017).

2.4.1 *Adventure sports*

AS are a 'broad church' of similar activities that are incorrectly associated with risk taking and thrill seeking (West, 2012). This misconception is unhelpful (Collins & Brymer, 2020) given that the use of the terms 'thrill seekers' and 'extreme sports' (Brymer & Gray, 2009; Grouzet, Vallerand, Thill, & Provencher, 2004) in the media entrenches this misrepresentation. Evidentially, many non-AS are riskier in terms of injury rates (Ball & Ball-King, 2021), especially considering the recent prevalence of incidents of concussion within football and rugby.

Within practice and academia, the distinction between the differing genres of AS has been unclear and detrimental (Collins & Carson, 2021). The terms are used and applied very loosely with limited attempts to differentiate between them (Eastabrook & Collins, 2020; Cohen, Baluch & Duffy, 2018). However, AS possess some specific characteristics. They are often non-competitive in nature, take place in natural outdoor environments, operate to a set of ethics that are held within the community of practice or by the individual participant, and can be characterised by an active engagement with risk (Brymer & Gray, 2010). The combination and extent of the relationship between these factors differentiates AS from other sports, such as action sports that occur in manufactured or maintained environments. As an example, downhill skiing and ski racing are undoubtedly risky with opportunities for injury, but they take place in managed environments which facilitate prompt access to medical assistance. By contrast, back-country skiing or winter climbing take place in natural and unmanaged settings where prompt assistance is rarely available, resulting in a requirement to be engaged with risk appraisal and management on a higher and more connected level (West & Allin, 2010). Consequently, those working within the domain of AS are required to dynamically manage the potential for harm against the anticipated benefit for the learner, (Cohen, McDaniel & Crabtree, 2004). This occurs through a situation specific, nuanced and considered risk versus benefit analysis which combines pedagogy and client welfare.

2.5 Making the Case for the Adventure Sports Professional

The complexities and interchangeable nature of terminology used in AS can cause difficulties when allocating awards and qualifications, given that the designation should do ‘what it says on the tin’ but this is inconsistent. With regards to the AS domains of paddlesport and skiing, British Canoeing (BC) and the British Association of Snowsports Instructors (BASI) have addressed in part the terminological intricacies of the roles and remits of their professional workforce by adopting the United Kingdom Coaching Certificate (UKCC) framework of coaching levels where the holder of a Level 1 Coach award signifies the entry point to the coaching pathway and a Level 4 Coach indicates reaching the upper end of this progression (Sports Coach UK, 2012). The positive aspect of the framework is that the coaching levels appertain to numerous other mainstream sports and therefore any interested party can discern a clear understanding of the seniority and capability of the coach in a range of activities. However, a subtle illustration of the complexity within this lexicon is that although BASI have adopted the UKCC framework of levels for clarity, they are still called an association of ‘instructors.’

Within the specific scope of the thesis, the awarding body for mountaineering and climbing in the United Kingdom is Mountain Training UK (MTUK). The awarding body offers a 'coaching' route and an 'instructing' route in parallel (MTUK, 2019). Although this offers the ASP a range of pathways, it arguably detracts from the acquisition of clarity in terms. This is simply because it is possible for the aspiring ASP to be a mountain *leader*, a development *coach* or climbing *instructor* under the one awarding organisation of Mountain Training.

In April 2019, MTUK offered the non-specialist some prospect of understanding the role and remit of award holders by renaming the more abstruse designations. For example, moving from the term of Mountain Instructor Award (MIA), the role of the MCI (Mountaineering and Climbing Instructor) could now be accurately envisaged. However, this still does not attend to the issues of whether the MCI award holder coaches, leads or instructs irrespective of title, or to what extent this matters. A common theme is that the neophyte professional starts as a leader and then progresses to becoming an instructor, certainly within the mountaineering and caving contexts of the thesis. The highest awards offered by the British Caving Association (BCA) and MTUK are the Caving Instructor Certificate (CIC) and the Winter Mountaineering and Climbing Instructor (WMCI), respectively. The designation of WMCI describes the role adequately to the non-specialist, but the remit and responsibility of the Caving Instructor Certificate (CIC) holder remains inexact, acting in a similar way to the MIA which did not describe the role or remit, rather a title.

In an effort to offer precision and to conceptualise the role and remit of the ASP as a sub- group of those working in outdoor adventurous environments, Collins and Collins (2012) discussed the interplay of the roles of teacher, guide and coach, suggesting that the roles are transferable temporally and environmentally according to the demands encountered whilst working in dynamic and consequential environments. Collins and Collins (2012) conceptualisation of the Adventure Sports Coach (ASC) is accurate and applicable in a range of situations and settings, and it has been particularly valuable in recognising and clarifying the sphere of activity of this specific group of coaches. However, it still does not fully encapsulate the complex role, extensive remit and significant responsibilities of the professional working in the adventure sports context. For this reason, the title of Adventure Sports Professional (ASP) will be adopted (Barry & Collins, 2021) within the thesis.

2.5.1 *A synergy of coaching and leadership*

There is a requirement for the ASP to work in dynamic and unconstrained environments, and there is an undoubted necessity to lead whilst concurrently focusing on the demands of the group in the environment, which will include roles of welfare management, rescue and pedagogy. Given that roles of teacher, guide and safety officer often interchange quickly and subtly, coaching and leadership are synergetic and often hard to differentiate (Christian, Hodgson, Berry & Kearney, 2019).

Routinely, the ASP 'coaches to lead' and 'leads to coach' in a range of contexts and to satisfy a range of environmental constraints (Davids, Button & Bennett, 2008). An example of coaching to lead is where the ASP is required to manage a group of cavers through a constricted passage but finds it necessary to coach movement skills to ensure clients do not become fatigued and so that efficient progress can be made. In this example, the coaching is unlikely to be experientially orientated, but more direct to encourage movement patterns to change promptly. In this context, it is justified in order to protect against exhaustion or delay, both being key factors within underground settings. An example of 'leading to coach' is where the ASP may have to navigate a group efficiently across a wintery mountainside in order to reach the venue for the coaching of ice climbing skills, or to coach efficient belaying technique whilst leading a client on a multi-pitch rock climb. Rather than attempt to segregate, it may be best to consider the coaching and leading behaviours in AS contexts as existing on a sliding scale or spectrum, which allows for occasional distinction but regular interplay.

In operation, the ASP routinely inhabits the areas of intersection and overlap between the roles of coach and leader, incorporating actions of coaching and leadership, leadership and teaching, teaching and coaching, and for some, the teaching of leadership and coaching via coach and leader education, typically on the behalf of awarding bodies. For example, MTUK, BC and the BCA training and assessment schemes all utilise experienced practitioners to deliver coach education and training courses to aspiring outdoor professionals across their respective schemes.

Transferability of skillsets is recognised and occurs across AS domains. In addition to specialist but still transferable skills such as navigation, it can also include the generic time management, group organisation, coaching knowledge and welfare roles associated with good quality coaching in any activity (Lyle & Cushion, 2016). It is worth noting that although there is undoubted overlap in quality behaviours across all coaching activities, there are certain skills such as personal ability in the coached environment, and risk management for example, which could be considered to have greater significance and a higher profile in the AS context (Collins & Collins, 2016).

Underpinning this transferability process is a continued openness to learning (Christian, Berry & Kearney, 2017). This allows for the change of role and designation and the movement across outdoor sectors, facilitated by employing a refined PJDM ability depending upon deployment, venue, environment, learner outcomes and implications of safety. Undoubtedly *'...it is the explicit interaction of these components that defines the role of the outdoor professional*' (Collins & Collins, 2013. p.90) and a significant facet of the PJDM process in context.

Considered by some a semantic exercise, it is difficult to separate coaching and leading behaviours in AS contexts *per se*, yet alone on a minute to minute, hour to hour or longer term basis. As a contemporary case in point, British Canoeing no longer offer a National Coaching Conference, instead deliver a National Coaching and Leadership Conference (British Canoeing, 2018). It is therefore considered in this paper that coaching and leadership are collaborative, synergetic and conceptualised as a key and often indivisible working instrument of the ASP.

2.6 The ASP: A Multi-Faceted Role

In 2012 and 2016, Collins and Collins conceptualised the role and reach of the ASC and provided a model that illustrates the typical role demands in practice. They presented their model of the ASP as having three interacting roles: performance development (coaching), personal development (education/ therapy) and experience development (leadership). The role is scaffolded around the ASPs sophisticated epistemology (Schommer, 1994; Christian, Hodgson, Berry & Kearney, 2019) and synergised by a refined judgement and decision making ability based on a nuanced comprehension of the situational demands in a given situation (Collins & Collins, 2020). In other words, the views of the ASP about how knowledge is constructed and known serves as an underpinning structure upon which subsequent PJDM rests (Howard, McGee, Schwartz & Purcell, 2000). This may present as a positive view of adventure, session organisation which promotes independence through shared agency in decision making processes. The ability of the ASP to autonomously make prompt decisions on how to utilise the risk for benefit (as opposed to deciding how to remove it) is a vital tool that is complex in both nature and deployment

(Brown & Fraser, 2009).

ASPs share skills across the three broad roles and move between performance, experience and personal development functions as the situation demands. The ASP role is additionally supported by a skilfully independent ability in the activity, ensuring that the ASP can focus their attention on the learning and security needs of their group. As an example, an ASP may aim to develop communication skills between individuals in the group (personal development) by undertaking a canoe journey in tandem canoes (experience development) and will need to teach the group the skills to paddle the canoe effectively as a pair (performance development). To undertake the journey, the ASP would need to be able to paddle their own canoe sufficiently well in order to be able to focus on the demands of the group in the environment, which will include the roles of welfare management, rescue and pedagogy. The approach utilised will presumably reflect the ASPs own views of effective teaching and learning (epistemology), based on their life experiences and worldview (ontology). The ASP will fulfil the different functions to achieve the session aims while retaining a coherent epistemological stance that links the philosophical position directly with the ASPs practices, namely an epistemological chain (Collins et al., 2014).

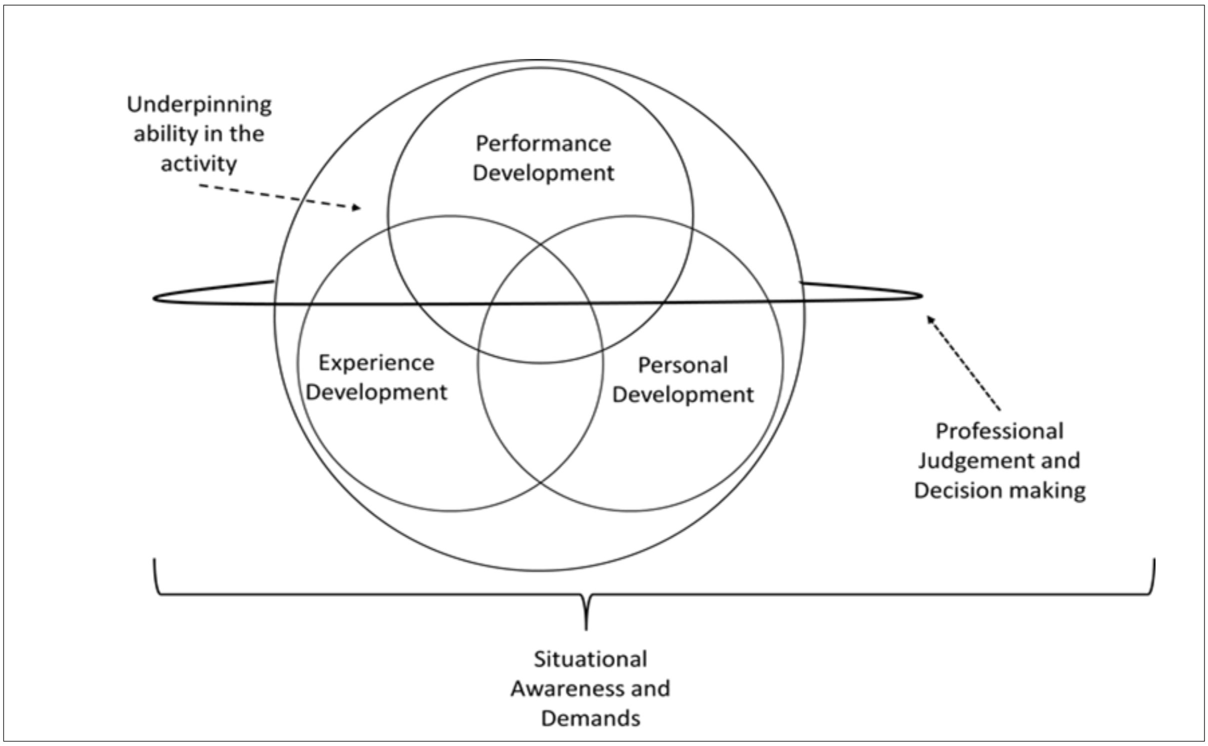

Figure 1 Conceptualising the Adventure Sports Professional (adapted from Collins & Collins, 2012, 2016)

While Collins and Collins (2012; 2016) conceptualise the coaching role, the notion of the ASP is more centralised in Figure 1, employing factors of each role, with the locus being the three over-lapping circles. The ASP moves between the roles in response to the situational demands of the session (Abraham & Collins, 2011) and encompasses a multiplicity of combined roles and diversity of function, given that there is high demand to exercise effective management of oneself, the group, tasks and even over specific aspects of the environment. In their early development, the ASP makes decisions and judgements to move between the functions based on their comprehension of the situational demands. Reflecting the need to move around the roles in response to perceived demands, the ASP requires a comprehension of the discrete functions of each role, as well as their integration in practice. The ASP draws on skills, such as risk–benefit exploitation, pedagogic skills, leadership skills, domain-specific declarative knowledge and technical skills as required to fulfil their complex and challenging role. As highlighted earlier, the misconception regarding participation and risk can be unhelpful. Contemporary research increasingly recognises that participants are not driven by risk alone but by a range of sophisticated factors and motivations (Eastabrook & Collins, 2020) that include socialisation (Gray & Collins, 2016), engagement with nature (Nettleton, 2013), management of oneself under pressure, and cultural identification (West, 2012). The historic and social misconception regarding risk has logically led to a focus on risk and safety, its perception, mitigation and management in training programmes (Breakwell, 2014). However, the growth in demand for professional leaders, coaches and instructors in this sector has led to the need for training that focuses beyond 'just' safety management and towards leadership and pedagogic skills (Collins, Carson, Amos & Collins, 2017). Indeed, although security is essentially a legal requirement, it is the quality of the clients' experience not the promise of security that differentiates providers and is the focus for clients (Eastabrook & Collins, 2020).

Safety factors that can be managed out in other contexts are inherent in the adventure context and arguably cannot be removed without removing and losing a key and intrinsic component of the 'adventure' (Breivik, 2010). Further, Breivik advocates that ". *we should confront danger and take risks but only when we have the tools to do so"* (p.87) reinforcing the concept of how risk and adventure are proportional to participant skill and experience.

For the ASP, the working environment itself is highly dynamic, relentless and always complex. As a metaphor, imagine playing on a pitch where the surface varies continually, the goal posts consequently shift in size, shape and position, the lines demarking the playing area alter and therefore performance and strategies must be continually adapted. Additionally, in context, the learner changes as performance improves, fatigue develops, or motivation varies. Authors have variously described the coaching and leading context as wicked (Martin & Murray 2011), messy and hyper-dynamic (Simon et al., 2017). Coaching and leading in these dynamic natural settings present significant additional demands on both the ASP and participant as a result of the complex and continually changing environment. These can be cognitive, physical, pedagogical and temporal (Christian, Hodgson, Berry & Kearney, 2019). For clarity, it is understood that both AS and traditional sports coaching and participation have elements of undoubted complexity, but the environments and situational demands vary significantly.

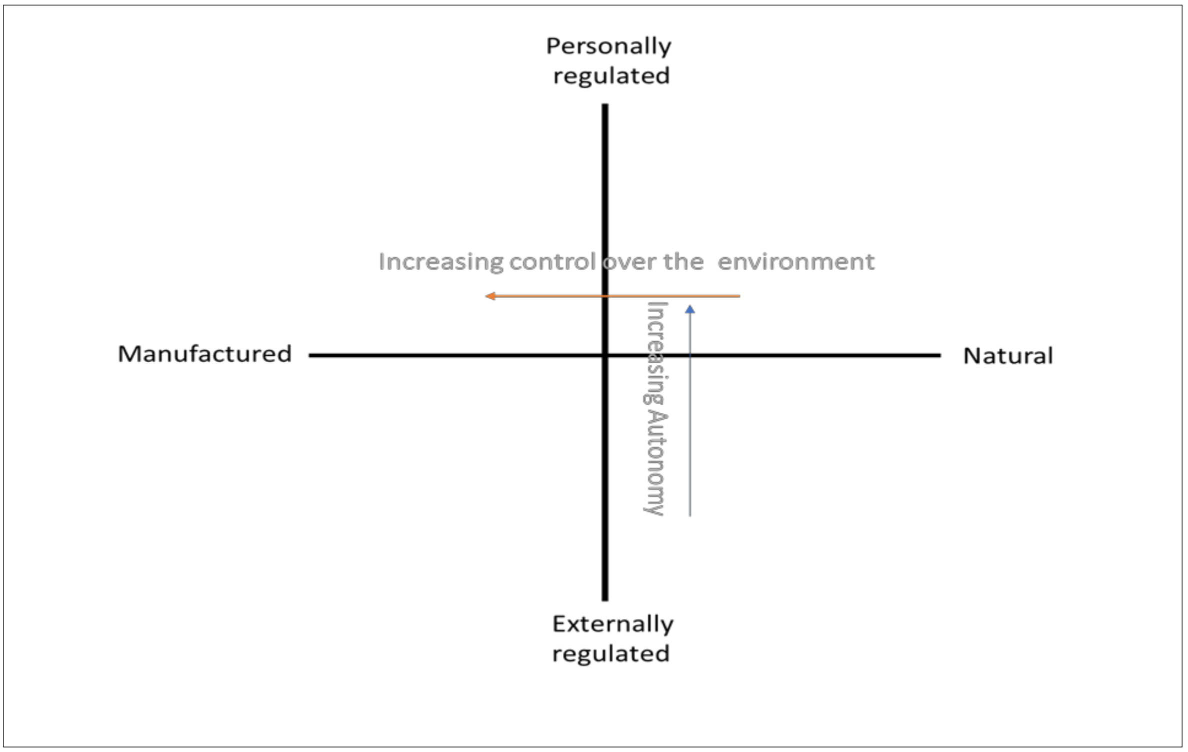

Figure 2 Regulatory and environmental factors in sport (Carson & Collins, 2021)

More recently, AS have become increasingly commodified (Loynes, 1998) as aspects of the risk are removed to lessen uncertainty and ensure consistency of product. An aspect of this commodification is also the ‘sportification’ of AS (Crum, 1991) and regulation of the activity in which a ‘level playing field’ for competitors is manufactured or managed (climbing at the Olympics and whitewater kayaking competitions on artificial courses are examples). Indeed, AS now encapsulates a wide range of activities that could be conceptualised across two intersecting spectrums, as shown in Figure 2. The environment axis (manufactured to managed to natural) sits at right angles to a regulatory spectrum axis (externally prescribed and managed rules to a set of socio-culturally accepted ethics to personal values). While traditional notions of sports sit in the lower left quarter, AS can be found across the full illustration in its various forms.

2.7 Decision Making and the ASP

Collins and colleagues (2016, 2017) presented PJDM as a possible model for the decision making aspects of the ASP role. PJDM proposes a contextually situated, dual decision making processes in which CDM and NDM work together (Shea et al., 2016). CDM places high cognitive demands on the decision maker because of the requirements for accurate, expansive information and processing (Kahneman, 2011). This demand can be reduced through time spent in pre-planning and session organisation. However, NDM enables decisions to be made in shorter timeframes with less or poorer quality information. This NDM aspect is less cognitively demanding in simpler tasks but prone to bias and decision making traps (McCammon & Hägeli, 2007). In complex tasks, the process appears equally cognitively demanding because of the timeframe context and sub-optimal information (Collins & Collins, 2019b). Additionally, a metacognitive (Collins et al., 2016) aspect (i.e., knowledge about the knowledge) of the process takes the form of a continual audit by the decision maker, which extends beyond *just* the quality of the outcome. During pre- and post-activity, CDM is used to a greater extent and weighting than NDM because time can be allocated to a more complete process of information gathering and verification of its reliability. This aspect includes the planning of a range of decisions on venue choice, activity, logistics and equipment, and one that is often implemented initially via a 'strawman plan'[1] (Collins & Collins, 2019). In-action, NDM is predominant in response to short-term challenges, ambiguous information and the hyper-dynamic environmental pressures commonly experienced in AS settings.

Kahneman and Klein (2009) described this blending as skilled intuition, and as being appropriate for the applied and dynamic practices typically found in the AS environment. Such skilled intuition, though, needs to be considered against not only the environment, but also the known fragility of the human decision making process (Martindale & Collins, 2013). Intuition has a long tradition in coaching (Nash & Collins, 2006) but has particular relevance for the ASP, as reported in the frequency of the 'feel right' decisions in adventure contexts (McCammon & Hägeli, 2007).

[1] A disposable plan created with the intention to be adapted as factors change.

However, Ball et al. (2008) and Vickers (2007) have all indicated that experts do not always make sound decisions. In this respect, NDM may only really be the realm of the adaptive expert with broad, lengthy and rich experience. By default, a novice has little experience (Kahneman & Klein, 2009). Learners gain experience while practicing decision making in authentic, varied and contextually appropriate environments, situating the cognition required under the guidance of more experienced coaches and tutors.

Dowding and Thompson (2003) acknowledged the positive role of intuition in coaching and hazard evaluation. Kahneman and Klein (2009) indicated that a key attribute of an expert is that they know when they are wrong, whereas non-experts do not know when they do not know something, akin to the Dunning-Kruger effect (Dunning & Kruger, 2011). Such issues are highlighted by the nature of being ignorant of one's deficiencies and of the abilities of others. This effect may be applicable in the over perception of personal capability and more importantly, by being unable to understand how a learner may struggle with practice environments that the ASP finds undemanding.

There is no shortage of research to indicate the value of PJDM across domains and Collins and Collins (2013, 2016) found that PJDM is a vital element of the education of the ASP. However, the training and practice of these PJDM skills is a situated cognition that is conspicuous in its absence within many coach and leader education programmes.

2.7.1 *A Central paradox*

The challenge for the aspiring ASP lies in balancing the risk and benefits of a given activity via effective decision making (Collins & Collins, 2013), but risk is sometimes mistakenly perceived as a central component of outdoor education and adventure programmes (Brown & Fraser, 2009; Brown & Beames, 2017). In the ASPs role, the relationship between risk and benefit is recognised, manipulated and exploited rather than simply minimised, as in many other situations, and in this context, risk-benefit decisions are an essential aspect in maintaining authenticity for the learner (Beames & Brown, 2016). Engagement with real risk (Frey et al., 1997) is the central paradox of coaching or leading in adventurous environments (Priest & Gass, 2017), a factor virtually absent in the commodified activities mentioned earlier and reduced by being 'built out' literally or via regulation (Collins & Carson, 2021).

This paradox is fundamentally different from concepts of risk aversion (Ball et al., 2008; Gill, 2010) and the risk naivety engendered in the proceduralised practice associated with risk management in manufactured and managed environments. The ASP is required to make a 'risky shift' (Stoner, 1961, cited in Breakwell, 2007) and have a refined comprehension of 'edgework' (Lyng, 2008; 2017). Although the concept of edgework is based on voluntary risk taking chiefly for its own sake, there are strong links which underpin risk management in-action for the ASP.

Figure 2 is conceived as the preliminary framework to highlight potential PJDM requirements according to context of operation, as presented. The vertical axis reflects the constraints acting on the outdoor practice as a result of the rules or culture of a given activity (for example, resting on gear while climbing, or the placement of bolts), which influence the decision making aspects of the ASPs role. The horizontal axis represents the range of natural or manufactured environments in which the activities take place. Caving, for instance, can take place in a natural cave system or an indoor caving tunnel facility, but the experiences will vary significantly, as will the demands on the leader.

Some adventure-based activity examples are presented for the reader to consider. Traditional (trad) climbing has few rules other than the ethics agreed by the community of practice (Wenger, 1998) and typically takes place in natural, unmanaged environments and would therefore be plotted in the top right-hand quadrant. Contemporary slalom kayaking, which takes place on managed or manufactured white-water courses and has strict rules, would be plotted in the bottom left quadrant. Although some adventure-based sports can have rules (e.g., bouldering) and take place in manufactured settings (e.g., ice climbing towers), paradoxically almost every AS can take place in a managed or manufactured environment, with each bound by regulation and rules. This reflects trends in participation and arguably, how risk is tolerated. It is not so much the activity, more the how, why and where of the participation. However, whether white-water kayaking on an artificial course (or caving indoors) can still be considered an adventure sport is contested, as definitions such as these remain unclear and varied (Immonen et al., 2017). Indeed, such anomalies may equally apply, for example, to skiing on or off piste, or climbing on an artificial wall or on a natural crag.

It can be considered that ASPs operate in the upper right quadrant, where they work in natural and largely unmanaged environments, maintain skilful independence in their domain, have a positive view of adventure and maintain an epistemological position where risk is sought to be understood and harnessed for learning, rather than simply avoided. The present challenge is that the experiences and training of the aspiring ASP prepares them to work in a manner more suited to the lower and upper left quadrants of the figure. Although work and professional practice associated with those quadrants may be valuable for a range of reasons, the obvious risk is that the AS workforce will be unable to work across the whole spectrum of their professional domain. It is posited as a framework for useful academic debate and development, rather than as a source of contention and one which serves to highlight the potential differences in role, and in the coaching and leadership demands according to the quadrant or field in which the ASP works.

2.8 Moving Forwards: The Cognitive Apprenticeship as One Approach

A cognitive apprenticeship (CA) approach is presented, which builds on work highlighting the importance of PJDM in varied AS domains, (Collins & Collins 2013; 2016; Carson, Davies & Collins, 2020; Martindale & Collins, 2005). The CA may be one avenue of exploration to help focus attention on how best to address the widespread omission from learning and training programmes and courses.

The CA is a graduated multi-stage approach (Larsen, 2015; Collins, Brown, & Newman, 1989) that has been highlighted as a potential method for developing the cognitive and PJDM skills associated with AS coaching and leadership (Collins & Collins, 2019a). The CA has been advocated and applied in a range of activities, such as reading, writing, mathematics, clinical skills, teaching, web-based learning, and musical improvisation (Collins et al., 1989; Woolley & Bowen, 2007; Järvelä, 1995). CAs attempt to bring the tacit (McLeod et al., 2006) aspects of a process into the open by guiding participation in the learners' zone of proximal development (Vygotsky, 1978, cited in Hedegaard, 2012). In exploiting this dynamic region just beyond the learners' ability, skill levels and comprehension can be developed in synergy. CA enables aspects of the process to be articulated and considered once a clear conceptual understanding of the process has been gained, facilitating improved training, knowledge generation and education of ASPs. The CA is rooted in the constructivist assumption of learning (Brown, Collins, & Duguid, 1989), where knowledge and meaning can be constructed by the individual, in tandem with a professional or as part of a community of practice and are considered important factors of a developing and situated cognition (Tversky & Hard, 2009).

During a CA, social interaction between the apprentice (aspirant ASP) and experts, important skills, interactions, decisions, problem solving, and experiences are all contextually shared. The expert often passes down techniques, methods and the culture associated with the apprentice role and their development. The apprentice learns in an authentically situated sense, specifically the interwoven processes of cognition, practice and application, comprehending that the apprentice understands knowledge to be time and contextually framed, dynamic and culturally bound yet gradually accumulated and developed by the learners themselves (Howard et al., 2000; Schommer, 1994).

The expert, in this case the trainer, should be a skilful practitioner, versed in the traditional meaning of the skills used and practiced in their application in everyday life. A CA approach relies on the decision maker recognising and comprehending how they make decisions, namely the meta skills. Providing a practice environment that has sufficient authenticity, validity and contextual accuracy is crucial in the development of PJDM skills via the CA, allied to plentiful opportunities for prolonged practice. Receiving prompt, unequivocal and high quality feedback is central to this process (Martindale & Collins, 2013).

Collins et al. (1989), and Marton and Säljö (1976) proposed six teaching methods that are integral to CA. These are modelling, coaching, scaffolding, articulation, reflection and exploration. Such methods enable apprentices to develop cognitive and metacognitive strategies to support the construction of knowledge by the apprentice, while also addressing the criticisms linked to other situated learning approaches (Clancey, 1995). Expert modelling is utilised to build a conceptual and practical model of the task at hand, a mental model in the learners' mind of the full process and its context. A shared mental model (Converse, Cannon-Bowers & Salas, 1993) is created by engaging with a range of practical experts and other apprentices. Significantly, the cognitive and practical aspects of the process are given equal attention, and support structures such as coaching and scaffolding with fading (the gradual withdrawal of support) for independent performance are put into place. In some instances, the expert may have to help with aspects of paying attention to the environment, the context, or to introduce new tasks that the learner cannot yet accomplish, which is akin to, but not exclusively, a problem-based learning (PBL) approach (Ojala & Thorpe, 2015). The guided aspects of CA, namely, modelling, mentoring, and coaching, are highly socialised elements of the process. Often this guidance is provided tacitly by the expert in a naturalistic and thus contextual way. For these interactions to be successful these interactions must occur within the learning zone of proximal development (Vygotsky,1978), be authentic and gauged at an appropriate level for the apprentice. Vygotsky defines the zone of proximal development as the evolving space between the learner's current ability level and potential ability. Consequently, the zone for the learner is continually being reconfigured and shaped as the learner develops. As the learner progresses and the zone shifts, so do the nature of the social interactions, with the apprentice taking an increasingly prominent role in the construction of the knowledge associated with the process or task at hand.

Articulation of the process may be situated such that the apprentice is encouraged to separate, expose and clarify the component knowledge and skills as well as their synergetic interaction (McLellan, 1996). Apprentices are encouraged to articulate their knowledge, reasoning or problem-solving procedure in context, thus developing the meta-aspects of the process. The expert may ask apprentices pre-structured questions via the use of crib cards for example, which allow the learner to refine and restate their learned knowledge and form conceptual models (see inquiry teaching by Collins & Stevens, 1991 and 'The Big 5', Collins & Collins, 2020). Concurrent and retrospective thinking aloud approaches can also play a part in encouraging apprentices to articulate their practices, thoughts and problem-solving strategies (Kuusela & Paul, 2000).

Learners are encouraged to reflect on-action, in-action and on-action in context (Schön, 1983) to situate the cognitive processes and to examine their past performances with those of the expert to identify similarities and differences. In particular, they *'compare their own problem-solving processes with those of an expert*' (Collins & Stevens, 1991, p. 483). Doing so will enable the apprentice to form a mental conceptualisation of adaptive expertise. The apprentice's reflection involves the requirement to look back and analyse their performances with a focus on understanding and making self-improvements towards the behaviour of an adaptive expert.

The apprentice is encouraged to problem-solve independently and develop personal exploration strategies (Collins, Willmott, & Collins, 2016). The former requires the expert to gradually withdraw support (fading) and to scaffold both the problem-setting and solving methods. The latter requires the expert and apprentice to explore, research and hypothesise in an accurate and authentic context. Such problem-based approaches have a positive role to play within the development of high quality and agile ASPs given the real-world environments in which they operate, but these approaches should not be considered the only route to achieving contextually accurate training and coaching for the development of the ASP.

2.8.1 *Critical Summary*

This short critical summary is positioned to act as a concise rationale to the research of the thesis. Simply, it considers the questions of '*where are we at now, where do we want to be, and how might we get there*?' This assists in identifying the gaps that the work seeks to fill, from an academic and practical perspective.

- Trainee ASPs are likely to originate from a traditional sports background where risk minimisation strategies are typical and must make a transition into adventure based activities where skilful risk management can be associated with positive human progression. These ASPs must transition from being led to being the leader.
- The present professional landscape is associated with manufactured or managed environments and a proliferation of regulations. Preparing ASPs to work across all sectors of Fig.2 will maintain a versatile workforce.
- Technical and rational skills tend to be privileged over PJDM expertise. Deficiencies in PJDM correlate more closely to serious accidents and fatalities than lack of technical skills, yet the development of expertise in decision making is conspicuous in its absence.
- In adventure based settings, there are complex interactions between decision making, risk management, skilful technical independence and pedagogic expertise, further illustrating a requirement for development of capability in PJDM in a comparable rate to technical skills.
- Across AS domains, there is insufficient research into how the epistemological position supports the epistemological chain, which is operationalised by PJDM. This is especially the case with winter mountaineering and caving, both of which typically take place in complex environments.

- Applied recommendations will be generated through a series of empirical studies and subsequent production of training materials designed to enhance PJDM expertise. It is acknowledged that experienced cannot be fast-tracked, but it can be optimised.

2.9 Conclusion

Most UK undergraduate students who embark upon an outdoor or adventure-based degree originate from a traditional sports background (Barry, 2015; Christian et al., 2017) and consequently must make a significant 'double paradigm shift' to reappraise their views of risk and personal constructs of adventure as they move from a position of 'follower' into the role of 'participant then pilot' within the scope of outdoor and adventure-based coaching and leadership. There is a requirement for the aspiring ASP to become skilfully autonomous in the environment of their leading and coaching expertise and it is contended that until this independence has been acquired, the cognitive demands of managing the constraints of task, environment and pedagogical needs of the learner through a PJDM process may be overwhelming.

This considered, there is a requirement for the new generation of ASPs to become better thinkers in context, where the ability to access a PJDM process is central, characterising the transfer from proceduralised training and assessment practices to which learners may have become accustomed, to a more expertise and experience-orientated approach. Achieving this could be through the use of real-world scenarios and the avenue of adaptive expertise and cognitive apprenticeship with the training and enhancement of decision making skills as a potential starting point for PJDM. It is contended that metaphors and analogies are inadequate and not sufficiently robust in the authentic domain of the ASP. As suggested by Philipps, Klein and Sieck (2004), utilising scenario-based, well-structured training sessions, it is possible to successfully facilitate the acquisition of decision making expertise as it relates to the specific domains found within the multi-faceted remit of the adventure sport professional. The practical implications of this chapter are that the review and discussion clearly identify the requirement for PJDM training support, whilst acting as an initial foundation for the development of applied resources as the thesis evolves.

Chapter 3 – Investigating Epistemology Across Adventure Sport Domains

3.1 Preface

The primary aim of this chapter is to investigate the personal epistemology of the ASP across a range of AS domains. This is to further recognise and comprehend the presence and utilisation of the EC and the impact it has on PJDM in-action. Given the perceived research gap in the activity areas of the thesis and the requirement to learn more about the skills, attributes and philosophy which underpins PJDM in context, the chapter conducts an exploration of the connections between cognition, experience and action in authentic professional environments. It utilises initial pre-session interviews, observed coaching sessions and post-session interviews. The research used an Interpretive Phenomenological Analysis (IPA) approach and found that although epistemological chains were evident in practice, they are not identical and reflect the technical skills required to ensure security in each given setting in addition to the dynamic nature of the environment. The practical applied implication of this chapter is a greater understanding of the nature of epistemological chains across previously under-researched adventure sport domains.

3.2 Introduction

Participation in adventure recreation activities has grown globally (O'Keefe, 2019), and consequently, the demand for adventure activity coaches, instructors and guides (Eastabrook & Collins, 2020). Research had focused on high level paddlesport coaches (Collins & Collins, 2013, 2017; Sinfield et al., 2020) and, more recently, multi-activity instructors (Mees et al., 2020). Several investigations of adventure sports professionals have explored the epistemological underpinnings of coaching and leadership practice (Collins et al., 2015; Christian et al., 2017). These authors among others have referred to the importance of the coaches' epistemology (Crowther et al., 2018; Grecic, MacNamara & Collins, 2013; Mees et al., 2020, 2021) though few have considered it explicitly. Researchers have highlighted how the philosophical stance of adventure sports professionals influence their practice and describe an 'epistemological chain' that links beliefs to practice (Christian et al., 2017; Collins et al., 2015). However, to date, investigations into the epistemological underpinning of caving instructors, winter mountaineering instructors and rock climbing instructors practice have received limited interest, if any (Barry, Collins & Grecic, 2023).

Acknowledging the work of Collins et al. (2015), Christian et al. (2017) and Christian et al. (2020), the work of this chapter aims to broaden understanding of the epistemological underpinnings of ASPs by investigating a greater range of domains. Consequently, this chapter investigates the epistemological stance and potential for an epistemological chain (EC) in a group of UK-based caving instructors, winter mountaineering instructors and rock climbing instructors.

Christian et al. (2017, 2020) have suggested that the dynamic natural environment, typical to all adventure sports (Collins & Carson, 2021), is central to the beliefs of ASPs concerning what, how and why they teach or lead in particular ways. Logically, an overview of the working environment of these instructors is offered, before exploring the related research in this area.

3.2.1 Working Environments of ASPs

In the UK, ASPs typically hold National Governing Body (NGB) qualifications which have evaluated the coach's competency in essential safety skills (Barry & Collins, 2021). However, limited attention is paid to pedagogic skills or perceptions of good teaching or learning beyond the approach demonstrated in NGB qualification training and assessment programmes. It is increasingly clear that coaches develop their skills uncritically, focusing on replicating skills from congested curricula that are typically consolidated via periods of unmentored experience. Indeed, time pressures and a cultural and almost exclusive focus on safety and rescue techniques have led some (Mees et al., 2021; 2022) to question the value of low-level awards in adventure and outdoor education settings. In this environment, the development of the coach's epistemology has limited explicit guidance or support, except to potentially align with the awarding bodies' educational philosophies, if stated (Cushion et al., 2022). Alternatively, coaches may develop their epistemological position through reflection on their own experiences of learning and teaching rather than any broader understanding or education (Melhuish & Ryan, 2022).

As with other adventure sports, winter mountaineering, caving and rock climbing are physical activities with a degree of risk. They are typically non-competitive in origin and are guided by their ethics (Collins & Brymer, 2020; Collins & Carson, 2021). Each activity has an element of physical challenge and takes place in dynamic natural settings where the ASP must be skilfully autonomous in that environment and acts as a precursor to any coaching or leading role being assumed (Collins & Collins, 2013). Coaching and leadership tend to be characterised by a need to work in both physical and professional isolation for extended periods in natural, unmanaged environments. Managing client welfare, levels of task difficulty, environment, and pedagogy present complex, hyperdynamic professional settings with conflicting demands, and require high quality, frequently time-pressured and high stakes judgment and decision making (Barry & Collins, 2021). ASPs must contend with a range of environmental risks such as rockfall, navigation and route finding, exposure, steep or slippery terrain, exhaustion, and environmentally induced injury. These working environments are physically stressful and psychologically demanding (Cheung, 2010), with inherent complexities in the coaching process (Cushion, 2010; Simon et al., 2017). This makes adventure sports coaching a challenging sub-set of mainstream coaching.

3.2.2 Working Environment of the Caving Instructor

The caving instructor must contend with the additional risks presented by cold water, working at height, darkness, entrapment, confined spaces, suspension trauma, route finding and a need for self-reliance and independence (Marbach & Tourte, 2002). The remit of the caving instructor is to teach caving techniques and lead in extended horizontal and vertical underground systems, which entail prolonged periods of lone working and sole responsibility for clients. There may be extended periods of crawling, stooping, walking or climbing, and the ascent and descent of vertical pitches by rope or ladder. Caving activity also has an inherent difficulty of rescue with limited access to outside assistance (Lambrou et al., 2003). It is one of the few remaining environments where technology has not reduced decision making load in-action given that aids such as mobile phones and GPS are inoperable underground.

3.2.3 Working Environment of the Winter Mountaineering Instructor

Winter mountaineering in the UK is seasonally limited to the higher mountain areas of North Wales and the Lake District, but predominantly to the Scottish Highlands in the winter. Winter mountaineering instructors are expected to be able to safely navigate and lead small groups across mountain landscapes in conditions of poor visibility, low temperatures, darkness, and potentially high wind speeds. The remit includes teaching multi-pitch snow and ice climbing and winter mountaineering techniques and will entail working independently in remote mountain environments for prolonged periods. Consequently, these mountaineering instructors must be fluent in self and client rescue in multi-pitch climbing settings in winter conditions.

3.2.4 Working Environment of the Rock Climbing Instructor

Rock climbing in the UK takes place on various types of terrain, from small single-pitch crags to steep multi-pitch climbing routes on higher mountains and sea cliffs. The rock climbing instructor operates in any mountain and rock climbing venue within the UK in non-winter conditions. The remit of the rock climbing instructor is to safely navigate and lead small groups across steep climbing and mountainous terrain. They will be expected to manage clients effectively and safely in sub-optimal conditions, such as those associated with wind, rain, damp rock, or poor visibility. The remit of the rock climbing instructor includes the guiding and coaching of multi-pitch rock climbing and scrambling/ mountaineering techniques and entails extended periods of lone working and sole responsibility for clients. The rock climbing instructor needs to be fluent in self and client rescue in the scope of multi-pitch climbing and mountaineering.

3.3 Epistemology- Nature and Impact

Epistemology is critical because it is fundamental to how the caving instructors, winter mountaineering instructors and rock climbing instructors think, perceive, value, and learn about knowledge associated with their domain (Perry, 1981). Importantly, it underpins the understanding of how knowledge is created, constructed, acquired, and developed. Therefore, the epistemological position, or stance, of the ASP has far-reaching impacts based on their perceptions of knowledge, its creation and dissemination (Barry, Collins & Grecic, 2023; Christian et al., 2020; Collins et al., 2015). Furthermore, underpinning the epistemological position are the ontological and worldviews of the caving instructors, winter mountaineering instructors and rock climbing instructors (Schraw & Olafson, 2008). Ontology therefore impacts the value, control, certainty, nature, organisation, application, creation, and acquisition of knowledge. (Perry, 1981).

Schommer (1994) highlighted epistemological development as a continuum, with beliefs being naïve or sophisticated at the poles. The naïve perspective accepts knowledge as clear, specific, held in authorities, primarily fixed, grounded in accepted prescribed models and reinforced by authority sources such as training manuals, training courses and successful 'expert' instructional texts. In action, ASPs with a naïve position apply a narrow range of teaching strategies that ensure explicit learning and defined practices. The ASPs 'own' the knowledge, manage its dissemination and are constantly required to provide reinforcement that generates a coach-dependent performance. In contrast, the sophisticated perspective holds that knowledge is complex, changing, dynamic and learned gradually via both tacit and explicit cognitive processes, and that it can be constructed and constantly developed (Howard et al., 2000; Schommer, 1994). Such ASPs apply a range of teaching styles that are selected to optimise learning. In practice, the ASPs may use constructivist approaches to develop a performer's independence, self-analysis, reflection, and promotion of lifelong learning. These ASPs question authority and challenge orthodoxy or accepted practices.

3.3.1 Epistemology and Practice

Christian et al. (2020) suggest that Schommer's (1994) spectrum can be ostensibly linked with Mosston and Ashworth's (1990) spectrum of teaching styles. Schommer's (1994) naïve pole would align with the 'instructor' centred teaching styles, whilst the sophisticated ‘teacher’ with more student-centred styles. Christian et al. (2020) propose that a sophisticated epistemological position requires ASPs to have a range of teaching styles and apply them effectively. The logical link is to select an appropriate teaching style in response to context, via a refined situational comprehension, which enables the selection of the most suitable approach. In short, an epistemological position may be demonstrated by the range of styles, not just by using a specific or single style. For example, a coach who only uses student-centred approaches may be as epistemologically naïve as one using a single coach-centred approach.

3.3.2 Philosophy to Practice

Collins et al. (2015) employed the concept of the epistemological chain (see also Grecic & Collins, 2013). The chain is a consistent, rationalised, and logical relationship between the epistemology of the ASPs and their practice. In adventure sports research, Collins et al. (2015) and Christian et al.

(2020) demonstrated a consistency in this relationship in the ASPs they studied, supporting the notion of sophisticated epistemological beliefs underpinning high level ASPs' practices.

Notably, a disconnect between belief and action (an epistemological void) (Collins et al., 2015) may indicate a developing belief and can be desirable in coach and leader education. However, epistemological voids between ASPs and the students or with the certifying body may have significant implications for adventure sport's coherence, safety, practice, and certification. Indeed, Mees et al. (2021; 2022) describe an epistemological chain that links the coach to their employer and awarding body. Further, Christian et al. (2020) reflected that "*the coaching environment in which ASPs operate is the mediating factor*" (p.78), suggesting that it is the hyperdynamic environment that necessitates a sophisticated epistemology. Building on the work to date regarding the epistemology of ASPs, the following are considered:

(1) What is the epistemological underpinning of these caving instructors, winter mountaineering instructors and rock climbing instructors?

(2) Do epistemological beliefs vary across domains or bear similarities to previous research findings?

(3) Does this manifest itself in an epistemological chain?

(4) How does this influence the judgements and decisions of these caving instructors, winter mountaineering instructors and rock climbing instructors whilst operating under their specific environmental constraints?

3.4 Method

3.4.1 Design

In line with the stated aims of this thesis, an Interpretive Phenomenological Analysis (IPA) approach (Smith, Flowers and Larkin, 2012) was adopted allied to a qualitative methodology. Observing the guidelines for investigations within IPA (Smith & Osborn, 2008), data collection for this stage of the enquiry utilised extended one-to-one semi structured interviews. as it facilitated exploration of the depth and breadth of the data and richness of anticipated responses. Looking at data through such an interpretivist filter reveals that truth and knowledge are subjective, often culturally situated and based upon people's specific understanding of their own lived experiences (Cooper, Ells, Ryan & Martin, 2018), showing strong research alignment to explorations of epistemological and ontological characteristics. IPA has its roots in hermeneutics, phenomenology and ideography, such that it accepts the uniqueness and individualised nature of the lived experiences of each of the participants of the thesis (Smith & Shinebourne, 2012).

To uncover the essential meanings of an experience or event, the aim of the IPA approach is to explore the lived experiences (phenomena) from a position which is free from assumptions or previously held misconceptions (Husserl, 1970). Phenomenal reduction as an epistemological strategy is a necessary facet of the research process which was initially introduced and then further developed and refined by other phenomenological scholars such as Merleau-Ponty, Schultz and Heidegger (Dowling, 2007). Although the work of Husserl, Heidegger, Schultz and Merleau-Ponty formed the philosophical foundation for the development and application of phenomenological theory (Rice & Ezzy, 1999), there have been significant developments since its origins. Within the last century, variations and elaborations have appeared and therefore the outcomes of a given research project may be influenced or even directed by the school of philosophical phenomenology selected (Lopez & Willis, 2004).

Although it is beyond the scope of this thesis to discuss the full historical background of the phenomenological movement, for the purpose of methodological direction, there is value in distinguishing between the two most dominant types of phenomenology. These are the transcendental approach of Husserl and the interpretive approach of Heidegger (Koch, 1995), which are summarised in Table 3.1.

Table 3.1 Phenomenological approaches of Heidegger and Husserl (Koch ,1995)

Heideggerian phenomenology	**Husserlian phenomenology**
Hermeneutic / interpretive	Transcendental / descriptive
Questions what is experienced and understood	Questions what is known
Person is viewed as a self-interpreting being	Mechanical view of person
Person exists in and is part of the world	Person lives in a world of objects
Analysis is the relationship between the subject and the situation	Analysis focuses on the meaning giving subject
Interpreter's ontological position plays a role in interpreting data	Meaning is untouched by the interpreter's view of the world
What is shared is culture, history and language	What is shared is the essence of the conscious mind
Development of individual criteria ensuring rapport	Strict procedures of interpretation guarantee validity
The interpretation of subjects' meanings can only highlight what is already understood	Subjects' meanings can be reconstituted by perceiving data to speak for itself

The traditional phenomenology of Husserl emphasises that which people consciously know, whereas the interpretive phenomenological position of Heidegger puts greater focus on what humans actually experience and the meanings which are made from those lived experiences. In short, the stance of Heidegger focuses on the world which is inhabited by the person and the transactions between themselves and the situation (Koch, 1995).

There is recognition that the ontological position of the researcher will influence any inquiry irrespective of any control measures taken to limit it. It is understood that the researcher's interpretations are undoubtedly shaped by their ontologically formed and evolving worldview, but in the context of a thesis such as this, these views may help in the shaping or understanding of the data due to the setting in which it is found (Maggs-Rapport, 2000). Accordingly, the development of trust and understanding is central to this type of data collection, but notably such rapport building is an aspect of the investigative process which Husserlian phenomenology avoids. Therefore, and although it is acknowledged that Husserl is the founding figure of phenomenology, it is considered that the phenomenological lens of Heidegger demonstrates a closer alignment to the research aims and objectives of this thesis.

The IPA approach was chosen as it encourages participants to make sense of their own reasoning through the opportunity provided for thinking, and subsequent articulation of the epistemological chains which support and scaffold the PJDM process (Collins, Collins & Grecic, 2013). Without this cognitive space and opportunity, the reasoning and thinking behind the decision making process would remain tacit or unspoken. The method is valuable simply because it offers these high level practitioners the opportunity to discuss within a semi-formal structure, the nuances and subtleties of their practice. Further, it offers neophyte professionals an insight into the accumulated experience and subsequent reflection which supports their decision making. As a method, IPA facilitates a 'stripping away' of preconceptions, deploys the thought processes of exposing the taken for granted, and attempts to declutter the biases accumulated through the process of living one's life (Eatough & Smith, 2006). Further, Heron (1992) eloquently suggests that phenomenology enables "*... a pristine acquaintance with phenomena unadulterated by preconceptions: it encourages the enquirer to sustain an intuitive grasp of what is there by 'opening their eyes' ...keeping them open …looking and listening …not getting blinded*" (p.164).

The authors' own professional experience facilitated the process of understanding the lived experiences of each participant and utilised a two-stage process of interpretation, known as the double hermeneutic. In other words, "*the participants are trying to make sense of their world; the researcher is trying to make sense of the participants trying to make sense of their world*" (Smith & Osborn, 2008, p.53). Wellington (2000) describes hermeneutics as '*the art or science of interpretation*' (p.197), where hermeneutics fulfils the task of sharing meaning between people, and texts are a means of transmitting those meanings, values, experiences or beliefs. IPA therefore serves as a particularly useful methodology for investigating topics which may be ambiguous, complex or considered as inferred in operation (Smith & Osborn, 2015) and it is noted that IPA is a useful approach when the area of interest is under-researched. At the time of writing, there is minimal epistemologically based research within the fields of multi-pitch rock climbing and winter mountaineering. Research into vertical and extended horizontal caving is non-existent and therefore the gaps in research are evident.

The author is an experienced outdoor practitioner with certifications in the domains of caving, rock climbing and mountaineering, which is recognised as crucial in comprehending the participants' experiences. Importantly, without an in-depth knowledge of coaching and leadership practice in these domains, the essential value of the actions and behaviour of the participant in action may be meaningless. In short, the views of the researcher aid in shaping and comprehending data. This established rapport is valuable in that it facilitates openness and honesty throughout the process between the interviewees and the researcher who understands the demands of their working practice (Sparkes & Smith, 2009).

Reflecting a pragmatic research philosophy (Kaushik & Walsh, 2019) and the relatively small size of sample, this was research *with* rather than *of* the participants (Reason, 2006), which acknowledges that trust, rapport and a common frame of reference are integral to the research of this kind. The epistemological beliefs of the participants and how they relate to session design and delivery were explored by combining an initial pre-session interview, an observed coaching session, followed by post-session interviews. Audio and video files were digitally recorded and augmented by field notes, which were utilised as the primary data collection methods and to aid in recall.

3.4.2 Participants

The participants for the study (n=9, seven male, two female) were high level ASPs based in the United Kingdom (*M*age = 48.6 years, caving instructors (n=3), winter mountaineering instructors (n=3) rock climbing instructors (n=3)). To ensure sufficient domain expertise, experience and inherent quality in terms of self-reflective ability, purposive sampling (Silverman, 2013) was employed based on the following criteria:

(1) A minimum of 10 years of practice following senior accreditation.

(2) Accredited as holder of the Caving Instructor Certificate (CIC), Winter Mountaineering and Climbing Instructor (WMCI) or Mountaineering and Climbing Instructor (MCI) awards.

(3) A willingness to 'unpack' and discuss their professional practice.

(4) Being well regarded by their peers and the community of practice.

(5) Geographical and timeframe availability.

In total, the participants for the study had a combined accumulated experience of 156 years following senior level accreditation, with a mean of 17.5 years. This does not account for the accrual of significant previous experience and gaining of knowledge over an extended timespan as each worked through their preceding consolidation periods and qualification levels. In the absence of more effective or objective markers, the guidelines for selection criteria were consistent with the approach used by Nash et al. (2012) in their work parameterising coach and leader expertise. There is confidence that this group represented 'high levels' and good practice. Steps were taken to ensure the anonymity of the participants, performers or other significant people involved in the study and guard against the potential for deductive disclosure.

It is worth noting that this research took place across the spring and summer of 2019 which coincided with the timing of the awards' designation change within Mountain Training UK (MTUK), which is the overseeing awarding body for climbing and mountaineering certification. The certification titles were changed to better reflect the role and remit of the qualified climber and mountaineer. However, within the caving domain, the role and designation of the 'CIC' remains unclear to the non-specialist. Participant demographic and relevant qualification data are included in Table 3.2.

Table 3.2 Summary of participants

Participant code	Gender	Age	Qualification	Age Gained	Years held
WMI1	M	43	WMCI (MIC)	31	12
WMI2	M	52	WMCI	29	23
WMI3	M	44	WMCI	27	17
CI1	M	49	CIC	30	19
CI2	M	44	CIC	29	15
CI3	M	56	CIC	38	17
RI1	F	47	MCI (MIA)	30	17
RI2	F	50	MCI	35	15
RI3	M	53	MCI	32	21

Key: WMI-Winter Mountaineering Instructors, CI- Caving Instructors, RI- Rock Climbing Instructors

3.4.3 Procedure

Following ethical approval and informed consent, interview guides were designed for the pre- and post-session interviews, which are displayed in Table 3.3 and Table 3. 4.. In addition, cognitive pilots were conducted (Kartoshkina & Hunter, 2014) with a representative sample (n=2), and adjustments were made to three questions to improve clarity before data collection.

3.4.4 Pre-session Interviews

The approach aimed to facilitate an insight into the philosophical stance of each participant as it related to their coaching and leadership practice. These openly structured interviews varied in length from 49 minutes to 87 minutes (mean 58 minutes) and commenced after a short rapport-building conversation. Key points were presented to encourage the participants to speak candidly and freely. Prompts were used to foster the elicitation of specific examples from their professional lives and to promote reflection on their philosophical position. The guide (Table 3.3) scaffolded the process to encourage a richness, depth and breadth of response through a free-flowing dialogue that allowed emergent themes to be explored in the participants' own words, thus serving as a functional platform for the IPA (Brocki & Wearden, 2006).

Table 3.3 Pre-session interview schedule

Question	Probes / stimuli	Purpose
How long have you been working in the outdoors?	Formal settings. Non-formal settings. Other ASC disciplines. Other non-ASC activity areas /explore general background / scene setting.	Opens definitions and meaning of ‘coaching,’ ‘leadership,’ ‘professional’ etc.
What is your professional identity?	According to role. According to the awarding body. Personal identity.	Explores ontological and epistemological underpinnings.
What do you feel are your key qualifications / experiences that underpin your practice?	Education / training background. Education background. Training and CPD. Sources of knowledge.	Helps explore reflective practice. Begins to unpack qualifications against experience. Personal view of ‘where they are at’.
What are your key attributes that enable you to be a professional working as an adventure sports coach / leader?	Experience. Health and fitness management. Continued training / updating. Attitude to continually improve. Awareness of how risk and challenge are used. The value of role modelling. ‘Professionalism’. Personality.	How does professionalism manifest itself / what makes them good / well respected?
Are there any personal or professional factors that enhance or limit your work?	Keeping injury free / healthy. Mental health / getting scared. Time management. Logistics. Conditions. Bodyweight management / fitness. Flexibility. Injury. Equipment.	Concerns of career longevity. Exploring links to being skilfully independent in the professional environment. Exploring links to remaining skilfully independent in the professional environment.
Where do you (or have you) gained knowledge about leading and coaching in outdoor adventurous contexts?	Formal / informal balance. Changes over time? Why? Intelligence (IQ / SQ / EQ).	Explores sources of learning. Previous successful learning (other domains). Development of a philosophy / EC?

Consider your attributes and skills which allowed changes in your coaching practice or beliefs?	Openness to continued learning. Flexibility / adaptability. Recognition of crucial / pivotal moments.	What does it take to make the changes / 'keep pushing'?
How do you manage or value the risk and benefits in your work?	Critical self-reflection. Is risk exploited / harnessed or avoided? How does this change according to the day / mood / group / weather / conditions? Risk periodization? Skill 'portability quotient'.	Relate to ontology. Developing epistemological stance. Develop autonomy for clients own future learning / adventure.

3.4.5 Session Observations

Augmenting the pre and post-session semi-structured interviews and steered by the participant, in-situ discussions and field observations were used as a valuable source of data (Nicholls, Holt, & Polman, 2005). Each observed session was recorded utilising an unobtrusive chest mounted Hero7HD GoPro camera worn by the researcher. Time-referenced field notes were recorded on a waterproof notepad. In-situ conversations (Purdy & Jones, 2011) which occurred throughout the sessions were either recorded as field notes or on a Dictaphone as the environment dictated. The video recording and field notes were specifically utilised to accurately capture the detail within each practical session and aid recollection in the post-session interview.

3.4.6 Post-Session Interviews

The approach aimed to facilitate insight into the coach's practice, namely the 'how and why' of the practical session and the thinking underpinning their actions. These openly structured interviews varied in length from 24 minutes to 49 minutes (mean 38 minutes) and commenced as soon as practical after the observed session (see Table 3.4).. The question and prompts were utilised to encourage participants to speak openly and freely and to facilitate reflection on the session.

Table 3.4. Post-session interview schedule

Guide Questions	**Probes / Stimuli**	**Purpose**
How did it go?	Purposefully generalised to ‘relax’ into the interview. More of what and less of what? According to plan? Plan used /abandoned / not desired? Why?	Relaxed ‘opener’. Evidence of reflection. Use video to unpack the ‘act-on’ moments.
What parts of the session went well?	What supported this success? ASP performance? Conditions? Intuition? Experience? Familiarity? Knowledge? How do you continue to build on this? Why?	Evidence of differentiation. Act / store / ignore?
Were there any parts of the session you feel went less well?	What led to this feeling? ASP performance? Conditions? Intuition? Insufficient experience? Lack of familiarity? Information / knowledge (of students)?	Reflection in self-critique. Use of markers or key points against which to gauge. Lack of evidence of differentiation / client specificity.
What do you think were the key / pivotal moments of the session?	Range and scope. Timings. Safety. Risk management / utilisation. Changing conditions. Tuition vs. Intuition? Value of TTPPEE.	What are the main foci of the ASP? What does the ASP place value on? Explores the ‘6 Strands’ (*tactical, technical, physical, psychological, environmental, equipment*).
On reflection, what would be changed in future to improve the session?	How do you know? What informs this decision?	Levels of theoretical underpinning Value of reflection.
Did the session work against the stated aims and objectives?	Was there a void between the aims and objectives and the working practice? Why? Were there differences between the stated ‘aspects	Explores sources of learning.

	of good teaching' and that videoed (ASP in action)?	
Why did you choose to intervene or not to intervene on the occasions you did?	Why? Agency / autonomy. Responsibility for own learning. Lack of perceived risk.	Explores the bigger picture re' the EC. What does the ASP respond to?
What type of style or approach did you use?	Are there any models in mind? Where or how has the professional education taken place? Current / in the past / ongoing?	A balance of methods? Opportunities / agency to change session direction.
When and where is the real learning taking place?	Why /according to what? Does this relate to the epistemology or ontology as discussed at initial interview?	Explores any epistemological void.
Who is in charge of the learning?	To what level is this deemed important?	Relatedness to agency.
What do you feel about the level of risk within the session?	High / low? Good / bad? Why? Purposeful / perceived / subjective / objective?	Explores the 'TSC / ASC' factors and background.
How does the coaching observed in this session relate to what may have happened in the 'early career' stage, and to what may be viewed as aspirational in the future?	What is considered 'development' or progression within the journey of the ASP? Why?	Reflection / awareness of professional development in relation to epistemological stance / chain. How are the PJDM components developed?
How are the balances or ratios between 'what and when' to 'how and why''?	Is there evidence of a naïve or sophisticated epistemology (simple to complex)?	Insight into Schommer's' (1994) spectrum.
Proceduralised / mapped out or working to the needs of the students?	Does this show up in the planning or is it emergent?	Proceduralised practice and declarative knowledge in action. Relying on session plan vs. emergent approach. Scope for dynamism / fluency.
Risk manipulated and harnessed for purposes of learning and decision making, or avoided?	Does this relate to the background or other disciplines of the ASP? How does this relate to the epistemology or ontology as discussed at initial interview?	Exploring role of risk in the work of the ASP/ Importance of the EC.

The range of data collection methods supported a complete session picture (Cohen et al., 2011). Following each episode, interviews were digitally recorded and later transcribed verbatim and without prosodic detail.

3.5 Data analysis

The transcribed texts and audio were studied and corrected to ensure accuracy and then repeatedly reviewed in line with the IPA procedures suggested by Smith et al. (2012). The text for each interview was read whilst listening to the original digital recording thus facilitating a complete analysis (Smith, 2012, p. 82). The text was considered in terms of common recurring and underlying themes while recognising the hermeneutics involved when reflecting on the main themes recounted and observed from the three data collection points. As themes emerged, they were grouped and categorised as raw data, sub-ordinate and super-ordinate themes depending on the frequency of occurrence, relationship, content and context.

The authors' experience was exploited to interpret the participant's actions in light of their interview responses and a reflective commentary was maintained throughout the process. During analysis, the role of personal experiences and values were accepted (Smith et al., 2015) and forms of external and internal member checking were utilised (Iivari, 2018; Sparks, 1998) in acknowledging researcher bias. For example, a colleague with no involvement in the study but significant experience in adventure sports provided a sense-check of both the realities of the research and the researchers' interpretations of them. In plain terms, an additional researcher was included to add quality and interpretative depth (Braun & Clarke, 2019). Participating coaches and the author provided internal checks by reading the transcripts before analysis. In cases of disagreement, the author returned to the original transcript and discussed the coding with the additional researcher until a consensus was reached.

3.6 Results

The initial analysis recognised 605 codified units which were then grouped into 64 raw data themes, and subsequently organised into 13 subordinate themes and four supraordinate themes, as displayed in Table 3.5. These were: (1) Creating an authentic learning environment, (2) The role of challenge, risk and adventure, (3) Professional practices employed, and (4) Adaptability and flexibility. In accordance with the guidelines of Smith et al. (2012), examples from at least 50% of the participants have been included and direct quotes of varying lengths utilised where appropriate to support the depth and richness of the data.

Table 3.5 Results

Supraordinate themes	Subordinate themes	Raw data themes
Creating an authentic learning environment.	Short term and long-term goals.	Asks and questions rather than tells.
		Learner centred / differentiated.
		Coaches for independence vs. guided experiences.
		Utilises and values learning from peers / the Community of Practice / CPD.
	Working to client needs.	Deploys range of core coaching tools.
		What is coaching?
		‘Sits on hands’.
	Concepts and transferability.	Learning portability / transferability.
		Challenges the orthodox.
		Judgement vs. procedure.
		‘It’s more than either qualifications or experience’.
		Humanistic approach > positive human development.
		Audits of performance of teaching and learning through questioning.
		Develops coaching practice over time.
		Empowers the learner.
		Uses loose parts theory / units.
		Promotes typical behaviours.
		Facilitates space for practice.
		Informs and offers decision making power to clients.
		Adapts due to client capability / environmental dynamics.
Challenge, risk and adventure.	Reflection.	Importance placed on the role of adventure.
		Aspects of challenge and risk used.
		Risk vs. benefit approach adopted.
	Engaged with and by challenge.	‘Risk periodisation’ considerations.
		Engaged by decision making complexity.
		Progressive and managed exposure to risk.
	Mastery and control.	Mastery rather than risk seeking.
		Breadth of experience and environments.
		‘Intuitive’ decision making based on strong foundations.
		Lifelong involvement and belief in adventurous outdoor learning.
		Learning from ‘close calls’.
Professional practices.	Sources of information and knowledge.	Development of cognitive space aided by pre-preparation.
		Confidence to ‘let it run’.
	Intuition and experience.	Lifelong learning – remains open.
		Fine-tuned time management.
	Reflection in-action and post session.	Reflection in-action and post session (recognises errors).
		Interplay of roles – right role at right time.
		Actively keeping fit/ managing bodyweight.
	Independent performer.	Need to perform at appropriate level in the present.

		Professionalised approach, especially in pre-preparation and gaining of information. Honest and open with clients. Lyme Bay / Cairngorms catalyst. Intuition linked to experience. Control of fear / anxiety. Mental and physical resilience. Reputation and credibility. Identity via qualification. Interplay of terms unhelpful but behaviours inseparable. Prompt decision making from a range of alternatives. Challenge of environment.
Adaptability and flexibility	Skilful interplay of roles Reality of consequences Complexity in risk vs. benefit decision making	Uncertainty of outcome requires adaptable approach. Safety of ASP occasionally depends upon client. Significantly variable conditions. Dynamic thinking. Skills to deal with most environmental constraints (above level of award). Constructive collaboration of coaching and leadership. Requirement to change roles promptly (e.g., to maintain momentum on adventurous journey / coach > /< leader). Accentuated nature of specific environments. Positioning crucial. Significant (overwhelming) range of tasks. Genuine, natural environments. Unrelenting conditions for extended periods. Operation in consequential terrain.

3.6.1 Creating an authentic learning environment

Several authors have highlighted the significance of the physical environment while coaching adventure sport (Christian et al., 2020; Collins et al., 2012). The findings of this chapter support the significance of situational comprehension of the physical environment. As RI 3 stated:

> The poorer the likely conditions, the more forecasts I look at in advance of the day. I do my best to ensure I can offer them a decent session by finding somewhere out of the worst of it that still works.

And continues to say, "*you really need to know plenty of places that work in a really wide variety of conditions that match the aspirations and abilities of your group*."

RI 1 supports RI 3 and highlights the depth of knowledge required of local conditions and venues by ASPs, which supports findings regarding the high level of situational comprehension required to offer an appropriate learning environment (see Boyes et al., 2019; Collins et al., 2020; Mees et al., 2021; 2022.) As he states:

> …what a day! – I had this gut feeling that Dinas Cromlech would dry up and be in the sunshine as we got kitted up. My client was well chuffed to be on this amazing mountain crag with no-one else there – it meant he could learn lots in a brilliant context!

Creating a safe, positive learning environment links to a clear understanding of the needs and wants of the client, and the situational demands beyond just situational awareness, echoing the findings of Mees et al. (2021, 2022). Of particular focus is managing the anxiety caused by the perceived risk and its potential impact on client learning. RI 2 confirms "*…most of my clients are pretty fit, but the one thing that trips me up sometimes is their 'fear monkey' – it's the psychological stuff I really have to be on top of."* WMI 3 elaborates on the point:

> There is absolutely no point in me trying to work with my client if I have scared them – it just doesn't work and at any rate, they wouldn't book with me again. I put significant effort into communicating with them beforehand to make sure we really nut out what they want or don't want. Really important if they want to be taught and to learn or prefer me to guide them.

There is clearly a judgement made regarding the level of real risk and potential benefit to the client: namely the risk-benefit decisions that Collins and Collins highlighted in 2014. WMI 2 discusses the concept of learning through shared decision making. Having an insight into the decision making process and creating a shared mental model of practice was viewed as beneficial. This aspect reflects a cognitive attribute to adventure performance that may differ from just the physical performance. Decision making reflects the focus of the ASPs on generating independence, as highlighted by Eastabrook and Collins (2020; 2021) and echoes Eastabrook's queries regarding the appropriateness of the skill acquisition models espoused on NGB coach development programmes.

As WMI 2 states:

> I check their level of understanding of what we could be doing but also their readiness to accept the risks or not of that particular day. The winter environment can be very unforgiving. Shared understanding is necessary, especially on winter mountains… I offer my thought process and ask what they might do, so I know they should be safe independently of me.

In addition, engaging the client in the process assists in a shared and mutual agreement of any group and individual goal setting. CI 3 highlights the availability of options available to ASPs as ‘loose parts’ or discrete functional units (Nicholson, 1972), which are presented as technically focused, closed skills. CI 3 states:

> I think it’s far better for me to offer them a range of transferable bits and bobs. Concepts, almost, rather them tell them ‘do this then this’ because the situation in a complex cave is unlikely to be the same next time. They need to work it out themselves, although underground SRT techniques are either safe or not.

CI 3 offered a range of practice options in a realistic learning environment but actively chose not to engage in more complex coaching. This appeared as a rather utilitarian passage of technical information and demonstration. CI 1 and CI 2 also shared this practice. The adaptation, application and combination of these loose parts and functional units being left to the learner in a safe environment. Such an approach requires the CI to have a good comprehension of how these parts may be combined in different applications and contexts; the adaptive expertise noted by Mees et al. (2019), rather than simple replication. This also requires a sophisticated epistemological position, one in which knowledge is constructed rather than simply imparted. In short, developing the concept of doing the right thing in the right place, at the right time with the right people (Mees et al., 2021). It seems essential that these functional units also have the capacity to be interchangeable and the ability to be interlinked with other parts; a point that to the knowledge of the author is not noted in any other research.

Reflecting earlier studies by Eastabrook and Collins (2020), the participants in this study placed value on ensuring the learning environment was safe, enjoyable, appropriately challenging and authentic.

The term of authenticity is possibly overused in the literature and its' complete meaning unclear, thus requiring further investigation. The importance of managing a contextually accurate learning environment is evident as a recurring theme across all supraordinate themes which supports an epistemologically sophisticated position.

3.6.2 Challenge, risk and adventure

The participating coaches embraced and manipulated levels of risk (West & Allin, 2010) as an integral aspect of the activities and an essential aspect of learning (Collins & Collins, 2012). In retaining this authenticity through considered exposure, it becomes necessary for the ASPs to harness and exploit the nuances of risk rather than attempt to simply remove or completely mitigate it. As WMI 1 states:

> Working in risky environments with clients is very engaging and to be honest I enjoy the complexity in the decision making. As the saying goes 'ships are safest in the harbour, but that's not where they are designed to be.' I think we all get a bit of a buzz from pushing it a bit, but ultimately, I have to be safe enough and retain some control.

WMI 1 reflects on the enjoyment derived from leading and coaching, relishing the challenge of the complex decisions and professional environment in relation to risk management and exploitation. There is a difficult balance of providing authenticity whilst ensuring the client remains 'safe enough' to learn. A nuanced and complex decision given that safety is a legal requirement (Eastabrook & Collins, 2020). As an example, there is a risk of falling from height associated with any activity around a steep icy slope or rocky edge, but the likelihood of a fall can be managed by selecting a particular environment. In this case, one which promotes the development of individual ability, specifically with skilful movement over the terrain and being more balanced over the feet. It is the likelihood of a fall that is managed rather than the consequence, where the inherent level of risk is managed by reducing the likelihood. This differs from those required of ASPs when in a guiding role where the subtleties of predicting and gauging arousal levels then matching to learning potential is not required. As CI 1 suggests:

> In my last job, we were brought up on the 6 or 7 HSE steps to risk assessment. Utter nonsense in my book. The vertical caving environment is so complicated and variable that there is no time for all that – it has to be within you somehow where you just….'know.' Is it intuition?

While CI 1 alludes to intuition, the interviews suggest an identifiable cognitive aspect to the learning and decision making process. CI 2 describes:

> Managing risk and working with risk is all about decisions – I don't think I'm paid to teach knot tying or SRT as it's not really that hard. I think I earn my money by making the right calls at the right time. In a cave it's about whether to push on or not, or to understand how somebody is doing as most of the time we cannot just walk out.
>
> and
>
> …most of the time it's that risk / benefit thing. Should I allow things to push on a bit given the learning that it will give them? The issue is that on a wet pull-through trip for example, we have to complete it within certain timeframes, and I need to balance their learning against 'cave system' safety aspects.

CI 2 seems to acknowledge the significance of decision making, similar to the studies of Collins et al. (2018) with mountain leaders. Intuition is certainly appealing as a descriptor in its simplicity given their experience. However, intuitive decision making is rare and is more likely to be orientated to specific experiences and the frequency of decision making opportunities in that context which are reflected on. The more that ASPs use decision making processes, the easier they are to access and this decision making appears to improve (Collins et al., 2016). In CI 3's case the cognitive aspect suggests that it is more naturalistic than intuitive. Decision making seems swift because of easy access to naturalistic processes via recognition primed and heuristic development, which is a key factor in differentiating expert versus non-expert cognition (Klein, 2015). WMI 1 sheds further light on his decision making process and states:

> Working in a winter mountaineering context places big [*cognitive*] demands on me from the conditions, the weather, the clients getting tired or anxious, me delivering the right session, getting off the hill before dark etc. etc. Over the years I realise that I have to make

a series of ‘good calls’ rather than top notch or perfect calls. The main thing is just not to make any bad ones!

This highlights the potential for a series of sub-optimal decisions that are clearly synergetic, where classic decision making and naturalistic decision making are ‘weighted’ and biased according to context. A choice of teaching approach that facilitates rapid skill acquisition may be suboptimal from a longer skill acquisition perspective. However, it may be highly appropriate when a skill must be applied rapidly in a safety critical context. Kicking steps to cross an unexpected snow patch en-route to a rock climb in the early spring for example. Although recognised as a causal chain in accident planning or review, WMI1 suggests a readiness to acknowledge a series of best-fit or sub optimal decisions as part of a safety chain much less than a single ‘grand safe decision.’ The implication being that a chain of bad decisions cannot be compensated for with one good one. In the context of adventure sport, this aspect deserves further investigation.

Most of the participants report an overwhelming weight of decision making and cognitive loads associated with their practice, particularly whilst operating in complex environments commensurate to the levels of certification. Reflecting the work of Webb et al. (2020) these participants also identified that situations of uncertainty present the greatest learning potential for the ASPs. The challenge being that although most learning appears to take place through “bad calls” (WMI 1) and “having epics” (CI 2) there is a cognitive cost to working in dynamic and risky environments. RI 2 manages the cognitive load whilst still ensuring the challenge and adventure remain a core part of her work, and states:

> I just try to keep them in that corridor – the one between being scared or bored - feeding in a few more components or building blocks of the skills they’ll need to use and then I’m orchestrating a situation where they have to use it… a bit like teaching how to take a bearing and then going for a walk in the fog!

RI 2’s analogy has links to Vygotsky’s (1978) concept of the Zone of Proximal Development and thus perhaps a cognitive apprenticeship. It also implies a bandwidth method as a pro-active coping strategy, supporting the cognitive load studies of Collins and Collins (2019). RI 2 is modest and underplays the complexity of balancing the rate of skill acquisition and exposure to risk, which echoes the work of Christian et al. (2017, 2020) in discussing the epistemic beliefs and behaviours of high level

ASPs. However, despite the extensive experience of the participants, in terms of a 'risk quotient,' not all days feel the same. WMI 3 concedes:

> Some days I feel pretty 'on it' and I'm happy pushing it with a group, providing they are up for it too. Other days though, I just don't want to manage the risk. I feel OK in myself; I just don't feel like having a 'risky day' if you know what I mean?

This managed exposure to risk is mentioned briefly by two other participants (WM 2 and RI 3) which suggests a meta-aspect to the ASPs' decision making process already identified by Collins and Collins (2019). This warrants further investigation as in their research the authors could not decide if this cognitive resource was "*ringfenced or acts as an overdraft*" (p.10). Clearly, overdrafts must be repaid. All the participants promoted a positive view of challenge and adventure with most citing a love of the outdoors and adventures from an early age, conferring a subsequent close lifestyle and professional relationship. Integrating challenge and adventure into pedagogical delivery suggests a sophisticated epistemological stance (Christian et al., 2020; Schommer, 1994) supported by the risk versus benefit approach cited by several participants. This may best be considered as an ontological position given the interaction which helps to shape the participants' worldview and subsequent behaviour. WMI 1 sought to challenge the notion of being a risk taker stating that he sought mastery in demanding environments and managed risk appropriately as part of the greater experience, corresponding directly to the findings of West (2012). He states: '…*contrary to what is publicised, we tend to be control freaks rather than thrill seekers or adrenaline junkies.*'

3.6.3 Professional Practices

While coaching and leading, a student-centred approach was predominant. Physical and cognitive space for practice was commonly offered and some (CI 1 for example) removed themselves from the practice area once satisfied the client was safe. CI 3 states:

> …in a vertical caving environment once they have got the gist of it, I kind of hide round the corner a bit – I want them not to be able to talk to me. I think it's for their independence in that I 'won't be there' next time, but it also gives me a second or two to plan ahead.

Both CI 1 and CI 3 recognised and articulated the need for independence, reflecting the findings of Eastabrook and Collins (2020). RI 1 relates a similar consideration in a rock climbing environment and states:

> …to be honest, I don't need the practice – they do. I make a conscious effort not to intervene providing they are safe – I will have already told them that. 'Sitting on my hands' is weird in that I am being paid to lead but they need practice space. If time is pressing and it's cold and wet and they're fumbling I will offer to help, but I still try not to take over.

Refraining from intervening wherever possible to maintain the practice space was considered important by both R1 and WMI 2. Although RI 1 mentioned the necessity to '*sit on their hands*' and WM 2 used the expression of '*letting it run'*, other participants expressed similar sentiments using different terms. How the expert learns to distinguish between opportunities to let it run or a need to intervene is unclear and worthy of further investigation. This may be indicative of coaching decisions that align to a sophisticated epistemology (Christian et al., 2020) presumably in recognising and anticipating skills development, the construction of knowledge and its application regarding levels of risk.

The knowledge and confidence required to identify and balance benefit with risk and refrain from unnecessary intervention seems unlikely to be developed on NGB training and assessment courses. This is due to the focus on risk assessment and risk management rather than coaching or leadership, allied to short course timeframes and congested, technically orientated syllabi (British Canoeing, 2022, Mountain Training UK, 2021).

It seems most likely to be a product of reflection on experience, presumably also involving poor judgments and errors. In short, letting situations unfold that should not have been allowed to continue. This '*watchful neglect*' (Collins & Collins 2016, p.7) has been identified by other authors to develop independence in practice, and also learning (Martindale & Collins, 2012; Schön, 1983). It requires expert supervision but presents as a source of dissonance in co-tutored sessions and is proposed as a tactic to create time for reflection on-action and in-context. RI 2 describes this as a chance to '*to recharge'* implying comprehension of a cognitive reserve.

Notably all ASPs demonstrated an ability to select from a large range of options quickly and to '*pull it down to the proper few*' (CI 1). This supports the findings from other studies on option choice by experts (Collins & Collins, 2019) and supports the suggestions of Christian et al. (2020) regarding the range of teaching styles being an important characteristic of coaches with sophisticated epistemological positions; a characteristic of the epistemological chain. Inexperienced instructors present a potentially overwhelming array of options (Mees et al., 2021), many of which the expert has already discounted in the distilling process. The use of these contextual priors (Gredin et al., 2018) is a strategy that aids in managing the cognitive resource. In common with other ASPs, the cognitive resource is further safeguarded by prior planning and preparation for the activity, reducing unrequired or expected demands. As WMI 1 suggests "…*given where we operate, having your weather forecasts, avalanche conditions and kit together the night before is important. Very, very important*." WMI 3 concurs and states:

> …it kind of gives me the space in my head to make the harder decisions when we are out on the hill, often in a blizzard! - Last thing I want to worry about is whether or not I have a map and compass in my jacket in them conditions.

This supports the PJDM theory that although the decisions are nested, classic decision making processes are predominant in the planning and review of activity, while naturalistic processes are predominant in-action (Collins & Martindale, 2012). More importantly, the strategies of the expert ASPs facilitate time to consider and then select from a full range of pedagogical and practice opportunities according to context.

All of the participants expressed eagerness to continue learning throughout their careers, relating it to their community of practice and own professional development. As RI 2 stated:

> …although I'm a bit of an old timer now, there's still loads to pick up. We do have professional type get-togethers, but social media and the various climbing forums are brilliant. I pick up technical tips, but the best part for me is the keeping on top of conditions and changes.

It seems likely that RI2 also applies a degree of professional criticality to their knowledge sources, though Cushion, et al. (2022) caution that this may not always be the case.

3.6.4 Adaptability and Flexibility

The professional environment of ASPs is typically natural and unmanaged. It is susceptible to changing conditions that are unrelenting and where poor conditions need to be tolerated over extended timeframes. Christian et al. (2020) suggests such settings promote the development of sophisticated epistemic beliefs and the resultant chains which connect them to practice. In AS environments the safety of ASPs is occasionally dependent upon the client, especially in multi-pitch climbing scenarios. WM1 notes:

> There have been two occasions when I have fallen off lead-climbing where my client has caught me – they thought it was great and genuine and I was pushing the adventure a bit! They wanted reality rather than a 'sterilised' experience of a climbing wall which is what they got!

Although the pre-planning and venue considerations are accorded lots of thought, there is certainly a need to have alternatives given the dynamic nature of working outdoors in real environments. RI 1 states:

> Although I have a fairly good idea of what I want to do with the day, sometimes it goes nothing at all like I thought it would 'cos either the venue I chose was busy or not right, as in being too greasy to safely climb, or the weather bore no resemblance to the forecasts!

But qualifies "*…you know what, those ones are often the best sessions of all. I usually tell my clients that we are kind of 'working off reservation' but they come for the adventure too."* The theme of being flexible in the working environment given its propensity to change, and that such uncertainty of outcome requires an adaptable approach is echoed by RI 3, who talks in terms of interplay of roles but also making tough decisions:

> I don't get hung up on instructor, guide, teacher, coach, or whatever, I just work with what it says on my ticket. I do know though, that the knack is making a quick change from one role to another – I know to be patient and more 'hands-off' when I'm teaching but if we need to get along a wintery ridge and time is short, I'll have no qualms about dropping any coaching aspirations.

All ASPs within the study indicated the prompt need to access skills in-action which exceed those tested at the assessment stage of their respective awards. This is understandable given that at the time of assessment the assessor has to be able to guarantee the safety of the personnel involved with that process. This does however demonstrate a misalignment with the range of demanding conditions encountered post-assessment. As CI 2 reports:

> You might have a caver injured at the bottom of a pitch through rockfall and you have to be 'on it 'immediately…. a billion things whizz through your head. You don't go through this properly on assessment. Really, this decision stuff should be covered by an expert as part of training because it all relates to how you lead and coach, I think.

Table 3.6 is offered as a summary document of the factors which describe the epistemological chain and position of the sample of ASPs. It offers an overview of the PJDM behaviours from session initiation to goal setting and review. It is a précis of the understanding acquired through the range of formal and informal data collection methods utilised across the three adventure sport domains.

Table 3.6. Epistemological position of the high level adventure sports professional

Stated Epistemological Chain	Epistemological Position
Epistemological and ontological stance.	Client centred and adventurous. Comprehension that knowledge is both time framed and context bound such that knowledge and understanding can be generated in numerous ways and in a variety of formats. Knowledge flows in a range of directions, not just from 'instructor' to 'client'. An openness to learning appears to be maintained irrespective of experience and qualification. Experiential approaches to continued development and knowledge generation facilitates transfer, aids longevity and creates valuable ownership of learning. Ontological position is one of significant accrued experience, a close lifestyle /professional interaction resulting in a positive view of adventure and an informed appraisal of risk for the purposes of learning and growth.
Relationships.	Based on understanding the needs of the client and the extent to which they wish to become skilfully independent. The nature of consequential environments and a positive view of adventure encourages supportive professional relationships with challenging yet caring and supportive behaviours. Leadership methods promote agency and practice in decision making Recognition of prior capabilities and transferability of skillsets into new domains. Clients frequently become friends as a result of the shared experiences in adventurous settings.
Planning process.	Significant time spent in planning and preparation stages, especially the cavers and winter mountaineers which presents as very frontloaded. Communities of practice used in the planning stages. Greater likelihood of using well known venue the poorer the conditions or potential for client over-representation of capability /experience. Clients involved in the planning process when appropriate as part of the cognitive apprenticeship to gaining skilful autonomy in the domain, and to gauge their level of perception of the environment in which they will be operating.
Practice and learning environment.	Learning environment created by particular choice of a multi-purpose venue which facilitates task differentiation and a range of learning opportunities. Seeks to maximise varied practice opportunities unless environment contra-indicates, rather than focus on direct imparting of information / teaching, with conscious efforts to avoid intervention during practice. ASP utilises a 'soft' plan – one that is designed to be robust but reconfigured as information is accumulated or verified. Open discussions between ASP and clients to decide learning outcomes and optimum design of session and locations. Refined ability in venue selection and importantly, deselection.

Session aims and delivery strategies.	Decided in discussion between ASP and client(s), routinely in advance of session. May purposefully decide to use behaviours and actions from across the full range of Schommer's (1994) naïve > sophisticated spectrum, or teaching styles from either end of Mosston and Ashworth's (1990) spectrum of teaching styles. Experimentation and repeated practice opportunities in safe parameters and guided discovery opportunities evident, with rapid coaching and developmental progressions utilised. Consent given if requested by clients to utilise the ASP in a synergised coaching and guiding capacity to support their outdoor endeavours.
Cognitive load management.	Planning very carefully considered to aid in balancing the weighting and ratios of CDM and NDM demands. Skilful strategies utilised to gain small pockets of time and space away from group to aid in the management of the cognitive demands of task, environment and individual requirements (welfare and pedagogy).
PJDM in-action.	Judgements based on the progress the client has made towards their chosen goals in that domain. Decisions made in a collegiate manner with discussions about available options designed to promote understanding of environmental constraints and affordances. Flexibility in delivery driven by dynamic nature of environment and in balancing a range of factors.

3.7 Discussion

The results demonstrate that this group of UK-based caving instructors, winter mountaineering instructors and rock climbing instructors are adaptable and flexible in both session planning and delivery, adding further support to Mees et al. (2020) among others, who identified outdoor instructors as adaptive experts. Furthermore, the results indicate that the epistemological beliefs of this group of outdoor professionals link to their practice via an identifiable epistemological chain that is manifest, in part, by the use of a broad range of teaching approaches which in turn is indicative of an adaptive expertise (Christian et al., 2020; Collins et al., 2014; Mees et al., 2020). This finding has a clear implication for the manner in which ASPs are trained and developed (Christian et al., 2020; Collins et al., 2014) given the lack of awareness in how the EC links to PJDM in-action.

The first novel finding is the existence of this link in the caving instructors, winter mountaineering instructors and rock climbing instructors and their practice, in addition to the ASPs already studied by Collins et al. (2014) and Christian et al. (2017). Further, it is possible to say that the coaches have a broadly sophisticated epistemological position (Schommer, 1994) which is informed by three factors:

(1) The nature of the working environments supporting the assertions of Christian et al. (2017).

(2) Their aim of developing an independent performance, which supports the findings of Eastabrook and Collins (2021).

And the second novel finding,

(3) The nature of the skills coached, namely closed skills such as safety-critical techniques which differ from the open and cognitive skills, such as movement over the terrain.

It seems likely that these three factors operate in a synergy in which the environment affects both technical requirements and safety, which in turn also relates to the possible degree of independence in that given location at that given time with the learner's skill level. In these cases, each ASP recognised that safety skills might need to be taught in a directive or coach-led manner which may outwardly appear as being drawn from a naive epistemological position. When in fact, it is the context and security implications that dictate such an approach and a choice by the coach. This practice enabled independent, safe practice in which the learners constructed their comprehension of the skill and its adaptation to the task and environment.

The rock climbing instructors emphasised movement over the rock face in addition to the technical safety skills, on the basis that better movement equates to less likelihood of falling. This emphasis should be seen in the context that a natural progression for most climbers is to lead-climb; namely to be on the ‘sharp end’ of the rope. The winter mountaineering instructors however, offered fundamental movement coaching with the tools of ice axes and crampons to secure safe and efficient passage across variable and mixed terrain over an extended duration as is typical on a winter mountaineering excursion. There is a requirement to guard against falling on a similar basis, though this incorporates the skilful manipulation of those tools as an added dimension.

However, the caving instructors offered no movement coaching but plentiful technical input. Whilst using single rope technique for example, there was a justifiable focus on the technical rope work, which is more complex than that employed in the other contexts. The focus of coaching appears highly contextual and requires the instructor to have high levels of situational comprehension for its appropriate deployment. Both the winter mountaineering instructors and caving instructors appeared to be driven by environmental security demands which determine the task requirements, use of tools or particular techniques. However, the rock climbing instructors coached fluency, efficient movement over the terrain in addition to the ropework on the basis that it is better to avoid a fall rather than just teach the ropework to catch you once you have fallen. The winter mountaineering instructors and caving instructors chose to teach these closed skills directly while having sufficient situational comprehension to allow the learners to practice safely without any coach intervention following that initial input.

This behaviour suggests two points. First, an approach that allows the learner to construct their comprehension of the techniques taught and their adaptation to the context that can be facilitated via a range of teaching styles once the learner has experience of more learner-led tuition. Second, a level of situational comprehension that predicts developments in the learner's performance and changes to the environment that enables safe, independent practice. The coach's approach does not preclude their sophisticated epistemological position or the chain of rationalised and logical justification to their practice. The behaviours of the winter mountaineering instructors and caving instructors outwardly appears naive but are driven by their sophisticated epistemology. Logically, the coach's choice evaluation should not be measured just on the observed outcome and requires an understanding of the decision making process. This raises questions regarding the evaluation of decision making and requires further study.

It appears likely that these professionals established their epistemological values across significant career spans. Their values being products of reflection on their own experiences in dynamic environments with clients, those of their colleagues and in their practice as active, high level outdoor practitioners. Their sophisticated epistemological stances appear to be at odds with the naïve epistemological chain (Collins, Collins & Grecic, 2014). This is demonstrated in coach education courses via structure, content and delivery, and despite NGB claims of sophisticated epistemological underpinnings (Dempsey, et al., 2022).

Reflecting the requirement for ASPs to underpin their practice with a skilful personal ability (Collins & Collins, 2012), it is contended that these reflective traits are an aspect of high level adventure sports practice. This may also explain why ASPs do not perceive themselves to be reflective, it being integral to successful high level AS participation; clearly an in-action process. Two points are raised. First, the possibility of an ontological chain, already implied by Mees et al. (2020) linking the dynamic, changing and flexible world beyond an epistemological chain and second, the possibility that the reflective tools advocated on coach development are unsuitable, being on-action rather than in-action. It would be difficult to identify if coaches with these views are disposed to adventure sports settings or if they develop these dispositions toward adaptability across a career by 'surviving' their own adventures (Webb et al., 2020).

3.8 Limitations of this chapter and further research

Reflecting the IPA approach, sample size is not a specific weakness, however participants were white, predominantly male and with an average age of almost 50 years, which is representative of these high level ASPs, and particularly caving instructors. Future research could seek to purposefully select, where possible, a wider demographic sample. Examination of early-career or mid-career ASPs such as that completed by Mees et al. (2020; 2022) with multi-activity instructors would clearly be of value. This investigation revealed the use of ‘best-fit’ decision making in which a practice is considered sufficiently safe, even if the performance is sub-optimal. This choice to accept ‘safe enough’ decisions while enabling progression and learning through safe experimentation and experience is a sophisticated call which warrants further investigation in this under-researched area.

3.9 Conclusion

The work has demonstrated that the epistemological beliefs of caving instructors, winter mountaineering instructors and rock climbing instructors link to their practice via epistemological chains. This confirms that they share a similar epistemological stance to other ASPs and confirms the decision for this to be the first study of the thesis, to serve as a comparative benchmark. It is noted that these epistemological positions are not identical and reflect the technical skills required to ensure security in each given setting in addition to the dynamic nature of the environment. The epistemological position being a synergy of these two factors. For example, the caving instructors and winter mountaineering instructors purposefully adopted coaching and leadership behaviours that could outwardly appear driven by a naïve epistemological position due to the nature of the environment aligning with the proposition of Christian et al. (2020). However, that environment also necessitates a requirement to develop closed skills promptly or on an 'as needs' basis, the purpose of which is to ensure client safety in unsafe environments. This coaching presents as being context specific and highly authentic, driving rapid skill acquisition.

It appears that ASPs hold sophisticated epistemological views and demonstrate these via epistemological chains. The epistemological position seems likely to have been developed via both reflective and reflexive processes centred on the ASPs' personal and professional experiences. Here, the environment is one of several key factors at play and includes the culture of the activity, the skills being taught and the value which the coach places on reflective practice.

The practical applied outcomes arising from this chapter include:

1. A greater understanding of the nature of epistemological chains across previously under-researched adventure sport domains.
2. That the epistemological position reflects the nature of skill requirement and operation in specific settings with a requirement for security demands in professionally demanding environments at particular times.
3. That Chapter 3 formed the foundation for a peer reviewed article which has been published in the Journal of Adventure Education and Outdoor Learning (JAEOL). The paper offers a

clear starting point for adventure professionals in comprehending the links between epistemological position, learning chains and session design.

4.1 Preface

The work of this chapter further investigates the presence and utilisation of the EC and its influence on the PJDM processes of the caving instructor (CI). It broadens the analysis and evaluation of data generated in the research of Chapter 3. In that chapter it was apposite to look at the findings across a range of adventure sport domains, but given the lack of cave based research, there is justification in further investigating the realm of vertical and extended horizontal caving. An abundance of quality data was collected but it was appropriate to use only specific sections of it within the work of Chapter 3. Although offering multiple insights, the extent of the collected data signified that a thorough examination of it in its entirety put it outside the scope of one chapter. Further utilising an IPA approach, four supraordinate themes were identified, in addition to the development of a bespoke EC for the caving instructor.

4.2 Introduction

The primary aim of this chapter is to build on the epistemological findings of Chapter 3, with a focus on the connections between experience, cognition and PJDM of the CI working in authentic contexts (Miller, Booth & Spacey, 2019). The secondary aim is to contribute to the very sparse literature base.

Given the availability of data and the initial findings, Chapter 4 is conceived as a launchpad for more detailed investigation into caving leadership and decision making, and as an evolution in research direction and thesis development. With regards to the data, interviews totalled over four hours in duration, video capture amounted to eight hours of footage and the observed caving trips themselves totalled over twenty-seven hours. Furthermore, the range of notes, in-situ conversations and comprehensive field observations aided in the construction of a full picture of the professional caver in-action. A similar abundance of data was generated in the rock climbing and winter mountaineering episodes, and equally, further analysis and evaluation is viable in those domains. However, caving has been chosen for this extension due to the accentuated nature of the professional environment allied to the paucity of writing as noted.

4.2.1 Available caving literature

Studies exist into subsidiary aspects of research within caving and human interactions (i.e., how tired or anxious novice cavers may become), but none that consider how the epistemological position and utilisation of an EC supports the PJDM processes of the high level caving professional, in this context the CI. Nor how the EP informs, drives and supports the connections between cognition, experience and subsequent action. For example, a caving group was used as a control set in a sensation seeking study within a group of mountain athletes (Rossi & Cereatti, 1993) and studies into the physiological and psychological effects of claustrophobia utilised cave environments (Lambrou et al., 2003). The physical demands and energy expenditure of cavers was studied by Pinna et al. (2017) and the damaging effect of the cave on the human body by Stenner et al. (2006). More plentiful are studies into the epidemiology of injury and fatalities (in short, how cavers come to be injured or killed). For example, see Stella, Vakkalanka, Holstege and Charlton (2015) and Stella-Watts, Holstege, Lee and Charlton (2012). In furthering the understanding of the psycho-physiological demands of caving, Tornero-Aguilera, et al. (2020) conducted their study into the stress responses of novice cavers. Although insightful, this study was based on a single caving trip of just three hours in a cave appropriate for novices. This is arguably non-representative of the challenges typically faced by the participant CIs of this study who often work in extended timeframes underground whilst negotiating more complicated and consequential terrain. In short, there is almost no academically orientated caving literature available. One of the practical implications of this thesis is that this lack of research and literature is addressed.

4.2.2 Caving context

The field data collection evaluated in this chapter took place in a range of British caves, specifically in northern England, and it may be useful for the reader to understand their scale and scope. Vertical depth within British caves is determined and constrained by the thickness of the 350-375 million years-old carboniferous limestone strata in which they are found. Most caves, including those in Britain, are formed by solution whereby rainwater mixing with naturally occurring carbon dioxide forms a dilute carbonic acid (Sparrow, 2010). This acid slowly dissolves the limestone as it percolates through overlying soil to the bedrock below, becoming increasingly acidified from organic material within the soil. Although the resultant carbonic acid is relatively weak, it has a significant solution effect on the limestone strata owing to the extended timescales involved and because the rock itself is chemically alkaline. Consequently, the cave passages are formed by fluid processes but governed by fault lines, joints and other physical constraints such as the dip and strike of the overall geological landscape (Marbach & Tourte, 2002). Because of the relatively low angle of slope of the limestone beds (known as dip), cave development in northern England has occurred vertically as well as horizontally. The total depth of the limestone strata in the UK tends to be between 120 and 140 metres and therefore the vertical span in which the CI will work sits within this range. Once at the lowest depth of a typical British cave, the caver finds themselves at a layer of mildly metamorphosed sandstone rock (known as a greywacke) which is impermeable and therefore holds water (Bell, 1996), creating completely submerged passages and sumps. This is the realm of the cave diver, which (fortunately) sits outside the research scope of the chapter.

Most sheer caves are descended and re-ascended in a series of smaller vertical sections referred to as pitches. It may seem counter-intuitive but breaking down the vertical cave journey into smaller segments of 20-40m for example, provides a number of benefits. Primarily, the re-anchoring of the rope allows it to be rigged clear of water or sharp rock edges. A further significant advantage of this method is that each time the rope is re-anchored (or 'rebelayed') the section immediately above becomes unweighted as the caver descends the next section and in this way many people can travel down the cave concurrently. This is especially important in later ascent when a single caver could otherwise take up to 30 minutes to ascend a long individual pitch, which is both time consuming and exhausting (Sparrow, 2010).

However, this adopted rigging system has one main disadvantage for the CI. In practice, it is almost impossible to be in the right place at the right time to aid members of the party who may need help in the event of entanglement or injury, or simply to give advice and encouragement. It presents a range of wicked problems (Skaburskis, 2008), ones to which there are no straightforward resolutions. One wicked problem, for example, is how does the CI lead a group vertically downwards through a series of pitches and rebelays at significant height? Instructor positioning at the top, middle or bottom of pitches all carry significant disadvantages which identifies an immediate additional decision making load specific to the CI.

Even with the utilisation of smaller pitches and rebelays, the CI can still be distanced by 35-40 vertical metres. Any rock climbing instructor would find this problematic and seek to avoid if at all possible due to communication difficulties and complications in assistance should the client require it. In caving however, there is often no choice as the nature of cave shafts dictates the pitch length and where the rope needs to be rebelayed to avoid water, sharp edges or unstable rock.

Many northern British caves offer the opportunity for extended horizontal exploration once the pitches have been descended. To offer some context, the Lancaster Easegill system which is located under the limestone landscape of Casterton Fell just north of the Yorkshire Dales town of Kirkby Lonsdale, has in excess of 100km of underground passages, with many yet to be explored and accurately surveyed (Marshall & Rust, 1997). These solution derived channels cross and interlink in an extended three-dimensional maze which can easily confuse. This is no place for the inexperienced, unskilled or faint-hearted and given that such a system is within the remit of the CI, most assessments for the qualification of the award of the CIC include an extended underground caving day in the Easegill system (or similarly demanding cave) as part of the BCA awarding process. Such is the scale and complexity of the system, there is plaque within the cave which acts as a memorial to a caver who in the 1980s went for a short solo exploration. It is presumed he became disorientated and lost and has never been seen since nor his body recovered, despite extensive searches at the time (Eyre & Frankland, 1988).

4.2.3 Group management underground

In Chapter 3, all the CIs interviewed discussed the additional difficulty in decision making when managing their clients across ground that was neither vertical nor horizontal. In the sheer terrain of rock climbing, winter mountaineering and vertical caving the requirement to be firmly attached to an anchored rope system is obvious, but although secure, this method is relatively slow. On flatter terrain the lack of necessity to be firmly anchored is also self-evident, but it is the terrain which is steep but not vertical which requires higher levels of skill and judgement to be able maintain safety without sacrificing speed unnecessarily.

Referred to by a number of participants in Chapter 3 as the '*grey area*' this zone of operation for the climbers and winter mountaineers required a significant allocation of their cognitive resource, not least of all because the decisions about how to move safely across such terrain were based primarily upon underfoot conditions allied to client capability. In short, the PJDM processes concerning client movement across compacted snow or grippy, dry rock will be different to when moving across this terrain when it is covered in unconsolidated snow, or if the rock is damp and slippery. This highlights that conditions, consequence and PJDM are closely linked when operating in authentic, natural and unmanaged outdoor settings.

This environmental aspect and how it constrains and shapes the decision making process was described as particularly important in forming the session plan, taking into consideration the underfoot conditions as part of the risk management strategy. In a UK caving context, the rock is almost always wet and/or muddy, and always slippery. Although this presents as a known variable, the chance for injury or significant trauma is amplified because of it. Avoidance of injury is paramount given difficulty in rescue, so managing clients across varied and complex underground terrain requires a fine balance of efficiency and safety. This requires the prompt utilisation of natural rock anchors, braced waist belays, prompt deployment of a safety rope and 'spotting' techniques in addition to a range of techniques characteristically associated with high levels of competence in climbing and mountaineering leadership.

A mantra often used by practitioners in both mountaineering and caving contexts is to be as 'swift as possible and as secure as is necessary' given that speed in consequential environments can be a factor of safety (Collins & Collins, 2013). An example is crossing a rockfall-prone section of mountainside. Being very secure in all movements may be detrimental if it exposes the party to objective hazards for longer than necessary. There are comparisons to moving through caves which may be prone to flooding, or in specific areas termed 'boulder chokes' which are known to be structurally dubious. In-action, the levels of risk tolerated, and secure support offered is scaffolded by an individual's skilful movement and the overarching objective of maintaining independent progress whilst limiting the risk of injury.

Given the nature of the underground environment, the demands on individuals who embark on caving trips are significant and varied, becoming accentuated for the leader given their responsibility for both pedagogy and client welfare. Although subject to variation according to the actual cave chosen, the CI needs to have skills in technical ropework and vertical rescue to the standard of the highest qualified climbing instructor, water and hydrology skills to the standard of the highest qualified canoeist and the complex navigation skills of the highest qualified mountaineer. Many caving trips take place over a number of hours and occasionally days. This drives a requirement for high levels of mental resilience and physical fortitude, and it is no coincidence that the European Space Agency (ESA) use extended caving systems to replicate the demands and isolation of space travel by taking prospective astronauts underground to face some of the challenges noted above (European Space Agency, 2016). The participants in this chapter refer to themselves as cavers or CICs, whereas the ESA refer to their people underground as The Cavenauts!

4.3 Method

Method, design and participants have been detailed in Chapter 3 and are not repeated, given that the purpose here is to afford the opportunity to look more closely at the data generated, and to inform the work of the next chapters. With regards to limitations, it is accepted that greater analysis is being performed on a relatively small sample size of CIs, but this should be viewed in consideration of the initial in-depth IPA research process and that the high level CIC award holders' pool from which to draw is in itself very small. Further, this is against a research backdrop which saw the United Kingdom being subject to dynamic constraints of the various Covid lockdowns. In total, the caving based research utilised six of thirty currently active CICs, which although numerically small, constitutes 20% of that available and therefore may be considered characteristic and sufficiently robust.

4.3.1 Field research environment

For context and clarity, the research environment of each of the field observations is included. The grading system for caves exists on a scale of 1 to 5, with 1 being straightforward and 5 being the most technically or physically demanding (Marshall & Rust, 1997).

CI 4 – Simpsons Pot (pull-through) - Grade 4

This caving trip took place with four undergraduate university students. These young adults had prior but limited caving experience. Simpsons Pot contains an initial 60 metre flat-out crawl in water followed by 13 vertical pitches and in this system the ropes are retrieved after each pitch indicating that there is no way of re-ascent in the event of an emergency. Pull-through trips therefore have the highest commitment factor but allow for a one-way, vertically orientated subterranean journey through an extended system. Part way through the caving trip there is a duck. Here the cavers are required to completely submerge themselves in order to pass through the cave passage that is flooded almost to roof level, before continuing. This presents as a realistic data collection opportunity as only holders of the CIC award are qualified to lead pull-through caving trips given the commitment of the rope retrieval procedure.

CI 5 – Alum Pot via Dolly Tubs and SE Exit - Grade 3-4

This caving trip was undertaken with a small group of military personnel on a caving development course. The group members had one week of prior caving experience and therefore had similar levels of experience to the university students led by CI 4. This trip involves a series of short cave pitches, culminating in two long and free-hanging pitches in the impressive open shaft of Alum Pot, before descending two smaller pitches to the final water- filled sump, passable only to divers. In ascent, SE Exit was pre-rigged to allow an ascent of the whole shaft in a series of very impressive pitches. This is a trip on the list of 'must-dos' for cavers across the UK and Europe and as such represents another realistic and authentic data collection opportunity.

CI 6- Gaping Ghyll: Bar Pot to Main Chamber - Grade 3-4

This is another underground expedition which may be considered 'top of the pots' and an aspirational cave journey. This trip was undertaken by a small group who were on a caving training course for the award of the CI. Accordingly, the group members on this trip were the most experienced in the data collection phase. The surface entrance to Bar Pot is preceded by a strenuous, hour-long walk-in. The first vertical pitch is tight and awkward but after a series of small, unroped climbs the main descent is reached, which is a free-hanging vertical shaft of over 40 metres. Once at the bottom of this pitch the cave is mainly horizontal in nature but with sheer drops, with many intricate passages in which it is easy to get confused and lost. If good navigation and survey interpretation skills are utilised, it is possible to travel underground to find oneself underneath the open and impressive 100m towering shaft of Gaping Ghyll itself. Upon completion of the underground traverse the whole journey is reversed but the awkward initial descent of Bar Pot becomes a tortuous and tiring game of 'physical chess' in ascent and has led to caver exhaustion and subsequent rescue on a number of occasions. A classic trip into one of the most well-known features of northern upland limestone scenery, Gaping Ghyll represented another very realistic and genuine opportunity for data collection. Photographs evidencing these trips are found as appendices E, F and G.

4.4 Data Analysis

Fieldwork and interviews yielded a significant amount of data. The wealth of data presents as both 'a blessing and a curse' but offers a complete and rich synopsis of the CI in-action. This approach was considered necessary to gain the required depth and theoretical purchase of how high level caving instructors manage the physiological, psychological and PJDM demands of this professional environment, consistent with their epistemological position. From a pragmatic research perspective, collecting data in wet, cold, muddy, vertical and often constricted settings of the caving environment required the adoption of a range of methods to ensure a successful data collection outcome. The use of video capture and to some extent the taking of in-situ notes was essential due to the extended nature of the data gathering period. Data were necessarily collected over several months, with each discrete episode typically lasting for a whole day. Consequently, the video footage and field notes played a vital role in the recollection and temporal situation of the collected data.

The video was reviewed several times and handwritten notes made to capture the essence of what was seen and what were considered to be the main verbal signals, actions and behaviours of the CI in-action (Rosenstein, 2002). Using the video footage and notes to link to both the pre-session interview and post- session review enabled the creation of a simple videotext; a document to pair visual images with words spoken. This was deemed necessary to be able to answer the questions of '*what are the CIs trying to tell me*' and '*what are the data trying to say*?' Initially, the videotexts were re-read and rewritten with the aid of in-situ conversations and field notes to ensure accuracy whilst watching and listening to the original digital recordings. The purpose of this was to imagine the voices of the participants in later re-reading of the material and in an attempt to engage in a rich and complete analysis (Smith, Flowers, & Larkin, 2012). The videotexts were reconsidered in view of emerging recurrent, common or causal themes which were grouped and considered as appropriate to begin to understand the relationships within the data and how the epistemological stance of the CI scaffolded the PJDM processes in-action.

Throughout the IPA process, care was taken to ensure that the themes and meaning units were supported evidentially by the text with reference back to the video recording used as necessary. This procedure was repeated across the collected interviews, in-situ conversations, field notes and video data of all three participants. In the subsequent re-readings and in following a similar pattern to that utilised in Chapter 3, handwritten comments from the videotexts and interviews were used to form clusters which could be categorised (Smith & Osborn, 2015). Once the raw data were organised, subordinate and supraordinate themes were identified, and the next phase was to note connections across the themes to enable the creation of a thematic map (Crabtree & Miller, 1999). Evidence of the field notes and initial processing of primary data are found as appendices H and I.

4.5 Results and Discussion

The initial analysis recognised 497 codified units which were then grouped into 61 raw data themes, and subsequently organised into 14 subordinate themes (including one which was seen to recur), which are displayed in Table 4.1. Following analysis of the rich array of data, the four supraordinate themes emerge. 1) Managing the cognitive resource, 2) Independent performance, 3) Planning processes, and 4) Knowledge transfer. Chapter 3 was able to identify differences and similarities in the epistemological beliefs across the sampled adventure sports domains, whereas here it has been possible to 'drill down' to investigate the specific decision making process and contexts of the high level CI more thoroughly.

Table 4.1 Summary of themes and raw data extracts

Supraordinate Themes	Subordinate Themes	Raw Data Themes
Managing the cognitive resource.	Cognitive load.	Cognitive space aided by pre-preparation. Appropriate allocation of resource. Delegation of tasks.
	Metacognition.	Informs and offers decision making power to clients. Low intervention. Invests time in training for client self – organisation. Recognition primed decision making. Overdraft, ringfenced, a deeper well?
	Creation of space.	Avoids leading when appropriate / feasible. Thinking ahead. Maintains bigger picture. Visualises rescue in that specific environment. Gains 'space' through technical speed / capability.
Independent performance.	Personal ability.	Need to perform at appropriate level in the present. Ready to react (hold a reserve).
	Role modelling.	Risk vs. benefit approach adopted. Positioning crucial. Use of CLAP and PLOW acronyms. Promotes typical behaviours. Progressive and managed exposure to risk.
	Skill accessibility.	Client performance > encourages to lead. Distance from leader a big factor. Learning from mistakes in safe parameters – care shown.
	Extensive depth and breadth of experience.	PJDM tools for future independence. Empowerment. Authenticity.
	Skilful interplay of roles.	Long term learning vs. short term gains. Reduce guiding function. Intrinsic feedback. Divergent questioning. Tight use of 'surface' time. Environmental constraints.
The planning process.	Sources of information and knowledge.	Planning the caving trip. Accentuated nature of environment. Fine-tuned time management.
	'Intuition' and experience.	Reflection in-action and post session (recognises errors).

	Reality of consequences. Complexity in decision making.	Interplay of roles – right role at right time. Absenting overview. Prompt sifting process from range of alternatives. Uncertainty of outcome. Real risk in consequential terrain. Continual auditing. ‘Strawman’ plan / flexible.
Knowledge transfer	Natural / humanistic approach to coaching. Skilful performers but not coaches	Tacit understanding of coaching process (not explicit). ‘Asking and questioning’ prioritised. Lifelong learning. Empowers learners. Adopts ‘loose parts’ theory / principles approach (not procedures). Gives space for practice. Learning transferability. Humanistic approach > positive human development. Genuine context. Auditing of performance of teaching and learning through questioning. Observation and analysis initially on surface. Peer to peer support. Peak experience and best learning environment contradictory. Purposeful choice of naïve EC / position.

4.5.1 *Theme 1: Managing the cognitive resource.*

The three subordinate themes of Creation of space; Cognitive load; and Metacognition all scaffold the supraordinate theme of Managing the cognitive resource. The role of metacognition in adventurous activity coaching and leadership has been fully discussed in prior research (e.g., Eastabrook & Collins, 2020), but how the CIs manage the cognitive load underground and retain a readiness to react are considered most valuable for discussion within this section.

The working domain of any ASP, not least of all the CI, can be complex and mentally draining which can result in decision making fatigue or a depletion of the cognitive resource. In the environments typically utilised by the CI, the consequences of poor PJDM are often immediate and can be associated with poor outcomes. Therefore, a comprehension of the implications of cognitive load issues underground is essential. Cognitive load is considered as the requirement for sufficient information processing capacity, or power, to expedite the decision making needs of a given set of tasks or circumstances (Reif, 2010), which therefore suggests that this decision making capability will be impeded if the functionality of the working (short-term) memory is exceeded (DeJong, 2010). The CI is able to plan the caving episode but cannot account for every eventuality and therefore will need to operate in response to situations and their attendant demands which requires high levels of situational awareness and foresight (Endsley, 2000).

Decision making capability has been considered along a spectrum with metacognition at one end (thinking about the thinking) and what researchers have termed ‘decision paralysis’ at the other (Fukukura, Ferguson & Fujita 2013). A decision maker with metacognitive capability is immediately able to audit their decision making process and promptly deploy the resultant required action without necessarily having to contemplate and cycle through every alternative (Galloway, 2002; Collins & Collins, 2013).

Considered a facet of decision making expertise (Kahneman & Klein, 2009), a relatively recent and renowned example of a ‘meta-decision’ scaffolded by the metacognitive process (Collins, Carson & Collins, 2016) can be found in the case of Chelsey Sullenberger’s 2009 landing of his stricken airliner in the Hudson River, shortly after a bird-strike on take-off from La Guardia airport. Despite skilfully ditching in the river with no casualties, he was initially reprimanded for not following the relatively laborious and time-consuming bird strike protocol. He highlighted that had he followed the prescribed procedures, all on the aircraft would be dead, plus however many more on the city streets of New York below (Eisen & Savel, 2009). The decision not to follow a relatively time-consuming protocol and deploy a very prompt NDM sifting process in comprehending risk versus benefit proved to be the right choice in consideration of the many lives saved.

An example of when a prompt decision was required but not implemented can be found in the Ladbroke Grove crash (also known as the Paddington rail crash) of 1999 in which 31 people were killed and 417 injured (BBC News, 1999). The signal controllers were aware of the impending head-on collision of two trains, and evidence suggests there was an opportunity to switch either train signal to red for at least 18 seconds. Succumbing to decision paralysis, neither signal was switched in time which resulted in one of the worst rail disasters in recent British history.

ASPs work in demanding and dynamic environments with a requirement to manage and consider a multitude of variable factors (Collins & Collins, 2016), where prompt decision making will be required. In the case of the CI, this can include client factors such as performance in vertical or extended horizontal cave systems and environmental factors such as the risk of flooding, entrapment or rockfall. The interaction of these factors generates a high cognitive load which must be managed as part of an overall professional coping strategy in the underground environment. Cognitive load can be generated as a consequence of managing the well-being and development needs of clients in this specifically challenging setting, and for the CI in context, there is the requirement to ensure their own welfare is not overlooked. The professional environment within a caving context occasionally offers time for deliberation or forethought, but that is not always the case. In the example of vertical cave rescue, a prompt response is crucial, and the required speed of the decision making process may drive a course of action in which all the risk factors cannot be adequately considered. Here a factor of expertise in PJDM is the ability to identify a sufficiently correct course of action without cycling through a range of alternatives, as a way of maintaining some control of the cognitive reserve.

All the CIs in this study appeared to employ a nested and synergised blend of classical and naturalistic decision making processes to share the cognitive load equitably into phases within their control (Collins & Collins, 2016), the weight and ratio of each fine-tuned according to specific demand and context. Time spent in pre-preparation and in post-session reflection predominantly utilised (but not only) the slower and logical CDM processes, but whilst working underground in the demanding context of the subterranean environment, the bias appeared to shift towards the faster but potentially incomplete processes of NDM (Kahneman & Klein, 2009, Klein, 2015). Another approach all CIs took to reduce cognitive load was through their preparation strategies in advance of the caving session. Described as a pleasant aspect of the role, CI 5 states, "*I quite enjoy the time getting my kit ready, checking my cave lamp is charged and sorting out the ropes and so on.*" And further states, "*I'll always get a few weather forecasts together and not rely on just one. I use Facebook to check in with mates about conditions too.*"

CI 4 continues:

> It's good having a bit of thinking space in the pre-prep cos I know that once I meet the clients it will all get very busy and although well-meaning, I know I'll get asked about eleventy-million questions… If I can do stuff in advance, packing and thinking things through a bit, it's time very well spent I reckon.

This comment is indicative of the value placed on the community of practice where information and tips on cave conditions or water levels are shared openly by colleagues. Although many CIs work on a freelance basis and compete for a finite amount of work, cross-sharing of information among immediate colleagues and associates for the greater good is common-place and aids in building the bonds of affiliation for a group who work in the specifically demanding environments of the vertical or extended cave systems of the UK. This is manifested in times of need when CIs promptly assist in rescue attempts of fellow cavers without hesitation, as exemplified by a mass response to the rescue of a badly injured caver in South Wales in 2021 (BBC News, 2021).

CI 5 and CI 4 both express that time spent in pre-preparation is valuable, but CI 6 takes things a step further by ensuring that this pre-session planning is specifically discussed with his clients, asking questions of how they might organise their own preparation as part of the subtle cognitive apprenticeship in caving instructor development. It was described as the '*foundation phase*' or '*springboard for success'* undoubtedly considered to help generate independent performance. This is a subtle, yet solid strategy given it is a pathway to reduction of cognitive load. Although at odds with an emergent approach to high quality coaching (Cushion, 2010) where pressure or lack of resource may act as a catalyst in promoting some of the best coaching practice, the careful organisational procedures of the CIs (who consider themselves as performers and instructors, rather than coaches) seem to work best for them with regards to knowledge transfer. It was noted that in terms of complexity in decision making as part of the planning process, the CIs were readily aware of and anticipated the inaccuracies or deficiencies in the available information to support the session. This was in specific reference to local weather forecast accuracy and ground saturation levels that influence the speed at which rainfall runs off the surface into cave systems. It is apparent that the apparent 'intuition' and experience levels of the CIs in the sample are important here. They use the weather forecast and other sources of information to build their own picture of the anticipated conditions of their working environment, rather than accepting the views of others, even in their specialist role (weather forecasters in this example). This ought to be considered in light of a series of cave rescues in northern England where groups have been trapped underground by floodwater as weather forecasts were trusted implicitly, even as far as planning the timings of the sessions based on predicted arrival of thunderstorms.

It is worth noting the maturity of the CIs sampled for this study given that weather forecasting throughout their formative years has been imprecise, and therefore would not have been relied upon with confidence, hence the '*building of their own picture*.' It suggests that experience levels and consequently the time available to assimilate and synthesise deeper understanding forms a crucial element of this aspect of practice. The incidents referred to above involved younger cave leaders who undoubtedly will have had prompt access to comparatively accurate weather data across the duration their career span and have become accustomed to relying upon it, occasionally to the detriment of the welfare of their charges. In the working setting of the ASP and particularly with specific reference to the CI, the environment will always be the arbitrator of session type, duration and success (Christian et al., 2019).

As reflected in conversation with CI 6:

> …regrettably the natural world doesn't recognise the experts. If the cave is flooding or the mountain is experiencing poor conditions, even world class performance would not make a difference. When they think it does, that's when fatalities happen. Remember Everest in 1996, think 8 or 9 died in 24 hours?

Deemed as a 'conservative heuristic,' in poor conditions each CI reported that when information to support their session was sub-optimal, the more prudent their choice of venue or the greater probability of utilising a well-known one that facilitated differentiation. CI 4 mentioned that in conditions where he could not fully satisfy himself that the weather would accommodate a safe underground session, he would choose a venue where it would be possible to return to the surface at intervals to physically check on weather and conditions above ground. Described by him as '*keeping one eye on the surface*' his actions indicated a fine-tuned situational awareness and comprehension of potential future demand in retaining a proportion of the cognitive allocation. This represents a tacit understanding of a complex process given that this aspect was not specifically verbalised but evident in-action. The CIs also reported applying a process of judgement that considered the assumed ability of caving clients to be lower the more demanding the likely conditions, thereby utilising what may be termed an inverse heuristic (Collins & Collins, 2019). As CI 6 reported with reference to a planned trip to higher ground on which the Gaping Ghyll entrance shaft is located:

> "I just can't take them up there in these conditions - when we come out of the cave, we will be wet through but on an exposed moor with no shelter in -20 ^{0}c windchill and an hours' walk out. If it was you or me, we could get sorted in no time and handle it, but I really don't know how these guys will cope."

One of the main characteristics of managing cognitive load in the context of the CI is the acquisition of physical space at a small distance from the clients in order to gain what CI 5 simply called '*head space so I can keep seeing the big picture*." It was interesting to observe that all CIs overtly made this space but in subtle and different ways. For example, CI 4 took the time to demonstrate and role model excellent procedures and confirm that the clients were able to mirror his technique. He then essentially left them to their own practice once having established peer-to-peer buddy checking, whilst he worked at the front to facilitate further independent practice for each member of the client group in turn. By any standards, this is really good coaching! Portrayed by CI 4 as '*just common sense*' he was appropriately and concurrently utilising a number of elements of Mosston & Ashworth's (1990) Spectrum of Teaching Styles whilst unconsciously displaying behaviours associated with a sophisticated epistemic position (Schommer, 1994).

CI 5 had honed his rigging ropework and technical skills such that they were exceptionally quick, which meant that he was able to establish the ropes to be followed more quickly than the clients could ascend, descend or traverse through them. This gave him the required physical and mental space which allowed for clarity of thought, which enabled a full overview of client progress and the thinking time which he described as absolutely necessary for him. CI 6 had yet another subtle but effective strategy in that he simply always stayed at the back of the group but remained available for technical consultation. This is no doubt connected to the type of work undertaken in that most of his employment is based on technical training and award scheme work with relatively capable clients.

All CIs in the study have a close lifestyle and professional interaction, namely that they go caving in their free time in addition to maintaining a professional role. Thereby each has accrued significant personal experience and larger base of instances (Phillips et al., 2004) which allows them to comfortably cope with most eventualities underground, as a result of having had prior involvement in them. This capacity is secured directly as a result of experiences and crucially, their reflections upon them.

Management of the cognitive loads in caving appears to occur by a process of proactive coping (Sohl & Moyers, 2009) rather than a reduction in the actual loads, given that it is difficult to obviate them once underground (Collins & Collins, 2019). Although unclear from this specific study, professional caving in vertical and extended caving systems may encourage the development of the proactive coping strategies of positive psychology (Greenglass, 2002) which includes elements of a growth mindset (Dweck, 2015), high levels in planning ability, reflection capability and access to a supportive community of practice (Lave & Wenger, 2002). Alternatively, these abilities may already be present in the individuals as a result of them being independent, skilful practitioners in such environments before joining the CIC training and assessment award scheme. This offers an avenue for further study.

4.5.2 *Theme 2: Independent performance*

The five subordinate themes of; Personal ability; Role modelling; Skill accessibility; Extensive depth and breadth of experience; and Skilful interplay of roles underscore the supraordinate theme of independent performance. Given the scope and scale of the thesis, the subordinate themes of extensive depth and breadth of experience and skilful interplay of roles will be concentrated upon as they are seen to link most directly to the investigation of the EC and PJDM processes of the CI.

AS in unmanaged natural environments such as those found in caving are commonly associated with risk (Peacock, Brymer, Davids, & Dillon 2017), which in the specific setting of the thesis study area includes additional issues of variation in challenge duration and intensity, allied to perceptions of control (Varley, 2008). However, it is inexact to assume that the experienced cavers in the study find the cave environment stressful in the way that 'normal' people might. As CI 6 stated *"…you know, I don't really find British caves that hazardous or dangerous. Compared to some of the unstable ones I've been to in Russia, these are fine."* Similarly, CI 5 commented that *"a cave's a cave and once I'm down here everything feels familiar and right."*

This presents as a process of habituation (Cheung, 2009), whereby the risks and challenges of the underground environment are not lessened, but the CIs have somehow become accustomed to them or simply find the conditions perfectly acceptable, especially when coping with poor conditions in pursuit of greater expeditionary reward (Zuckerman, 1991). High level caving activity (as considered when operating within the full remit of the CIC award) takes place in very changeable environments which under certain conditions can be inescapable, and this knowledge drives a certain type of resilience which anecdotally seems to be found in many cavers.

When working with adults, the aim is to create independence from the leader for a number of reasons, including the development of their own experience and skill within safe parameters. This approach also aids in generating a capable team without resorting to the skills of the CI. As CI 6 clearly informed *"...there is absolutely no point in me doing any rigging – I don't intend to do any at all today."* Rather than this being orientated towards idleness, CI 6 went on further to explain that he felt better placed to observe them gaining their experience under his watchful eye, rather than for them to copy. With regards to the skilful interplay of roles theme, CI 6 continued:

> Earlier on in the course I showed them the speed and slickness that they needed to aspire to for this level of award – sorry I should rephrase that a bit – they should be doing the rigging without even thinking about it – automatic you could say, because there will be bigger stuff to think about at some point.

Considering this from an ‘authentic’ rather than ‘commodified’ perspective (Valkonen, Huilaja & Koikkalainen, 2013, Loynes, 1998), the role of the CI is to focus the learning experience on the cognitive skills, understanding and technical ability such that the caver can undertake the activity independently of them (Christian et al., 2017). It was interesting to note that during the pull- through trip into Simpson’s Pot with CI 4, once it was realised the group was being guided, tasks were immediately delegated such that CI 4 could ease away from this leading or guiding mode, and explained:

> I really want these folk to crack on with their own adventures and to be heartened to feel in control of the job. Can’t really see the point of leading them through it to be honest – it’s not as though they are paying 40 quid each for a cave adventure that might be advertised somewhere.

It was clear that the CIs in the study had each given significant consideration to this aspect and despite working with different groups and in varying delivery contexts, all promoted thinking and action towards self-reliance and autonomy from the leader. Caving, among other adventurous outdoor domains retains a lack of rules or regulations and performance objectives and therefore adventurous independence is central to participation (Collins, et al., 2015, Barry & Colins, 2021) and is no doubt one reason for choosing this type of activity. In short, the enthusiastic or experienced adult cavers do not wish to be led, moreover, to learn how not to be. There is a more consequential aspect to this factor of independence which relates to the earlier discussion on the ‘wicked problem’ (Skaburskis, 2008) of the difficulty in positioning for the CI, due to the disadvantages of each position. CI 5 substantiates this when referring to the single rope technique (SRT) utilised in vertical caving, allied to the theme of complexity in decision making, when stating:

> I love teaching SRT, but the problem is that I can't be everywhere at once, and in reality, the optimum position does not exist – if it does, I haven't found it! - If I'm at the bottom of the pitch I can't see what's happening further up, and if I'm up the top I need someone to be able to rig safely, and I can't check that until I get down there! It is quite engaging though. It's more involved in SRT – how do you lead downwards??

Therefore, the creation of independent performers and enhancement of autonomy is an essential component of safety and progression. CI 5 continues:

> When we are doing a vertical caving trip, or even a horizontal one where we are a bit spread out in snug passages, I get them to look after each other – you know, carrying bags, spotting one another and stuff, but also in the de-rigging on the steep stuff. They might not be experts, but they know when something looks wrong, and I tell them that they must shout out and look after their mates.

CI 4 alludes to this in slightly different terms, noting that the 'coach-client interaction' is quite close:

> I love the fact that really although we start off where 'I am the gaffer' it doesn't take long before we feel like we are all in this together and engaged in the same positive adventure, just with slightly different responsibilities, perhaps.

There exists within the caving context genuine inter-reliance despite promotion of independent performance, given that in ascent any member of the group may be climbing a rope rigged by another group member. If improperly positioned, the rope could rub and fray, so there is real consequence in the decision to allow a client to rig or not and implies significant trust.

Echoing this thinking, Christian et al. (2017) concluded that one of the main priorities of the high level ASP is to enable the learner to make decisions for themselves in the absence of their leader, or in caving, when the CI is simply and unavoidably too far away to intervene. Given that the vertical cave environment directly impacts the proximity of leader – client interaction, information sharing, and transfer of knowledge takes place in advance of entering the cave or must be carefully considered whilst underground, so that the client is equipped with the understanding and skills required to operate in isolation. In the example of SRT where the caver may be on the rope of a vertical pitch of up to 40m, the need to be able to cope with unexpected problems in the absence of direct assistance is obvious. Although fortunately rare, an example is equipment failure with the consequent immediate need to improvise or be promptly supported. This independence supports a high 'learning portability quotient' such that the skills practiced and developed in one cave or pitch should transfer to almost any other.

Part of the continual encouragement to independence from the leader and development of personal autonomy underground relates to the picture of good practice offered by the CI. It was evident that all participants were extremely skilful in ropework and rigging, vertical caving techniques and in their abilities to move through the rigging efficiently. In offering a high level of demonstration as a role model, each represented a performer in the present.

From the epistemological perspective where a personal philosophical stance relates directly to actions, behaviours and outcomes, the commonly held beliefs that caving instructors typically take clients into tight, wet and scary parts of caves is simply unfounded. Rather, they promote independence for the development of self-esteem and improved confidence and to furnish the clients with the 'tools' required to conduct their own underground adventures thereafter. It is worth noting here that in isolation to one another, none of the CIs chose caving trips in conjunction with their clients which were at the upper end of difficulty (grade 5), reflecting the objective to provide a positive learning environment, rather than an intimidating or overly demanding one.

4.5.3 Theme 3: The planning process

The four subordinate themes of; Sources of information and knowledge; Intuition and experience; Reality of consequences; and Overall complexity in decision making underscore the supraordinate theme of the planning process of the CI. Due to the scope and direction of the thesis, a conscious decision has been made in a necessary allocation of value to concentrate on the lower order theme of complexity in decision making within this section, as it relates specifically to the EC, underpinning belief structures and PJDM processes of the CI working underground.

In planning the caving activity, the CIs in the study drew on their epistemological beliefs and domain specific expertise which was reflected in the links between their own EP and the resultant connections between cognition, experience and action (Miller et al., 2019). This informed and drove the design and implementation of the session content. In cave environments which can be prone to floodwater, rockfall or poor anchors, continual decisions need to be made amid multiple factors of environment, task and client needs which combine to generate a burden of decision making load for the CI.

Accidents outdoors tend to be the product of an accumulation of small decisions which are slightly 'off' that relate to assumptions made or to a lack of quality information on which to base accurate decisions (Galloway, 2005). Consequently, there is a requirement to make a series of good decisions, rather than necessarily optimum ones, but the ones made must be of sufficient quality (Collins & Collins, 2013) in terms of client security.

As noted, the decisions made which relate to a given outdoor session are a synergy of CDM and NDM processes, nested in a ratio which varies according to context (Boyes, Potter, Andkjaer & Lindner, 2019). Where and when the decisions are made are important considerations given that in the non-time pressured environment of the planning stage, the rational, logical and more complete CDM process can be utilised, but in the time-pressured setting of the CI working in-action, the faster but incomplete and potentially biased processes of NDM are more likely to be deployed (McCammon & Hägeli, 2007). It is acknowledged that biases are explicitly linked to experience, such that if the experiences on which the decision making is based are few or of limited variety or quality, the resultant decisions may be poor. Because the processes of CDM and NDM are often synergetic, it means that such a lack of experience would be detrimental to all decision making, irrespective of process (Kahneman & Klein, 2009). This is echoed by CI 6 whose main professional caving work is in the training and assessment of the higher level awards, including the CIC, and in considering the theme of experience explains:

> I think it's ace that the BCA insist on a really good quality logbook of experience before they can sign up for CIC training. They need to have loads of depth and quality – I'm not too bothered so much about the quantity as they can think of themselves as really experienced if they have done the same caves loads of times – those sorts of cavers are often not very good at making the right calls with clients underground.

The nature of the experiences rather than the volume of them is considered most valuable by all the participants. Purposeful involvement and the accumulation of quality experience with focused reflection on practice are regarded as crucial steps in learning how to become equipped for the PJDM demands when working in the accentuated underground environments of the CI. CI 4 discussed the ongoing requirement to ensure that his decision making is prompt and adequate but may not need to be exceptional evidencing the epistemological position. He exhibits a heightened level of PJDM in-action given that he is making a conscious choice about how much time he will allocate to a given decision. CI 4 continues:

> There are stacks of small decisions to be made underground and to be honest, they have to be quite quick, otherwise folk will get cold or lose faith in me. I know that my decisions are normally perfectly fine, but they could occasionally be better. We can't mess about getting it perfect and there isn't time, plus it wouldn't be an adventure, would it?

Noting that a series of 'good calls' need to be made throughout an extended session of caving, rather than perfect ones, the timing of these decisions is also of significance to the CI in operation. For example, taking additional time to collect the full picture of information in a cave which may flood could put the group at further risk and therefore a quicker decision based on incomplete facts may be more beneficial. To illustrate with the military saying often attributed to US Army General George Patton in World War 2, *"... a good plan executed decisively now, is preferable to a perfect plan executed next week*." Given the discussion about time, place and quality of decision making in the environments in which the CI typically works, the planning process occupies a crucial role. An overarching plan must be put in place; one which is strong but also designed to be flexible enough such that it can be subject to change. Supporting the complexity in decision making theme, CI 5 offers:

> There is a lot of risk in what we do and quite a bit of intricacy too which means that you just have to think on your feet. The plan I make is a solid foundation, but there’s no way it won’t change!

CI 4 shares a similar view and states:

> I plan really well to help give me a bit of space later, but I know I’ll need to fine tune and adjust, fine tune and adjust, depending on what presents itself or how the clients are getting on. Sometimes something really good comes up, you know, an opportunity, and we’ll just go with it, but it was never planned!

The flexible execution of the initial plans was a key feature of all the CIs who created and recreated micro-plans, amalgamating them together into what presents as a professional session. This utilises the skills of adaptive expertise (Tozer, Fazey & Fazey, 2007) and is one which appears to be the result of subtle but continual auditing of these smaller and interlinked yet discrete planning units (Nicolson,1972). CI 6 recognises the complexity mentioned by CI 5 in considering the environmental factors and states:

> The cave environment is the boss really, isn’t it? It will only allow what it will allow and to think you can do what you want when you want is daft. Anyway, the clients often require me to change the plan even when the cave cooperates!

What appears as an exclusive characteristic of the ASP within the planning phases of adventurous activity, and vital to the CI, is the adoption of a flexible, adaptive and creative approach. Known colloquially as a ‘strawman plan,’ it is a strategic and purposeful aspect of the planning process which is designed to put the greater substantive parts into place, such as transport, equipment, macro-session aims, but still allow for significant flexibility, even to the point of reorganising the substantive parts. This type of planning (Kathan et al., 2010; Mees et al., 2020) appears as a specific functional component of the organisational phase of activity due to the potential variability in client demands and environmental conditions.

It was notable that all CIs showed limited adherence to their original plans if their presumption of conditions and reality did not align. This was particularly evident in the trip led by CI 6 into Gaping Ghyll which was postponed due to the forecasted weather conditions and the experience on the ground being significantly different. None of the participating CIs felt that detouring from or abandoning their initial plan showed a lack of professionalism or quality, more that it showed a level of cognition and expertise in situational awareness allied to an openness to a revision of aims when necessary.

In the case of the flooding incidents in northern England mentioned earlier within Theme 1, those cave leaders were much less experienced than the CIs in the study and all had admitted to adhering to their original plans despite the problematic weather and conditions forecasts. Further, it was disclosed that they had undertaken the caving trip because they had seen a more experienced colleague undertake the same one successfully on a prior occasion (although crucially, either in a different context or set of conditions) and mirrored it. It appears that the less experienced cave leaders were somewhat emotionally bonded to their plan as a result of the effort put into constructing it and therefore exhibited over-adherence despite plenty of warning signs to revise it.

The more experienced caving instructors follow an important auditing process in their PJDM, namely through reflection in asking the rhetorical questions of ‘did I make the right decision in the right way’ and ‘was it OK to follow my gut’ or ‘should I have made more time for a CDM biased approach?’ Such a meta-decision process serves to interrogate and audit the decision making and assist the development of expertise in PJDM (Collins & Collins, 2019), which is facilitated by generating small pockets of time and space away from the clients as discussed.

However, it is acknowledged that there are significant issues in expert decision making (Nash & Collins, 2006) and in the context of this chapter, the CI who works across domains may transfer their expertise with more confidence than is justified due to existing decision making capability and situational awareness qualities. It is entirely possible that heuristic traps and biases may be brought from one field to another in the absence of crucial domain-specific knowledge. Conceptualised as a ‘referred heuristic’ this is a case of being confident but in the wrong thing. It is posited that the more experienced CI would be able to detect and address this problem more promptly than a less experienced colleague as a result of the meta-decision auditing process which is utilised.

The roles of intuition and experience were discussed at various points within the data collection phases and justifiably, each CI verbalised that their decision making processes allied to the planning process at some point relied on what was termed '*gut feeling*' (CI 5). This is an interesting insight given that CI 5 shows a tacit understanding of CDM and NDM, whilst tentatively noting that he may also be relying on what he later terms his '*rules of thumb*' (McCammon & Hägeli, 2007). Both CI 4 and CI 6 talk in similar terms with regards to using their significant experience to make quick decisions but are wise enough to understand that they can still make poor judgements. CI 4 who enjoys canoeing, used a paddling example to illustrate his point about heuristic traps, and states:

> There's this river which I have canoed loads of times. When I went over this small drop, because I know it well, I didn't inspect it. As I paddled over the lip, I realised there was a tree stuck in it from a flood a week earlier. Had a nasty swim and lost my best paddle!

Although each of the participants at some point used terms associated with apparent intuitive decision making, it is more likely that as a result of their experience and currency, they were able to promptly access a fine-tuned and high rate NDM process, as previously considered.

4.5.4 Theme 4: Knowledge transfer

The two subordinate themes of 'Natural / humanistic approach to coaching' and 'Skilful performers but not coaches' underpin the supraordinate theme of knowledge transfer and are fully discussed within this section given the links to the EC and PJDM processes which are supported by the EP of this sample of CIs.

All the participants in this chapter present as very experienced CIs with significant amassed time spent working in adventurous environments. Reflecting the sematic discussion of terminology and role designation in Chapter 2, although each participant holds qualifications in other AS domains, none have come through a training or professional background which has a clear requirement for coaching. As noted, the CIC holder is very much an advanced 'instructor' with limited expectation to have explicit involvement or understanding of the coaching process given the requirements of the award. However, among the range of duties, there is unquestionably a requirement to impart knowledge and accurately convey information relating to improvement in practice as part of the process of leadership and underground progression.

Under gentle questioning within the data collection process, none of the participants were able to describe or articulate any recognised coaching process or access common coaching models, though it is acknowledged that finding a common and acceptable definition of coaching itself is problematic (Jones, 2013; Cushion, 2010). The fact that the participants demonstrate very high levels of domain specific skill but are not necessarily fluent coaches supports the work of Berry et al. (2015) who found similar findings in their research, but mainly within paddlesport. Namely, that high performers do not inevitably make good coaches nor do they decide to engage in coaching episodes unless it is specifically required. However, as CI 4 displayed earlier, good coaching can be about explaining carefully, demonstrating accurately and facilitating practice, without necessarily having a feeling of being hampered by coaching models or theory.

Although there appeared to be an inability across the sample to clearly articulate or discuss coaching *per se*, quality transfer of knowledge and learning had obviously occurred. For example, immediately prior to going underground, all the participants utilised time on the surface very judiciously to ensure that essential skills were in place for safe vertical movement. Notably, CI 4 used the rear bike carrier on his van to simulate the pull-through technique which would be utilised thereafter. This simple process served the dual purpose of checking both understanding and technical competence, but also to frame the time point at which the delegation of tasks would be possible in order to remove himself from his guiding role. This displays a natural coaching ability but one which could not necessarily be verbalised at the time.

As CI 4 explains:

> I just ty to think about how I would break this down for my 10-year-old son, and I suppose it's just 'show him slowly, then let him have a go, and then I would give him a few tips'. It worked for him, learning how to ride a bike!

CI 4 continues "*I just need them to show me that they are OK getting on the 'correct' side of the rope – once I've seen them do that a couple of times underground, I will leave them to it.*" CI 5 openly admitted to knowing little about '*coaching stuff*' but adopted similarly utilitarian tactics by facilitating repeated practice opportunities, whilst he largely kept quiet (arguably an enhanced coaching behaviour) and clarifies:

> When I was learning this stuff, my instructor never shut up and it was really distracting. He thought he was helping but it was the opposite – just too much info - so now I tend to say what I have to say and then let them get on with it. I'll only get stuck back in if what they are practicing is badly wrong or unsafe.

These logical approaches to transfer of knowledge presented as common strategies across the participants, but CI 6 was notable in the way that he prioritised asking and questioning rather than telling. Although CI 6 held a significant amount of knowledge which would be very useful to any CIC award trainees, this knowledge was not readily shared. CI 6 continues:

> If I just tell them everything or show them how to do things, they will either remember it or not – I need them to work it out for themselves so that they gain a bit of ownership of it, and they will hopefully have a better chance of properly understanding stuff. They need to make judgements, rather than remember what I did or said.

This is insightful in that it demonstrates a meaningful grasp of the coaching process, but one which is tacit in nature and challenging in articulation yet designed to promote learning, transfer and longevity of skills. This is an enhanced coaching attribute and firm evidence of a sophisticated epistemological position.

In the vertical context, the caver wears a harness which has five essential pieces of technical equipment attached to it. There are two short safety lanyards, two ascending devices and one auto-locking descending device. Unconsciously, all participants at some point described utilising a principles and loose parts concept (Nicholson, 1972) by using the 5 pieces of equipment in different configurations at various times. This allowed the cavers to learn from mistakes in an authentic context and in relative safety but is not an easy task for the CI (Collins & Collins, 2013). In essence, these 5 items of safety equipment can be deployed in various sequences of functional units of skill to establish safe and self-supporting routines, which over time become more efficient.

Coaching is routinely associated with improvement in performance (Cushion, 2010), but it was apparent that when the skilful progression of an individual within the caving environment was poor, limited interventions were evident. It appears at this juncture that a knowledge transfer process or brief period of observation and analysis appeared to be non-existent. In one case it resulted in a client caver becoming almost hyperthermic and on the brink of exhaustion for the want of adjusting equipment to facilitate efficient upward progression. This was analogous to watching a cyclist struggle as a result of the saddle height being far too low and not acknowledging it. However, it may have been a decision to lessen cognitive overload, although in this instance it could have been a prompt fix with immediate benefit. However, this example seems to be at odds with the short observation sessions which were conducted by all CIs on the surface prior to venturing underground. During these times, each CI carefully looked to ensure that harnesses and equipment were attached and fastened properly and that the basic manoeuvres for the immediate future could be completed satisfactorily. Yet it would appear that provided the irreducible minimum standard of safe technical procedures had been reached, coaching in movement and technical skills once underground was disregarded or simply not prioritised. This is a potential area worthy of further research with CIs or similar ASPs who also have a coaching background.

It was obvious from the reactions of the clients on all three observed caving trips, that the independence offered led to feelings of empowerment and the building of self-assurance in their technical and personal abilities. Each of the caving trips entailed the requirement to be autonomous from the leader due to constraints of the vertical environment, but once regrouped, each client reflected positively on their 'adventure' so far. As CI 4 noted:

> It's all about encouraging positive human interactions…this might sound a bit deep but it's not really the caving, is it? – it's just that this is the vehicle we use, I suppose. I feel this when I'm climbing, as well as caving – great places, great people, good times.

CI 6 continues the theme:

> I know that caving can be hard and dirty etc. and that by the very nature of it my clients are on their own at times in what are probably quite scary situations for them, but if they can take that confidence in their own abilities back into their general lives, I can be pretty happy with that. That's probably why I tell them the minimum they need to know – it isn't really about slick caving in a way, although being efficient does help in the positivity bit.

This is undoubtedly a very valuable insight and one which seems to be considered by the CIs to balance the benefit of improving technical movement skills underground. With superficial observation, the coaching skills of the CIs may appear rudimentary, but they are traded off against the 'bigger picture,' namely relating to promotion of development in self-confidence and agency (Brown & Beames, 2017). Sufficient knowledge is transferred to ensure independent safe progression underground without the apparent need to for coaching episodes. However, when asked an explicit question by a client about how to solve a problem or tackle a specific pitch, each was generous with movement advice and accurate guidance associated with good coaching practice. Given that this guidance was not offered unless requested suggests that the observation and analysis stage of the coaching process is absent (Côté, Young, Duffy & North, 2007), limited or simply not a session aim. However, there are some crucial insights here into the EPs of these caving professionals, in that the EC is becoming primed to act as an academic yet coherent and accessible framework for discussion of the mental models which underpin their PJDM in-action. For example, in answering questions of 'why do you rarely lead from the front?' or, 'why are you letting us teach each other? given that these queries are based on the translation of beliefs into action and are therefore fundamentally epistemologically orientated.

The facilitation of this agency for clients to learn at their own pace and under their own terms is discussed by Stoszkowski and Collins (2017) using the term of heutagogy, originally coined by Hase and Kenyon (2000) as an extension to pedagogy (the teaching of children) and andragogy (the teaching of adult learners). Their contention is that heutagogic learning is typified by the notion of human agency whereby autonomy and drive for learning are situated firmly in the hands of the learner who maintains control and responsibility for the what, when and how of the learning episode. Consequently, heutagogic learning is said to develop competence in unstructured, unanticipated or novel situations (Tozer et al., 2007), which are certainly found in vertical caving environments where the client is distanced from the leader. The utilisation of heutagogy as a development tool within the role of the CI is certainly worthy of further research.

In light of the work of this chapter in identifying the core themes, behaviours and practice which link beliefs to action, this additional theoretical purchase has facilitated the development of a tailored and specific epistemological chain, which is presented in Table 4.2.

Table 4.2. The epistemological chain of the caving instructor

Epistemological Chain	Epistemological position
Epistemology (the scaffold)	The CI recognises and portrays that knowledge is time framed, context bound, not necessarily fixed and culturally rooted. Knowledge can be generated and transferred multi-directionally and does not inevitably flow from 'teacher' to 'pupil.' An openness to learning is maintained and it is acknowledged that experiential approaches to learning and knowledge generation facilitates transfer, aids longevity and that challenging orthodoxy may lead to innovation in practice. The EC acts as a framework for the reflective process and may be closely linked to the ontological position of the CI.
Learning environment / venue (the 'where')	Learning environment created by careful selection of a multi-purpose venue which facilitates task differentiation. CI utilises a 'strawman' plan – one that is designed to be robust but reconfigured as information is accrued or verified. Planning is carefully considered to aid in balancing weighting and synergy of CDM and NDM demands. In poor conditions well-known venues may be utilised, but in good conditions the CI and clients may explore new venues together. Open discussions between CI and clients to decide learning outcomes and optimum design of session.
CI > client relationship (the 'who')	Based on understanding the needs of the client. The nature of consequential environments and a positive view of adventure encourages supportive professional relationships. Client typically needs to become skilful and ultimately autonomous from the support of the leader, therefore leadership methods promote agency in decision making, varied practice opportunities in context and a holistic overview. Challenging yet caring and supportive behaviours. Recognition of prior capabilities and transferability of skillsets into new domains.
Session aims (the 'what')	Negotiated. Considerations of emotional, social and spiritual intelligence (the 'big picture') in the reasons why clients may be undertaking a caving session or journey. Delegated tasks allow each client to learn in a variety of roles (navigator, rigger, weather person, etc.). Learning and experience privileged above meeting session / trip completion aims.

Session delivery strategies (the ‘how’)	Decided in discussion between CI and client(s), routinely in advance of session. Aims to develop skilful independence and agency in decision making in contextually rich, uncertain and authentic environments. Managed or manufactured settings rarely used, except when specific ‘surface training’ requirements dictate. May choose to use behaviours across the full range of Schommer’s’ (1994) naïve > sophisticated spectrum. Experimentation and guided discovery opportunities evident. Management of cognitive load is aided by significant time and effort spent in planning and preparation stages and skilful strategies to gain small pockets of time and space away from group. Rapid vertical and leadership progressions utilised.
Professional judgements and decisions made (the ‘why’)	Judgements based on the progress the client caver has made towards being autonomous in their own decision making and in supporting their position as an independent, safe caver. Decisions made in a collegiate manner with open discussions about available options. CI is the arbiter due to the consequential nature of the professional environment, but conversations facilitate the development and understanding of decision making agency. CI discloses options available and the process by which selection and deselection occurred as part of a cognitive apprenticeship opportunity. Risk vs. benefit ratios carefully considered in authentic contexts as client moves swiftly to going solo on big pitches. Safe training based on principles and loose parts theory rather than doctrine or a rules-driven approach or premeditated responses.
Long term goals (the ’what next’)	Future plans determined by the cavers’ progression towards their holistic development and linked directly to their goal of being an independent performer in an adventurous and consequential setting.

4.6 Limitations

This chapter was deemed necessary to afford an opportunity to look more closely at the data collected across Chapter 3, although as stated, no additional data collection took place. However, it explored and evaluated the EC and its relationship to the PJDM of high level CIs working in the specialised domain of vertical and extended cave systems in a depth not possible within the previous chapter, or in reality, in one chapter.

4.7 Conclusion

The CIs in the study employed an evolving session design process utilising a 'strawman plan' which is robust but ready to change according to the alignments of their existing sources of information regarding conditions, session aims and client capabilities. Pre-session planning is regarded as crucial in order to manage the cognitive loads associated with their professional environment as this pre- action planning by the CI serves to manage the in-session aspects by reducing variables. This facilitates the generation of cognitive space required for the more complex elements which may be encountered in-action.

The epistemological positions of the CIs sampled are formed in part by a close professional and lifestyle interaction which values the role of adventurous experience and a comprehension of the positive role of risk. The role of adventure in client development, positive expressions of '*being in the adventure together'* (CI 4) and the intention to develop skilful independence reflects the philosophical stance of the participants and in this respect signifies the central role of the EC in session organisation (Collins et al., 2014). It was apparent that the technical learning and development needs of the client are prioritised but that a coaching process was conspicuous in its absence. Although knowledge transfer occurred, it was ostensibly upon request. This suggests that coaching is not considered within the overarching session aims but that the ability to impart knowledge based on utilitarian logic is well developed and forms one aspect of PJDM in-action. Transfer of skills to other domains and longevity in these aspects is deemed particularly important given that expertise across settings may include the cross-skills of group management, risk appraisal and session management. Technical skills of ropework and navigation contain many of the key loose parts (Nicholson, 1972) of skills, reordered according to context. Of note is that the development of self-esteem and positive human progression was considered at times to outweigh the development of technical caving skills.

It is observed that the participants occupy a role similar to that of the pracademic (McDonald & Mooney, 2011), which may be conceptualised as practical wisdom. In the research setting, the practical skills of group management, movement through vertical and horizontal caves merges with the necessary knowledge of peak impact forces, rigging loads and advanced hydrology. The rapid skills progression within vertical caving via a loose parts and principles approach utilises five key items of safety equipment in a range of configurations to facilitate prompt independence.

The CIs in this chapter used a range of pedagogic tools and leadership techniques which they described as 'intuitive' but occasionally were unable to verbalise or further articulate. The aspects which emerged about how the CI retains sufficient cognitive resource in reserve should it be required in demanding situations, is particularly relevant in the dynamic environment of cave leadership and shows transferability across AS domains and other complex work environments (for example, emergency services and military contexts). Whether there is a deeper well of this reserve than originally believed, if some is retained and 'ringfenced' or if there is access to an emergency reserve or 'overdraft' is not clear and worthy of further investigation. Furthermore, it was advised that an extended series of 'adequate' calls was required rather than excellent ones owing to the nature of progression in this challenging environment. This approach of 'sufficiency' in decision making should be the subject of further investigation.

The practical applied outcomes arising from this chapter include;

1. The creation of a bespoke caving EC, noting the presence of the essential underpinning role of the EP and the 'where, who, what, how, why and what next?' elements of professional practice.

2. Table 4.2 acting as an effective' road map 'to understanding how high level CIs organise, design and adapt their leadership in dynamic caving environments. It is useful for aspirant CIs, for NGBs in considering their professional development offer, and may be widely translatable to other adventure sport domains.

3. Chapter 4 forms the basis of the third submission from the thesis to the Journal of Adventure Education and Outdoor Learning (JAEOL). Based on the research of how caving instructors operationalise their EC-PJDM link, it will be the first publication to address the demands of the professional environment of this AS domain. For a wider readership, a condensed version will be submitted to the BCA training website and for publication in 'Horizons' which is the professional magazine of the Institute for Outdoor Learning (IOL).

Chapter 5 – Investigating PJDM and the Epistemological Chain within Caving

5.1 Preface

To gain further theoretical purchase on the PJDM processes of CIs in-action, an Applied Cognitive Task Analysis (ACTA) approach (Millitello & Hutton, 1998) is utilised in this chapter. The primary aim is to elicit reflection on demanding situations which have been encountered within the participants' extensive professional caving careers. Specifically, the Critical Decision Method (CrDM) is utilised to investigate the decision making strategies and cognitive processes of high level CIs. This technique seeks to capture knowledge and experiences involved in real-world decision making and problem solving (Hoffman, Crandall & Shadbolt, 1998). In the context of the thesis, it is an appropriate research instrument, used to stimulate reflection about past experiences and to elicit information about cognitive functions such as sense-making, planning, situational awareness, improvisation, coping with equipment failure and complex decision making processes. This knowledge elicitation is founded on specific references to challenging events chosen by the participants (Kartoshkina & Hunter, 2014), which itself is fostered by the EP of each. In the context of cave research, this is a study of situated cognition which supports PJDM in real world situations, exploring practice 'when things work.'

The investigation of expert reasoning is based on exploring 'tough case' scenarios (Cruickshank et al., 2020), with participants who are at the peak of their profession. To the best of the author's knowledge, this is the first time ACTA approach has been employed in adventure sports research, and without doubt, in caving based research.

5.2 Introduction

The working environment of the CI is contextualised as being psychologically demanding, physically arduous and typically associated with high cognitive loads that are derived from a range of pedagogic, leadership and welfare demands (Christian, et al., 2019). Consequently, the CI utilises a specific set of PJDM skills in order to work successfully in this challenging environment. Research into decision making in other domains which are considered high pressure or complex (such as firefighting, flight training, surgery and military operations) is available (Klein & Borders, 2016; Kennedy et al., 2010; Shaban, 2015). However, there is a scarcity of investigation within the realm of leadership challenges of underground exploration, which typically involves traversing consequential terrain and where access to outside assistance is routinely problematic. The decision making research in the areas noted often focusses on the hints, cues, and subtle signals that experts are able to draw upon in time pressured and high risk situations, which offers realistic transfer to the domain of caving. This reflects the balances, synergy and 'nested' nature of the CDM and NDM systems (Collins & Collins, 2016; Galloway, 2005) in operation across these fields.

5.3 Method

ACTA encompasses a range of psychological research techniques suitable for the recognition and representation of what participants know and the cognitive process which scaffold it. In the context of this chapter, ACTA is an appropriate method to gain a deeper understanding of PJDM processes in context and the cognitive strategies deployed in dealing with challenging situations (Crandall et al., 2006). The most prevalent protocol is a structured or semi-structured interview with those deemed to be expert. Performance observations and self-reporting tools regarding the levels and application of knowledge are also applicable.

ACTA can be used to investigate the role and comparative relationships of expertise in that specific field and how the behaviour of experts differs to that of non-experts (Phillips et al., 2004). One of the benefits is that critical incident analysis can explore tacit knowledge to indicate decision points, critical cues and sense-making strategies which can then be taught to relative novices in a more explicit format as part of professional development. This approach is seen in paramedic practice, pilot training and firefighter education (Klein & Borders, 2016; Rajabi et al., 2020). ACTA is essentially based on the macro cognitive processes of the expert practitioner or coach, which deserve to be studied given they ought to offer increased understanding (Crandall et al., 2006) and that "*cognitive task analysis methodology developed specifically to study the cognition of experts performing challenging tasks can be a useful tool to gain this insight*" (p.51).

One of the most widely applied methods within ACTA is the CrDM, which is used in this chapter. This approach seeks to capture the knowledge and lived experiences of problem solving and PJDM in real-world, full context settings. The CrDM is a case-based method utilising a semi-structured interview and discussion technique, which can be particularly helpful in studying leaders and educators working in challenging environments (Kartoshkina & Hunter, 2014). Given the noted demands of the caving environment, the CrDM serves as a fitting technique and is suitable for this investigation. It is an approach which seeks to elicit a participant's thinking in a specific, non-routine incident where they were an active decision maker and played a central role. It employs a series of sweeps or passes which interlink to build a full picture of the incident and the cognitive processes which may have scaffolded it (Crandall et al., 2006). The essential purpose is to get the participating experienced professionals to articulate and describe some of the toughest challenges they have faced within their CI role. Utilising carefully crafted nudges and probes, the ACTA interviewer aims to create a story by teasing out how they promptly assessed situations and acted upon decisions which were made in critical moments of their significant accrued experience (Klein, 1998), utilising multiple sweeps to promote recall.

Fundamentally, there are five main stages to any initial ACTA process (Ward, 2013). These are; background preparation to ensure familiarity with the domain; elicitation of knowledge to draw out the thought processes and tacit knowledge of the participant experts; an analysis of the qualitative data (which is likely to be in the form of transcripts following from interviews); representation of this knowledge; finally and arguably the most important, the design and development of models and applications for educational development. This process is utilised in the field of paramedic practice, among others (Kartoshkina & Hunter, 2014).

Given the contention that expertise is revealed during tough circumstances rather than routine ones (Militello & Klein, 2013), it is important that participants in the study have an opportunity to discuss and explore situations in which their PJDM expertise was put to the test. This occurs through the use of the discussion interview which seeks to unpack the decision making process based on the full context of events which have been experienced. Crandall et al. (2006) suggest that once the necessary preparation has been undertaken by the researcher to understand the domain, tasks and cognitively demanding aspects associated with it, the semi-structured interviews should consist of four interconnecting phases, which regardless of the specific technique or model considered, tend to be common to all. These are; incident identification; an accurate verification of the timeline and chronology; a deepening and 'fleshing out' phase; and a final "what if" enquiry phase which is based on temporally extending or contracting the scenario which the interviewee describes.

Accordingly, Kartoshkina et al., (2014) contend that the main practice in a CrDM dialogue is to repeatedly discuss an incident with the intention of approaching it from a range of perspectives, analogous to a detective interviewing a suspect in a case where the details are traversed over multiple times and from a range of angles, in order to build a deeper and more complete picture or ‘story’ of the events. It is acknowledged that supporting probes from the ACTA ‘toolkit’ of Militello and Hutton (1998), which involve both retrospective and prospective probes can be valuable at this stage. A final querying phase ensures the researcher has a full insight into the processes and decisions made, by posing a range of scenario-based hypothetical questions and inviting the participant to speculate on how the outcomes may have altered, for better or worse (Militello & Klein, 2013). For clarity it is worth noting that this phase is not based on reaction to given scenarios or simulations, more to extend the thinking and rationalisation of the knowledge elicited from the specific initial incident offered by the participant. The primary aim is to develop the thinking and understanding of the prospective decision making processes of the participant, in a bid to transfer their knowledge from tacit to explicit.

This extension of thinking and consideration of potential future events is known as situational awareness (Endsley, 2017) and is a vital element. A key aspect of developing expertise relates to the concept of what may occur next and the ability to accurately comprehend a situation to generate an informed appraisal of the likely outcome. A typical outdoor journey-based scenario might be ‘where would we be in 10 mins or in 1 hour in the current conditions?’ and consequently, ‘do we need to act now or purposefully delay?’ (Collins & Collins, 2019). This offers a specific insight into how the participant believes a dynamic situation would unfold, which is crucial in a range of time pressured decision making environments, not least of all those found in AS leadership contexts (Collins, Giblin, Stoszkowski & Inkster, 2020). The accuracy of this situational awareness capability itself is considered as a factor of expertise (Phillips et al., 2004).

Linked to the concepts of the Recognition Primed Model (Klein, 1998), such decision centered research design focusses on understanding the decision making steps and processes during challenging or new situations. Klein theorises that in any novel situation there exists a succession of hints, clues, cues or subtle signals that allow experts to recognise patterns more readily. The contention is that the more varied and robust experience somebody has accrued, the more of this pattern matching will be recognised, understood and promptly acted upon in a process which reflects evolving expertise in NDM. Furthermore, this aspect of the NDM process more readily recognises when something presents as anomalous. It has links to later research into trajectory tracking (Klein, Snowden & Pin, 2011) which aids in preparation for the potential unfolding of events, and cognitive priming for the range of consequences which may follow.

There is little doubt that unforeseen and exacting situations require most PJDM capability (Maranges & Baumeister, 2016) and given the nature of the work of the CI in underground environments, the caving professional is provided with many opportunities to practice their decision making skills and gain prompt and explicit feedback on the consequences of their choices. Although a complex environment in which to make critical decisions, it affords an opportunity for lots of decision making (and therefore learning) practice, and is positively conceptualised by the CI as 'target rich' in view of the EP.

It is deemed vital that researchers who choose this method of knowledge elicitation have a thorough understanding of the PJDM demands of the setting and typical tasks associated with it. The author is a current and qualified Caving Instructor Certificate holder (CIC) with 24 years of experience accumulated post-award and is considered to be in a robust position to conduct an enquiry of this nature. To ensure credibility and trustworthiness within this phase of the data collection, triangulation of data points was achieved by following the lines of enquiry and information accumulated through the extensive data gathering within Chapters 3 and 4.

5.3.1 Participants

The sample of cavers recruited for this study are among the most talented and experienced within the UK and are very well respected within the British caving CoP. Due to the expertise requirements (Ward, 2013), the participants formed a purposive sample (Silverman, 2013). It was felt important to access as many current CIs as practicable, even given the very small pool on which to draw. The small sample size of three is recognised as a limitation, yet this is the reality of the professional caving community, especially at the higher levels of award. All participants are known to the author through professional contact, and for clarity, although an interview process has been utilised, the new participants of this sample have not been previously interviewed or in the very specific way required by the ACTA protocol. This constitutes a strong effort to utilise high level and experienced professionals from a very small pool during a difficult research period.

For the purposes of trustworthiness and transferability, it was essential to ensure that in selecting the participant CIs for the study, it was possible to justify them as experts (Nash et al., 2012) as it is one of the requirements of the CrDM process. In discussions prior to the selection process for participation, the author asked each to share some of their experiences which were considered demanding from a PJDM perspective. In listening to their accounts, there was little doubt that the participant CIs were not only able to draw upon some arduous and taxing experiences for the CrDM, but that they were undoubtedly positioned at the top of the standings of qualified caving instructors within the UK. For example, each holds a seat on the Training and Assessment Committee of the BCA instructor development and qualification panel. Within the caving community of practice, this standing alone justifies their inclusion in the sample in representing a rarefied professional field. Aspects of their experiences are presented in the results section and participant details are displayed in Table 5.1.

Table 5.1 Adventure sport professional (caving) participant demographic

Participant	**Age**	**Age at time of award**	**Years holding senior accreditation**
CI 7	57	38	19
CI 8	68	42	26
CI 9	50	27	23

CI 7 is one of the most respected cavers in the UK, having been at the forefront of the development of caving awards for the last 10 years and is a CIC Trainer and Assessor. CI 8 is well known for enthusiasm, wealth of cave knowledge and experience over a very significant career span. He is also a CIC Trainer and Assessor and has been involved in military caving expeditions worldwide. CI 9 has held the top level of award in caving for almost half of his life, being among the youngest to be awarded the CIC. He runs his own caving training company and is at the forefront of British cave diving.

Allied to the factors previously described in Chapter 4 and in the absence of other markers which may have been more objective (Martindale, Collins & Abraham, 2007), there was a high level of confidence that this group of cavers represented a very strong sample that captures the good practice of the CIC award holder. As with the other studies, all ethical procedures were followed, and voluntary informed consent was obtained.

5.3.2 Procedure

This investigation applied the single, extended semi-structured interview as one of the available procedures for conducting an ACTA when utilising the CrDM. It briefly utilised the task diagram method within the interview itself to blend research approaches without it presenting as overwhelming to the participants, whilst still maintaining adherence to the ACTA protocol. At the time of the research, face-to-face interviews were not possible, and it is acknowledged that there are both benefits and disadvantages of face-to-face interviews compared to telephone interviews, and contemporary digital face to face calls (Jones & Abdelfattah, 2020). The participants were each contacted in advance to discuss the interview process and were notified of the expected duration. In relation to the CrDM aspect of the ACTA process, it was important that the participants were given some advance notice to consider incidents and instances where their decision making ability and cognitive processes had been put under some duress.

Ultimately, the goal of the CrDM interviews is to employ a range of appropriate methods to leverage expert data in ways which will lead to improvements in performance and generate resources for the purposes of educational development (Ward, 2013). Specifically in this chapter, the CrDM method is utilised to investigate the primary influencers in decision making processes, utilisation of PJDM tools in challenging and consequential subterranean environments, and to explore the links of their decision making strategies to their epistemological position.

Interviews were carried out via telephone at a time convenient to the participating CIs and were recorded. Digitally supported video calls were trialled but discounted due to technical issues for some participants. The interviews were conducted in a collegiate, friendly, and professional manner. At the end of the data collection phase, each participant expressed that they had enjoyed the process and stated that they had welcomed the opportunity to articulate and unpack their thoughts on caving leadership and adventures with clients.

Given the relative complexity of the CrDM as a series of interwoven interview segments, it was deemed necessary to practice the process. Therefore, prior to the commencement of the data collection phase, the ACTA procedure was rehearsed, piloted and adjusted with similarly well qualified AS colleagues. Minor amendments were made throughout this process to the interview guides used to scaffold and aid in the elicitation and articulation of the critical decision making aspects. A deeper range of subtle questions enabled a number of sweeps to take place, rather than acceptance of the first account, which occurred in the piloting stages. Questions were reworded to ensure they utilised plain English and were asked clearly in the manner in which people might typically converse. For example, '*can you tell me about an occasion when*…' replaced *'identify and discuss a specific incident…'* Once sufficiently refined, it was utilised for the data collection procedure.

ACTA methods do have some limitations. One is that the technique relies on verbal reports based on memory and that there may be difficulty in identifying true experts in certain fields, especially ones which are new and emerging. The other limitation is that the CrDM interviews are not easy to conduct and require practice for the interviewer to know when to expand and redirect the participant, or how to recognise important cues and clues (Ward, 2013). However, the participants within this study were clearly able to recollect the incidents which were discussed and were repeatedly able to recount specific details with ease. It was felt that the process was made more fluent owing to the practice and piloting which had occurred prior to the main data collection phase.

An ACTA table of prompts and questions was utilised to support the interview process and to promote the knowledge elicitation required within this method, which is displayed as Table 5.2. A results table was constructed to aid in consolidation and synthesis of data, which is displayed as Table 5.3.

Table 5.2. ACTA table of prompts and questions

Question	Follow-up	Prompts	Purpose
Consider a situation where you are taking clients underground for the first time. They are largely unknown to you and conditions are not favourable. Please list 3-6 steps you go through and identify which you feel are the most cognitively difficult.	What are the steps identified? How have these been decided? What are the situational and environmental demands? Heuristic involvement?	Ensure clarity of question / situation. Can be a paper and pencil exercise. Aware of FACETS acronym and bias?	Ranking of steps – why? Frequent / likely occurrence. Has this changed through time and experience?
Identify a relevant, specific incident where you felt your decision making ability was stretched. Tell the whole story without interruption, recounting the events in their entirety.	What are the critical decisions that were made, where understanding changed, and other turning points during the episode.	"Could you just tell me again the bit about…" How did you know these were critical moments?	Noticing - what, when, how, where etc. Subtlety in acquiring information. Can others do this? Metacognition. Meta-decision making.
The "what if" questions founded on own acts or omissions or the behaviour of the client(s).	Gaining a sense of anticipated outcomes that were tacit and therefore never realised. Were trade-offs made? How was this known?	Range of timespans (10 minutes / 1 hour / 1 day). "Can you tell me about a time when you didn't intervene and perhaps should have, or vice versa?"	What are the known PJDM aspects? How / what are you picking up on the clues from the client(s)? > what is seen? > what is heard? > what is unsaid? > the role of body language

Can you describe a situation where you knew something was amiss or going away from the expected norm? What was the nature of the feeling or the experience?	Cues, clues, signals Heuristics 'Intuition' Exceptional Just atypical Felt wrong	Irregularities. Incongruence . How did you know? Were you proved right or wrong (how did you know?)	Insight into 'trajectory tracking' and the confidence to 'let things run' or not.
What was it about the situation that let you know what was going to happen?	Observation . Analysis. 6th sense / intuition (speedy NDM).	Why? Why not? Has this happened in the past?	Important – what are the cues, clues, signals, body language of clients, words spoken or not said, change in air or water temperature, change in draughts, change in water colour, increase in drips, volume increase or decrease, etc. As a factor of expertise?
What were you noticing at that point?	How was space made to allow for this noticing? Subtlety in cue / clue recognition and assimilation.		See above, plus how is this sense developed if it is developable? Is there a form of 'masking' going on to be able to home-in on subtle signals that others may miss or may not make the opportunity to notice?
What information did you use in making this decision?	Prioritising. Leader vs. guide. A useful probe for investigating strategies, cues, signals and goals.	Information from the pre-planning or garnered as the caving session progressed?	What sort of sifting or ranking takes place here? How is the resource conserved or allocated?
Can you describe a situation where you	Flexibility. Transferability	Does this relate to the participant EC	Agency to use 'my own rule book'.

improvised either through necessity or choice (to do something better).	Power to act 'Tricks of the trade'	with regards to positive adventure and learner independence?	Opportunity knocks – is this the 'bright idea' or has it been considered in the planning?
What were you hoping to accomplish at this point?	Agency. Safety. Fluency / momentum	Any particular strategies, cues, signals and goals	How are the stated aims of the session balanced against decision making requirements?
Are there times when you have had to make a hard decision which went against perceived wisdom?	Based on experience? Pitfalls and problems.	What where and when?	Links to question above to find out what goes through the CI's mind when demands are potentially high.
Have you found ways of working smart (not hard) using cognitive ability?	Context. Agency and control (practice) for clients.	Well worked short cuts Linked to EC Linked to maturity	How does the CI use this to manage cognitive load / peaks in demand?
How do you maintain sufficient cognitive resource to avoid becoming 'maxed out?'	'Overdraft' facility. Deeper 'well' than initially comprehended Ringfencing / 'banking' strategies.	Can you recognise surges in demand and how do you cope with these?	Tacit or explicit? Is it understood or recognised by the CI? Chronic vs. acute demands upon the cognitive resource and subsequent allocation.

The three extended recorded interviews were transcribed verbatim by the author, but without prosodic detail. Interview times ranged from 94 minutes to 117 minutes (mean duration 106 minutes). The mean transcript length was 5500 words, with the longest approaching 8000 words. In order to process this considerable amount of data, combined methods were adopted. The first was to print out the interview transcripts to paper copy and then highlight key words within the text. The second part was to insert more lengthy word comments into the electronic version of each transcript and then collate all the comments from the script into a more condensed word document. This facilitated a logical process of poring over the data utilising two corresponding and blended methods, and which enabled greater comprehension of the meaning of the participants (Shenton, 2004).

5.4 Data analysis

After conducting the interviews and in acknowledgement of the data generated within Chapter 4, an ACTA Cognitive Demands Table (CDT) was constructed (Table 5.3). This was primarily to aid in the analysis and organisation of the qualitative data, with the secondary aim being to retain a focus on the aims and objectives of the thesis. Attention was paid to the problematic cognitive elements which underpinned the difficulty. These included how the challenges can be addressed, indications and strategies for success and anticipated likely errors, showing alignment to the ACTA analysis recommendations of Millitello and Hutton (1998).

Table 5.3 was utilised to aid in the identification of commonalities in the data and any associations between information and relationships. The foci of the ACTA were grounded in the initial overarching scenario of leading a group of relatively unknown cavers underground when conditions on the day were sub-optimal, with an exploration of how the cognitively demanding elements of the extended sessions were managed. In plain terms, the questions offered a range of scenarios designed to elicit telling responses. Consequently, the data were analysed deductively against the framework of important influential themes that have been termed Decision Making Influencers. These were classified according to recurrence and the importance stressed within the interviews.

In addition to the creation of a results table following the extended interviews, a concept map was generated (Figure 5.1) to assist in recognising and categorising the full range of decision making tasks required of the CI, which was valuable in identifying the range of cognitive steps which support successful outcomes. Concept maps have been found to be important in promoting learning and understanding in a range of fields, including nursing (All, Huycke & Fisher, 2003), adult education (Yelich, Biniecki & Conceição, 2016), and science education for young people (Kinchin, Hay & Adams, 2000) among others. The value of concept mapping is that it creates a mental model of practice on which to focus learning and interpretation, facilitating a process of educational constructivism (Bada & Olusegun, 2015) which represents the production and illustration of knowledge, and ideas. It is an applicable instrument to aid in the representation and evaluation of the complex PJDM processes of cave professionals following the CrDM within ACTA.

5.5 Results and Discussion

Arising from the interviews of the CrDM were four main categories, conceptualised as Decision Making Influencers. These are 1) Client information, 2) Sustaining positive sessions in variable conditions, 3) Venue selection and 4) Managing cognitive loads. The four categories were established as common ground across the sample. Each addressed the decision making influencers in subtly different ways but were all able to work to similar outcomes, which relate directly to the epistemological position of each participant. This is summarised as 1) Positive engagement with adventure, 2) The development of agency in decision making, 3) Promotion of independence, and 4) Knowledge transfer and learning which is multi-directional.

Table 5.3 ACTA results

Decision making influencers	Why influential / demanding	Cues, clues and strategies employed	Errors / learning opportunities
Client information.	Lack of information on group. Capability vs. expectations Inconsistency / veracity of information. Potential for performance collapse.	Keep plan 'soft' for as long as possible. Commit but retain options - continually seek opportunities to confirm client capability. Observation of both physical and psychological state.	Aware of potential misrepresentation of client information. Client capability not verified in advance of session. Not noticing client cues promptly.
Sustaining positive sessions in variable conditions.	In the 'DNA' of the caving CI to provide good sessions in any conditions - sessions rarely cancelled.	A range of differentiated tasks created - short trips with lots of variety in activity. Agency in client decision making - offers 'loose parts' and a principles ethos to clients.	Rigidity of plans. Underestimate impact of conditions and weather. Continuing with 'hard' plan in presence of contra-indicators.
Venue selection.	Venue selection acts as a constraint. Continual updating of the plan to incorporate the client, the environment, the tasks, and their interrelation.	Use of Community of Practice / networks. Selection process made open to clients for their future development. 'Tricks of the trade' and judicious use of specific venues.	Insufficient local knowledge. Commitment to venue that does not provide for task variety.

Managing cognitive loads.	High cognitive loads given dynamic and high risk nature of the cave environment. Routinely across extended timeframes.	Progressive delegation of tasks. Subtly maintains physical and cognitive space from group. Comfort in environment and autonomous skill level of ASP enables valued cognitive space. Continual reflection and reviewing.	Heuristic traps (familiarity' confirmation bias, expert halo effects. Unaware of decision making traps. Unaware of accumulation of cognitive load. Failure to review and reflect in-action.

Each of the CIs employed subtle and well refined approaches in the management of both chronic and acute cognitive loads generated throughout the vertical and extended horizontal caving trips discussed within this chapter. For clarity, chronic loads or stressors, refer to those which accumulate progressively as part of the leadership of a group underground, such as anticipating client behaviour or risk management, whereas acute stressors are those derived from unexpected events such as client incapacitation or equipment failure. The articulation of these cognitive load management strategies, deployment of PJDM skills and relationship to their own EP were predictably conveyed in the everyday language and vocabulary of the participant. Therefore, given the experience of the researcher who has comparable experience in this domain, it was important that '*words were not put into the mouths*' of the participants (Ward, 2013, p.67). This aids the elimination of bias when studying the information obtained through the CrDM.

In examining the accounts of the participants, commonalities of how each manages the decision making loads and accumulated stresses of leading groups underground were noted, in addition to recounted incidents which utilised significantly different approaches. This was important given that the participant CIs know one another as colleagues and are part of the caving CoP, but do not necessarily cave together or work collaboratively.

5.5.1 Client information

Each CI demonstrates high levels of professionalism in their work, as one may expect. Client record sheets are routinely used in advance to collect information and are often followed up by further emails or phone calls as necessary to ensure that the CI has the best possible picture of the clients prior to the caving session. Client information misrepresentation is cited as potentially problematic, but a process of anticipatory thinking allied to proactive coping is manifested in the planning of skill based sessions or underground journeys which accommodate a range of tasks and client development opportunities. It is understood by all that the information gathered and the "*person standing in front of you*" (CI 8) rarely match, and is a situation acknowledged by the participants as one associated with a surge in cognitive load and decision making demand.

Accordingly, each of the participating CIs placed significant emphasis on gaining accurate client knowledge. This is to reduce the likelihood of taking people underground into consequential and potentially hazardous environments to find out that they cannot cope. The twofold problem in such circumstances is that an individual may feel anxious or insecure, whilst the aims of the rest of the group are unable to be met.

CI 7 articulates this point in terms of his ability to promptly "*scan the group as a unit*" with particular reference to refined perceptive abilities to "*notice things which are different about individuals compared to the rest of that group.*" Similarly, CI 9 states that "*I hoover up client information really consciously - finding out in subtle conversational ways why they are there is a real priority.*" This self-proclaimed 'hoovering' action serves to further update the field capability and knowledge audits (Klein & Militello, 2001) and inform the ongoing planning and decision making process. According to all the participants, the underlying issues concerning caver information is one of misrepresentation, given that it would appear most clients are likely to overplay their strengths and experience, rather than undersell themselves. CI 8 discussed gentle, fun and understated ploys designed to elicit information about genuine client capability, and states:

> …having a quick race to see who can put on their SRT harness first yields quite a lot of info quite quickly - some will do this fluently whilst others will look at the harness as if they haven't seen it before, which is because they might not have...!

CI 7 mentioned that if a rope needed to be re-coiled or packed into a caving bag, the task would be given to a group member. In fact, any task at all which could be reasonably managed by one of the clients would be completed by them, rather than the CI. A common strategy among all, this served to aid practice, promote learning, offer immediate agency (Beames & Brown, 2016) but crucially, to artfully provide subtle opportunities to quickly ascertain the competency levels of a number of individuals and verify information. Viewed through a theoretical lens, each CI has conducted a knowledge audit (Burnett, Williams & Illingworth, 2013) which in the case of caving, is particularly beneficial if completed before going underground, although not always possible. In this instance, a prompt inventory or 'stock-take' of the current skill, comprehension and experience levels of the clients occurs. Seeking to ascertain the abilities of individuals against the stated criteria of a given course or trip requirements can be considered as a field audit which further refines the initial information gathered. This denotes that the aims of day can be skilfully adjusted according to information which is verified and updated as it is collated. As CI 9 pragmatically stated *"…there is great power in having a plan B whilst knowing that you may or may not choose to use it."* The issue surrounding the misrepresentation of client ability presents as a significant concern to all participants, which is probably as an outcome of the considerable accrued experience of the sample and therefore their direct involvement with occurrences when problems have arisen as a consequence of technical inability, a lack of physical fitness or of mental resilience.

One of the stated EPs of the CI relates to client independence. In traditional sports coaching, gaining independence from the coach is a rational pedagogical step, whereas in the caving context of AS leadership, independence is as much a necessity as a logical or progressive phase. The point at which the CI decides to let the client descend through rebelays without an additional safety rope or close supervision may be considered a 'dark art' by some, but in reality, is generated through careful observation scaffolded by significant experience. CI 7 noted his ability to '*promptly scan the group*' and CI 9 discusses '*hoovering up*' client information judiciously in what presents as a very utilitarian process.

The common model of practice presented is one of constructing an opportunity to observe the behaviour of clients with particular reference to two key factors. The first is the fluency in which the clients handle ropes and technical pieces of equipment, and the second is the ease and speed in which technical manoeuvres on ropes are learned and established. As CI 8 confirms "i*f they can't handle and screw up a karabiner without fuss, I know I will have to really keep my eyes on that person, or even change the emphasis of the trip."* The issue of fluency in movement and technical capability is more crucial than may be first considered, as it combines the factors of safety management and comprehension while the trip progresses. If the completion of relatively simple tasks consumes much of the clients' cognitive resource, further learning about movement and technical requirements associated with risk management may prove too onerous for safe progress through the cave system. This further highlights the point made earlier by CI 7 in describing that the autonomous nature of his own skills (Fitts & Posner, 1967) allowed him to think a '*few steps ahead and maintain the bigger picture*' of client performance and progression.

Group management in steep caves can be complex but is eased by facilitating cavers working in small groups. They may be offered information as individuals but are also able to work in cohesive micro-teams. CI 9 notes *"I can soon suss out who the quick learners are and who I can trust a bit to be an extra pair of eyes for me - small supportive groups work great, just looking out for one another."* This delegation instils a sense of independence from the CI but also creates learning opportunities and skill development which arise from client-to-client interaction, rather from the 'instructor.' A great example of clients working together to solve problems was evident in the data collection of Chapter 4, where CI 4 purposefully removed himself from a guiding role to facilitate the cavers working through a range of tasks unhindered by his immediate presence on the pull- through trip in Simpson's Pot. From the perspective of an EP and the utilisation of a learning chain, independence from the CI was encouraged. This facilitated agency in both decision making and task progress, with knowledge being generated and exchanged in multiple directions.

Given the accentuated nature of the caving environment, matching the demands of the caving trip to the abilities of the participants is crucial. CI 8 discussed this issue as it related to his leadership of a pull-through trip in Cueva Badalona, Spain. This particular trip is considered to be a world-class adventurous underground journey through a particularly impressive subterranean landscape which therefore is on the 'tick list' of any cave explorer. But this may lead to the exaggeration of experience or misrepresentation of ability in order to secure a place on the trip. CI 7 explains:

> Caves do tend to find you out! As much as you might want to do a great trip like Badalona, if you are not caving fit, both mentally and physically, or not technically skilful enough, there is simply nowhere to hide.

Extended trips such as the one in Badalona offer all the assumed physical challenges of caving but with the additional mental burden of knowing that the caver must keep moving over a time period of at least 36 hours with no way of retreat other than to continue, due to the system of rope retrieval. In Badalona, there is a real risk that the final exit sumps off in the event of thunderstorms, which results in an unmistakable sense of time pressure that can gnaw away at each member of the party.

In many AS domains, and particularly in relation to caving, the leader has to complete the trip with its' associated demands in order to lead it. There is no requirement to be a 'hard' caver, but there is an obvious requirement to be skillfully independent in that environment. However, one of the main differences between the skilful independence of a whitewater kayaking or rock climbing ASP for example, is the known difficulty in rescue. One of the main dissimilarities between such domains is that the CI has to remain practiced at performing complex vertical rope rescues promptly and in difficult situations, in the knowledge that outside assistance is rarely available in acceptable timeframes. This presents as a necessary factor of expertise and cognitive load in this specific domain.

Individuals who begin to labour physiologically or psychologically will generate significant additional and acute cognitive demands relating to decision making tasks and of overall group security. The greater the uncertainty associated with group capability and veracity of information obtained, the greater the likelihood of returning to well-known venues, in order to control at least some of the variables. CI 7 states:

> …the poorer the conditions the more communications I will need to have with the group leading up to the course or trip, and probably, the greater likelihood of me going somewhere I know well. I've got lots better at managing group expectations in poor conditions than I used to, and if I have to change venue I will, but it is on my terms. Clients simply don't know what they don't know.

Seeking to understand why a person attends a course or caving experience is important. It aids the CI in choosing a venue and designing a session which will be appropriate by reducing the likelihood of unanticipated situations developing, although it is accepted that this is part of adventure (Hunt, 1990). All of the CIs discuss that significant energy and time is allocated to the pre-preparation stages of a caving trip, but none more so than CI 9, who states:

> I place a real onus on planning my caving trips with groups, which probably stems from the fact that I go cave diving solo, and so the planning for that is pretty intense. I don't go cave diving solo because I have no mates, it's just that always in cave diving and quite

often in vertical caving, you have to be completely self-contained, so on your own or not makes little difference. I plan well in order to minimise nasty surprises.

This level of pre-planning as part of professional practice is common, as too is the desire to avoid the stated unanticipated '*nasty surprises*.' Given the difficulty in seeking assistance in the event of a problem underground, this is understandable and presents as a consistent theme throughout the BCA award schemes at all levels (BCA, 2020), especially for the CIC award. Decision making in adventurous outdoor contexts is undoubtably a synergy of CDM and NDM systems which may overlap, or be nested (Zsambok & Klein, 2014). However, in the extended horizontal and vertical caving environments of operation, a significant emphasis appears to be placed on the planning phases of a caving trip to ensure that everything goes as smoothly as may be reasonable. As CI 9 reviewed:

I am really happy that there are no stories to be told! As a caver you really don't want a reputation for daring do and solving big problems underground. If that happens you have probably done something badly wrong in your own planning and organisation or have been exceptionally unlucky.

As part of his role in cave rescue, CI 7 recounted the story where a group of cavers had worked hard to get themselves out of a cave which was flooding. Lots of equipment was lost, a member of the party came very close to nearly drowning, and they were trapped underground for several hours. "*They only just 'got away with it*" and continues:

…despite their significant efforts to try to sort themselves out, no matter the skill or resolve, they just couldn't make up for their rubbish planning - the ground was saturated, and the weather forecast was consistently set for heavy rainfall, but they chanced it.

This is an example where the fast, frugal and in-action NDM aspects cannot, nor should be expected to, counterbalance the deficiencies in the CDM parts of the process. To use metaphor, it appears that such is the gulf presented by inadequacies in the CDM and pre-planning stages, that the NDM aspects of decision making are unable to act as sufficient 'sticking plasters' and cannot compensate. CI 7 continues in discussing the resources offered to cavers following a spate of flood related incidents and offers *"This was before we at the BCA started distributing the PLOW cards, which* *encourage cavers to take a seriously hard look at all the weather components and how it might relate to flooding."*

5.5.2 Sustaining positive sessions in variable conditions

Although each participant CI has worked with a range of clients, most sessions tend to be with adults who are learning to cave in both horizontal and vertical environments or are proceeding through the various stages of qualification and leadership awards offered within the BCA accreditation scheme. Consequently, and representing a positive EP (Collins, Collins & Grecic 2015) all participant CIs discuss how the role of offering decision making power to influence the design of the session are perceived as positive. Undoubtedly, when there is a sense of ownership of a procedure and agency is shared (Beames & Brown, 2016), the session can be viewed as satisfying and valuable even in unfavourable conditions. As CI 8 comments:

> I have run caving courses when it has been freezing cold and where motivation has been expectedly pretty low. Rather than a normal full day's caving session, we agree to a shorter, sharper one where lots is going on and lots is practiced, but in the knowledge that it won't be too long before we get out and have a hot cuppa – they have to buy into it, but it does work.

Agency in peer-peer working and delegation of leadership roles further adds to a positive attitude within a group, whether adults or young people. Taking turns to lead a section of cave using the survey and compass is engaging and worthwhile in terms of skill development and generates an understanding of leadership positioning. As CI 6 affirms:

> I understand that me always being at the front is a limiter for the development of an individual caver. In other words, if I were to lead from the front all the time or don't give others a chance, their learning is curtailed - all they get to see is the back of the person ahead of them!

The skill and experience of veteran outdoor professionals comes to the fore in poor conditions, and it appears that there is a 'badge of honour' to provide positive sessions in even the most unfavourable conditions which hints at the requirement for the CI to remain a competent performer in the present. It was described by CI 8 as "*…being in my DNA to make things work well for clients*" which in itself is a marker of the EP of maintaining a positive view of adventure. CI 9 continues:

> I returned to the centre having had a great day out caving with my group, who are rosy-faced and buzzing, only to find an instructor and group who stayed in all day doing map work because they felt conditions were too wet. Knowledge of where to go and how to construct a great session even when conditions are far from ideal for me is a 'tool of the trade' for a decent instructor.

CI 7 continues the theme and suggests that *"…. you should have loads to offer the group. Find somewhere in the cave to get the group shelter out, get them inside with a candle carefully lit and everyone soon warms up."* CI 7 comments that it is usually possible to access a caving venue which has shelter or dry sections available in almost any weather, and once underground deploys contextual and purposeful teaching strategies to develop appropriate caving skills useful in the clients' own adventures. Tacitly considering the reciprocal stage within the Spectrum of Teaching Styles (Mosston & Ashworth, 1990), CI 9 continues:

> …if I have 6 clients, I split them into pairs and teach one of them a specific skill, and they have to then teach it to their mate. They swap over with another skill or technique, and this can be really good fun and where the time usually flies. If I show them all a range of techniques together - once they have got all the hang each one, we sometimes do a bit of a 'Dragon's Den' to see which is best!

Although second nature to CI 9, this is arguably high quality session management that any school class teacher or sports coach would be satisfied with and is indicative of the scope of role and attributes of the CI. In terms of span of control as an aspect of the PJDM process (Collins & Collins, 2016), CI 7 appreciates when the environment is the arbiter of any given session and recalls the plan to walk to a classic cave high up on the moors. It is realised that the forecast wintery showers would later entail the group emerging from the cave at night and into a snowstorm, and even with an experienced group, this would present a significant concern given the distance back to the vehicles. Thus, the plan was completely reconfigured, whilst still retaining the substantive parts and aims of the session. Similarly, CI 9 describes the situation where it was simply impossible to go caving due to high rainfall, but not all activities were curtailed and recalls:

> The group had planned to go caving but I knew that this was probably not going to happen given the forecast and sure enough, as I built my own more complete picture, it became certain. However, we went gorge walking instead and they had a brilliant day. Later we learned that two people had drowned nearby whilst crossing a river on an outdoor trip, and it put things into perspective for the group.

The working context and session aims are worth clarifying, given that in the view of the participating CIs, the main aspect of their role entails the promotion of independence from a leader in order for the client to safely embark upon their own adventures, and the PJDM skills demonstrated in the metacognitive reflection above serves as a pertinent example. This skilful independence from the leader and promotion of agency in decision making is related primarily to welfare and safety, rather than to their pedagogic needs (Collins & Collins, 2013), given that any coaching or skill development is focused on progressive participation in the activity rather than on elite levels of performance.

Applying contextual and situational frameworks to the planning phase of a session and integrating diverse mental models has been shown to reap rewards in its subsequent delivery (Collins et al., 2018). As noted, the anticipation of future events amid current conditions and available information can be considered a factor of expertise (Phillips et al., 2004) and one which is discussed by CI 9 in stating:

> It was the evening prior to the last day of the caving course, but the forecast for the following day was awful – heavy rain from 11am onwards. The group expected the last day to be written off, but I just turned things around a bit, and put it into the context of Alpine mountaineering. We got a really early night and were in the cave for 5am, had a brilliant trip and were out by 10am. Off to the cafe and had a well-earned late breakfast and reviewed the course there. All good!

One of the factors associated with expertise in coaching or leading is the ability to start and finish a given session punctually (Potrac, Jones & Armour, 2002). The logic underpinning this contention is that no matter how engaging or insightful the coach or leader may be, if the session finishes late, it will have ramifications on the subsequent appointments or commitments of the clients or co-leader. When CI 7 was asked how he finished on time (starting on time is the easy bit!) the response was:

> I'm not sure to be honest. I've been doing this for 30 years or more, and I know I can usually get back on time to the minute, but I have no conscious idea how I do it….It may be to do with the fact that I set my sessions up by having lots of mini-interlinking activities, so at some stage I must unconsciously decide that I have done enough and start easing out of the cave, but I can always do something else if we egress the cave quicker than planned.

Vertical caving in groups, however small, entails waiting for rope to become available in descent, but predominantly in ascent simply due to the effects of gravity, and as part of his pre- planning, CI 8 pro-actively planned to constructively fill these small waiting times with points of interest or topics worthy of discussion. When asked when this practice started, the response was:

> I remember one of my first SRT caving trips and there was quite a bit of hanging about, mostly being a bit cold but definitely bored. The leader just sat there waiting. I thought to myself, if ever I become a caving instructor, I'm sure I can do better than this.

Undoubtedly CI 8 had, through a process of reflection, convened a range of topics, skills, useful anecdotes and teaching points to positively and pro-actively utilise these small parcels of time to the best effect. This aspect of his positive session delivery is not happenstance but displays a metacognitive element in that the opportunities were anticipated and planned for (Collins, Carson & Collins, 2016), whilst modelling good practice to future leaders.

It is understood within the outdoor sector that caving has low levels of participation, relatively low levels of return engagement following an initial experience of caving (BCA, 2019), and is considered by some as just crawling in mud, for want of a more prosaic expression. Therefore, offering positive caving experiences is essential for the continuing development of this AS in the UK. Within this chapter is evidence that CI 7 purposefully chose not to expose a competent adult group to poor winter weather as part of the caving trip, and that CI 9 had an excellent day of gorge walking rather than to risk scaring a group in marginal and potentially dangerous high water conditions on a day where nearby, lives were lost.

Further commenting on having hot chocolate underground with groups to maintain morale and enjoy the subterranean experience, CI 8 relates caving to the first ride on the back of a motorbike:

> It seemed that when I was a youngster, it was an unwritten rule that if you went for a ride on the back of your mates' motorbike, you had to come back having been utterly terrified. I think that could be the attitude within caving at times, that you come back thrashed and scared. It is up to us to provide authentic but really enjoyable trips underground, and maintain the skills to do that, even when the weather is poor.

CI 7 continues this theme and states:

> …I try to go at a pace which keeps folk warm but doesn't wear them out - moving fluently underground is actually safer too - the longer you are there in one spot the greater the probability of something going wrong. Giving them the 'mental tools' too is important for managing the risky bits. If they can get the hang of 'really concentrating' at times and at others being 'quite relaxed' it's better all-round.

5.5.3 Venue selection

At the heart of the planning process lies the selection of a venue. Fundamentally it is one which is safe and appropriate for the developmental and experience needs of the client group, in consideration of weather and ground conditions. As CI 8 reviews, it is about having *"… the right people in the right place in the right conditions, ideally at the right time."* From an initial choice of several prospective venues available in balancing pedagogy and welfare needs to ground conditions (Collins & Collins, 2013), many were able to be discounted promptly as a result of intimate knowledge of how these caves react to environmental influences, corroborated by a small but trusted CoP. This process of venue deselection serves to reduce variables and therefore complexity in the decision making aspects of cognitive load management, the speed of which may be regarded as a factor of expertise in this domain (Klein, 2015).

The CI works in an environment different to other sports professionals, in that they may be called upon to handle emergencies or crisis situations and be required to make quick decisions under life-threatening conditions (Collins and Collins, 2013). Therefore, selecting venues carefully which are in the right condition is crucial in reducing the likelihood of such an occurrence. Venue selection methods among the three participant CIs varied but were designed to reach the same goal and were related to the EP discussed in Chapter 4, namely a positive view of adventure, client agency in decision making, progression toward independent performance of the client, and a continued openness to learning that is linked to multi-directional knowledge exchange and creation. Simply 'not choosing a venue which is likely to flood' does a disservice to the PJDM capabilities of the CI, in that each has a full comprehension and anticipation of the situation at hand, such that it may be possible to run positive caving sessions in conditions deemed marginal.

This is in part due to enhanced situational awareness (Hutton et al., 2017) and the utilisation of cognitive skills and subsequent PJDM leading to courses of action which may not have been considered by less expert practitioners. An example of this came from CI 8 who discussed how he promptly pre-rigged an alternative exit to a vertical cave system should it be required in the event of heavier rainfall than forecast, which also served as a practical demonstration to clients of how to manage the environment by "*thinking a little outside the box*." CI 7 also demonstrated such forward thinking and stated *"I just have to think a few steps ahead, and almost always be able to answer myself, the 'what if' questions. If I can't do that, I don't go into that cave or I consider somewhere else, or actually, doing something completely different!"* CI 9 describes a similar situation and states, *"I use a plan that I know I can be happy to change. Choosing a venue which gives me lots of options feels like the way forward, especially when the conditions are changeable or if I don't know the group too well."*

A common theme prevails which is that the more uncertain the conditions, the less known the group, or concerns about the veracity of the available information, the greater likelihood of utilising a well-known venue. Initial meeting of clients at the start of a session is described as a situation causing some of the greatest cognitive stress, given the multifarious tasks which seemingly need to take place simultaneously. In the process of collecting additional information about the clients at the first meeting, the CI begins to create a more detailed picture and construct a series of micro-plans plans which closely associate to their own technical and leadership skills. Refined situational and self-awareness are used to balance the needs of individuals against their actual capabilities (Hutton, et al., 2017), as experience suggests that what a client may say they are able to do and what actually appears may on occasion be significantly different (CI 8). Given the number of variables presented in an environment of high risk and real consequence (Collins & Collins, 2013), the CI becomes skilful at using a range of differentiated tasks within the weather and conditions constraints of a specific, but well considered multi-purpose venue. Similar to the decisions made by the participants within Chapter 3 (who included rock climbers and winter mountaineers), the CIs here rarely committed to an extended trip with a relatively unknown group if conditions were poor, instead undertook a more limited cave journey but one with lots of relevant tasks, interest points and group challenges. As CI 7 informs:

> …typically, in such circumstances I'll not do a very long or pushy trip, but one that is full of lots of varied skill developments and discussions, to cater for all capabilities in a group, so I'll try to find a venue that allows me to do that. I trained as a teacher a long time ago, so I do kind of understand what differentiated learning and tasks are.

CI 7 also relates the whole process of venue selection and deselection to the learning process and development of the clients and describes aspects of a cognitive apprenticeship (Larsen, 2015; Philipps, Klein & Sieck, 2004) in stating:

> If conditions are uncertain or there is no straightforward venue to use, I will often ask the group where they would choose to go and why, and perhaps more importantly, where they would not go, and why. If this is not appropriate for the group, the least I would do once at the cave is explain to them my decision making process, and how I can exclude quite a few caves quite quickly to leave me to concentrate on a few probable ones. I think it helps with their learning, and they do enjoy the power and part they have to play in the process. It's real.

This presents as a subtle yet powerful group management tool as it helps generate decision making agency, builds team cohesion, initiates aspects of the cognitive apprenticeship and manages expectations in one subtle but well-crafted process. CI 9 has quite a different approach, in that he will simply adjust the plan without informing the group, in stating:

> When I am working underground, I plan to take the clients to the best possible place to do the best caving trip, so that they come away having had a great time underground. I may inform them at some stage of the change of plan and it will be subtle, but I just figure that's what I'm really paid for. You know, the decision making.

This variation should be seen in the context of the client group, given that CI 7 routinely works with cavers undertaking awards courses, rather than novice adult clients to whom CI 9 refers in this example. The main background of CI 8 though, is one of adventurous training (AT) within military contexts where the role of caving is to simulate the demands of conflict and hardship utilising caving expeditions as a vehicle for personal development, learning and to fuel improvement in overall resilience. Accordingly, the CI within such an AT context has to lead and manage caving trips employing what may be considered atypical guidelines, so that the participants feel that they have been subject to demanding experiences but have coped well with the challenges it offered. Rather than choose a venue which can work in a range of conditions or offer a variety of differentiated task opportunities, the CI in a military context decides upon a caving journey during which significant challenges must be overcome, which are principally referenced to personal and team development, calling upon refined PJDM skills of the leader. As CI 8 explains:

> Cueva Badalona is a big prize, but I had trained the team and they were capable of it. However, I was worried that heuristics were coming into play - the scarcity bit, because we knew that we may not get another chance to do this amazing cave trip. I was proved right, as we had a really hard time in there during the 3 days. However, we stuck together, worked it out and it really fulfilled all the aims of AT!

There is no doubt that CI 8 called upon many years of experience and refined PJDM skills given the decision to commit to the trip and the leadership requirements necessary to safely complete it, but it is also insightful from the perspective of the EP. One of the characteristics of a sophisticated epistemic position (Schommer, 1994) is related to the co-creation of knowledge via the assimilation and synthesis of new data, and a dismissal of the notion that the leader is the holder of all required information. Continuing, CI 8 explains:

> At one stage well into the trip, we were all exhausted and also very much lost! We split down into small teams and went off from a central point for a maximum of 30 minutes, returning with any new information about where the passages went. We sat and sorted it as a team. It did the job as we put all our brains to it and after a short rest we were off again – I told them that I couldn't do all the navigating all the time as it was so complex and tiring, so I taught a pair of them who took over and then they passed it, whilst I kept a better overview. It was actually pretty cool and pulled the team right together but gave me the thinking space I needed.

Although presenting as a very challenging subterranean scenario, it appeared to further blur the distinctions between instructor and student, offering an example of how the accentuated nature of leadership within challenging caving environments promotes the development of sophisticated and positive epistemic beliefs (Christian et al., 2019). Furthermore, this is a great example of what Marquet (2015) describes as Intent Based Leadership, one where agency is delegated such that all available brains contribute to the task and feed information into a central decision making point.

5.5.4 Managing cognitive loads

It is understood that the working environment of the CI is appreciably different to almost any other AS domain due to the extent of objective hazards, range of consequential terrain and inescapable nature of many caving systems (Marbach & Tourte, 2002). In comparison, rock climbers may be able to retreat to the ground, mountaineers can descend to lessen the force of conditions and canoeists can paddle toward the shore or riverbank. Typically, this self-help occurs whilst being in reach of rescue services, including that of helicopters, but rescue scenarios within caving systems are significantly more problematic. For context, cave rescue services work on a temporal ratio of approximately 1:10, namely that for every one hour of caving progress made by a fit, uninjured caver journeying underground, 10 hours will have elapsed before the subterranean victim is in definitive medical care. Although potentially a surprising ratio, as soon as one factors in the time it takes to exit the cave to summon help, the organisation of that assistance and subsequent return journey to access to the victim, followed by the time taken in carrying the patient to the surface, the ratio soon appears more accurate and realistic.

In relation to managing the pressures of group welfare as an aspect of cognitive load for the CI, the Cueva Badalona trip discussed by CI 8 is a 30-hour journey. Given that a serious incident at the halfway point of the trip would have entailed 15 hours of arduous caving, the time-framed rescue ratio is approaching 150 hours (at least 5 days) before definitive medical care could be reached. Therefore, the realisation that help would not arrive in time to save the life of even a mildly injured caver has to be tolerated, of which there are numerous accounts to illustrate (Eyre & Frankland, 1988; Cave Rescue Organisation, 2019). This exists in the mind of the underground leader as a "*…mild yet constant source of pressure which has to be accepted"* (CI 9).

Within the UK, cavers typically experience a mean underground temperature of approximately 7-8^{0}C (Marshall & Rust, 1997), which when coupled with air draughts flowing through caves and the abundance of water underground, make it a prime setting for hypothermia. Furthermore, caving trips tend to be somewhat prolonged in duration (typically 6-12 hours), especially when vertical pitches are utilised to access the extended horizontal sections below. Any task, client demand or environmental factors which place loads on the cognitive management strategies of the CI (Collins et al., 2018) can be compounded by the typically extended duration of cave exploration. Increased timeframes offer greater scope for chronic and sustained accumulation of cognitive load, with further opportunity for acute demands to arise simply as a result of probability. Although a full day underground is common, multi-day trips involving the use of overnight camps with some lasting up to 10 days are not unusual, as noted by CI 7 when exploring the deepest and most complex caves.

It is evident within the group of participant CIs that despite their ages (50 to 68 years old), all are fit and make conscious efforts to remain healthy and demonstrate calm and non-excitable personality characteristics. These factors have a positive impact on cognitive load management, given that the CIs are rarely preoccupied with their own safety, comfort or anxiety levels whilst working underground. As CI 8 states:

> I feel really comfortable in the cave from a personal movement perspective. I wouldn't like my clients to suffer because I couldn't get to them efficiently enough or be in a position to help or supervise. I know clients can be quite tense underground and are sometimes keen to get back out to daylight, but I love just being there.

CI 7 is specific in the regard of being able to maintain an appropriate space from the clients and for his own thinking, and how it relates to issues of cognitive load, when stating "*I maintain a certain bubble of space from clients through overall comfort in the environment – I think it's just a function of experience and training and practice. It gives me time to think, but also time to not think.*"

During the earlier observation phases of data collection, it was interesting to note how CI 7 actually managed the physical space between himself and the client group. It was reminiscent of how a skilful schoolteacher politely ensures that no individual child monopolises their attention or time, yet still feels valued. In the caving situation, CI 7 was able to clearly set tasks and then busy himself a slight physical distance away from the client group, thus subtly managing their expectations and providing the message that clients should work on their given tasks without him, but also that he was accessible should there be a genuine problem. Consequently, he led from the back more often than not, but this is in the context of advanced cavers on training courses who were given tasks to investigate through a process of experiential learning. When asked about this leadership position, CI 7 stated:

> My leadership position depends entirely on the situation, so if I'm at the back of the group I can have some thinking space but also in a vertical situation I can pop forward and rig without even thinking about it, so I can look around and chat with folk whilst I'm doing the rigging, or ideally supervising someone else doing it. This automatic level of skill actually frees me up for other tasks.

As with the other CIs, the leadership position is entirely based on a refined situational awareness which is fluid in nature and certainly not fixed. Although none of the participant CIs have a paddlesport background, two were familiar with the British Canoeing (BC) originated leadership and positioning acronym of CLAP, and routinely used it as part of the in-action decision making processes. CLAP stands for Communication; Line of sight; Avoidance; and Position of maximum usefulness. Although originally conceptualised and refined for whitewater kayaking and open water paddling activity, the CLAP acronym is widely utilised across AS domains and is particularly effective as part of a group management framework in the leadership environments of cave exploration. As CI 9 illustrates:

> I'm not really a paddler but I have pinched the CLAP thing and use it a fair bit. A kayaker friend explained the avoidance thing – she said essentially if you're not sure, consider not doing it, especially when time is a factor. The example she used related to running a whitewater section late in the day – just walk around it instead otherwise you may end up with a rescue in encroaching darkness - not good.

The cross transferability of approaches which support practice across disciplines is associated with the sophisticated EP of remaining open to learning and gaining information from a range of sources. This includes from clients and learners, illustrating how the distinction between 'teacher and learner' is agreeably blurred, with knowledge transfer conceptualised as multidirectional (Schommer, 1994). CI 8 is the oldest of the participants and within the interviews it was interesting to note that significant aspects of his professional practice were tacit and occasionally difficult for him to articulate beyond "…*it just feels the right thing to do*." He knows exactly what he is doing but cannot necessarily explain or justify it. This is not surprising given that tacit learning is associated with the acquisition of knowledge without outside influence and that it is possible to perfectly understand a concept when no-one asks but struggle in articulation it when asked to account for it (McGinn, 2013; Reber, 1989). In response to an enquiry about where to position himself, given that an optimum location undoubtedly does not exist, he stated "…*I just think where I can be to offer most help, most of the time, which is normally near a rebelay when they are tired. I keep emergencies out of my head somewhat – I'll deal with those as and when."* This was very insightful in that BC train their whitewater leaders to adopt a position of maximum usefulness as one which offers an optimum location for the most likely event rather than the most serious, which is exactly what CI 8 expressed in his own words. When this was mentioned, he felt affirmed that he could relate his own professional practice to an existing and well-regarded model.

Whether at the back of the group or rigging a vertical descent, CI 7 contends that his skill levels are sufficiently refined that he is able to keep an adequate overview of the group, environment and tasks because the technical elements are completed with automaticity (Fitts & Posner, 1967; Kee, 2019). This does not suggest a state of operating on what may be termed auto-pilot, rather that the skills are sufficiently developed and practiced, and require little cognitive allocation in their execution.

According to CI 7, the decision making loads experienced by him are rarely acute given his capability and organisation in pre-planning, noting they are more sustained and incrementally accumulative, generating a requirement for small amounts of time and physical space away from the group. This occurs subtly such that the clients do not especially notice, facilitated through a range of finessed leadership and teaching methods. CI 7 states:

> I know everything is going well and that I am doing my job, but sometimes I just feel the weight of pressure on me to ensure they have a good day and that I get them out safely. Setting them tasks to do together whilst I keep an eye on them from a short distance easily affords me that opportunity.

In acknowledging the presence of autonomous skills, which according to Fitts and Posner (1967) indicate that a person can complete tasks not only without thinking about them, but whilst being able to contemplate other things simultaneously, CI 7 continues:

> …the thing about doing things kind of on autopilot is that you have to be mentally and physically fresh. We learned this deep in Voronya - if I wasn't well rested, I could go through the rebelays really quick and sort of on 'auto' but if I was mentally tired, I knew that I was prone to making mistakes, which in there would be pretty unforgiving.

This is a very useful insight into skill degradation and is indicative that a well-rested person can complete complex tasks with little drawdown on the cognitive resource, but that this may change rapidly as soon as mental fatigue accrues. CI 9 also discusses the requirement to be skilful and current in practice, but with regards to maintaining his required '*space in which to think*' he advocates a more pragmatic approach than the one used by CI 7, whilst still underlining the significance of maintaining a sense of coping and control over the decision making process. CI 9 states that "*...I just tell them that there will be times when I don't want them to talk to me at all - it might be a look or a subtle signal, but they will definitely know to give me a little space.*"

It is accepted that cognitive resources are finite and require astute deployment, and that continual audit checks occur in a bid to lessen the probability of acute peaks in demand. There was an ethos of 'banking' time and energy for when it was required in an explicit and proactive step to conserve, realign and recharge the cognitive resource. This is supported by processes of pre- planning and preparation which employ a soft, or strawman plan. The significant accrued experience of each CI generated a bank of knowledge which supports PJDM. Particularly, this knowledge scaffolds accurate situational awareness and prompt utilisation of dynamic risk assessment. The knowledge bank appears to support a metacognitive element (Reber, 1996; Collins, Carson & Collins, 2016); in essence an accurate account about the ongoing cognition of their PJDM in-action. It may be concluded that the CIs are aware of their cognitive resources and management of their allocation and expenditure.

All of the participating Cis within the CrDM interviews discuss maintaining physiological capability in the physically and psychologically demanding context of cave leadership, with particular reference to body temperature management, hydration and nutrition. In the case of multi-day underground expeditions, this also extends to sleep deprivation factors. CI 7 discusses his efficient movement patterns in both vertical and horizontal planes and considers that if he is feeling tired or cold, for example, it is likely that his clients are likely to be experiencing similar feelings, but which may be amplified. Therefore, he dedicates part of his cognitive resource to the welfare demands of his clients as well as his own, which links back to the steady but accumulative loading effect of underground leadership, as mentioned earlier.

Although the onset of hypothermia underground may not be surprising, hyperthermia often is. For a relative novice, ascending a vertical pitch can be very demanding and routinely, more effort is expended than is necessary due to a heightened state of arousal, or activation (Cox, Martens & Russell, 2003) which can lead to 'over-gripping,' a similar situation experienced by novice climbers. Given the need to wait to commence ascending, the caver may be wearing spare layers to retain warmth, which remain worn during the climb, leading to completion of the pitch in an overheated and often dehydrated state. In such instances, it does not take long for client performance to significantly deteriorate and is something all CIs in the sample had witnessed. Consequently, all experienced CIs become adept at swift clothing transitions and are fastidious about temperature regulation, hydration and nutrition. However, the accentuated nature of the caving environment in relation to environmental constraints often means that maintaining the required and desired level of comfort and control is not always possible. This physiological strain is known as homeostatic stress (Cheung, 2009), where the systems of the body are unable to maintain the required biological equilibrium. This has been shown to have serious implications in decision making efficacy in fields such medicine and the judiciary. For example, it has been shown that on very warm days in non-air-conditioned court rooms, judges imposed longer sentences (Heyes & Saberian, 2019). Resulting from the findings of that research, numerous retrials were ordered.

First-hand accounts from the sample verified that decision making processes and cognitive load management are compromised by environmental and physiological factors such as the effects of heat, cold, dehydration and fatigue. Comparable studies based on high altitude mountaineers indicated that working memory is significantly degraded by cold (Van Orden, Benoit, & Ogsa, 1996) and it would be reasonable to assume that working memory and the decision making process of the CI can also be affected by the range of stressors experienced underground. Consequently, significant forethought is utilised in an attempt to manage the environmental stressors where possible. This acknowledges a genuine requirement for the CI to maintain an adequate level of PJDM capability even in difficult conditions to ensure acceptable levels of client progression and welfare underground.

The serious implications of homeostatic stress on the decision making process and subsequent management of cognitive loads was discussed by CI 7, recounting when a colleague became separated from the group during their exit of a particularly cold French cave called the Scialette du Silence. The account forms the basis of a resource vignette, which is found as Appendix P. CI 7 acknowledges that this was a relatively simple error catalysed by the deteriorating physiological factors of poor body temperature management and compounded by inadequate nutrition and hydration. In such a state, the decision making process became laboured and prone to errors. In this example, the issue manifested itself as attention deficit and insufficient allocation of cognitive resources to process the clues and signals for appropriate judgements.

Clearly, the critical implications in environments such as caving are obvious, but would equally apply to firefighting, emergency service work and medical practice (Klein, 2008) among others. In further interview sweeps an interesting revelation surfaces which corroborates how CI 7 is determined to gain useful learning whenever possible. Even with reference to incidents such as the one above, he recounts events in positive terms partly because there were so many "*…heuristic traps to learn from.*"

The environmental factors which impact in-action PJDM is further considered by CI 8 who discusses that he has a real awareness of decision making fatigue. On longer caving trips, the sheer number of decisions required concerning the client, the tasks, the environment and a synergy of all three (Mees et al., 2020) results in the potential for a flawed process with real and unforgiving consequences, of which he is fully aware. CI 8 explains:

> If I am tired or anxious, I know my decision making could be inconsistent, so I do whatever is required to avoid that. I reckon most of it is in the planning and prep, so that if things go a bit off, it should only be in a small way. If need be, we will sit down, have some food and drink and regroup.

There is a clear message here and growing awareness that all are prone to making mistakes, noting that human decision making processes are simply not as robust as may be supposed (Kahneman, 2011). CI 8 contends therefore that it is important whenever possible to ensure any errors in decision making are limited to small ones, given the consequential environments in which he is working. CI 9 continues the theme. With regards to session preparation, he discusses that as a result of the effort and time expended in the planning process of a given caving trip, namely the logical, time plentiful CDM aspects, that there is an expectation that the cave journey will unfold against a given set of anticipated outcomes. This rigour in pre-planning means that on the occasions where events begin to deviate from the norm and are becoming atypical or anomalous, the deviation is relatively easy to identify. CI 9 confirms:

> When things start to go off my plan, I don't worry too much, but need a bit of time to think things through. If for example water levels seem unusually high, or a key piece of equipment stops working, or client performance drops right off, that's when I could do with a bit of space because I know at those times it is when I need to make good decisions without always doing what worked in the past, because it might not work this time.

Acknowledged as the recognition of typicality (Hoffman, 1988), such perception enables potential problems can be recognised without delay. This is important in a range of natural settings, not least of all in the context of underground exploration. The awareness of heuristic traps and rigour in pre-planning is common across the participants, but there is also a realisation that the decision making process itself can be informed by prior experiences which are compared against the current situation as part of an audit process (Klein, 2015). This process considers the beneficial aspects of experience and prior exposure to similar events which may be drawn upon.

There is little doubt that each participant exploits a significant reserve of accrued knowledge when confronting challenging situations, but this seems to be balanced by their awareness of confirmation bias and a working knowledge of heuristics (Kahneman & Klein, 2009). In this case referring to cognitive shortcuts that may be employed in resource-scarce or time pressured conditions, that usually offer a correct judgement of a situation. However, because they are short cutting the process and thereby failing to consider all available information or potentially not allocating appropriate weighting to it (Wickens, Keller & Shaw, 2015), the decisions can be flawed and hence the participants voice that they treat heuristics with a sense of '*respected deference'* (CI 8). Accordingly, there is a reluctance to rely on just one information source and all participants used terms similar to '*build my own picture*' as a facet of PJDM. In constructing that depiction, each CI discussed that they accessed the CoP of a small group of dependable fellow caving professionals. Further, they trusted the judgment of the CoP to be on a par with their own and fit to compare their own decisions against.

Given that the domain of underground exploration is authentic, dynamic, consequential and cannot be mollified, there is rarely a need for the CI to overplay a situation to make it appear more demanding than it already is (Cater, 2006). More likely is the requirement to underplay a situation to make it appear less consequential, and therefore the CI needs to be able to manage their own anxiety levels in addition to those of their clients. As CI 8 approached the final water filled sump in Cueva Badalona, which was longer than anticipated, it was necessary to manage the stress levels within the group whilst outwardly portraying a calm exterior. CI 8 continues:

> …that is the main drawback of a pull-through trip – you can't go back! I knew the sump was going to be a 15 second breath hold but told them it was about 10. I went first knowing that in 10 seconds they would just have to push on for a few more. I gave them the feeling that this was just another day swimming a sump, no big deal, but deep down I was a bit concerned. I was so, so glad that I had recce'd it a few days prior.

Pre-swimming the sump in advance of the trip shows the levels of pre-preparation considered necessary and typical for such undertakings, and in comprehending that the decision making capability of one individual can have powerful consequences for others, CI 8 said:

> …it all came together at this point, and afterwards we felt that we had achieved a lot together on that trip, and certainly met the aims of AT. But I had an enormous weight of responsibility on my shoulders over those few days. You can't help but feel it.

Such anxiety management has been linked to personality type, particularly regarding levels of trait or state anxiety (Cox, Martens & Russell, 2003). It is contended that an individual with low levels of trait anxiety as a factor of personality (i.e., someone who presents as non-anxious or not readily excitable) is more likely to cope with increased levels of anxiety caused by a given situation, or state. In short, those with low levels of trait anxiety have much more headroom when an anxiety inducing situation arises. As noted, all three participants showed clear indications of low levels of trait anxiety and given that CI 7 has explored to the bottom of Voronya, the world's deepest cave, CI 8 led his group through the Badalona sumps, and CI 9 undertakes cave diving solo, it is just as well. As CI 9 summarises:

> Anxiety breeds irrationality due to the worry of things which may or may not be there. I just think that you need to keep this stuff under control so that you can use your energy to cope with things that you actually know are there as a result of the preparation. There is no place for excitable folk on proper caving trips- they wear you out.

This statement illustrates the CIs recognition of the cumulative impact that the environment has on arousal levels of the client, where the leader may not have received any details of their likely behaviours prior to the session. This alone will place additional demands on the CI given that they will need to manage the cognitive loads of the clients and their own concurrently (Sweller, 1998). Questions of interest here are ‘does the accentuated nature of caving develop appropriate personality characteristics?’ or ‘have the participants been drawn to the demands of caving and cave leadership as a result of their existing personality traits?’ This is a topic undoubtedly worthy of further investigation but falls outside the scope of the present work.

For clients venturing underground for the first time, or for experienced cavers attempting a more committing trip, the cave environment can feel intimidating and has been known to generate irrational fears. All of the participating CIs express their feelings of physical and psychological comfort underground such that they manage to maintain controlled levels of state anxiety and homeostatic equilibrium, scaffolded by enduring low levels of trait anxiety. One of the ways they help clients manage these aspects is to offer very short but regular breaks to adjust clothing or have something to eat, for example, but more importantly from the perspective of the study, they inform clients when they can relax or must concentrate fully. As time spent underground increases, the client cavers appear to become progressively desensitised to the environment. They begin to feel more comfortable in their surroundings, recoup their perceptive abilities for additional ‘noticing’ and regain the ability to respond readily to additional learning inputs or direction from the leader.

When asked about leading his group through Cueva Badalona, with regards to his knowledge of the final sump and the prospect of difficult progress through it, CI 8 responded, “*there’s really no point worrying about things you can’t control. I decided to shelve the sump in my mind and worry about it when we got there.”* Known as psychological compartmentalisation (Cox et al., 2003) it presents as a powerful tool for those involved in situations which have the potential to generate anxiety. The use of this method to maintain a state of reasonable cognitive calm is subtly distributed to the clients when they are informed when they must give undivided attention and absolute focus, and times where they are afforded the opportunity to relax or regroup. In addition to these desensitisation and compartmentalisation strategies which are found across coaching and sports psychology disciplines, it is also worthwhile considering the concept of habituation. The process of habituation submits that it is possible for a person to become more comfortable in a physiologically stressful environment, even though the body shows no signs of acclimatisation or adaptation (Lenzholzer & de Vries, 2020).

There is ample research on the topic, but of particular interest to those who operate professionally in the cold, damp conditions often associated with caving, is the research of Cheung (2009) with fishermen operating in high latitudes. Cheung demonstrated that the surface skin temperatures of local fishermen who were routinely working for extended periods where their hands were frequently in and out of very cold water (1-2^0 C), were almost identical to those of any tourist visitor who came to the area and had similar exposure through fishing or kayaking. Through a process of habituation, the locals found the water temperature quite tolerable for extended periods of working, whereas the visitors found the water unbearable and could only sustain exposure of their hands to the water for very short durations.

The process of habituation presents as a synergy of both physiological and psychological processes, and although not fully understood, it does appear that with increased time spent in a given activity, it is possible simply to ‘get used to it’ which seems to be exhibited by the CI participants of this chapter. This is evidenced by their adventurous underground journeys where they have been able to maintain a “*…bubble of self-control and comfort*” (CI 7), which aids in their ability to manage both chronic and acute cognitive loads due in part, to an ability to assuage a range of environmental factors.

However, the CIs process of habituation to cold subterranean air and water temperatures is boosted by their knowledge of how to be comfortable via an assortment of ‘tricks of the trade’ accrued through significant exposure and time spent exploring. These included careful body positioning to avoid getting wet, especially early in the cave journey, and various home-made adjustments to equipment which is not commercially available. The use of such tricks of the trade and an experience-derived, fine-tuned approach to working as a professional caver may best be termed behavioural rather than adaptive (Blumstein, 2016), hence habituation being considered as a blend of both cognitive and physiological functions rather than purely physiological acclimatisation.

The final part of this chapter aims to answer the ‘so what?’ question. The research work to this point of the thesis has identified a strong relationship between the EP of the participants and a bespoke EC. These underpin and promote a specific set of PJDM tools which aid in maintaining a holistic view of client development. The beliefs, behaviours and actions of the CIs are operationalised by their PJDM, which present as greater than the value of the individual parts. The capacity to assuredly adjust to dynamic and consequential working environments presents as a factor of expertise in this domain.

The research within Chapter 3 identified that the climbing and mountaineering participants demonstrated high standards of planning and preparation, as may be expected. In the context of these domains, it is usually feasible to move to another part of the crag or to explore different aspects of a given mountainside if dictated by weather issues or client need. However, in an underground setting, this prompt change of plan which can be adjusted as the client progresses or conditions change is much more difficult given the constraints of the cave environment. One benefit of working above ground is that deterioration in weather can be observed and acted upon accordingly, often in advance of its arrival.

Although there are similarities to work completed in other AS domains of paddlesport (Collins & Collins, 2014), and skiing (Christian, Berry & Kearney, 2017), the caving environment provides a unique professional environment which requires bespoke PJDM and practice. This is most evident in the preparation stages where, as a result of the specific constraints of routinely working underground for extended periods, the planning aspect of caving session delivery is given significant importance and weighting and evidently involves greater attention paid to it. Consequently, the synergetic weightings and ratios of CDM and NDM presents as being very much aligned to the CDM, or System 1 processes of Kahneman and Klein, (2009). In short, the slow but accumulative cognitive and physiological demands associated with leading an advanced caving trip can only be managed by meticulous planning, and when this preparation is not scrupulous, near misses and serious incidents are much more likely.

The EP of the participants in practice is revealed through a confidence in their abilities to skilfully manage a group underground with '*plenty in reserve*.' (CI 9). This is only possible with experience, training, and technical currency, but must be implemented by specific PJDM, most evident in what may be termed over planning. This is simply because the consequences of poor performance in this aspect means that at best, the quality of the session would deteriorate, and at worst could have serious implications for the welfare of the client group. The requirement for this over planning is clarified in the concept map displayed as Figure 5.1 which illustrates the range of tasks and demands which must be managed by the CI.

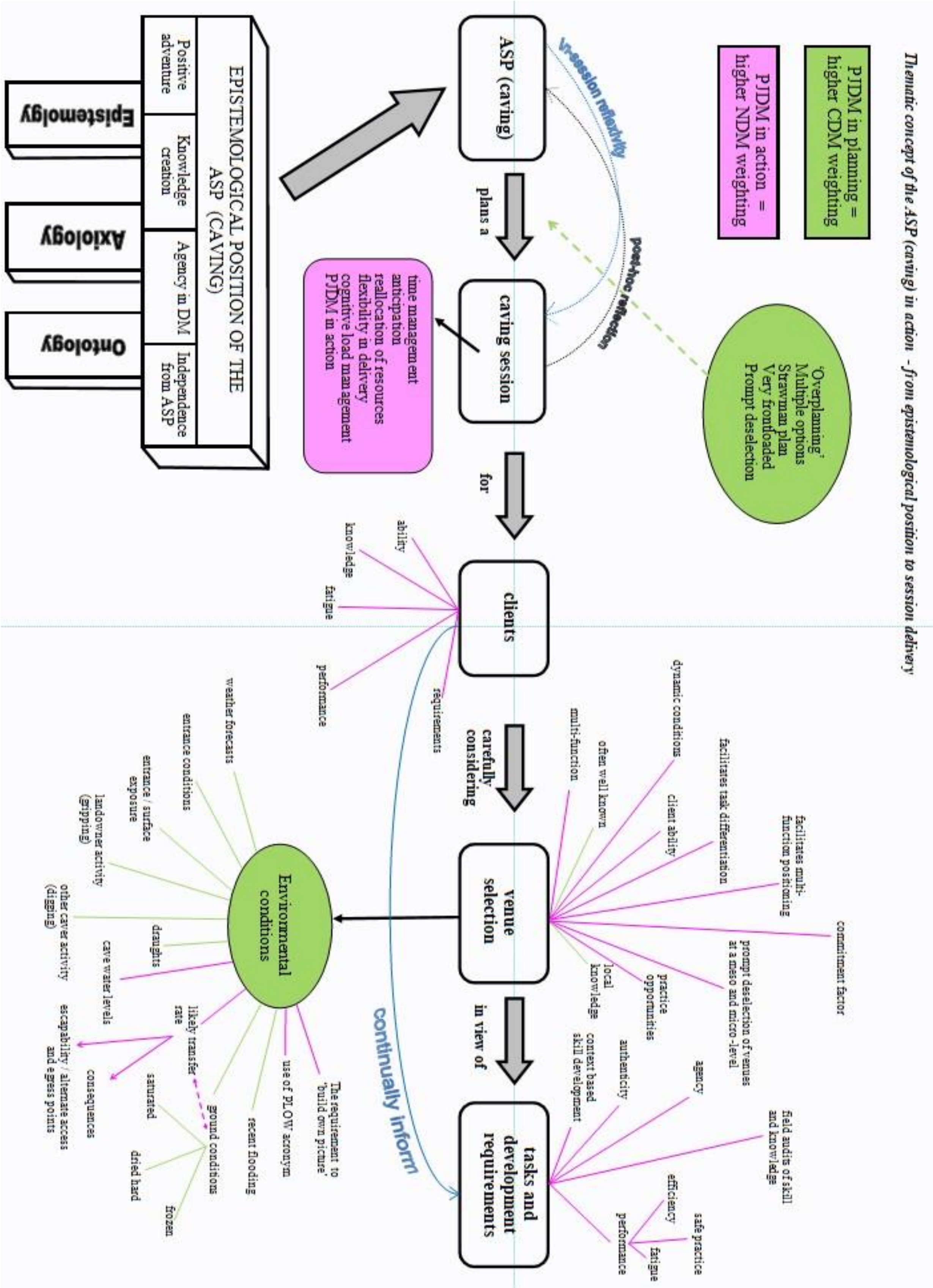

Figure 5.1 Thematic concept map of the adventure sport professional (caving) in-action - epistemological position to session delivery

At the planning stage, CDM is crucial (Collins & Collins, 2016) given the time afforded and logical steps taken in preparation, but which presents as somewhat proceduralised. However, such pre-action planning can function in a similar way to what many organisations refer to as SOPs (Standard Operating Procedures), thereby reducing decision making load once in-action. It is considered somewhat logically that when the more predictable elements of a decision are replaced by a procedure, the decision maker can cope with additional complexity more adequately (Millitello & Hutton, 1998) as they arise. Such aspects "…*include inference, diagnosis, improvisation, judgement and decision prioritisation*" (p.1619). This reasoning certainly aligns to the caving research of the present chapter.

Consequently, the research within this chapter specifically identifies that due to the physical constraints of the caving environment and issues of entrapment and rescue, the CI places significant weighting on the proceduralised processes within the CDM phase. This serves to partially regulate the NDM aspects which aids in the management of overall cognitive load once underground. The CI also opportunistically creates and utilises time and physical space in which to recharge the '*decision making batteries*' (CI 9) in a robust attempt to constantly maintain an adequate cognitive allocation in reserve. Compared to other AS domains, the cave setting facilitates more opportunistic moments of time and space away from a client, in comparison to multi-pitch rock climbing for example, where the RI is typically attached to the client(s) by rope. In this regard, the decision making processing power and resource presents as ringfenced in anticipation of future peaks in demand.

The ACTA process of this chapter has facilitated a critical review of the EC of high level CIs in practice and how this supports specific PJDM requirements, revealing significant extra detail to build on the work of Chapters 3 and 4. It is worth noting that the ACTA research discussed within the present chapter (for example Crandall et al., 2006; Millitello & Hutton, 1998; Kartoshkina & Hunter, 2014; Klein & Snowden, 2011; Ward, 2013) is derived from research within military contexts and emergency services work where lives are predicted to be lost as a consequence of the setting (armed conflict, rescue and trauma resulting from a variety of events). This ACTA research reveals that the level of planning which takes place prior to the commencement of a caving trip is sufficiently refined that life threatening situations cannot readily materialise except in rare or completely unforeseeable events, and therefore the research should not be considered to be completely relatable.

The ACTA process also specifically reveals a strong link between the EP of the participant and the PJDM tools deployed to deliver a session that coherently aligns with the EC whenever possible. Sometimes, however, this alignment is not possible. For example, where philosophical beliefs and values are overridden by higher concerns of safety and welfare, or when the CI purposefully chooses to utilise behaviours more commonly associated with a naïve rather than sophisticated epistemological position (Schommer, 1994). This is presented as an informed choice rather than a constraint due to the experience and competence of the participants.

Each participating CI is fully aware of the hazards of working underground, but this does not prevent them from exploiting risk for the purposes of learning and development (Collins & Collins, 2013), and engaging positively with it as part of their professional role. The EP is one of exploration, affirmative human interaction and positive adventure, where risk is harnessed, managed and tolerated in pursuit of the greater good (Zuckerman, 1991) rather than pursued as an end in itself (West, 2012). Consequently, it can be seen that in delivering a positive session in challenging and consequential environments, the CI is required to deploy PJDM tools in very specific ways.

The construction of the thematic concept map has been invaluable in offering a mental model and roadmap against which both aspiring and established caving instructors are able to ratify and audit their planning and decision making. Moreover, within the scope of a professional doctorate, research should have a value and ideally a practical outcome for it to be worthwhile. The concept map has been crucial in identifying extra levels of detail and in bringing the tacit understanding of each CI to the explicit fore. In this regard, all the CIs in this study described the considerable time and effort expended on the logical, less time pressured CDM planning and preparation stages prior to a caving trip and expressed feeling that they felt decidedly uneasy if this stage was minimised or not possible. They noted that the underground incidents and near misses of which they were aware had demonstrated poor planning as the primary causative factor, whilst acknowledging an accumulation of further contributory issues.

The CIs planning served to minimise the quick response, partial information NDM processes once underground as an aspect of controlling variables and managing cognitive loads (Collins & Collins, 2019). However, in colour coding what has been termed on the concept map 'PJDM in planning' and 'PJDM in-action,' one factor is clear. Despite the time and effort expended in the organisational stages, there remain many factors which require a significant weighting of decision making which typically must be swift and based on incomplete or unverified information, namely a greater utilisation of NDM processes.

Given the complexities of professional caving, it is almost impossible to reduce the cognitive and decision making load that the CI faces, but they may be tempered and managed through a process of proactive coping. This uses anticipatory thinking which is based on the CIs own cognition and professional reflexive practice. Pro-active coping stems from the field of positive psychology (Greenglass, 2002) and it is theorised that individuals who engage with such a strategy are accountable for their own actions and remain open to learning, even in circumstances of failure, correlating to data collected herein.

5.6 Conclusion

The work of this chapter developed the research objectives of the thesis by further exploring the PJDM processes and the EC of the caver using a CrDM protocol within the scope of ACTA, in a range of authentic contexts. Consequently, the critical incidents discussed provided experientially derived and authentic first-hand information that can be offered to neophyte leaders as part of their developmental process (Rajabi et al., 2020). The incidents included examples of when to use 'tricks of the trade' or careful application of heuristics, improvisation in dynamic environments and compensating for equipment failure or limitation. They revealed the complex PJDM processes of the CI which were illustrated through the concept mapping exercise, and which noted, that despite significant preparation and planning stages in advance of a caving session, the number of in-action NDM aspects to be considered were numerous and multifaceted.

In the complex and consequential environment of the cave, the PJDM actions of the CI were observed to uphold an alignment to their EP, an example being evident in the maintenance of client agency in decision making even when deep in a vertical cave or during an extended trip. In short, they retained many elements of expertise even in demanding settings or complex situations.

The practical applied implications arising from this chapter include;

1. That a CrDM protocol within the scope of ACTA can be successfully used in AS research, and for the first time, has been applied to cave based investigations.

2. The work identified four distinct and articulated demands within caving contexts, which may form an accurate foundation on which to build appliable and accurate training processes and resources for Caving Instructors and agencies involved in caver training.

3. For the first time, research into the decision making and leadership strategies of high level caving instructors has taken place, where tacit understanding has been made explicit, and therefore accessible.

4. The production of a concept mapping of tasks, which clearly offers a roadmap to illustrate the range of demands which must be managed by the professional caver.

Chapter 6 - Comparing PJDM Capability in the Expert and Novice Cave Leader

6.1 Preface

Chapter 6 explores how the knowledge derived from discussion of critical incidents can be utilised to support instructor and leader progression by developing improved practice via the creation of applied training resources. This is accomplished by comparing the practice and behaviours of relative novice cave leaders to those of expert caving instructors who have achieved the highest level of accreditation within the BCA award scheme. The primary aim of this chapter is to understand how the EP, EC and PJDM skills of the relative novice cave leader relate to their experienced expert colleagues. The secondary aim, and one which corresponds to the ethos of the Professional Doctorate, is to create educational resources and applied models which assist in developing PJDM in this domain, whilst extending the literature base, which is sparse.

6.2 Introduction

Insights from novice-expert studies could be instrumental for the design of caver education and professional development. Although expert-novice studies are well-established approaches in the domains of medicine (Norman et al., 2018) or sports (Mann et al., 2007) and in the development of pedagogic process (Berliner, 2001), there are no studies exploring novice and expert skills associated to cave leadership and risk management underground. Although the specific focus is on caver development, there is an expectation of high levels of portability and transfer across AS practice and leader education.

6.2.1 *Setting the scene of the study*

As the thesis developed, the initial focus on multi-pitch rock climbing and winter mountaineering shifted to an emphasis on vertical and extended horizontal caving, for two main reasons. The first relates to the unique and consequential professional environment of the CI in revealing the significant cognitive loads which must be managed, and the second relates to the almost complete lack of literature linked to this aspect of cave leadership. The research also revealed epistemological incongruences which were acknowledged by the participants. For example, although the suite of awards offered by the BCA are very much promoted as leadership awards, the upper qualification level of the same scheme is the Caving

Instructor Certificate. Within the qualification schedule for the CIC award, there is an assessed day of coaching, during which the candidate is logically referred to as the coach. Although this may present to some as semantic, it may expose epistemological voids between different stakeholders within the scheme. It also reveals that although coaching ability is assessed as part of the awarding process, at present there is minimal specific training for candidates, trainers or assessors about the coaching process within a CIC awarding course, aside from the guidance of a short and unsophisticated PowerPoint presentation. However, this is not atypical. This pattern is evident in other award schemes where the training course explicitly states that it will not and cannot prepare a candidate for every element which may be subsequently assessed (MTUK, 2019). Further, it is apparent that within the scope of the BCA award scheme there are significant judgement 'jumps' between the levels of award. Exploring how these gaps in expertise and decision making may be bridged will provide a focus to this work, given that deficiencies in judgment rather than technical inability is shown to be the primary causative factors in incidents.

By means of a brief overview of the scheme there are three main qualification elements available in what is termed by the BCA as a progression of leadership awards (BCA, 2020). The first two come under the umbrella sub-scheme of the Local Cave and Mine Leader Awards (LCLMA). These are Level 1 Cave Leader (L1), and until recently, Level 2 Cave Leader (L2), the third being the CIC. Mine Leader awards are available but are not discussed here.

The L1 is an introductory accreditation for those wishing to lead others underground in predominantly horizontal cave systems. It has a remit which is restricted to a specified list, hence the use of the term 'local.' The next progression from the L1 award is the L2, which was renamed by the BCA in September 2020 to the Vertical Cave Leader (VCL) to better represent the award to the layperson, which followed a similar pattern adopted by Mountain Training in April 2019. The VCL is the qualification required to lead others in vertical environments, but with a maximum pitch height of 18 metres, and is again restricted to a specific list of caves of which the award holder must have recent experience. In demonstrating a significant leap in remit, the CIC award is one which qualifies the award holder to lead groups of cavers in vertical and complex, extended horizontal systems without constraint. The remit includes pitches of any length and number, the use of pull- through techniques and the requirement for the rescue of clients in vertical environments. It is fair to state that the CIC has been classed as a prestigious qualification due to the limited number of candidates willing to put themselves through the rigours of assessment. In 2002/3 the CIC scheme underwent a significant revision to make it appear more accessible, as the number of candidates presenting for assessment had all but dried up, and in typical cavers humour, the CIC had become labelled as a post-humous certification, or it was reserved as an honorary award.

The L1 and VCL awards described above are limited by a requirement for the holder to demonstrate intimate working knowledge of the cave venues before they can be placed on their validated operating list, and it is contended that the PJDM and experience requirements of the roles are constrained and attenuated by this factor. The design of the BCA scheme at L1 and VCL (L2) purposefully promotes cave leadership within firmly constrained parameters, essentially due to the consequential nature of the environment in which this AS activity takes place. Whilst the BCA scheme of awards qualifies leaders to work in challenging professional environments, to date the number of incidents and fatalities compared to participation rates is fortunately very low (BCA, 2020). The fact that many novice and intermediate cavers have enjoyed safe and rewarding caving experiences without incident is evidence that the training and accreditation scheme at these levels is fit for purpose, and that a proceduralised approach at the lower award levels is justified. However, as Collins and Collins (2014) note, proceduralised practice does not support the development of the PJDM skills required in more dynamic coaching and leading environments, such as vertical and extended cave systems where the CI is able to operate without constraint.

Consequently, the main disadvantage of the local approach is that it presents a significant PJDM and experience gap for those wishing to progress towards the CIC, which is acknowledged as a Level 3 /4 award, the highest being 4 (Sports Coach UK, 2012). In short, the gaps between L1 to VCL and then to CIC are significant and do not present as graduated or relatively linear, which may help explain the limited number of CIC award holders.

The investigation builds on the work of Mees et al., (2021) by comparing participants who have significant accrued experience and established capability in caving leadership to those who are beginning their developmental journeys in this domain.

6.3 Method

6.3.1 Design

An ACTA (Millitello & Hutton, 1998) of a group of novice CLs (participants n=4) was employed in order to make explicit the different stimuli and knowledge base that underpin PJDM when compared to the expert cohort of the previous investigations. This chapter therefore seeks to develop the knowledge framework established in Chapter 5 in order to identify differences in expert versus novice decision making in the caving environment. It is an exploration of how the participants currently deploy and understand PJDM in complex situations and considers their opinion and comprehension of the demands of their role. It reviews what information is deemed most influential when evaluating a caving situation and in selecting the course of action which followed (Flin, O'Connor & Crichton, 2008). The ACTA should be considered as an evolving partnership and professional relationship between participant and researcher by means of a discussion which helps unpick tacit understanding and where a legitimate applied outcome is the result. This is in an attempt to go beyond the straightforward knowledge elicitation associated with the CrDM utilised in Chapter 5.

The three stages of the ACTA protocol involve (1) a task diagram and associated discussion, (2) a knowledge audit and (3) a simulation interview. This leads to the production of a Cognitive Demands Table (CDT) which is used to consolidate, synthesise and present the data that reflect the role and remit of a Level 1 Cave Leader within the BCA scheme of awards.

The research was undertaken during the midst of the Covid-19 pandemic and therefore a utilitarian approach was appropriate in accomplishing what was possible within the various periods of lockdown. I was cautious not to commence a process which later had to be abandoned or postponed and therefore a practical and functional approach was utilised. In this instance, it was accomplished by conducting research via phone conversation and by using Microsoft Teams. The advantage of MS Teams is that it facilitates a face-to-face element of an interview which can be valuable in terms of nuance and body language (Silverman, 2013), but allows for the recording and transcription of conversations which can be more closely considered post-interview.

6.3.2 Participants

Four main selection criteria for the participants were identified:

1. Each has achieved the qualification of Level 1 Cave Leader but not Level 2 (VCL).
2. That each are commencing their outdoor careers without the accumulation of major awards in other AS domains.
3. Participants are willing to discuss and unpack their experiences of decision making strategies when leading groups underground.
4. Availability.

Steps were taken in the research process to maintain anonymity and to avoid disclosure through deduction, with the abbreviation of CL (Cave Leader) used to denote the participant. As with the other studies, approval was granted from the university ethical approval committee and voluntary informed consent was obtained. Cave leader participant details are displayed as Table 6.1.

Table 6.1 Cave leader participant details

Cave Leader (years qualified)	Age	Gender	Other adventure sport interests
CL1 (6)	28	Male	Diving
CL2 (2)	22	Female	Sailing
CL3 (3)	23	Male	Climbing
CL4 (2)	22	Female	Mountain walking

6.3.3 *Procedure*

The participants were asked to construct a simple task diagram which identified three to six main stages involved in running a caving session for an unknown group of clients in conditions which may be considered sub-optimal. These were stated as poor ground conditions and unfavourable weather forecasts. Each was asked to rank the stages and offer a brief explanation of the reason for the order and clarify why one aspect was more cognitively demanding than another. Once complete, the task diagram was sent to the researcher as an email attachment such that the diagram could be discussed and the meaning developed synchronously, whilst not genuinely face to face. The simulation interview was used to provide focus on the decision making process of the participants, and the knowledge audit was employed to ascertain how expertise was allocated in context. The prompts and questions displayed in Table 6.2 were used in a semi-structured way to ensure completeness in data collection and parity across participants but were not used verbatim.

Table 6.2 Task diagram prompts

Question	Follow-up	Prompts	Purpose
Recall a situation where you are taking a caving group underground for the first time. They are unknown to you and conditions are sub-optimal.	What are the 3-6 steps identified? Can you flesh things out a little?	Ensure clarity of question / situation	Ranking of steps – why? Awareness of heuristic involvement or confirmation bias?
Please list 3-6 steps you go / went through and identify which you feel may be most demanding?	How have these been decided? Why have you chosen this particular order? How do you balance environmental constraints against the group learning, activity and welfare needs?	Can be a paper and pencil exercise.	Is this becoming easier as experience develops?

This aspect of the data collection process felt more comprehensive and fluent as a result of the experience acquired through the data collection of Chapter 5, noting that the ACTA process improves with practice (Ward, 2013). It was evident that the young cavers involved in the study welcomed the opportunity to discuss and unpack their caving experiences.

The subsequent knowledge audit developed the information offered in the task diagram through an informal, semi-structured interview. Focused on expanding the diagram, the knowledge audit identified how the participating CIs utilised and allocated their expertise. It was associated to other categories of knowledge which have been found to characterise expertise across a range of other domains but in similar contexts (Klein & Borders, 2016). These categories include but are not limited to; diagnosis and prediction; adaptability and flexibility; skills of perception and observation; improvisation; recognition of familiarity and typicality; prompt recognition of absence or anomaly; compensation for equipment restrictions or malfunction; and personnel limitations. Lastly it was linked to the important and overarching term described as situational awareness (Collins et al., 2021).

Although considered an academically sound exercise, it is worth noting that some researchers (see Klein and Hoffman, 2008), have chosen to redirect their focus from a compare and contrast approach between expert and novice behaviours, instead capturing specific categories of expertise which relate to the challenging tasks of that domain. For example, reasoning using domain specific rules (in caving, this would relate to meteorology and ground conditions); sensemaking (understanding how a cave may react given the circumstances presented); noticing emerging patterns (observing client behaviours throughout the duration of a caving trip); seeking information (verification of the client information supplied); and tapping into mental models (how clients are reacting to any teaching practices employed or challenges offered). In the context of this chapter, both approaches are valuable, not least of all for the novice caver to understand and learn from the cognition and practice of expert CIs.

The simulation interview was developed to focus on the decision making processes of the participants in the realistic contexts of a leadership or group management caving scenario which the participant had experienced. Given the relative lack of involvement and experience of the cavers at this point of their outdoor careers, the scenario was designed to be challenging yet comprehensible and therefore had a logical requirement to be accessible through recollection. In short, if a scenario is offered which is complex or too multi-faceted, the likelihood is that each participant constructs a series of different mental models or recollections on which they are offering their reflection and insight, and therefore the risk is that the responses become too varied to be suitable for this aspect of the research. Therefore, the simulation interview was based on an actual event which had been experienced by the participant and was grounded by returning to key decision making points within the caving scenario being explored. These key points were 1) first client meeting to discuss the day, 2) venue selection, 3) equipment sorting and distribution, 4) walk up to the cave, 5) cave entrance where clients are finalising their kitting up for the trip, 6) horizontal cave journey through underground terrain involving a typical range of cave movements, 7) any slippery ascent or descent which requires physical safeguarding or additional safety measures, 8) exiting the cave, 9) return journey back to the road or vehicle, and 10) session conclusion and review.

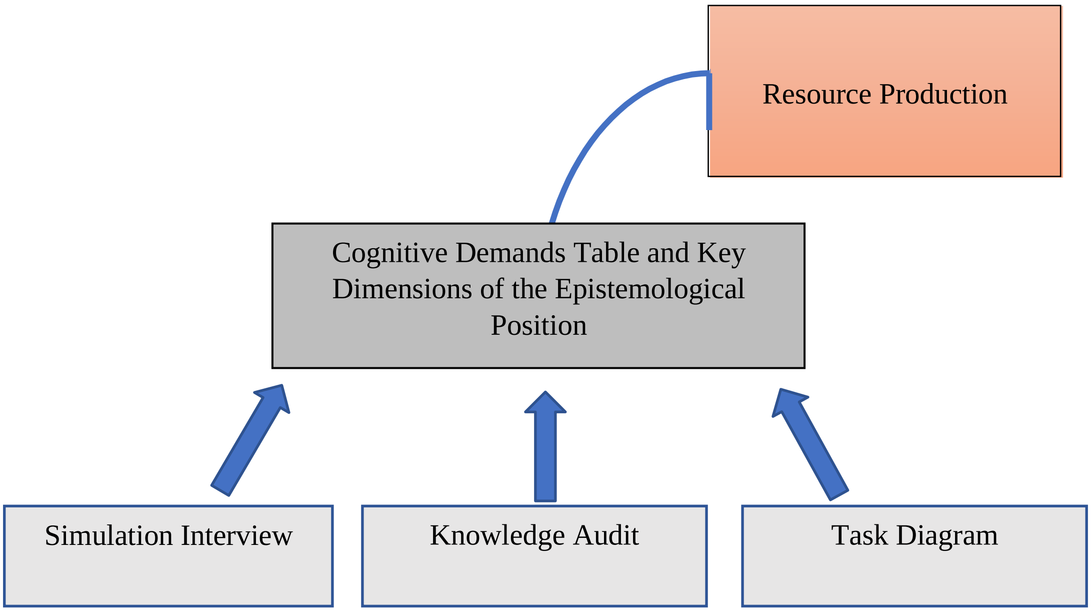

Figure 6.1 Development of resources

The final aspects of this research process are the construction of the CDT and the formulation of the Key Dimensions of the Epistemological Position, which present as the final outputs to the ACTA process. The CDT is based on the specified decision making points noted above and supports the design of the resources which aim to develop PJDM skills whilst considering the context of BCA award. The table of Key Dimensions of the Epistemological Position notes the significant distinctions in practice of the CL and CI, based upon their relative EPs.

The participants sampled in the research of this chapter are relatively inexperienced and are beginning their outdoor careers. Consequently, they are likely to be starting their developmental journey concurrently across other AS and it is reasonable to expect that any progression and increased understanding of their EP, utilisation of ECs and PJDM will be transferable to them. The domains are noted on the participant details table.

6.4 Results and Discussion

The preparation of a CDT forms the primary aspect of data analysis within an ACTA protocol and has the benefit of yielding results in a format which promotes logical and informed discussion. The analysis was based on interviews and notes from each session, collated to result in one single transcription per CL. Content analysis (Vaismoradi, Turunen & Bondas, 2013) was employed as a flexible method to interpret the text data, in this case by identification of keywords and reiterated contextual reference which allowed the construction of the CDT. Following the task diagram, knowledge audit and simulation interviews, three main aspects were identified in this process, which were articulated as challenging, problematic or anxiety inducing (i.e., cognitively demanding). The aspects were cited as; 1) exhausting existing knowledge, 2) clients not responding as expected or offering inaccurate information and 3) uncertainty in when to use one technical safeguarding procedure over another. These aspects are displayed in Table 6.3.

Table 6.3 Cognitive Demands Table

Cognitive Aspect	Why Difficult	Common Errors	Strategies Used
Exhausting existing knowledge.	Accuracy or quality of information acts as a constraint. Lack of information to offer clients creates anxiety / poor session.	Insufficient synthesis of available cave conditions data. Lack of research applicable to client group. Commits to venue with insufficient variety. Adherence to 'hard' plan.	Very conservative venue choice. Quickly abandons trip / foreshortens. Utilises out of context information. Repeat activity. Returns to well-known venue habitually.
Client information inaccurate.	Clients do not respond as expected. Lesson planning negated. Venue selection acts as a constraint.	No deployment of subtle strategies to verify information or client capability. Does not have back- up plan ('*what happens if…*') Does not recognise levels of variability or task differentiation.	Session is based on least strong member. Repeat activity. Use of heuristics.
Uncertainty in choosing one technical procedure over other options.	Balancing progression and safety is difficult, even for the experienced.	Safety is overtly prioritised over progression. Group likely to get cold which leads to further issues of safety. Skill development and team cohesion opportunities lost. Complex techniques often chosen first.	Simple caving trips chosen where PJDM skills are unstressed or challenged.

‘Exhausting existing knowledge’ had two facets associated with it. The first was having an incomplete understanding of meteorology and conditions relating directly to the planning and implementation phases of the caving session. The second correlated to the ability of being able to offer learners additional information or tasks when everything that had been planned was expended more quickly than anticipated. This also applied to caving related activities which had been planned but were unable to be deployed. It tended to occur when conditions were poorer than expected, specific areas of the cave were too busy, or if clients appeared to be very anxious. In this case it was deemed unlikely that the task or challenge would be positively managed.

The second aspect of ‘Information from clients proving inaccurate or not responding as expected’ was described as challenging and therefore associated with generating anxiety. This occurred when a trip or venue which had been selected based on the information supplied proved to be unsuitable once the group were underground. Subsequently, the CL described being unsure how to promptly remedy the situation in order to be able to offer a safe and enjoyable caving experience.

The third aspect of ‘Uncertainty in when to use one safeguarding technique over another’ was grounded in the balance of safety versus progression. This presents as something which the CLs had difficulty in fully appreciating. However, balancing safety and progression can present as a seemingly insurmountable or ‘wicked’ problem (Skaburskis, 2008), and proves to be problematic even with higher experience and qualification levels. Especially in the context of caving, if the leader ensures everyone is completely safe at every stage, it typically necessitates some of the participants remaining stationary for considerable time periods, which naturally results in cold and discomfort. This can be obviated in several ways. For example, when the leader is especially swift in their deployment of the appropriate safeguarding technique, by small group sizes, and when their PJDM process determines that reducing the necessity for technical safeguarding procedures is actually the better option through shrewd route choice.

Of the four participants, three were of a very similar age (22/ 23 years), with one (CL1) being somewhat older (28 years). Those additional five years of experience proved valuable in that only CL1 was able to reflect upon any depth of experience in discussing the leadership scenario provided. The experiences of the other participants echoed problems in planning and simple logistics, in what may be termed ‘noticing’ issues, in failing to improvise promptly for equipment deficiency, or understanding how homeostatic stress impairs judgement. All these relate closely to the expertise categories offered by Klein and Borders (2016). As CL2 notes:

> Me and the group had lots of fun splashing around in one of the pools inside the cave at the start of the trip. It was a pretty chilly day. Anyway, when we came to sit down for my caving geology talk, they were fidgety and inattentive. I realised only later that they were wet and cold, and we should have stayed dry until much later in the trip.

In demonstrating a lack of awareness in a developing situation (Collins et al., 2020), CL4 describes the scenario when practicing vertical rope rescues with a caving partner in readiness for a forthcoming training course. CL4 states:

> We chose this pitch to play around on but there was quite a lot of (cold) water flowing down it. We decided that we wouldn’t get that wet and cold and would be quite prompt with what we were doing so didn’t put extra layers on or rig away from the water. We both got very cold.

For CL1, his greater experience had allowed him to take responsibility for an aspect of a caving trip and from which he states that he learned a significant amount, owing to the cumulative nature of the small errors which he describes making. In brief, towards the end of the trip to which the incident relates, as a trainee, he was permitted by the supervising CL to travel separately through the cave with one student in order to attempt a small breath-hold sump that the youngster had heard was a great challenge. As this unfolded, the student was unable to attempt the sump due to being too cold and low on energy owing to the rigours of the caving trip to that point. CL1 continues:

> This was a really stupid idea. With hindsight, everything was wrong. The group was heading out of the cave at the end of their trip, and I was on my own as an unqualified aspirant leader with one student whilst attempting to free dive a sump with him! On the way out this lad completely ran out of energy and enthusiasm, and I was having to drag him up small climbs and the like. It turned into a bit of an epic really; by the time we got out I was completely exhausted.

Although this was a difficult experience, CL1 further discusses in the interview how much he learned from it, ultimately considering the experience in positive terms. Understanding how a given situation will unfold is an expert characteristic of situational awareness and is undoubtedly valuable in the context of cave leadership. It is evident in the discussion that at the time of the incident described, CL1 was a capable aspirant CL with appropriate levels of technical skills, as evidenced by his BCA training completion, yet his PJDM skills appeared to be significantly underdeveloped. Such technical or 'hard' skills in many activity contexts can be relatively straightforward to progress using skill acquisition practice scheduling (Davids et al., 2008) and coaching inputs (McMorris & Hale, 2006), yet PJDM development presents as being hard won through experience and reflection over longer timespans (Collins et al., 2018).

The sampled CLs all expressed concern that they might '*run out of steam'* (CL2) when working with their groups underground, especially when the chosen cave was out of condition, or if their plans were interrupted by the presence of other groups. CL1 as the more experienced of the four felt this concern less keenly, as he had had time to create activity tasks in a variety of cave conditions, developed his repertoire of cave teaching and essentially had accrued more group management tools for his metaphorical toolbox whilst working with Scouts. This suggests that a greater variety and quantity of outdoor teaching experience instances is both valuable and transferable. 'Learning the trade' as a leader should be anticipated as an ongoing process, with a professional requirement to increase the knowledge base and seek to access a greater range of tasks, tools and differentiated activities. It also indicates that an EP associated with a positive view of adventure must be sustained by sufficiently developed PJDM skills. This balance of technical and group skills allied to PJDM capability is clearly evident in the practice of the expert CIs in Chapter 5.

The aspect of the information being supplied by clients as being inaccurate, allied to individuals within the client group not responding as anticipated, was cited as being very cognitively demanding by all participants. It generated responses such as *"…what am I supposed to do now?"* (CL3), or "*…it shouldn't be my problem to solve if they say they are all confident underground, and then half of them are actually really anxious*" (CL2).

Being unable to rectify such issues is likely to cause anxiety for an inexperienced CL who is not fluent in decision making in time pressured situations, where new information is plentiful but messy and complex (Simon et al., 2017). The concept mapping exercise of Chapter 5 identified that despite thorough planning and preparation, the requirement to make numerous fast paced decisions is evident and that a nested synergy of NDM and CDM or dual process is necessary in balancing the decision making load in-action.

Verifying the information offered by the client group was a technique which the CIs in Chapter 5 soon became skilled at. This was achieved by asking clients to navigate to the cave entrance, re-coil a rope prior to the commencement of the trip, or in asking the cavers to don their harnesses without additional input or instruction. A range of subtle, nuanced and barely noticeable ploys were used to explore if the capability of the clients matched the information supplied. The experts CIs were able to create thinking time and an affordance for reconfiguration of plans on the walk-in to the cave, having chosen a cave venue at the early stage of information verification which offered sufficient variety and scope for task differentiation. It is evident in the example of the youngster who wished to dive through the sumps, that any verification of abilities, subtle or otherwise, simply did not take place.

Furthermore, the expert CIs tended to view deviations from the rarely used session plan as opportunities rather than the nucleus for stress generation. However, this is borne from significant experience and additional learning focused on group management and leadership, with accumulated knowledge of Karst landscapes (the geological term for limestone strata which produce cave systems) and cave development (Marbach & Tourte, 2002). The most experienced of the CIs in Chapter 5 stated that within his caving leadership and training career, whenever it appeared that all planned tasks were expended, it was when he became most creative and arguably delivered some of his best sessions. From my own experience in caving instruction and in coaching paddlesport, this scenario of providing some of the best sessions when all content appeared to be exhausted certainly resonates and presents as a scenario which should be embraced rather than feared by the CL. This in itself is representative of a specific epistemological position which manifests itself in the subsequent EC.

The final issue identified as cognitively demanding related to the tension of the CLs in providing adequate safety for the clients whilst ensuring reasonable progression and movement. Caves within the UK tend to have a mean temperature of approximately 6-8ºc. When coupled with draughts, the presence of cold water and spray, and the cumulative effects of energy depletion, they are a fertile ground for hypothermia in the human subterranean explorer. Consequently, keeping a group warm, enthused, and moving is a context specific factor of expertise within a number of AS environments, of which winter mountaineering is a prime example. Although seemingly counter intuitive, moving too slowly through the terrain and being overly cautious is in itself a threat to the safety of the group (Collins & Collins, 2014). Specifically in Alpine mountaineering terrain for example, the tardy mountaineer risks avalanche and stone fall from melting conditions in the heat of the afternoon sun. In the context of the caving environment, chilled cavers not only move more slowly but are prone to making mistakes in personal safety and decision making due to being preoccupied with their feelings of discomfort (Cheung, 2009), rather than a deterioration in motor skills (see the Scialette du Silence vignette (Appendix P) as a good example).

Moving slowly underground is of no consequence in terms of fading daylight or benightment, but in the dynamic setting of the cave, the longer one is underground the greater the probability of incidents owing to environmental conditions (Marshall & Rust, 1997), or simply to fatigue (Cheung, 2009). The environmental aspect is the one cited by all as being most important. This tension is represented by CL4 as "*if we move too quickly are they safe enough and if I ensure maximum safety, some will be getting freezing cold.*"

In practice, the expert CIs showed an ability to balance this tension in any caving terrain by being extremely polished and practiced in their own technical abilities, in conjunction with utilising strategies which saw small groups of cavers working together in order to undertake authentic and realistic tasks (Beames & Brown, 2016). Through the ACTA process, the CLs described routine selection of less ambitious trips so that resolving this tension remained largely unnecessary, yet this practice does not support the development of the PJDM required in more complex situations, which is necessary as the caver progresses through the BCA award scheme. In short, this strategy keeps the group safe whilst progressing through a caving trip but has the unintended consequence of missing the opportunities to develop or refine their PJDM capabilities in-action and context (Martindale & Collins, 2012). As CL2 noted *"… if I think we will spend too much time in a section, I'll go somewhere else. I do tend to get bogged down with ropework, which I quite enjoy, but the group can be hanging around quite a bit."* CL4 continued the theme whilst considering the range of techniques available for safe group progression, and the fact that a more complex (but safer) technique was used when it may have been unnecessary:

> I was faffing around and using lots of time up. Just as we finished and moved on from this slippery little climb, another instructor quickly tied a knotted handline for the group and then supervised them up it. Took them about 5 minutes compared to my half an hour!

A commonly used acronym within adventure sports (and no doubt other contexts) is KISS, which relates to Keep It Simple and Safe, translating in-action into adopting the simplest and safest practice first (Ferrero, 2006). It can also relate to initially utilising the lowest risk option in a rescue scenario (Marbach & Tourte, 2002), increasing complexity as it becomes necessary. It was notable in the work with the CIs that the technical equipment of each was very neat and well-ordered and that they requested the same of their clients. Keeping things well-organised facilitated appreciation of typicality and recognition of anomaly (Klein & Borders, 2016) such that any issues associated with the kit of the client could be addressed very promptly, thereby negating problems before they arose. The sampled CLs tended to describe little concern with keeping equipment ordered, feeling that it was not altogether necessary, although reflection may change that view. CL2 in describing that caving can be wet and mucky and therefore deemed as not requiring technical precision or order stated *"… well, I just jammed the rope back into the tackle bag without coiling it properly. Of course, the next time I needed to use it…took me ages to uncoil the dammed thing!"*

It is considered that as a result of their own reflection, the participants here may elect to become more ordered given the scenarios they described, but also because it presents as a common factor of expert practice among successful ASPs, which itself has been generated through their own reflection (Boud, 2010). It may be considered that attention to the small details which would otherwise act as precursors to situations that escalate to become problematic, is transferable across many professional fields and certainly the AS domains of this chapter.

From the author's experience of working alongside qualified Mountain Guides, it was noted that each always promptly attended to minor issues, such as bootlaces becoming undone, whilst taking care not to be too fastidious to the detriment of the client experience. The simple message is that it is senseless to have an accident attributed to small issues that are quick to rectify, and that the neater the presentation of equipment the easier it is to spot atypicality or omission. Interestingly, it was reported that this tidiness served as a gauge to the mental and physical condition of the client, especially when at altitude.

The results and discussion have informed the construction of Table 6.4 which compares the beliefs and subsequent actions of the expert CIs to the novice CLs. The identification of the EC and subsequent PJDM in-action informs the resource development needs as one of the stated end points of the ACTA process and shows alignment to Schommer's (1994) Dimensions of Personal Epistemology model and to Mosston and Ashworths' (1990) Spectrum of Teaching Styles model. As noted, the ACTA with the CLs was conducted remotely due to the constraints of Covid 19 restrictions and therefore it was not possible to observe them working in-context as it was with the CI participants. However, the stages of the ACTA were sufficient to begin to identify the EPs of this group, which informs their PJDM in-action (Collins et al., 2014).

Table 6.4 Key dimensions of the epistemological position - CL and CI

Characteristic	Novice CL	Expert CI
Session planning	Decision making and session design remains with CL.	Agency in decision making and session design is shared with clients.
Decision making process	Decision making processes tend not to be collaborative or shared.	Decision making processes tare characteristically collective and support an approach aligned to a cognitive apprenticeship.
Professional Interaction	Professional interaction with clients tends to be singular (one-off) and with little requirement to move towards independent performance.	Professional relationships with clients extend beyond the short term as they develop independent performance.
Safeguarding	Responsibility in safeguarding remains with CL (occasionally utilising an assistant) typically using the safest option.	Utilises speedy and 'safe enough' safeguarding techniques with delegated responsibility (i.e., peers supporting one another).
Adherence to plan	Greater adherence to a specific plan. Chooses venue which will work in most conditions as a factor of reduction in decision making load.	'Soft' plan is configured with limited adherence to a 'hard' plan, if created.
Role of adventure	Adventure tends to be commodified and orientated to risk minimisation.	Positive view of adventure and comprehension and utilisation of risk is maintained.
Knowledge generation	Knowledge resides in the CL, is transactional and may flow uni-directionally.	Knowledge is generated together and flows multi-directionally.
Venues	Well known venues habitually used, especially if conditions deemed sub-optimal.	New venues routinely explored with clients.
Independence	Limited requirement to develop independent performance in clients.	Engagement with client based on development of independent performance.
Agency	Responsibility for safety and enjoyment of caving episode normally resides with CL.	Shared responsibility for safety and enjoyment of caving episode.
Value	In sub-optimal conditions or when session content depleted, session is typically foreshortened.	Evidence of creativity when conditions poorer than expected or session content exhausted.

CL – Cave Leader. CI – Caving Instructor

Each of the expert participants have accrued and developed a significant quantity of knowledge and variety of experiences compared to the novice cavers. To some extent, many of the factors on the Table 6.4 which compares beliefs to subsequent action (i.e., the EC) could relate equally to other professional fields, for example a newly qualified schoolteacher compared to a very experienced one. The main difference within AS contexts though, is the specific connection to the comprehension and utilisation of risk for the purposes of learning and development (Breakwell, 2007), in environments which have the potential to cause harm.

Risk itself is a very complex and subjective field of study and the fact that the CLs are relatively young may be indicative of their recent exposure to school systems and to traditional sports coaching (rather than ASs) which support and sustain risk minimisation strategies (Gill, 2010). Therefore, knowing how to move safely and progressively away from the risk aversion paradigm, to which they may have been accustomed during the greater period of their adolescent and adult lives, will take time, experience, reflection, and good mentorship (Barry & Collins, 2021).

Table 6.4 partly reflects the differences in remit of the CL and CI and therefore the typical requirements of different clients. However, it serves as a useful platform from which to understand the steps required for the CL to begin to bridge the gaps in knowledge and practice such that progression through the next levels of the BCA award scheme may be supported. Developed from this table, the PJDM and Knowledge Framework presented in Table 6.5 explicitly recognises the required steps in progression and aids in the identification of tasks and behaviours which identify expert leadership in more complex environments. This is a valuable aid to progression irrespective of any aspirations to proceed through an award scheme. Such knowledge frameworks can act as foundations to the production of applied meaningful resources which are beneficial for training and development purposes (Kartoshkina & Hunter, 2014) across AS domains, and which denote the end point of an ACTA process.

Table 6.5 The developed PJDM and knowledge framework

Session stage	Novice CL	Training Opportunity	Expert CI
Pre	Planning process tends to utilise limited access to the community of practice.		Significant access and utilisation of community of practice in planning stages.
Pre	Plans from a limited range of options and session content variability owing to constraints of award.		Overplans but prompt selection / deselection of venue and session content from wide range of possibilities.
Pre	Utilises weather forecasts in planning process to build satisfactory picture.		Endeavours to build own, more complete picture of conditions.
Pre / in-action	Risks tend to be mitigated or the situations avoided.		Risk harnessed and exploited for purposes of learning and personal development.
In-action	Selects from a limited range of leading or safeguarding options.		Demonstrates ability to select from an extensive range of leadership and safeguarding. options
In-action	Adopts 'fully safe approach' to safeguarding but one which may be slow and non-progressive.		Adopts 'safe enough' approach to safeguarding, but one which ensures progression.
In-action	Fully safe approach may retain group in hazardous areas of cave for longer.		Comprehends that speed may be a factor of safety.
In-action	Unrefined safeguarding deployment tends to be non-differentiated.		Refined approach to safeguarding displays differentiation.
In-action	'Follow, do, follow, practice' routine - leadership underground tends to follow a procedural approach.		Range of learning and development challenges set within agreed parameters. Leadership underground characteristically non-procedural.
In-action	Uses limited teaching and information delivery styles.		Shows ability to select from a wide range of teaching and information delivery styles.

In-action	Restricted utilisation of behaviours across the epistemological dimension and teaching styles spectrum, with reduced movement to adjacent categories. Likely to be constrained by client demographic (usually novices / children).		Uses behaviours across the whole range of the epistemological dimension and teaching styles spectrum with focused lateral movement across of each – i.e., adopts purposeful teaching and epistemological positions. Much less constrained by a very varied client base (all abilities / ages).
In-action	PJDM in-action follows the process of cycling through range of options and selecting a choice.		If no negative contra-indication, choice is promptly made and actioned without cycling through range of options.
Post	Reflection post-session utilised to shape next session delivery.		Reflection in-action utilised to shape current, ongoing session delivery.

In consideration of the importance that the CLs placed upon the tension of progression versus safety, it was decided that this aspect should form a central point of the specific applied character of this chapter following the ACTA. In conjunction with the contributions of the participants and in utilising the data generated through Chapter 5, the following model shown as Figure 6.2 was conceptualised, with the working title as noted.

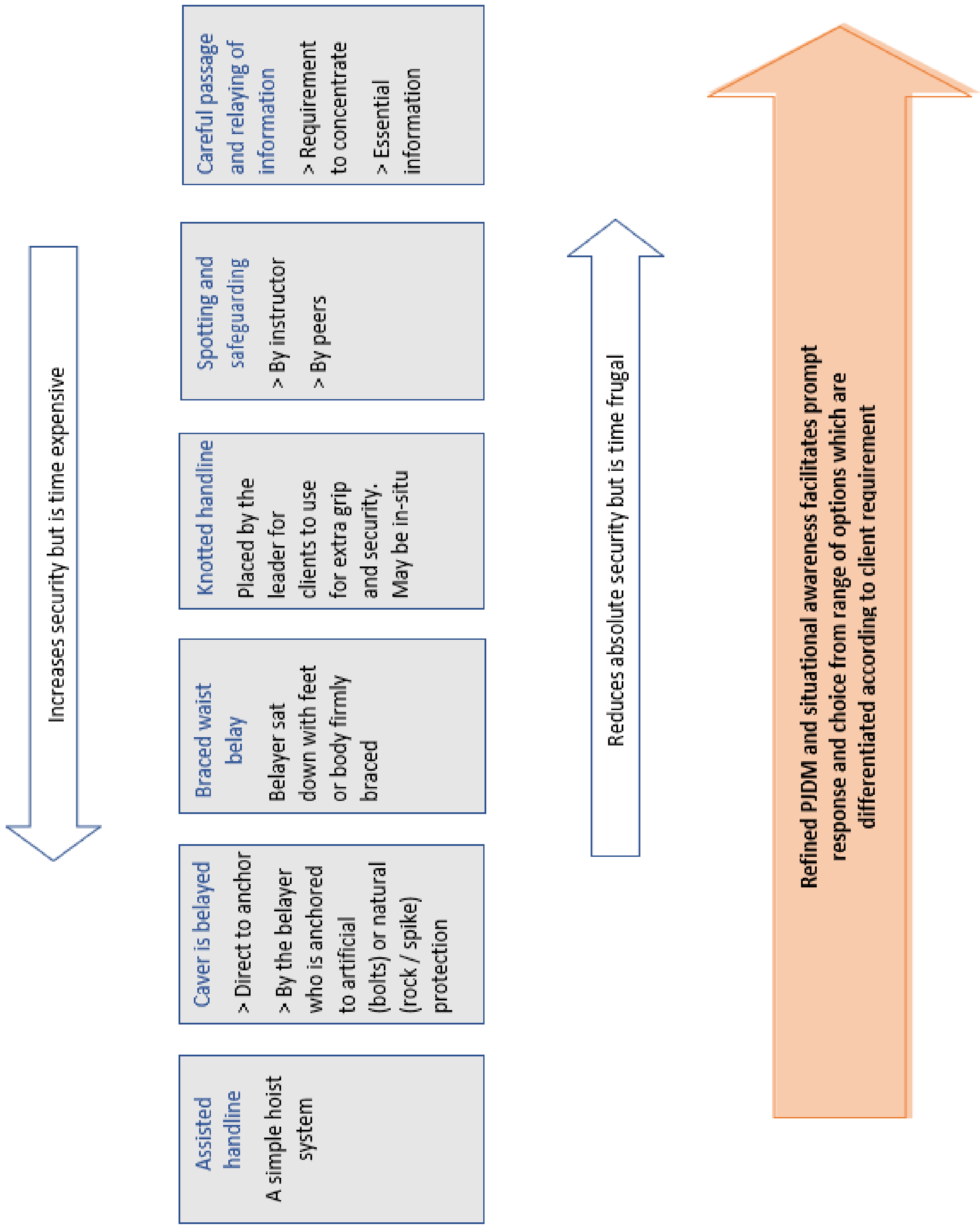

Figure 6.2 Level 1 Cave Leader Progression Model

Within the ACTA process, it became apparent that the approach to safeguarding was unrefined, with clients being either 'spotted' by the leader or fully belayed on rope, with little middle ground or subtlety in differentiation. The potential time stress caused by belaying each client up a slippery part of the cave ultimately dictated that in the absence of other constraints, many of the steeper and potentially more engaging aspects of the cave exploration were typically bypassed. Both the time stress and typical avoidance are echoed by the comment of CL4 above in describing how a more experienced instructor took five minutes to safely manage their group, whereas she had taken thirty.

The more expert caver seems able to promptly choose from a larger range of options without cycling through all the alternatives (Schraagen, Klein & Hoffman 2008), utilising a process of in-action observation and prompt reflection aided by scrutiny of performance. In differentiating levels of safeguarding and security, the ones who require most supervision or assistance receive it, saving time by withholding it from the ones who do not, or in fact by exploiting the abilities of the stronger group members to support those who do. In perceiving that not all clients require an equal level of security, the model assists in identifying the broader range of safeguarding techniques which may be selected from and then deployed. It signposts that although one or two clients may need to be belayed, others may be secure enough to be spotted or to simply grab a secured rope, thereby gaining economies of time by this decision making and progress differentiation.

It is evident that experienced instructors and leaders seem able to use all practices within the range of teaching styles (Mosston & Ashworth, 1990). They purposefully select techniques across the teaching spectrum with the same carefully considered deployment of behaviours at either end of the epistemological dimensions proposed by Schommer (1994). However, from their personal accounts, the less experienced CLs and instructors tend to be more fixed and have a greater tendency to utilise behaviours and actions which reside towards one end of the teaching styles spectrum and personal epistemological dimension, displaying limited movement along it. This begins to explain why the safeguarding techniques of the less experienced CLs tend to be 'one or the other.'

In practice, the expert CIs demonstrated an ability to choose from a greater range of techniques and leadership behaviours, which are grounded on accrued experience and exposure to a larger base of instances (Phillips et al., 2004). This is established on a sophisticated EP which supports refined PJDM behaviours, which in this case relates to physical safeguarding and support issues. The epistemological position and PJDM combined to offer greater safety and served to maintain more rapid progression. An example of this being the numerous times the expert CIs were observed to utilise or demonstrate the braced waist belay and in their use of direct belays which can be both speedy and secure, whereas the CLs had either limited experience of deployment of the technique or relevant working knowledge of it. This serves as a pertinent example of how holding a more sophisticated or complex EP can encourage decision making which improves client agency and fosters supportive development behaviours (Grecic & Collins, 2013). Further, in using the PJDM and Knowledge Framework allied to the Cave Leader Progression Model, the EC can support PJDM to inform choices based on coherent frameworks rather than on what may be termed an intuitive basis.

Supplementing the participant contributions, the Cave Leader Progression Model is informed by my own experience across domains, specifically in the context as an assessor of whitewater leadership awards for British Canoeing (BC). Echoing the courses of action of the CIs of Chapter 5, it was evident in the whitewater context that the more experienced paddlesport candidates utilised leadership techniques based on their refined PJDM which were sufficiently safe yet ensured progression. This led to completion of river journeys within daylight hours, utilising any remaining time to creatively further the participant's knowledge and progression. This serves to evidence the transferable nature of these PJDM skills across domains.

This understanding of risk and the judgment to act as safely as the context requires rather than selecting the safest option is part of the 'DNA' of participation within AS (Martin et al., 2017). For the CLs it presents an issue of choosing the most appropriate technique but from a limited range of options derived from experience and reflection, as the base of their PJDM is built (Hickman & Stokes, 2016). The Progression Model serves as a useful framework on which to base practical decision making (i.e., if spotting is not secure enough for the clients in this instance, the next stage will be to consider using a knotted handline rather than a slower belaying system).

However, the question remains as to how the PJDM skills are learnt and decisions made. The process must be developed in the specific context of caving to ensure refined deployment in more complex situations, given that this is a Level 1 Progression Model. This aspect will be covered in detail in Chapter 7.

Correlating with the study of Collins et al. (2018), the participants of this research indicated that although confidence in their PJDM skills was in its infancy, they indicated two mechanisms of support. The first identifies a limited amount from their caver training course at Level 1 allied to transferred-in decision making experience from other aspects of their professional lives. In particular this was from additional formalised training in their stated AS disciplines (CLs 2, 3 and 4) and work within a Scouting environment (CL1). The second related to the process of reflection on led caving sessions and of developing experience whilst retaining an openness to personal progression. This aspect resonates with most of the participants across the thesis who advocated a willingness to remain open to professional development across a significant career span, whilst acknowledging the concept of lifelong learning.

The CLs within this chapter all felt that the technical demands of the award (navigation and ropework) were manageable and considered as procedural aspects of the role. Cited as less manageable and giving rise to concern as noted in the CDT, were the declarative and conditional knowledge aspects. Summarised, this suggests that greater value is placed on PJDM capability by the CLs compared to technical skills, but the process by which PJDM is developed is unclear to them as they move towards an ability to show good judgment in a range of varying situations, namely the development towards adaptive expertise (Mees et al., 2020).

The weight and gravity of decision making for the CI is significant and likely to generate apprehension for the inexperienced CLs who must learn to become increasingly skilful with the factors of ‘how and why (or why not)?’ rather than just those of ‘what and when?’ For the beginner leader, the consequential nature of the domain in which they are working is significantly different to the ones in which they are likely to have more experience (Barry, 2015). Rather than the alternatives in a traditional sporting context being ones of either learning or performance goals (Cushion, 2010), in the professional environment of the CI the balance of pedagogical and developmental aims of the client must be carefully interwoven with the fundamental considerations of client welfare owing to the nature of the terrain in which the activity takes place. Therefore, expertise in PJDM acts as a precursor to a safe, enjoyable and developmentally progressive caving trip.

A significant difference in the working practices of the expert CIs and the CLs is that the role of the CI is typically to improve overall competence towards the establishment of independent performance and therefore any leadership and coaching elements tend to be collaborative. However, for the CLs, the clients have a greater tendency to be ‘passengers’ in the underground adventure (Brown, 2000). Those clients justifiably abdicate responsibility for most decisions by engaging the leader to utilise their PJDM in a potentially dynamic environment. This ensures a safe, enjoyable, and arguably commodified caving experience (Loynes, 1998). In this context, the PJDM skills of the neophyte CL need to be of a high order since the client group are customarily young and inexperienced, yet the development of PJDM for the CL (and across the BCA scheme) is in its infancy. Although this presents as a training gap, it is obviated to some extent by the requirement to log 20 caving trips in the expectation that PJDM skills might develop through the experiences which they provide. However, this is implied rather than stated.

One of the recommendations arising from this research is that the role of the cognitive apprenticeship (CA) be extended and considered, not only to address the training gap evident in the BCA scheme, but to furnish any CL or aspirant ASP across domains, with a direction to follow in order to develop and refine their PJDM skills. In short, to provide a coherent progression framework. There is an opportunity to build upon the research of Collins and Collins (2021), with regards to their ‘Big 5’ outline approach. This is a graduated reflective model which can be utilised in conjunction with the CA, which seeks to develop the PJDM skills and situational awareness of ASPs in context.

A collaborative approach between the inexperienced CL and more expert or qualified colleague is advocated in the professional mentoring relationship of the CA. This staged process of modelling, coaching, scaffolding, articulation, reflection and exploration (Collins et al., 1987, Marton & Säljö, 1976) submits that the expert informs the apprentice of their decision making reasoning. Over an appropriate timeframe, the apprentice begins to make decisions under the tutelage of the expert, informing them of the factors scaffolding their own decision making and reasoning, thus supporting the construction of PJDM knowledge by the apprentice.

In their conclusion, Collins and Collins (2021) state that their small-scale study using the 'Big 5' was positive and to be commended for use in professional development, but that a requirement exists for it to be established across a broader field of coaching and leadership environments. This reinforces that concepts such as problem solving, planning, and the understanding of how PJDM, and EPs interrelate are best understood and explored in their natural and applied working context.

Given the unique and consequential nature of the professional caving environment, allied to the significant decision making requirements between L1 and VCL to CIC, the field of caving leadership offers a particularly appropriate opportunity to develop meaningful applied resources which develop PJDM in natural and applied contexts. This is the primary focus of Chapter 7.

6.5 Conclusion

The ACTA process and subsequent production of the CDT highlighted three main areas which generate cognitive load for these younger caving professionals. The study with expert CIs indicated that those ASPs had worked out through experience, preparation and utilisation of their CoP, how to overcome the range of issues which generate cognitive loads in extended cave environments. The CLs appear not to have reached this stage of managing the range of PJDM requirements and across the sample, tend to utilise very well-known venues and foreshorten the caving experience if the conditions are poorer than expected or the group respond less well than anticipated.

For the novice CL, recognition of the EP and an understanding of how this supports PJDM in-action needs to mature and progress in tandem otherwise a stance which supports positive engagement with adventure will be poorly supported by decision making skills which are insufficiently developed. In a caving context this may result in psychological harm or physical trauma (Collins & Collins, 2013), as evidenced by CL1 in the sump example described earlier.

The proceduralised practices advocated and employed by the L1 Cave Leader via their awards courses within the BCA structure reflect the tension between the understanding and acceptance in society of the positive aspects of engagement with outdoor adventures and the justifiably low tolerance for accident and injury (Breakwell, 2007). It is understood that procedure- based practices and stage-by-stage decision making approaches rarely fit the dynamic context of AS leadership, therefore they have not been fostered here. This is because of the requirement to develop prompt decision making abilities which respond to the situation, rather than to an advocated pre-set pattern or guide. This approach is supported by the lack of utility analysis (Schraagen et al., 2008) by firefighters who deploy a course of action deemed best in conditions of uncertainty, one where decisions are required in short timescales and where there is a wealth of incoming and routinely incomplete information. In caving contexts, if a course of action is deemed to be appropriate with no negative consequences, the expert proceeds with it rather than generating alternatives or spending time in consideration of additional options. This issue is compounded when considering that for most CIs, it is often necessary to make prompt and important decisions in isolation.

For the CI, leadership in caving environments can be seen to a significant extent as a 'decision making game' in which they must decide upon and then deploy the optimum blends of PJDM tools (Collins & Collins, 2021) to best meet the needs of the subterranean context and stated goals of the clients. The AS context of leadership and underground exploration with clients represents a professional environment which is both complex and dynamic. In showing similarity to the firefighting example, it is one where poor decision making presents potentially serious and immediately apparent consequences.

The practical applied implications arising from this chapter include:

1. A tabulated key dimensions of the epistemological position comparing Cave Leader to Cave Instructor.
2. The developed PJDM and knowledge framework, which appraises novice and expert behaviours in a cave based setting.
3. The development of the Level 1 Cave Leader Progression Model

Chapter 7 – Training Resources to Develop PJDM Expertise in Adventure Sports Professionals (caving)

7.1 Preface

Chapter 7 captures the findings of Chapter 6 to guide the structure of a training resource which facilitates progression towards the expert levels of PJDM and cave leadership evidenced by the participants in Chapter 5. This presents as a specific, original, and valuable contribution to the professional field in this under researched domain. The content of Chapter 7 utilises the novel and original evidence-based research contained in the previous chapters to synthesise new content to educate ASPs. It is likely to have transferability to other domains but has been designed with particular reference to the caving professional. This work has the capacity to enhance coach and leader education across professional sectors and improve the experience of practitioners and participants across the UK and beyond. In the absence of any other work of this type, it significantly extends current theory and professional practice.

7.2 Introduction

The work of the thesis identifies the complexities and demands faced by the ASP, specifically noting the significant differences in remit and role between the CL and the holder of the CIC. The complex and multifaceted PJDM demands placed upon the leaders of horizontal and vertical caving journeys irrespective of any qualification considerations were illustrated through the Concept Mapping of Tasks of Chapter 5, and further developed in Chapter 6 through the creation of the Cave Leader Progression Model. The Key Dimensions of the Epistemological Position is conceived as the underpinning structure which supports the resource production, further established by the construction of the PJDM and Knowledge Framework.

The work of the last two chapters identified the requirements of knowledge, skills and behaviours related to underground leadership, and recognised the paucity of applied models or materials which foster development of progressive PJDM skills necessary in the domain. The implication of the new understanding generated in the last two chapters is that there is a specific requirement to enhance the PJDM skills of neophyte CLs at a comparable rate to the technical skills and other elements of proceduralised practice, thereby aiding the reconceptualisation of decision making training for cavers. This position is grounded in the principle that technical vertical skills and those of underground movement and navigation are relatively straightforward to learn through appropriate practice as noted (Schmidt & Wrisberg, 2008), but that the skills of PJDM, especially those which carry significant consequence, may take much greater timespans in both generation of experience and opportunity for reflection, to be acquired (Hickman & Stokes, 2016). Therefore, it is justified to start this process much earlier in the developmental journey of the ASP.

The primary purpose of this chapter is to synthesise and justify the inclusion of specific training materials which help to prepare and habituate relative novice CLs for the PJDM demands required in more complex environments or at higher levels of professional operation. Although an innovative approach within the scope of high level caving leadership, and arguably within AS generally, this approach is not new. For example, Hoffman and colleagues (2014) presented an important resource in assembling a collection of best practices for enhancing the development of expertise. Their work identified and developed strategies for practice, high quality feedback, transfer, and crucially, for retention.

Although the materials produced within the scope of this thesis may be transferable to other AS domains and training applications, they have been designed in response to, and are directed by, the EPs of the participants identified in the PJDM and knowledge framework. There are direct links to the initial research objectives of the thesis, which are to better understand and investigate the links between the EP of the participants and their decision making processes, but also to follow the research directions revealed by the cave data collection aspects as the thesis has evolved.

From a practical perspective, during Covid 19 times it was not possible to implement the planned roll-out of applied resources in caver training meetings or by testing them out at workshops, given that the activity of caving was among the most difficult to make Covid secure. In response to this challenge, an expert panel of senior outdoor coaches and instructors was assembled to provide feedback and offer suggestions for the direction of development. Given the potential for transferability of the resource, it was not necessary for this panel to be comprised solely of caving instructors. The details of this group are found in Table 7.3. The expert panel approach was considered a suitable and realistic option in the circumstances present at the time of writing, where a cyclical process of initial delivery, review and modification was simply not possible. Examples of expert panel feedback are found as

Appendices K and L.

Following the introduction, the remainder of this chapter is divided into three parts. The first offers the reader theoretical underpinning of the resource and provides a précis to indicate the rationale and reasoning for selection and inclusion for development. The second part comprises the resource which has been developed into a comprehensive PowerPoint presentation, and the final section discusses the socially validated expert panel feedback. It concludes with findings and a review of the efficacy and utility of the intervention, with recommended next steps.

7.3 The Potential Models and Approaches

For the reader, Table 7.1 offers a summary of prospective models and approaches which have been considered for potential development of training resources. It is appropriate to review the models and mechanisms that have delivered positive outcomes in other fields and to consider how such interventions may be applied to caving leadership. In order that the chapter does not present as a literature review at this stage of the thesis, further details of the models are found as Appendix J.

Table 7.1 Potential models and approaches

Potential Resource	Advantages	Disadvantages
Concept Mapping Exercise.	Offers a very clear framework of the demands placed on the caver and proven to be effective in scaffolding learning and progression (e.g., Chang, Sung and Chen, 2001). Ready to be extended and developed to provide direction and support in PJDM across the CDM, NDM and blended aspects of the decision making chain. It shows alignment to the requirements of the doctorate to contribute to the field.	Does not currently present as meaningful applied resource but is ripe for development - its utility is in clarifying the range of requirements which it does well, which are key to understanding the expertise demands so vital in bridging the 'PJDM training gap.'
Cave Leader Progression Model.	Offers clear step by step guidance on technical progression and provides a road map which plots choices from which to select. Is ready to be developed and move safeguarding decision making from the tacit to explicit.	In the present format, does not necessarily aid in the decision making of the steps, rather it illustrates the choices. It does provide a solid framework on which to support decision making practice and expertise.
PJDM and Knowledge Framework.	Offers a very clear illustration of the differences in epistemological position of the LCL and CIC, which translates to the novice and advanced caving leader. It identifies the starting points of PJDM development and designates an epistemological position which may help to support and scaffold the expert decision making of the CI. It shows alignment to the requirements of the doctorate to contribute to the field.	Does not present in current format as a meaningful applied training resource – its utility is in clarifying the differences, which it does well.

Development of the Cognitive Apprenticeship approach.	Has the capacity to be adjusted for the specific conditions of the caving environment, is authentic and well regarded in a range of fields (e.g., Larsen, 2015). Would present as novel to a number of NGB training providers.	Requires peer support and access to more experienced colleagues. It will work well post Covid but is an approach which has been in use for some time. Anecdotally it seems that NGB training teams are not aware of its use in professional development.
Big 5 graduated reflection model (Collins & Collins, 2020).	Can be amended for use in cave leadership situations; builds in elements of the cognitive apprenticeship and is both socially constructed and authentically situated.	For CLs with little experience, it may prove difficult for them to answer the reflective questions posed by the Big 5. A model which is based on reflection rather than specifically developing expertise.
ShadowBox approach (Klein & Borders, 2016).	Contemporary approach to cognitive task analysis and cognitive skills training.	Reliant on scenario setting and progressive use of digital systems for evaluation. Culturally, may be more complex than cavers wish to engage with. Would be excellent if time and resources were abundant.
Situational Awareness (SA) development (Endsley, 1995).	Forms a crucial part of the PJDM process and can be achieved with 'crib cards' and use of simple resources underground and in-context. Develops practice in-action and in genuine professional environment, crucial in time-bound decision making environments.	Presents as a longer-term development approach to progress through the 3 main levels of SA comprehension and practice, but crucial, nonetheless. Would necessitate the development of a 'pre-Step 1' in order to operate positively with relative novice CLs.
The Delphi Approach (Brady, 2015).	A method (or 'approach') designed to generate structured (anonymous) expert consensus on a scenario, which could be applied to cave leadership and decision making development.	Is a standalone functional method for qualitative enquiry rather than a resource generating mechanism. Is valid but would require the levels of word count which cannot be accommodated.

Decision Training approaches (Vickers, 2007).	An approach by which decisions are trained in a graduated 3 step process, which seeks to make effective decisions under stress, useful in the context caving.	The work of this approach has largely been conducted in traditional sports which utilise drills and exercises and therefore may present as non-authentically situated.
Problem Based Learning (PBL) (Ojala & Thorpe, 2015).	PBL embeds the learning processes of learners into typical real-life problems, building upon previously acquired knowledge and skills. Contains elements of good coaching and leadership behaviours.	Originally designed to solve problems in medical settings but its' use has been contentious in adventure sports domains (Ojala & Thorpe, 2015) given that it is posited as an instructional methodology. PBL does not need highlighting as it already represents a small component of the PJDM approach already present, namely the elements of any good coaching or leadership behaviour per *se*.

7.3.1 Resources selected for inclusion and development

The overview of Table 7.1 indicated that each approach could potentially fulfil the requirements of an underpinning model on which to develop the training resource, whilst not fully satisfying the requirements of the thesis. In short, many of the approaches have been in existence for some time and are well known, although not necessarily used in the context of adventure sports PJDM development and the enhancement of expertise. One example is that of the CA. It was felt that the CA would work very well in this context given its applied character and lack of familiarity to most NGB training providers, but it is otherwise well-known in the applied sport psychology field (see Cruickshank et al., 2020) and was discussed at some length in Chapter 2. It is given some mention in the resource chiefly because I understand it to work very well in AS contexts and that there is limited utilisation of it across NGBs. However, one which deserves more clarification here relates to the situational awareness (SA) model (Endsley, 1995), which has a close and synergetic relationship to PJDM in AS practice. It has a significant role in decision making, as refined SA ability enables the appraisal of past, current and future events more accurately, and in evaluating potential consequences.

A common thread across domains is that a refined SA of demands informs the PJDM in- action which in the context of this chapter, presents as a central safety factor within led caving experiences. Research has been conducted across diverse fields such as aviation decision making (Stammers & French, 2005), within the fields of emergency response (Dow, Garis & Thomas, 2013), group management outdoors in adventurous environments (Mees et al., 2021) and specifically within the AS domain of sea kayaking (Collins et al., 2020). Consequently, the development of SA could be deemed an important avenue to explore with regards to the production of applied training resources but has been discontinued for two main reasons. The first is that the field of SA development already has a long history and the second is in anticipation of the difficulty of developing SA in relative novices if they do not yet have the fundamental mental models in place on which to situate the learning (Mills, 2011). This condition has the tendency to promote a focus on the technical aspects of adventure practice (the ‘what and when’ rather than the ‘why or how’) which presents as being in the opposite direction of travel to the findings of the thesis. Outside the scope of this chapter, there is merit in the development of this approach and one which can form the basis of further standalone research and publications that logically should flow into CL training and development programmes. This is based on the notion that a refined mental model of SA in dynamic AS contexts is a critical skill, especially with regards to a comprehension of how events may unfold in the immediate future.

Crucially in caving (and across a number of AS domains), refined SA as a central aspect of PJDM can inform a decision where movement of the group is vital to their safety, as is the requirement to retain position and postpone progress. Fundamentally in the context of AS and especially caving, the level of applied skill in PJDM can mean the difference between serious harm or not, in informing the 'move promptly or stay put' decision. There are several examples in outdoor adventurous contexts where SA related PJDM processes were inadequate with serious, stark, and direct consequences. Two key examples are found within the Cairngorms tragedy of November 1971 (Allen, 2019) and the Mangatepopo Gorge multiple fatality of April 2008 (Brookes, 2011). Details of these incidents are found in appendix Q.

In many fields, including within most AS domains, a refined comprehension of SA is a critical skill, and it is contended here that such SA enhancement is able to develop in tandem as an essential element of PJDM progression, namely through experience, mentoring, reflection and the development of context specific bodies of knowledge (Collins & Collins, 2015). It is observed that in the two multiple fatality incidents referred to above, a common factor was one of leadership from a relatively inexperienced instructor associated with a compounding lack of familiarity with the professional environment of operation. Although technically proficient, neither had received any training or skilled support to aid their development of expertise in decision making in the consequential environments in which they were required to work. The correctness of the PJDM approach in specific contexts is closely linked to success or failure which can directly impact lives saved or lost. Occasionally decisions of considerable importance need to be made by the cave leader or instructor, but fortunately more commonly relate to outcomes which effectively synergise pedagogy and leadership.

The Concept Mapping exercise of Chapter 5 was instrumental in revealing and illustrating the range and complexity of tasks required to successfully lead or coach an advanced underground journey, and it is owing to the presence of this utility that it has been chosen for further development. The concept map is regarded as a vital aspect of the thesis as it is both a resource and roadmap, and one which offers a template across a range domains and applications. The mapping exercise noted that many planning aspects could be completed in advance of the session in time-plentiful and resource rich environments, but despite the thoroughness in pre-planning that typically takes place, there are numerous decisions which must be made in short timeframes and where information may be incomplete or unverified. In short, the concept mapping exercise illustrates to the CL the multifarious and complex requirements of leading underground and is one that offers an overarching illustration of the demands faced in such settings. It contends that technical and procedural skills of rigging, navigation and rescue are manageable through skilful practice but not necessarily in developing the applied declarative and conditional aspects necessary during complex underground journeys. For this reason, the concept mapping exercise is incorporated to provide direction and support in PJDM for the caver.

The Cave Leader Progression Model was designed to fulfil a particular need for the participants of the research within Chapter 6, who disclosed difficulty in being fluent across terrain which required them to select from a range of safeguarding techniques to ensure physical safety whilst maintaining fluency within a caving journey. As humble as this model may appear, it simply does not exist in any caver training material and is therefore unavailable to novice CLs. As with the concept mapping approach, this model illustrates the various stages and progressions that are available to the CL and is offered as an effective resource to those participants. Although it does not specifically assist in selecting one technique over another, it revealed that all participants stated unequivocally they would have benefitted from specific training and differentiation on how to balance progression and safety while not sacrificing momentum underground. This aspect is presented as a PJDM 'training gap.' Although naturally expected due to novice and expert progression over time, it deserves attention in consideration that mountaineering and climbing trainees are allocated a proportion of their training course to consider the PJDM skills which facilitate leadership fluency via the transition from one method of safeguarding to another. Therefore, the Cave Leader Progression Model is deemed suitable for resource development, given that caving environments equally necessitate a blend of client safeguarding and progression.

The PJDM and Knowledge Framework of Chapter 6 fulfilled a vital role in identifying the differences in the underpinning epistemological position of the CL and CIC award holder and their subsequent behaviours. Therefore, it is chosen for further development as a meaningful training resource. As above, it identifies the starting points of PJDM development and designates an EP which may help to support and scaffold the expert decision making of the CI. Developing the PJDM and Knowledge Framework as a standalone resource is eminently feasible and would form the basis of an excellent long-term longitudinal research project (Prince, 2005).

The research of the previous chapters has considered the differences between sports biased decision making needs and those of AS. The decision making processes associated with traditional sports (such as hockey, cricket and football) tends to maintain an emphasis on coaching for performance and of success within competitive environments, whereas AS decision making maintains a focus on the learning and development needs of clients which are orientated to safe independent participation, and in managing and embracing risk as necessary for the purposes of client progression. Typically, when clients are operating with an ASP, it will occur in potentially consequential environments (Smith & Wilkinson, 2020) and any resources which promote decision making expertise must note that future independent participation by the clients in similar settings will not have the judgment or technical safeguards provided by them. Therefore, the selection of resource development options reflects these differences whilst acknowledging a requirement to contribute to the professional field.

That said, it is not deemed that work of this chapter is the 'be all and end all' of resource development for cavers and for ASPs in other domains, rather that it is a starting point for the instigation of meaningful, applied training resource evolution which can be further progressed through post-Covid conferences, professional training events and subsequent journal research papers post- thesis. This is due to the way in which the overall thesis has evolved, and how the direction consequently altered according to the findings revealed.

The position of this chapter within the thesis is also influential and carefully situated such that it should act as a valid support to the next stage of ongoing research into the PJDM processes of the CI which currently has a limited literature base. It is acknowledged that extended horizontal and vertical caving became an appropriate and valuable research 'vehicle' in noting that the findings originating from studies within this accentuated environment may be relatable to other AS domains.

7.3.2 Critical defence of the Concept Mapping of Tasks, the PJDM and Knowledge Framework and the Cave Leader Progression Model

The resource centres around three important elements which were founded on the Key Dimensions of the Epistemological Position construct (Table 6.4). These are the augmentation of the Concept Mapping of Tasks, the interpretation of a context specific PJDM and Knowledge Framework and the evolution of the Cave Leader Progression Model. It is important to note that sampled participants and members of the expert panel were not necessarily aware of their own EP, nor the terminology associated with it, and therefore it was necessary to provide theoretical support and a pathway to comprehension of this facet of philosophy. Here, the illustrative concept mapping of tasks proved advantageous in partnership with the supporting notes.

In critical defence of the resource approaches, the concept mapping approach has been successful in developing critical thinking and professional development in a diverse range of fields, such as nurse education (Yue et al., 2017), programme planning and evaluation (Rosas & Ridings, 2017), designing family support interventions (Rosas, 2005), and within Higher Education curricula appraisal (Hay et al., 2008). The knowledge framework approach has also seen extensive and successful application in a variety of fields, such as educational communication and pedagogy (Koehler et al., 2014), online learning development (Doering et al., 2009) and the development of content knowledge for teachers and teacher educators (Koehler et al., 2013). The Cave Leader Progression Model shows alignment to the needs of the field as evidenced by the data collection of Chapter 6. It reflected that all four participants felt under-prepared by their training course to manage the decision making load associated with blending safeguarding and progression.

Content from this section is utilised in the production of the applied materials and follows the structure outlined in Figure 7.1. This was informed by the research process which revealed significant practice differences according to the EP, which in turn necessitated a concept mapping exercise to reveal the task requirements. The concept mapping subsequently informed the PJDM and Knowledge Framework which generated the Cave Leader Progression model.

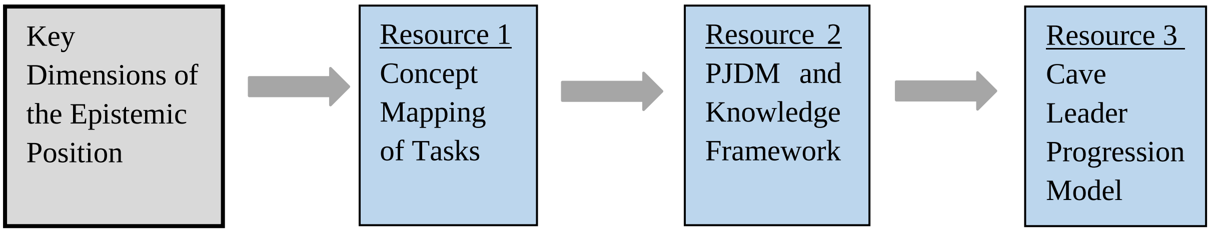

Figure 7.1 Resource structure organisation

7.4 The Resources

7.4.1 Resource 1 - The Concept Mapping of Tasks

The concept mapping exercise was a vital process which began to accurately identify the range of tasks and decision making requirements of the CI in practice and is displayed in Figure 7.2. with a full page version displayed as Figure 5.1. Even with the rigour and time spent in preparation where it is possible to complete many requirements of the planning phase in time and resource rich environments, there remains a significant necessity to access and utilise fast paced and incomplete decision making processes (NDM biased). For the novice CL who wishes to progress their leadership and PJDM expertise to cope with more demanding and consequential environments, they must accept that despite thoroughness in planning (higher weighting of CDM), there will still remain a significant requirement to make prompt decisions based on poor information (greater bias to NDM). The concept map acted as a starting point in recognising the distribution, utilisation and weighting of CDM and NDM, noting that in many cases, the decision making processes are subtly blended and feature aspects of each type of thinking according to context, affordances, and constraints (Davids et al., 2008).

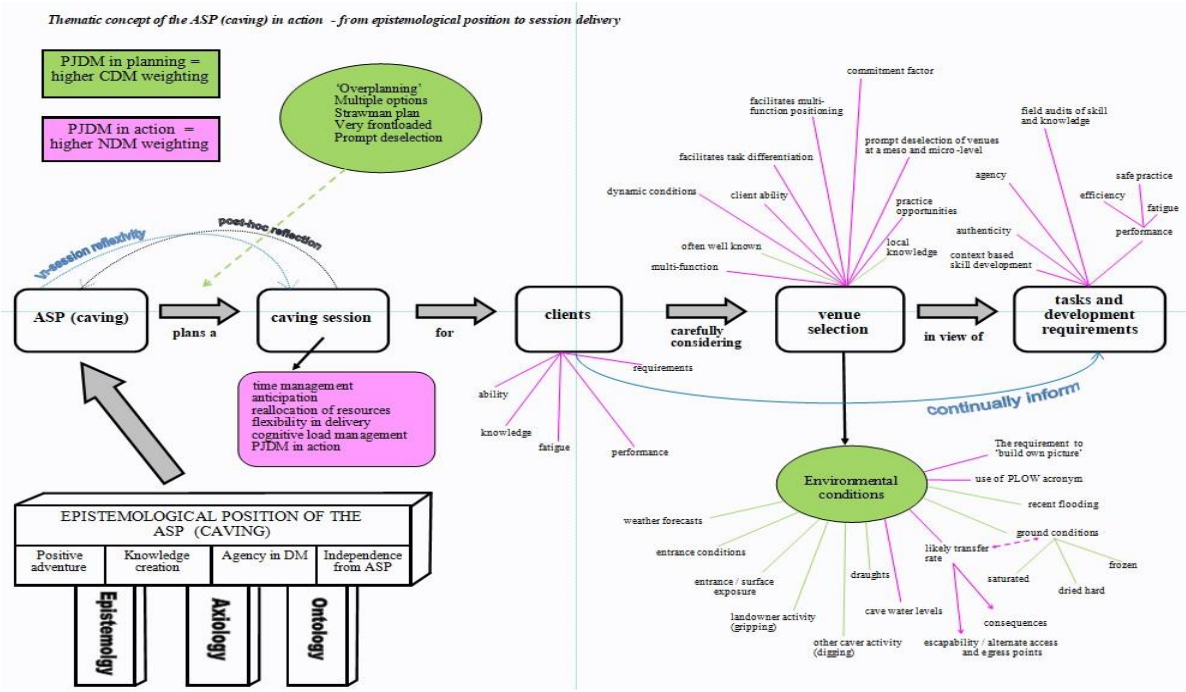

Figure 7.2 Concept mapping of tasks

For the novice CL, the range and scope of decision making demand may be overwhelming, which presents a good case for the role of the cognitive apprenticeship (Larsen, 2015) where the decision making is shared and practiced with the aid of a mentor. The value of the concept map as a resource to aid in the development of expertise in PJDM is to offer a route-map which identifies not only the range of tasks and interactions on which decisions will be required, but the likely balance and ratios of NDM to CDM to synergise decision making, in what has been termed skilled intuition (Martindale & Collins, 2013).

The synergy of NDM and CDM needs to be clearly understood and judiciously utilised in environments in which mistakes offer immediate feedback on performance and where both physical and psychological harm is possible if the decision making is poor. Here it is reflected that such PJDM skills need to be at a reliably good standard, rather than there being moments of sheer PJDM brilliance countered by significant lapses in performance. Arguably of equal importance to the novice CL is the awareness of how the decision making process works, given that it may be prone to a range of biases and heuristics which may be flawed (Kahneman & Tversky, 1982).

7.4.2 Outline to Resource 2 -– The PJDM and Knowledge Framework

The applied PJDM and knowledge framework developed in Chapter 6 is displayed as Table 7.2 and was founded on identifying the key differentiations in the supporting influences and EP of the novice CL, compared to that of the expert CI.

Table 7.2 The PJDM and knowledge framework

Session stage	Novice Level 1 Cave Leader	Coaching Options	Expert CI
Pre	Planning process tends to utilise limited access to the community of practice.	→	Significant access and utilisation of community of practice in planning stages.
Pre	Plans from a limited range of options and session content variability owing to constraints of award.	→	Overplans but prompt selection / deselection of venue and session content from wide range of possibilities.
Pre	Utilises weather forecasts in planning process to build satisfactory picture.	→	Endeavours to build own, more complete picture of conditions from wide range of sources.
Pre / in- action	Risks tend to be mitigated or the situations avoided.	→	Risk harnessed and exploited for purposes of learning and personal development.
In-action	Selects from a limited range of leading or safeguarding options.	→	Demonstrates ability to select from an extensive range of leadership and safeguarding options.
In-action	Adopts 'fully safe approach' to safeguarding but one which may be slow and non- progressive.	→	Adopts 'safe enough' approach to safeguarding, but one which ensures progression.
In-action	Fully safe approach may retain group in hazardous areas of cave for longer.	→	Comprehends that speed is typically a factor of safety.
In-action	Unrefined safeguarding deployment tends to be non-differentiated.	→	Refined approach to safe - guarding displays differentiation.
In-action	'Follow, do, follow, practice' routine - leadership underground tends to follow a procedural approach.	→	Range of learning and development challenges set within agreed parameters. Leadership underground characteristically non-procedural.

In-action	Uses limited teaching and information delivery styles.	→	Shows ability to select from a wide range of teaching and information delivery styles.
In-action	Restricted utilisation of behaviours across the epistemological dimension and teaching styles spectrum, with reduced movement to adjacent categories. Likely to be constrained by client demographic (usually novices / children).	→	Uses behaviours across the whole range of the epistemological dimension and teaching styles spectrum with focused lateral movement across of each – i.e., adopts purposeful teaching and epistemological positions.
In-action	PJDM in-action follows process of cycling through range of options and selecting a choice.	→	If no negative contra-indication, choice is promptly made and actioned without cycling through range of options.
Post	Reflection post-session utilised to shape next session delivery.	→	Reflection in-action utilised to shape current, ongoing session delivery.

One of the fundamental purposes of the resource development was to provide theoretical purchase and structure to the training opportunities which were identified in the framework, given that there is a requirement for the novice CL to begin to further understand the likely escalation in demand of PJDM expertise in the professional role as their own caving leadership responsibility develops. It is understood that the novice CL may be constrained initially by factors of award remit and therefore likely client base. The qualified CIC can work across the range of client age and ability, and in any caving terrain. The remit of the CL is to work in cave systems which are essentially horizontal and where the research indicates that the client base predominantly comprises of youngsters who are participating in their first experience of caving. Therefore, the CL who wishes to progress to VCL and CIC must gain their PJDM and developmental experiences in a somewhat ad-hoc basis via the logged accumulation of self-certified caving days. It is at this stage where a 'Catch 22' position is encountered. Unless these cavers are part of a supportive CoP or have access to an experienced mentor, it can be difficult to solve the problem presented, specifically, to gain exposure to the type of PJDM skill and expertise required in the applied practice associated with more demanding professional situations.

In designing a resource for the development of PJDM expertise when leading vertical and extended caving trips, an initial framework was based on the knowledge audit (Militello et al., 2015) and CDT arising from the work of Chapter 6. These factors were used as a benchmark for the PJDM and knowledge resource outline, adjusted for the specific context of caving by referencing each to realistic underground contexts or problems (see 7.3.2.1 onwards), thereby maintaining alignment within the research process and thesis objectives. The initial framework is seen in Figure 7.3.

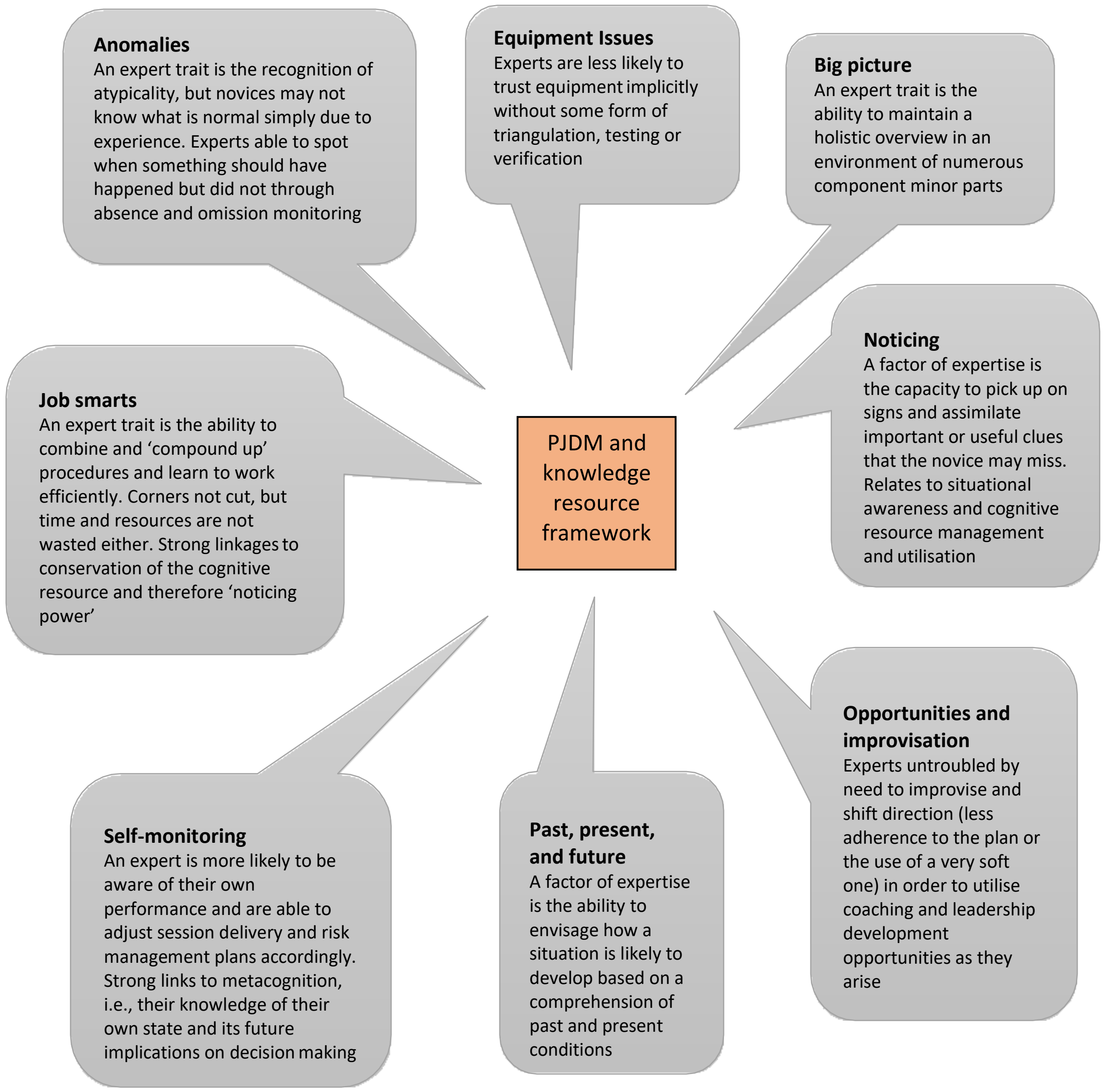

Figure 7.3 PJDM and knowledge resource framework

Using specific caving contexts assists in unpacking the range of situations and decision making requirements as identified in the PJDM and knowledge framework. These notes formed the basis of supporting comments to the PowerPoint presentation which acts as the resource available to CLs and trainers.

7.4.2.1 Anomalies

Anomaly recognition is based on situational awareness which itself is generated through reflection upon experience (Martindale & Collins, 2012). By maintaining a situational awareness overview, the caver is able to comprehend the demands and recognise when something is 'just not quite right' and act promptly upon it. For example, when leading, that "…we should have come to this junction or cave feature by now." This aspect is grounded in the notion that all humans are prone to mistakes (Kahneman, 1991) but that it is prudent to recognise them in an attempt to make the inevitable mistakes minor ones by noticing and acting upon them promptly.

7.4.2.2 Past, present, and future

Understanding how a situation is likely to develop based on a comprehension of past and present conditions is crucial in the context of underground journeys and caving skills development sessions. This aspect of the PJDM process is informed by both ground state and weather conditions in addition to the human factors present. Ground state will identify how likely or not the ground is to absorb water or to allow it to run off, which is known as lag time, or transfer rate. Saturated, frozen, sunbaked or poorly vegetated ground offers a very fast transfer rate, which can be exaggerated by agricultural attempts to drain surrounding land, known as 'gripping.' Alternatively, ground which is vegetated or naturally forested, and damp rather than waterlogged is likely to offer a safer delay to the transfer rate. In calculating how precipitation will affect cave conditions, the size, scope and characteristics of the water catchment needs to be understood, in that large catchments tend to be flashy (water levels rise and fall quickly but are powerful), whereas smaller catchments have a pattern where water levels rise more slowly but may remain high for prolonged periods. Expert cavers utilise an extended community of practice (Lave & Wenger, 2002) to gauge conditions in addition to what some cavers refer to as the 'Big 4' weather considerations, which are:

What has the weather been doing in the recent past?

What are the weather forecasts for the day?

How does the experts' local knowledge inform the plan?

What are the observations on the day?

The Big 4 was fashioned into the mnemonic of PLOW in order to foster more diligent access to weather and ground conditions following flooding incidents with led groups in Northern England caves across 2003-06. It has become useful in encouraging cave leaders to fully consider how past weather and ground conditions influence the present and future caving environment.

7.4.2.3 Big picture

Experts report the ability to maintain a holistic overview in a setting of numerous component minor parts, ensuring that caving trips or skill development sessions do not become mired by minutiae. Unless planning to spend the night underground, caving journeys tend to be somewhat time- framed, not least of all due to the harsh and often exhausting conditions which caves may provide. In order to provide positive caving and developmental experiences, caving trips require momentum and progression and ideally should keep cavers warm through movement. Showing clients how to remain dry in the early stages of a given trip are markers of good practice, as is promptly identifying those who are becoming tired or stressed. Delegating small tasks from the outset such as taking turns carrying safety equipment may offer a CL greater scope to manage the cognitive load and maintain a balanced overview of the caving session, whilst offering clients greater agency (Beames & Brown, 2016).

7.4.2.4 Opportunities and improvisation

Experts appear untroubled by the need to improvise and are able to shift the direction of a given session or journey according to how information is collected or verified. They show limited adherence to the initial strategy or utilise a plan one in which change is anticipated. A ‘soft’ plan allows for the use of coaching and leadership development opportunities as they arise, or when there is a requirement to productively fill small parcels of time, for example when waiting for another group to move though a section of the cave. In technical contexts, if an item of safety equipment is lost or forgotten, the ability to improvise and utilise such an opportunity as a productive learning occasion for the clients shows the type of mental resilience and adaptive expertise (Tozer et al., 2007) beneficial to the CI.

7.4.2.5 Self-monitoring

An expert is more likely to be aware of their own physiological and psychological performance and are thus able to adjust session delivery and risk management plans accordingly. There are strong links here to metacognition regarding the implications of maintaining an appropriate homeostatic state (Cheung, 2009). For example, being too cold, overheated or dehydrated and comprehending how this may impact future decision making. There is an awareness that if the CI is feeling mentally fatigued or physically stressed, there is a realistic likelihood that clients will be experiencing feelings of greater strain. Self-monitoring also relates to session design and delivery, in that there is rarely anyone else available to report to the CI if the session is running optimally and therefore must gain feedback in-action from subtle clues on how the clients are responding, changing delivery and approach accordingly.

7.4.2.6 Noticing

Noticing is a crucial aspect of PJDM which links to maintenance of the big picture, perception of future events and to self-monitoring. A factor of expertise is the capacity to identify and recognise clues, whilst assimilating important or useful signs that the novice leader may miss. The ability to notice also relates to situational awareness which can inform an emerging mental picture of latent situational demands (Endsley, 2000), which is essentially one element of PJDM in-action as discussed earlier. Noticing is intrinsically connected to an individual's processing power and an ability to manage and utilise their cognitive resource, so that the quantity and passage of information does not become overwhelming. Human elements on which to focus can include identification of movement skills that appear to be exhausting for specific individuals, and noting how personal administration is being maintained. Environmental factors may include flood debris, 'high tide' marks, increase of draughts or water noise.

7.4.2.7 Equipment issues

Experts are less likely to trust equipment or anchors implicitly without some form of testing or verification. Especially when tired, there can be a tendency to trust equipment and anchors without thought. However, cave systems are somewhat dynamic in terms of rock movement, consequently in-situ metal SPIT and Eco[7] anchors can weaken and corrode given their locations in perpetually damp and typically muddy environments. Caving equipment has a tough life and can become damaged in transit and in use, with essential bolts and fastenings on technical equipment becoming jarred loose. For the caver ascending a sizable vertical pitch, having a headlamp failure part way up without prompt access to a spare light would place them in a vulnerable position. For that reason, the experienced leader is likely to wear an additional light source around their neck so that such an eventuality can be dealt with swiftly, in recognition of planning for future events through situational awareness. These types of preventative actions would be encapsulated in the A of the CLAP acronym (Avoidance through planning and equipment husbandry).

7.4.2.8 Job 'smarts'

An expert trait is the ability to combine and 'compound up' procedures and learn to work efficiently. Corners cannot be cut due to the consequential terrain in which the caving professional operates, but time and resources are not wasted either. There are strong associations to conservation of the cognitive resource and therefore of noticing power, and what may be termed a 'big picture' overview. Such job smart efficiencies relate to trip packing and organisation skills, where clients are trained to perform tasks such as rope coiling, equipment management or rope-bag repacking and when appropriate, small groups take turns to lead while the leader maintains oversight. When belaying tasks are required, the expert purposefully selects a safeguarding technique so that under supervision, each caver can belay the next up. This has the advantage of permitting the group members to practice new skills whilst looking after one another, confers a degree of agency in practice and offers the CI the opportunity to manage the deployment of their own cognitive resource. The expert instructor may be able to perform non-orthodox procedures, but ones which are safe utilising a loose parts or principles based perspective (Nicholson, 1972). Examples may include the transfer of techniques or equipment from other AS disciplines into the caving domain.

[7] These are the brand names and known terms for self-drilling metal based rock anchors used by cavers.

7.4.3 Outline *to Resource 3 - The Cave Leader Progression Model*

A fundamental skill and component of the PJDM approach in the context of fluent safeguarding is the ability to promptly differentiate and identify the needs of an individual and provide a suitably secure intervention, rather than routinely considering the needs of the whole group as one unit. In short, it is about selecting the appropriate approach for the person rather than a 'blanket' style for all.

Advocating a fluent and 'sufficiently safe' approach opens the debate about risk levels within adventurous activity. If it were necessary to guarantee the absolute safety of each participant 100% of the time, it would be impossible to participate in many outdoor activities. It is similarly difficult to guarantee total safety in many traditional sports (for example the noted prevalence of head injuries and concussions within football and rugby), typically where injury levels per participation rate are higher (Brymer & Schweitzer, 2013). The concerns of interested parties tend to relate to the geographical locations of *where* the injuries may occur, namely an urban pitch versus a mountainside, or in the context of this chapter, a potentially inaccessible cave (Christian et al., 2019). However, CLs who maintain a risk management overview founded on an EP that supports a holistic PJDM approach based on client ability are more likely to provide safe underground journeys which are fluent, progressive and engender learning and development through client agency, rather than ones which are restrictive, non-progressive and lack momentum. Therefore, the Cave Leader Progression Model may offer a starting point for the novice CL to begin to comprehend and integrate a PJDM approach to risk management and leadership strategies (Carson, Davies & Collins, 2020) which are differentiated, fluent, encompass client agency and which contribute to the reduction of cognitive load. Consequently, the model of Chapter 6 is further developed to offer detail and aid in decision making for the novice CL when trying to balance safety with journey progression, which is displayed as Figure 7.4.

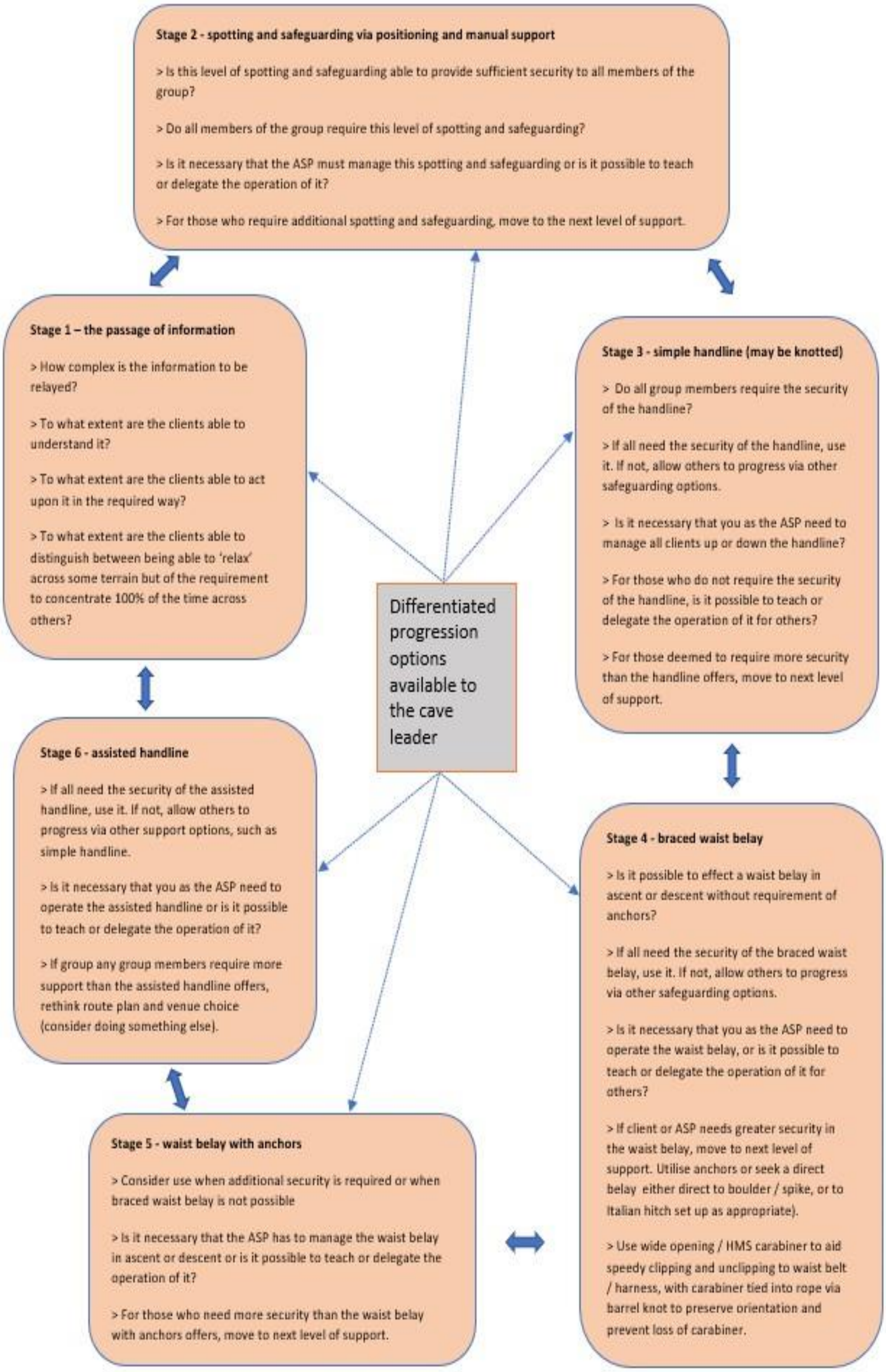

Figure 7.4 Cave Leader progression model (detail)

The notes contained within the body of the Cave Leader Progression Model augment the core supporting notes of the PowerPoint presentation as the resource available to CLs and trainers. The resulting model, displayed as Figure 7.5 encapsulates the differentiated options available to the CL who operates in predominantly non-vertical terrain but who will typically be confronted with a variety of slopes, inclines and slippery ground which may result in injury in the event of a trip or fall. This is the '*grey area'* of concern noted by the climbers and mountaineers of Chapter 3. The purpose of this Cave Leader Progression Model is to foster a realisation that the CL may select different safeguarding options according to the perceived needs of individuals, and that where appropriate, peers may be able to offer support to one another under their guidance.

The Progression Model (V2) is a worked example which clearly identifies options. Where the CL accesses the options of the model depends on the specific set of contexts within the cave but also their EP. For example, if the CL has an EP associated with risk minimisation, they may choose to access the model at a stage which offers the greatest levels of security. A leader with an EP associated with developing agency or exploring risk for the purposes of personal development may choose to access the model at a stage where security is less guaranteed but one which offers greater scope for reflection and learning, yet this itself is a factor of reflection on experience (Carson et al., 2020). In short, although constrained by the cave context, the epistemological position and experience base of the leader may inform their start point on the model.

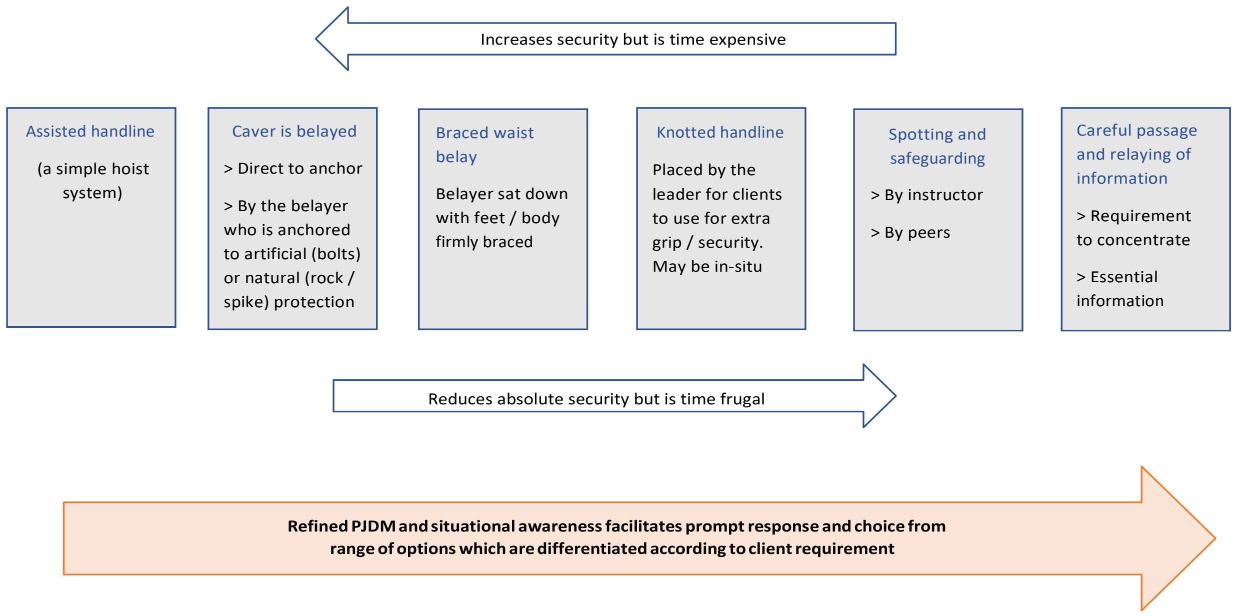

Figure 7.5 Cave Leader progression model V2

As noted, the focus on technical skills can occur at a relatively advanced rate compared to the development of PJDM expertise, partly due to the recent availability of technical online tutorials and owing to the prevalence of fora which often discuss the advanced practice of experts. This practice can be imitated by less experienced outdoor professionals giving an inaccurate impression of expertise, but in realistic AS contexts, access to PJDM capability is borne from extended cognitive deliberation, metacognitive processes and reflection on a range and depth of experiences, as encapsulated in the PJDM Framework model. Such a focus offers an illusion of competence, in that technical capability without the supporting foundation of PJDM expertise in context is a structurally unsound platform on which to base professional practice.

This view was echoed by the participants of Chapter 6 who requested support which has taken the form of the Cave Leader Progression Model. Through self-submission, they stated that skilfully utilising ropework techniques, tying a range of knots and deploying specific safeguarding techniques was straightforward. Professional concerns were focused on developing the judgement to understand why a safeguarding option was applied or promptly discounted in a range of situations.

In summary and as a backdrop to resource production, as the CL progresses, they are required to generate PJDM expertise which can contend with numerous multifaceted demands. These include operating in dynamic work environments of uncertainty and potentially vague goals. There is a requirement to maintain models of cognition which support lateral thinking, improvisation and change, with a need to sub-consciously develop decision making strategies that are routinely operationalised within short timeframes and where access to information may be incomplete, sporadic or unverified. It is necessary to manage cognitive resources in order to maintain a picture of typicality and perception of anomalies and learn to exploit prior experience to make sufficiently effective decisions in challenging environments. This will increasingly support 'pattern matching' and ultimately a recognition primed decision making (RPD) model (Klein, 1993). Throughout this developmental process, the CL will need to be informed and aware of their own heuristics and bias potential

Given that these demands typically need to be managed in consequential environments, it further highlights the requirement for support in the development of PJDM expertise in CLs. This needs to occur at a comparable rate to the acquisition of technical skills, the development of which routinely takes precedence. For example, NGB training characterises an imbalanced focus on risk management practice, which is primarily through technical skills acquisition (e.g., Mountain Training, 2015). This represents but a narrow range of the expertise required in practice and the scope of skills required (Carson et al., 2020). There remains a high potential that CLs, among other ASPs, will have a paucity of tools to enable them to individualise their leading and coaching practices according to the demands of the situation, be it centered on elements of the task, client, or environment as they organically interplay. It is contended that although one cannot and should not 'fast-track' experience, it can be optimised through skilful and applied developmental processes.

In view of the work of the last two chapters and in consideration of the current literature base which explores the role of PJDM within AS, the resource production specifically sought to offer functional stepping-stones. They begin to bridge the gaps between a proceduralised practice approach and PJDM, and to offer support in the comprehension of the complexity of human decision making in AS contexts.

7.5 Validating the Resource

7.5.1 *The expert panel*

As the resource evolved and progressed it became evident that although it was founded on cave-based research, it would be valuable across a range of AS domains and across professional practice in demonstrating how an applied process can enhance PJDM capability. Consequently, the expert panel was extended to involve outdoor professionals active in senior roles who met the sample criteria, noted below.

Purposive sampling (Silverman, 2013) was utilised in selecting the expert panel members (EPMs) as it was necessary to ensure sufficient domain expertise, overall experience, inherent quality of responses and ability to judge the value of the produced resources. The guidelines followed for expert panel composition were again consistent with the approach used by Nash et al. (2012) in their work of parameterising coach and leader expertise and showed alignment within similar qualitative studies of their work in conceptualising professionalism in medical practice (Van De Camp et al., 2004). This was to ensure that an appropriate sample was collated in the absence of more effective or objective markers, whilst appreciating that expert opinion is necessary in helping to define consensus of view in professional contexts (Hohmann et al., 2018). Following these guidelines there was confidence that this group represented high levels and good practice across adventure based leadership against the following criteria:

1. A minimum of 10 years professional practice following senior award accreditation.
2. Holding the highest level of award within their chosen discipline and /or senior professional role within adventure leadership practice.
3. Willingness to discuss their own professional practice as it relates to the resources.
4. Well regarded by their peers and the community of practice.
5. Timeframe availability in both understanding the materials and readiness to contribute to the project.

Given the experience requirements for the awards and that sample inclusion necessitates 10 years of professional practice following senior award certification, an approximate minimum age of the panel members may be assumed. However, the ages and gender are not stated, and pronouns are used interchangeably to prevent disclosure by reduction or elimination.

The expert panel consisted of four very experienced caver trainers who had not participated in the research to this point owing to reasons of timing and availability. It was augmented by three very experienced ASPs who hold senior roles within the field of outdoor education who met the selection criteria. A panel of seven was chosen for two main reasons, the first being that research consensus (Hohmann et al., 2018) suggested that a technical expert panel of no less than three and no more than eight is ideal especially if wishing to maintain research impetus. Further, this number of panel members was considered to hold representative expertise within a relatively small cohort concurring the advantage of prompt feedback, research impetus and response fluency not customarily associated with larger groups. Panel composition information is displayed in Table 7.3.

Table 7.3 Expert panel composition

Panel member	Criteria notes
EPM 1	Over two decades of training and assessing cave leaders and instructors globally.
EPM 2	Coach educator in paddlesport for over 20 years. Holds senior role and is responsible for instructor development in a large, well respected outdoor organisation. Major awards in sailing and associated to water safety.
EPM 3	One of a few professionals to hold an active role within Cave Leader and CIC training and assessment teams.
EPM 4	Very experienced coach educator (over 25 years). Holds senior role and is responsible for instructor development in a large, well respected outdoor organisation. Holds major awards in mountaineering and climbing.
EPM 5	Gained CIC early in caving career and has worked very successfully in own caver coaching business since. Holds senior award in second AS discipline.
EPM 6	Very experienced coach educator over significant timespan. Holds major awards across several AS disciplines and has held a range of senior leadership positions. Very well regarded across the community of practice.
EPM 7	Cave instructor and long-time Northern Cave Panel member. Validated for over 15 years to run training and assessment courses on behalf of the BCA.

A PowerPoint presentation was chosen as the medium for the resource, and which was welcomed by EPMs, as the format offered a presentation and design method with which most were familiar and could confidently operate in a training setting. This may reflect the experience and maturity of this group. The early draft of the resource took the format of a 12 slide PowerPoint presentation, but initial feedback from pilot studies suggested that there was simply too much material to fit into those slides given that the initial intention was to present the resource in a size which would facilitate a single session of delivery, where this number of slides may be considered realistic.

The completed presentation runs to 44 slides and although long, is designed to be utilised as a coherent resource which can be accessed in stages and in a variety of ways. For example, it may be used within caver training courses to set the scene of PJDM development, it can be used as part of a staff training package within larger outdoor centres utilising the case studies and vignettes, or it may form the foundation of a degree module resource on decision making in adventure based environments.

7.5.2 Expert panel feedback

The materials were sent to the expert panel members as a resource pack, available as Appendix N. This included the PowerPoint presentation which contained extensive supporting notes under each slide as appropriate, plus a two-page summary of the focus of the research with a glossary of terms. The summary was written in everyday language accessible to a knowledgeable layperson. Finally, a feedback form was included for EPM completion. Three of the EPMs chose to fill their form in and return via email, two preferred a video telephone conversation and the two remaining wished to meet over a socially distanced coffee for further explanation and clarification prior to offering their feedback.

The responses received via the feedback sheets, video calls and face to face meetings were beneficial in understanding the views of established outdoor professionals. Once all the feedback had been received, it was first organised by ensuring all forms of it were transferred to hard copy. The written responses from the three feedback sheets joined the data gained from the two video calls by making use of the transcription feature available within the group discussion facility offered by Microsoft Teams. The data from the remaining two face to face meetings was captured utilising a standard digital voice recorder with the resulting voice files transcribed by the author. A process of deductive and inductive reasoning was utilised to interrogate the responses of the panel, through a process of reading and re-reading, making notes and developing strong themes based on frequency and strength of message. This was possible owing to the relatively short length of transcripts (mean 800 words) and groupings of similarity in reply. Although appropriate research methods were maintained, from a functional perspective, the views of these experienced ASPs were fundamentally sought to determine if they felt comfortable with the content of the PowerPoint and the prospect of their delivering it. This was important because although it is likely that an EPM may state that they have a good level of comprehension of the material, this perspective may change when presenting it.

The three main themes which developed following the process were 1) Gaps in NGB provision and decision making demand, 2) Deliverability and utility of resource, and 3) Use of scenarios and vignettes. Specific comments from individuals are noted below and there follows a summary of commonly recurring feedback points which are presented and correlated to the main themes.

The main message which emerged is that in reading through the PowerPoint and supporting notes, this range of very experienced ASPs had only become aware of the identifiable decision making training gap in NGB provision and AS education by being involved in this research. This presents as a revealing disclosure, one which certainly does not portray a positive reflection of current NGB certification processes. Further, the acquisition of this new knowledge would generate pressure on trainers, assessors and those associated with similar course delivery to become sufficiently upskilled in order to deliver a similar resource. EPMs 1,3,4 and 7 each made specific comments about how they regarded deficiencies in PJDM to hold greater responsibility for incidents compared to that of technical inability and welcomed the resource in verifying their concerns.

All EPMs except for EPM 6 stated that they felt the resource was too complex for them to deliver, especially given that many of the terms used were new to them, despite having access to the glossary. Two panel members asked for '*more uncomplicated'* examples (EPM 2 and 4) of how differences in EP relate to session outcomes. This will be given full consideration when the resource is adjusted for context and target audience.

EPM 6 suggested that as this work has entailed significant work on my behalf, it should remain '*in their charge'* when delivered as a training package across a range of settings but stressed that it would be necessary to reconfigure the PowerPoint according to the context and target audience. EPM 7 stated that it was '*unique and relevant'* with the remainder of the sample stating that it appeared to have revealed a significant training gap, especially with regards to moving towards the higher levels of certification. EPM 7 further stated that it was '*undoubtedly too complex a resource for me to deliver'* noting that on reading and learning, he realised that PJDM underpins all of his delivery and is linked to his EP, whilst being quite clear that he had not used such terms previously.

It was interesting to note that EPM 2 and 4 who both work within large outdoor education centres, found greater difficulty in accepting a PJDM approach as their work has tended to be supported by proceduralised practice owing to their professional contexts. Although it may present as a simplistic position, their comprehension is that the working practice of the centre adopts a risk minimisation approach, rather than harnessing adventure and embracing risk and its management for the purposes of learning and growth. Each accepted that PJDM plays a greater role as working environments and tasks became more complex, or as higher awards demanded it. EPM 4 disclosed that a significant unintended incident (reported as a near miss) which occurred to a youngster under his charge was due to a lapse in the quality of his decision making rather than any technical deficiency. All respondents revealed that their participation in the feedback process for the resource had helped to further their understanding that PJDM development is a notable omission from both NGB course delivery and in the training of ASPs in other contexts (in-house or 'fast track' courses for example). The tension within this was expressed in terms of how to commence the enhancement of PJDM for the relative novice without it being perceived as overwhelmingly complex.

7.5.3 *Feedback summary*

The feedback is summarised below and referenced to the three main emergent themes.

Theme 1 - Gaps in NGB provision and decision making demand:

- The work has revealed to EPMs a clear training gap in CL and CI development.
- That there is an evident requirement for training resource(s) which address the gap.
- The Concept Map made clear the huge range of demands placed on the CL and CI.
- Delivering the material face to face would be preferable to online / Teams.
- That the PJDM Framework is comprehensive but not academically accessible for some.
- The links between epistemological position and decision making were insightful and understood.
- The requirement for a PJDM approach is now more fully understood and accepted.

Theme 2 - Deliverability and utility of resource:

- That very few have the confidence to deliver the resource in its present format.
- The EPMs would appreciate the use of non-academic language where possible.
- There is a requirement to re-present the resource according to audience and context.
- The PowerPoint is a valuable reference resource for information and ideas on PJDM.
- It would be difficult to find time for this on a caver training course.

Theme 3 - Use of scenarios and vignettes:

- The case studies, vignettes and tasks were very well received and brought the learning to life.
- The Cave Leader Progression Model would be great to use on training courses!
- That the 'noticing' and 'recognition of atypicality' aspects resonated particularly strongly.
- More worked examples would be appreciated, perhaps even examples in other AS activities.

7.5.4 Moving forwards - limitations and further research

The feedback received from the expert panel fulfilled a vital role in the development of the resource and in the understanding of how the knowledgeable layperson may be able to access and utilise it. Although all EPMs are intelligent individuals and specialists in their chosen fields, none are experts in human decision making. There is little in academic literature describing expert panel review as anything other than a positive stage in the research process, Given the experience and professional standing of the respondents, their expert views were valued but had to be considered in light of effective investigation which involved finding time in the lives of busy participants, echoing the research experiences of other authors (Fry et al., 2005).

The message from some of the panel members is that the resource may be too complex for NGB trainers and those in positions of training in other contexts to deliver. The raises an interesting point, namely that none of the senior outdoor coaches on the panel have previously encountered any decision making training or coaching, let alone begun to consider it for the development of their own clients. The EPMs accept the need for the development of PJDM and acknowledge the work of the current resource in addressing what have been termed 'training gaps.' Moving forwards, it is now necessary to use the content of the training resource in differentiated ways which suit a particular application. This may include outdoor centre staff training, NGB training courses, work with technical trade apprentices in a range of outdoor settings and as a foundational part of undergraduate module provision. The case studies and vignettes will need to be rewritten to accommodate different domains and contexts, and it will be expedient to divide the training package and PowerPoint presentation into more discrete modules with supporting documentation and resources. The limitations of a modest sample size utilised for the feedback process is acknowledged, yet purposive sampling generated responses from those currently working in appropriate domains, whilst the small group of EPMs facilitated research impetus.

The PJDM resource went through three versions and undoubtedly a continuation of the design, test and adjust cycle would identify requirements for additional modification and reframing. For example, further development could include the reorganisation of the PJDM knowledge framework chart so that it links explicitly to specific parts of each of the three resources in sequence and accommodates pre, during and post session actions and outcomes. Further development may include the design of tasks based on the 8 Factors of Expertise in the PJDM and knowledge framework infographic, but it is accepted that within the scope of this thesis, there is value in knowing when to stop.

It is acknowledged that the main thrust of the research of this chapter was based on cavers and caving and the transferability quotient across AS domains should be high (Taatgen, 2013), given that PJDM demands across the domains of the study show similarity, yet further research in a variety of settings would be advantageous. Finally, the author is known to all respondents and although there are potential impacts on the research because of it, the benefits of prompt rapport building and opportunities to discuss topics at deeper levels balance this factor. With regards to the scope of the present chapter, the work will continue post-thesis submission and will form the basis of a coherent body of work to be delivered across a range of settings.

7.6 Conclusion

The purpose of this chapter was to develop and justify training materials which facilitated interventions designed to enhance PJDM learning and the development of expertise in AS contexts, specifically in caving leadership. The first part of the chapter offered the reader theoretical underpinning to resource production in order to clarify and justify the choices made for inclusion within the main content. In deciding from a range of potential options, the three specific models selected for inclusion were the Concept Mapping of Tasks, the PJDM and Knowledge Framework and the Cave Leader Progression Model.

The models formed the basis of a comprehensive PowerPoint presentation, one designed to act as an accessible source of PJDM knowledge rather than perform the function of a slide show. Following an initial pilot and two iterations, the PowerPoint presentation with introductory letter and comprehensive supporting notes were sent to an expert panel for feedback. Assembling the expert panel was in response to research constraints imposed as a result of working within the time of Covid 19 restrictions.

Although the resource produced may be transferable to other similar AS domains and professional training applications, it was designed in response to and directed by the EPs of the caving participants identified in the decision making and knowledge framework. Thus, the exploration of cave leader PJDM development has acted as a catalyst to resource production which may extend beyond AS contexts for the development of PJDM in other fields. Feedback from the expert panel stated that the work had identified a significant gap in training provision primarily with regards to caving but also across the NGB awards schemes. The panel members recognised that the work so far has begun to address those training gaps, but in its present format may be too complex for their delivery. The resource fulfils the requirements of the Professional Doctorate to offer an original, evidence-based applied output, but as this work continues to evolve, it needs to be rewritten and revised for specific target audiences and contexts. The presentation with supporting documents is available as Appendix N.

The practical applied implications arising from this chapter include;

1. Further development of the Cave Leader Progression Model.
2. Significant further development of the PJDM and knowledge resource framework.
3. The production of a comprehensive PowerPoint presentation with supporting notes.
4. The successful utilisation of an expert panel to evaluate resources.

7.7 Epilogue

The 'Developing Expertise in PJDM' resource was delivered in 2022 at the Spring staff training conference for the Outward Bound Trust (OBT) during a lull in Covid-19 restrictions. The resource was delivered to 80 delegates across a full day of presentations and workshops, and although tiring, it allowed for fine tuning and the receipt of plentiful feedback. In order to tailor the resource to the needs of the centre, the case studies and vignettes were rewritten to reflect the working environment of the participants more accurately, who discussed them and offered feedback via breakout rooms and working sub-groups. The feedback was very positive, especially as several of the participants felt that terms and concepts had been explained carefully and progressively which initially, some had found complex and inaccessible. An aspect which is perhaps more telling is the number of post session requests for further informal discussions and access to the literature which had been referred to within the presentation. It appears that this had inspired several participants to 'dig a little deeper' into the topic to further their own understanding at their own pace, which is representative of a maturing and developing EP.

On personal reflection, it was felt that delivering the resource in advance of thesis submission was helpful in performing a test of functionality and value, evidenced by the feedback and follow ups from several experienced and established outdoor education and adventure professionals who were involved in the sessions. It was also felt that a consensus of understanding had developed, and contextually authentic relevance enabled what may be termed naturalistic generalisability (Mills, Durepos & Wiebe, 2009) and therefore transfer into working settings of the OBT. This occurred through the process of gaining insight through reflection on descriptions and applied, detailed scenarios presented in the case studies. These were carefully rewritten to allow most of the participants to recognise similarities which resonate with their own professional experiences.

Chapter 8 – Conclusions, Implications and Recommendations

8.1 Preface

The aims of this thesis were to explore the subtle yet complex relationships between the values and beliefs of the ASP and their PJDM behaviours and actions. It sought to understand how an epistemological position (EP) determines and shapes the epistemological learning chain (EC) so that when outdoor professionals make choices, they are based on foundations of logical and consistent mental frameworks. Owing to the existing literature on PJDM within paddlesport and how the EP and subsequent EC underpins it, the research explored the currently under-investigated domains of multi-pitch rock climbing, winter mountaineering and caving. As the work progressed, in an evolution of research aims and direction, the domain of vertical and extended horizontal caving became the main focus. This was due to a complete absence of literature on cave based PJDM research which appeared to be at odds with the accentuated nature of the professional subterranean environment. The work was modified and refined as it evolved to meet the needs of the sector, and indeed to fill gaps in research and knowledge. This is considered as a positive adaptation as the body of work grew and new knowledge emerged, which reflects good research practice.

8.2 Introduction

The research methods evidence the pragmatic philosophy required to fulfil the aims and objectives of the thesis, with interpretivist principles utilised to further explore participants understanding, experiences and sensemaking. Knowledge and understanding from my own perspectives are evident, alongside the views and perceptions of the range of participants. These perspectives include personal narratives, semi-structured interviews, detailed and extended field observations, video analysis and recordings of in-situ conversations. In seeking a deeper understanding of the participant's viewpoints, IPA guidelines were observed (Smith & Flowers, 2009) and in exploring the range of demands faced by the ASP, a range of methods within the field of ACTA were utilised (Millitello & Hutton, 1998).

The majority of the work has been written in the 3rd person, as may be expected, but in critical self-review it is important to state that whether planned or not, I have been integral to the research process. This is due to the bespoke nature of the investigations and my significant adventure sport experience, allied to what may be termed 'insider status.' It is considered that such access to the domains of the thesis augments some of the findings and adds to the work in its current form, whilst acknowledging that my philosophy has influenced the research process, findings and interpretation of data. It is trusted that the reader is aware of the value of this position and also how the findings and recommendations made in this context should be understood. Although my involvement in the research process has been integral, it should not be seen as a limitation, providing that one understands that the instruments of research are often the researchers themselves.

Chapter 1 introduced the aims, objectives and structure of the thesis, and research methods employed, with a brief overview of the terminology used throughout. It offered the reader access to a personal narrative which was designed to set the scene for the research directions and to validate the decision to commence doctoral study, concluding with a brief overview of my research philosophy. Chapter 2 served as both literature review and initial discussion of the demands, capabilities and experience bases required of the aspirant ASP, in order to help clarify the field of operation in which the studies are situated. Given my access and experience, the noted demands and requirements were considered within a Higher Education (HE) context, as the adventure-based degree exists as one of the primary routes to becoming established professionally within the outdoor sector. Further, my professional setting facilitated observations of trends and expectations of aspiring ASPs over a 10-year period. Given the more detailed discussion of roles and responsibilities, terms were more carefully clarified and justified. In making the case for the 'Adventure Sports Professional' Chapter 2 discusses the pressures typically faced by the ASP owing to the complex interactions between decision making, risk management, skilful technical independence, and pedagogic expertise (Collins & Collins, 2013).

Utilising an IPA approach, Chapter 3 was the first empirically based study which explored the personal epistemology of nine high level and experienced ASPs across the domains of multi-pitch rock climbing, winter mountaineering and caving. The supraordinate themes which emerged from this study centered around four aspects which were categorised as; Creating the learning environment; The role of challenge, risk and adventure; Professional practices employed; and Flexibility in the working environment. It was established that the EP showed high levels of transfer and correlation across the AS domains of the thesis but was bounded by specific environmental factors.

Chapter 4 became more focused upon vertical and extended horizontal caving. This was in recognition of the accentuated nature of the subterranean setting and the cognitive loads associated with managing the pressures of tasks, client welfare, pedagogical demand, and environment. The purpose of this was to ensure that the ECs which were articulated in the previous chapter could be validated as providing a coherent framework that guide and frame PJDM processes. The work of Chapter 4 was able to provide evidence of a bespoke EC deployed by high level caving instructors and to offer insights into how these CIs managed the cognitive demands and weight of decision making load in professional settings which are typically consequential and relatively inescapable.

Chapter 5 utilised elements of the ACTA protocol in order to further explore the PJDM strategies of high level caving instructors. This offered an intriguing insight into the work of the participating cavers in a range of realistic contexts. What emerged were four distinct and articulated demands which the participants were required to manage. These demands were; Client meeting and veracity of information; Sustaining a positive session in variable conditions; Venue selection; and Managing cognitive loads. The chapter concluded with the production of a thematic concept map which illustrated in infographic form how the epistemic position of the CI underpins a complex and synergised PJDM process. This process itself was guarded by significant levels of careful pre- preparation which involved access to a specialised and important CoP. The concept mapping exercise indicated that despite the rigorous preparation stages, a substantial weight of in-action NDM remained present in dynamic settings where time stress, uncertainty, environmental constraints and incomplete information were usual. Further, the participants of this chapter were very experienced and well regarded by their peers and appeared to illustrate access to a recognition primed model (RPD) of decision making (Klein, 1993). More recent literature suggests access to RPD is based on 10-20 years of quality experience (Maarten, Militello, Ormerod & Raanan, 2017), which aids in validating the research of Chapter 5.

The study of Chapter 6 set out to compare PJDM capability in the expert CI to the novice CL, based on the how the epistemological position informed the learning chain and subsequent PJDM process. This research informed the key dimensions of the EP which in turn helped pave the way for the direction of resource production designed to support progression. The Critical Decision Method (CrDM) within the ACTA protocol was utilised to compare the decision making processes of novice cave leaders to caving instructors, who had significantly greater levels of skill and experience. This was achieved using a task diagram, simulation interview and knowledge audit. The CrDM was valuable in generating the cognitive demands table (CDT) which indicated three main themes described as producing periods of anxiety for the novice CL. These were; Exhausting existing knowledge; Client information inaccurate or incomplete; and Uncertainty in using one specific safeguarding procedure over another. The CDT and Key Dimensions of the Epistemological Position Table were instrumental in the production of a PJDM and Knowledge Framework which clearly indicated the differences in decision making approach according to EP. The concept map of chapter 5 and the PJDM and Knowledge Framework served as a valid foundation to produce applied training resources designed to enhance and develop PJDM expertise.

Chapter 7 developed the primary training resources of Concept Mapping of Tasks, PJDM and Knowledge Framework, and Cave Leader Progression Model into a coherent package designed to promote comprehension of PJDM and develop expertise within AS contexts. The work of Chapter 7 evidenced a pragmatic research focus and provided a meaningful and applied training resource. In doing so, it presented as an important chapter not only because the stated research aims were shown to be met, but because of the purpose of the work in the broader context, or ‘big picture’ of the thesis.

A 44 slide PowerPoint presentation which incorporated the primary resources was created, which included extensive supporting notes. This, in addition to supporting background documentation, was sent out to carefully selected Expert Panel Members (EPMs) who provided valuable feedback. The PowerPoint presentation was chosen due to its familiarity of operation to the EPMs and was designated as a resource format, rather than an extended-length presentation for transmissive delivery. This was a realistic response to being unable to deliver the resource at planned training meetings and conferences held by the BCA and at staff training events at outdoor education centres, owing to a dynamic Covid-19 situation. The EPM responses replaced the ‘deliver / receive feedback / adjust’ cycle and was very beneficial. Following the receipt of EPM feedback, the presentation and supporting notes were reconfigured to the point at which they are found in Appendix N.

8.3 Summary of Main Findings

The work of Chapter 2 addresses the notion that the world of participation within AS is changing fast, reflecting the rate of change within society (Dueze, 2007). AS have become increasingly commodified (Varley, 2008), somewhat sterilised and where outcomes are deemed more certain. For aspirant ASPs there is the risk that becoming proficient in delivering AS activities in managed or manufactured environments subjugates adventure. Further, it nullifies the process in which the ASP develops the higher levels of PJDM skills required in more complex leadership or practice environments. Initially this does not appear to be problematic, but there is a potential for the deprofessionalisation of those working within adventure, and a metaphorical 'painting oneself in the corner' leading to the loss of a developing and versatile workforce. As noted, there is evidence to show that a lack of technical ability is rarely the root cause of accidents, rather that the PJDM processes which support professional operation are deficient, or of insufficient quality. When the ASP works in managed environments and adopts proceduralised approaches, the role of embracing risk for the purposes of development through a risk-benefit analysis, and the positive human progression aligned to this practice becomes suppressed. In identifying the trends in participation and lack of decision making training opportunities within ASP development programmes, a cognitive apprenticeship allied to problem and scenario based learning opportunities is advocated. Learning is required to be situated in context-rich and natural, applied environments, and where knowledge and understanding are co-created, echoing the work of Lave and Wenger (2002). It is felt that the work of Chapter 2 has been successful in identifying and recognising the PJDM requirements of the aspiring ASP, which was introduced as research objective number 1.

Within Chapter 3, the work across rock climbing, caving and winter mountaineering domains revealed that all participants shared what Schommer (1994) would describe as a sophisticated epistemological position. Whether in the depths of a cave, on a windswept winter mountain, or working in the near vertical environment of a rock face, all the ASPs advocated a client centered approach which sought to develop agency and foster independence. It is worth noting the high experience levels of the ASPs within this chapter and it was observed that each had the time to mature their EP due to exposure to a larger base of instances, and through engagement with an important professional CoP. This is evidenced by these participants appearing to access an RPD approach (Klein, 1993; Maarten et al., 2017) to decision making which takes significant time and experience to cognitively organise and exploit. The findings indicated that not only did the participants across the domains of Chapter 3 share a similar EP to one another, but that the findings correlate to the studies across paddlesport and mountain walking (Collins et al., 2018).

In common across all participants in the three AS domains was a recognition that terrain which was neither horizontal nor vertical was responsible for generating significant cognitive load within professional operation. When clients are walking, in the most part they are presumed to be safe as a result of their own movement skills and when they are clipped to rope or anchors (either in descent or ascent) they are also protected as a result of appropriate equipment and practice. When clients are in the zone between the two, which was labelled as the 'grey area,' the likelihood of them being at risk is increased but mediated by the skilful interactions of the ASP in that particular environment, i.e., what they choose to do in context specific situations to maintain progression and appropriate levels of safety. The work of this chapter is considered to have met learning objective 2, which was to explore how differences in epistemological position support PJDM across a broader range of adventure sports domains, namely caving, winter mountaineering and multi-pitch rock climbing.

The findings of Chapter 4 were used to generate a bespoke EC for caving instructors which was verified in the natural, context rich and applied settings of vertical and extended horizontal cave systems whilst working with genuine clients. It was noted that these experienced CIs showed limited adherence to a firm strategy, instead utilising a strawman plan, which was expected to be reconfigured as information was further collated and verified. Limited coaching inputs were evidenced in the caving journeys observed in the study, rather a pragmatic approach was adopted which was designed to foster agency using the bare minimum of technical input. All the caving CIs used behaviours across Schommer's (1994) epistemological spectrum and were seen to use strategies recognisable to those identified within Mosston and Ashworth's (1990) Spectrum of Teaching Styles yet were frequently unable to articulate it. This was particularly evident by the CI maintaining physical distance from clients when possible, to encourage agency and a gravitation to working in small, self-sorting groups. In the vertical world of cave ascent and descent, the speedy conformation of discrete units of skill

(Nicholson, 1972), and promotion of independence from the leader is more a risk management necessity than pedagogical aspiration, due to the nature of the cave environment.

In fostering independence within extended horizontal systems, all CIs used elements of what Marquet (2015) termed intent based leadership. One of the central tenets of this leadership approach is to use all available brains to solve a problem. This occurred when an understanding of what constitutes a successful final outcome is shared and acted upon. In short, once this understanding was established, none of the caving instructors intervened unless it was necessary for reasons of safety or where welfare would be unnecessarily compromised.

An affirmative finding from this chapter was that even when employed to lead in a caving environment, the value of positive human interaction underground was seen to balance developments in caving skill and trip completion, or at times, to outweigh it. Being part of a group of professional colleagues and succeeding together in relatively inhospitable environments was seen to offer positive outcomes which support physical and mental wellbeing. This reflects the work of Storry (2002) as noted, who discussed the four factors of adventurous participation, including those of personal achievement and social bonding. This is another avenue worthy of further investigation. It is considered that the work of this chapter has met research objective 3, which was to examine and evaluate how expert ASPs make decisions.

The findings of Chapter 5 were used to influence the design of the concept map which was further elaborated upon for the creation of meaningful training resources. The CrDM of investigation revealed that the caving instructors were very aware that their decision making capacity underground could be significantly eroded by environmental and physiological factors. These included the impacts of hyperthermia, cold, dehydration, fatigue, and energy depletion. Subsequently these CIs ascribed a high value to maintaining a personal environment of physiological and psychological comfort in acknowledgment of the genuine requirement for the caving instructor to safeguard and maintain an adequate level of decision making capability, even in very difficult settings. This strategy of not being overstretched wherever possible was achieved through task delegation, pre-training in relatively comfortable surface environments, and the significant importance placed on careful logistical planning.

It was evident that deselection of venues and routes underground was a prompt process, without a need to cycle through a range of alternatives. When conditions presented as suboptimal or when the group was less well known to the instructor, the greater was the likelihood of using a familiar venue or in choosing a restricted underground journey which offered the affordance to engage with an array of differentiated tasks and activities. A constructive attitude to proactive coping was evident as was a positive approach to adventure. This was demonstrated on the occasions of equipment malfunction (or it being forgotten) where the requirement to improvise was welcomed as a learning opportunity, further identifying aspects of a growth mindset (Dweck, 2015). The work of this chapter is considered to have met research objective 4, which was to investigate the specific decision making of the CI in the accentuated context of working underground.

Chapter 6 compared the PJDM processes of the novice to expert caver, the findings of which led to the creation of the PJDM and Knowledge Framework. The caving instructors of this chapter judiciously utilised heuristics in deploying timesaving ‘rules of thumb’ but in demonstrating a metacognitive aspect, were able to audit their own decision making which allowed each to construct a chain of adequate decisions in short timeframes, rather than relying on exceptional ones across longer periods. This ‘sufficiency’ approach to safeguarding which is used to maintain journey fluency is one of the main differences between the novice and experienced cave professional and is evidence of both a maturing EP, and adapted expertise (Tozer et al., 2007). Further, the experienced CIs tended to use a differentiated approach to physical safeguarding underground, rather than a ‘one size fits all’ approach of the novice CLs.

It was evident that although the CLs gained weather and conditions information from a range of sources, once collated it was trusted implicitly and therefore plans were adhered to more rigidly. This is at odds with the expert cavers who continued to gain and verify information and would adjust plans frequently in consultation with clients. This finding supports the background to the flooding related near-miss incidents across 2003-2006 in several caves in northern England, when groups of professionally led cavers became trapped by floodwater. In these instances, the weather forecast and ground conditions information had been trusted despite obvious evidence to the contrary whilst on approach to the cave. Further, the use of reflection was seen to vary considerably. With novice groups, the trip tended to be reviewed at its end, whilst the expert cavers tended to recurringly review the session in-action with clients in order to inform the next stages of the cave journey or skill progressions. This evidenced a reflexive, rather than reflective approach.

The work of this chapter also identified that the CLs had felt somewhat under-prepared by their training and assessment courses in PJDM *per se.* Across the domains of the thesis, it has become evident that technical progression training and subsequent assessment has been to a good standard, but rarely has any candidate on any course been offered a coaching or enhancement opportunity with regards to the crucial PJDM aspects of professional practice. In short, technical training at NGB level is of a high standard, but the development of comprehension, training, or progression of PJDM expertise appears to be all but non-existent. It is considered that the work of this chapter has met learning objective 5, which was to compare and analyse the practice of novice and expert professional cavers in relation to their EC and PJDM.

In identifying a significant opportunity for the training and enhancement of PJDM capability in the caving professional, Chapter 7 focused on the development of meaningful and applied training resources. In delivering the resource to 80 delegates during in-house staff training, the occasion served as a ‘dress rehearsal’ and an opportunity to gain feedback from experienced recipients who hold at least one nationally recognised outdoor NGB award. Once the role of PJDM had been explained, its omission from training and assessment courses for AS coaching and leadership awards seemed stark. This surprise was amplified when the delegates were offered the opportunity to consider multiple fatality incidents in outdoor contexts. Key examples were provided which showed that technical deficiency was evidenced to have a limited role in the incidents and that PJDM capability presented an area on which to focus attention. The work of this chapter is considered to have met research objective 6, which was to provide an applied resource that enhances PJDM within adventurous activity provision, specifically associated to caving leadership.

The work of Chapter 4 generated a bespoke EC for the caving instructor, but as noted, there was ample data available to extend the work within the domains of rock climbing and winter mountaineering to enable the conceptualisation of a bespoke EC for each of these domains. The bespoke nature of the current caving EC is in part due to the accentuated environment in which the caving instructor operates, but there are readily transferable elements to a range of adventure sport activities or rescue settings, and work environments which are complex. Two robust examples include the sufficiency approach of decision making and the loose parts or principles approach which fostered very prompt progress and autonomy in the clients, offering the immediate advantage of cognitive load management for the caving instructor.

It is accepted that some of the findings resulting from the thesis and noted above could be transferable to a variety of domains, including those of mainstream sport, but this must be tempered in view of the relatively small sample size. Of interest is that in considering the range and weight of decisions taking place in consequential and typically unrelenting environments, they present as being reliable, robust and of a sufficiently high standard to ensure the welfare and pedagogical requirements of the clients are largely met. In short, the quality and range of decisions made in sporting contexts and relatively comfortable AS environments (such as climbing walls or manufactured whitewater courses) are also taking place effectively on freezing mountainsides, deep and damp caves and steep rock faces.

When compared to participation rates, injuries and serious incidents within professionally led AS taking place in natural settings are few (Murphy, 2007). This is indicative of a chain of cognitive processes which links the EP to an EC, which in turn supports PJDM in-action safely and constructively. The aspect which remains to be clarified is how to assist novice AS professionals in this process, one which develops the acquisition of PJDM capability beyond that which currently presents as being an informal process. This is the ‘so what?’ question.

This thesis has developed theoretical concepts and contributed to the understanding of the EP, how it links to the epistemological learning chain and how the understanding of PJDM in context promotes professional understanding. The concepts of PJDM within AS have further been investigated and developed, with a particular emphasis on the caving environment. There are elements of the thesis which offer scope for professional learning and the opportunity for CPD in context- specific areas of operation. It has made an explicit contribution to the work of caving leaders and instructors and in initiating contributions to an almost non-existent literature base with regards to the implications of leadership and PJDM underground. Given the accentuated nature of the caving environment, the findings are likely to be applicable to similar high pressure areas of professional operation. Examples include but are not limited to mountain rescue and whitewater rescue settings.

The work has utilised a range of methods within the protocols of ACTA, and in doing so, has generated a detailed concept map, developed a PJDM and knowledge framework, and identified a bespoke EC for the high level caving instructor. Further, it has established a CL progression model which completes a meaningful training resource. This resource has been evaluated by an expert panel and valued by a large staff team of outdoor trainers who found it to be applied and functional.

8.4 Implications in Practice

Based on the findings of the thesis, there is a requirement to redress the predominantly procedural (Martindale & Collins, 2005) and technical, tactical and rational focus (Schön, 1983) of the training and development of ASPs. It is noted that the technical and procedural training which is delivered at NGB course level is of a high quality, but the training of PJDM expertise appearing conspicuous by its absence across most training providers is concerning. A focus on a PJDM approach which is underpinned by the progressive development of an EP supports a reasoned and coherent structure against which decisions in-action can be made, rather than one which is intuitive or inconsistent. When a professional has established an understanding of their EP, the knowledge sought, and development behaviours utilised provide the focus toward an informed view of client outcomes which is both pedagogical and philosophical in orientation.

In many professional domains, there is a reliance on training to ensure employees (in this case, ASPs) are ready for the workplace within reasonable timeframes. Evidencing the views of the participants of this thesis and those of myself, this training usually centres on rules, policies and procedures. What appears to be missing is a concern for the hard decisions these ASPs will be required to make once the training or induction periods are complete, and even within the scope of NGB awards, the technical advancement of individuals speeds ahead of enhancements in PJDM. Missing is the exposure to, as Klein and Wright (2016) note "*the difficult sensemaking they will face when confronted* *with ambiguous cues and erroneous data, the challenging problem detection when things are just starting to go wrong*" (p. 4). It is considered that the PJDM resource of Chapter 7 will be beneficial in beginning to redress this technical and procedural training focus in giving trainees a greater understanding of their own PJDM process and how it correlates to their underpinning EP.

The findings of the thesis indicate that younger and less experienced ASPs (or those working within novel domains) should aspire to attain a baseline of NGB awards which permit them to operate professionally within the outdoor sector. Once these baseline certifications have been achieved, it is considered that the greatest professional gains will originate from enhancement in PJDM, rather than in the attainment of higher level, technically focused qualifications. The experiences accessible as a result of certification provide an opportunity for the accumulation of a larger base of instances and therefore offer at least one initial route to the development of PJDM, providing the experiences are not simply replicated. In short, the ASP is not necessarily required to have high level NGB awards across domains in order to become a safe and accomplished outdoor professional.

More so now than ever, there is a requirement in society to embrace risk for the purposes of positive human progression and educational development, yet there is a justifiably low tolerance for accident and injury in AS domains, irrespective of the serious injury data concerning everyday activities, including driving or within mainstream sport. The procedural practice advocated within outdoor education and by default, in how aspirant ASPs are trained, presents somewhat as a recognised and axiomatic 'Catch 22' situation as accidents and injury tend to be associated with deficiency in decision making rather than through technical mistakes. It is a 'Catch 22' because procedural practice drives a technical focus, but when prompt and effective decisions are necessary as environments become more complex, or when higher levels of certification are aspired to, there is an absence of practice and understanding of PJDM at a foundational level. In view of this, adventure tends to be suppressed, commodified or restricted to manufactured or managed settings, further confirming this cycle.

Currently the decision making practice and accumulation of experience for trainee ASPs is accrued in an informal and arguably ad-hoc way. This either takes place by working outdoors with more expert peers, or in the case of NGB awards, in the gaining of logged days or trips which take place between training and assessment phases. None of these approaches (there are others which are similar) are robust, planned or designed to promote PJDM is a progressive or informed way. One exception is Mountain Training UK, who are the overarching training administrator of climbing and mountaineering awards within the United Kingdom. They have recently begun to address this issue with the advent of their instructor mentoring scheme and in doing so appear to be the first NGB to show awareness of this omission in professional training and development. This step was in response to a pattern of high failure rates for candidates who were assessed for the Mountaineering and Climbing Instructor (MCI) award. The preceding level of award (Rock Climbing Instructor - RCI) is largely mechanistic and requires relatively low levels of PJDM, and although the MCI award requires the candidate to have enhanced ropework skills, the main demands are undoubtedly related to PJDM and context specific decision making. In adopting the mentoring scheme, MTUK noted that almost all candidates who accessed it were successful at assessment (confirmed in phone conversation, S Paton, 2022, personal communication, 5 January).

The development of the PJDM training resource was based on the EP and learning chains following the research from Chapter 4 onwards, which focused on cavers. It was noted that the cognitive processes and decision making outcomes of the cavers, winter mountaineers and climbers correlated to the findings of the prior research undertaken within paddlesport and mountain walking. Therefore, although the resource is 'caving centric' it ought to be transferable across a range of AS fields following minor domain specific modification. Following the first round of delivery where positive feedback was received, utilisation of the resource at NGB training meetings is advocated, at least in the first instance. It will require context-based adjustments (for example in vignettes and scenarios) but offers a thorough grounding in PJDM and the supporting decision making roles which reside within the philosophical field of epistemology. This knowledge and comprehension is valuable in helping to ensure that engagement in the various sectors of outdoor leadership, education and coaching remains professionalised and importantly, that it informs how we may educate future ASPs. For example, the participants sampled in Chapters 3 and 5 were very experienced and were selected as they had held the highest levels of senior accreditation for a minimum of 10 years. As noted, Klein and Wright (2016) indicate that expert decision makers can access a RPD model of decision making but require context rich and meaningful experience of between 10 and 20 years to generate the associated traits of expertise.

Although such experience cannot be fast-tracked it can be optimised, but this can only occur if the process is planned, progressive and supported by a respected expert mentor or peer, or if it becomes an overt and explicit aspect of professional development. The implication for practice is the realisation that achieving expertise in PJDM in complex and consequential environments will occur and mature over a significant timespan, and furthermore, when demonstrable technical capability (the pursuit of which may be rushed or foreshortened) is no longer believed to represent an accurate picture of professional expertise.

In commercial contexts, an increasing level of responsibility tends to be offered to apprentices and novice employees as knowledge and understanding are verified or tested, and it is argued that the same principle should apply within AS domains. It is posited that if graduated scales of responsibility were allied to the development, verification and observation of PJDM capability, the multiple fatality accidents referenced in Chapter 7 would have had significantly less likelihood of occurrence, in addition to the numerous single fatality incidents that have occurred in outdoor settings within the UK. A good starting point for this verified PJDM capability lies within the comprehensive PowerPoint presentation discussed within Chapter 7. In correlating to the views of Klein (2011), there is a requirement to develop a larger set of routines and a more varied repertoire of patterns, and for trainees to generate a larger experience base of instances on which to ground their PJDM processes (Phillips et al., 2004).

In short, within appropriately planned PJDM development, there is a credible expectation that the underpinning EP will mature and aid the formulation and establishment of learning chains which better reflect the needs and development goals of clients in complex AS environments. However, this represents a commitment to long term development goals for the ASP in view of the requirement to manage an interplay of competing pressures. These include the cognitively demanding functions of NDM, planning, coordinating and sensemaking, in addition to the processes of problem detection, managing client attention, maintaining common ground across pedagogy and welfare, and of course the management of uncertainty and risk (Collins & Collins, 2019). Considering this task load, the 10-20 year evidentially advised experience accrual span (Klein et al., 2016; Maarten et al., 2017) makes perfect sense.

Briefly returning to the common view of the participants in Chapter 3 is valuable because each of this group of very experienced and capable ASPs found the technical and rational aspects of their role enjoyable, but that the so called ‘grey area’ of neither vertical nor horizontal terrain proved most professionally demanding and offered a higher weight of decision making load. It was noted that the novice cavers of Chapter 6 disclosed spending too much time making the passage across such intermediate terrain very safe, or they travelled across it promptly without regard to potential consequences of a slip. Simple stumbles which develop into injurious falls are the source of many accidents in outdoor contexts, rather than falls from significant height in steep terrain. In situations of slow progression when attempts are made to regain lost time, actions are rushed and decision making pressure mounts which may present as being outside the scope of their capability. The implications in practice are evident here.

The requirement to accumulate the skills and decision making capability gradually as the EP matures is required in order to be suitably equipped for the demands of the role. Further, given that this intermediate terrain is routinely found in a caving environment which is invariably slippery due to moisture and/or mud, the requirement to make sound judgements which balance safety and progression is real. It highlights a need for better training courses at the introductory levels of certification, where the concepts of ‘how and why?’ are not subjugated by those of ‘what and when?’ Specifically, this is a move from proceduralised practice to that based on declarative and conditional knowledge. It is advocated that this is best served using the range of approaches offered in the training resource, but primarily ensuring that the accrual of experience is planned, progressive and overseen by a trusted mentor in some form of a cognitive apprenticeship.

8.5 Dissemination

This thesis has explored the complex and subtle relationships between the epistemological position, establishment of learning chains, and the subsequent decisions and behaviours of the ASP in-action. It concluded with the creation of an applied and meaningful training resource to enhance PJDM expertise, specifically within the domain of caving, but transferable across fields. A requirement of the Professional Doctorate programme is to distribute the findings in both the academic and practitioner fields. With regards to the former, this has been achieved through publication of Chapter 2 (Barry & Collins, 2021) and Chapter 3 of the thesis (Barry, Collins & Grecic, 2023) within the peer reviewed Journal of Adventure Education and Outdoor Learning (JAEOL). The training resource of Chapter 7 was delivered to the whole centre staff training within the Outward Bound Trust. The 80 strong audience consisted of Instructors, Senior Instructors, Learning and Adventure Managers, Head of Learning, and a very experienced Head of Centre, which received positive peer review. An additional journal submission based on the work of Chapter 4, which focusses specifically on the caving research, is in preparation. Writing further peer reviewed articles based on the research of the thesis is the primary aim in augmenting the sparse literature base of leadership and PJDM within caving contexts, and to offer evidence-based justification for the adoption of better training and enhancement of PJDM at NGB level.

With regards to the requirements of the doctoral programme, the above may demonstrate an appropriate level of outcomes and engagement with the research process. Although journal article submissions indicate thorough peer review, they have a narrow and somewhat specialist readership, yet the findings of the thesis are valuable to academics and practitioners alike. It is my experience that even well-read outdoor professionals tend not to peruse academic journals, instead favouring a range of professional online and print magazines. Therefore, it is warranted to write specifically for these practitioner focused publications. For example, in April 2022, the Institute for Outdoor Learning (IOL) published in the spring edition of their professional magazine (Horizons) a paper entitled '*The 4-3-2 of Leadership and Learning*' which draws together thoughts on leadership frameworks within AS performance environments. In October 2022 a further article was published by the IOL entitled '*Dancing in the wind'* which discussed judgment based solutions to outdoor challenges. Within paddlesport, the professional magazine is British Canoeing's 'CoDe' and for mountaineering and climbing, it is titled the 'Professional Mountaineer.' I have previously published successfully in all of those titles, including the professional magazine of the British Association of Snowsports Instructors (BASI) and has experience of writing for each specific audience. BASI has been included here as from personal experience, they are a professional association who are very open to advancements in coaching and leadership theory, and it is likely that they will be interested in the EP and PJDM research. Disseminating the research through the route of professional magazines is likely to significantly increase the readership and reach of the thesis findings. For example, the Professional Mountaineer has a readership of circa 11,500 (MTA, 2022) and British Canoeing's coach development publication, 'CoDe' has a circulation of over 30,000 readers (Joy, 2017). Additionally, the IOL indicates that Horizons magazine has a readership of approximately 3200 people (IOL, 2022). The proposed publication dates, target audience and critical value are highlighted in Table 8.1.

Table 8.1 Professional magazine publication itinerary

Date	Location	Critical Value	Target Audience	Distribution
Summer 2023	British Canoeing CoDe	Disseminate practitioner-based applications of the thesis	A full range of paddlesport coaches and outdoor sector employers	Professional Journal Article
Autumn 2023	Professional Mountaineer	Disseminate practitioner-based applications of the thesis findings	National and international climbers, policy makers, coaches, leaders and guides, climbing sector employers, climbing sector stakeholders	Professional Journal Article
Winter 2023	BASI News	Disseminate practitioner-based applications of the thesis findings	National and international skiers, policy makers, skiing sector employers, coaching and training staff, skiing sector stakeholders	Professional Journal Article

In addition to the planned roll out of professional magazine publications, a number of conference presentations have already taken place, with at least one more scheduled. At the time of writing, the Covid 19 pandemic proved to be a key factor in the planning of training events and conferences. Table 8.2 indicates the dissemination strategy to the point of writing and into 2024.

Table 8.2 Publications and presentations associated with the thesis: past, present, future.

Date	Location	Critical Value	Target Audience	Distribution
January 2018	Plas y Brenin National Mountain Centre	At a UK level event, educate and critically explain the initial aims and objectives of the studies and their overall implications to practice	A range of coaches and instructors from elite level to novice practitioners. Coach educators and NGB policy makers	Presentation: Inaugural Adventure Sports Coaching Conference
Spring 2018	Horizons Magazine	Article indicating the pros and cons of overplanning adventurous activity	Professional practitioner audience of 3000+ strong readership	Published magazine article
February 2019	University of Cumbria	Linking the philosophical concepts associated with epistemological and ontological enquiry to undergraduate and post graduate research	Staff training – audience included new staff at Lecturer level to Professors, and all in between	Presentation: Large scale presentation to 200 colleagues.
Spring 2019	Horizons Magazine	Article relating how experienced practitioners can make poor decisions in relation to heuristic traps and biases	Professional practitioner audience of 3200 strong readership	Published magazine article
July 2019	University of Cumbria	Presenting research thus far to peers on similar doctoral journeys - critical discussion on implications and limitations of the data collection taking place in contextually rich settings (cave / rock face / mountain)	Academics, researchers, doctoral students	Doctoral Colloquium

Winter 2020	Horizons Magazine	Article promoting the use of agency and decision making within outdoor learning	Professional practitioner audience of 3000+ strong readership	Published magazine article
September 2021	Journal of Adventure Education and Outdoor Learning	Dissemination of research from Chapter 2 of the thesis to a worldwide readership	Academics, researchers	Journal Article (Barry & Collins, 2021)
Autumn 2022	Horizons Magazine	Article linking theory to practice in creative ways	Professional practitioner audience of 3000+ strong readership	Published magazine article
June 2023	Journal of Adventure Education and Outdoor Learning	Dissemination of research from Chapter 3 of the thesis to a worldwide readership	Academics, researchers	Journal Article (Barry, Collins & Grecic, 2023)
November 2023	Brecon, South Wales	Presenting research findings derived from Chapters 3-6 to a professional and practitioner focused audience of up to 300 delegates	A range of dedicated cavers and instructors, coaches and training teams	Presentation: Hidden Earth - the annual caving conference of the British Caving Association
December 2023	Journal of Adventure Education and Outdoor Learning	Dissemination of research from Chapter 4 and 5 of the thesis to a worldwide readership	Academics, researchers	Journal Article in preparation - (Barry & Collins)

8.6 Limitations

Although a comprehensive summary of results and implications for professional practice have been offered, it is necessary to discuss the limitations of any research which is bound by time, finances and word count. Consequently, a thesis such as this should be seen as a good starting point, but by implication, cannot be exhaustive. Chapter 1 provided a principally autobiographical narrative of the influences and experiences which shaped the authors' professional practice and engagement with adventurous outdoor activities. However, it was based on recollections of 35 years ago, so not only will the events of the time have become blurred by memory, but it is also likely that the interpretation of those events will have altered in line with a maturing EP and ontological perspective. Our recollections of past events serve as salutary reminders of how we may have behaved when guided by an immature philosophical position or when basing judgements on poor comprehension. For example, in his classic work, Goffman (1963) discussed how black citizens and women were denigrated in World War 2, with their significant efforts stifled by prejudiced representation and stigma derived fundamentally through lack of understanding or poor influence.

The sample of ASPs utilised in the studies of Chapters 3,4 and 5 limit the findings given that participants were selected on high level certification and body of experience but were predominantly male. Further, in selecting based on the aforementioned criteria, by default the average ages of the participants mostly fell into the 45-55 years old demographic, none of whom were from backgrounds other than white British. In summary, the participants for most of the studies were white, male and of an older generation. Although the sample of ASPs utilised does not fully represent the views, experience and professional practice of those who are younger, female and from a range of ethnic backgrounds, it is representative of the current professional AS workforce, whether we like it or not. Although outside the scope of the present thesis, academics have begun to open the debate concerning how to enable a differentiated workforce and provide opportunities to support professional accessibility (Christian, Kelly, Piggott & Hoare, 2020). The work of Chapter 6 began to address some of those limitations, in that the sample showed a 50/50 split of male to female participants, all of whom were in their early to mid-20's, although all were white British. The difference in ages between the younger sample of Chapter 6 and the older ASPs of the preceding chapters was beneficial in establishing the timeframes across which the experiences were accrued and where the EP was accorded the time and space to develop.

One of the more overt limitations to the thesis was the presence of the Covid-19 virus and associated global pandemic. The bulk of the planned data collections periods were cut across by the various lockdown periods as the government was forced to react to the ongoing dynamic situation. A decision was made across all data collection periods but specifically with regards to the work of Chapters 5, 6 and 7, to utilise methods which although imperfect would be sufficiently robust to complete the required tasks without the need for postponements. Examples of this include collecting the data for Chapter 6 through only digital means (rather than the originally planned field observations) and in assembling the Expert Panel for Chapter 7 in lieu of delivering the resource at training meetings to gain the feedback required to progress the materials further. Although the research was undoubtedly limited by the pandemic, a way was found to keep it progressing, whilst still generating new understanding. A limitation worth mentioning relates to the deliverability of the training resource. In the initial feedback from the expert panel, all stated that the omission of decision making training within NGB courses was a surprising revelation, but only one stated they would be comfortable delivering the applied resource due to a perception of complexity and the nature of the information it contained. In reflection, it is felt that offering the three main models on which the resource is based, may be a good starting point, with the PPT remaining available as an additional resource for those who wish to extend their knowledge and operationalisation of PJDM.

The generation of knowledge and development of understanding tends to be culturally bound, context specific and time-framed, therefore the research of this thesis may retain its validity for less time than one may hope. Contexts change, new knowledge and understanding are formed, and time does not stand still. Learned authors in the domain of decision making continually revise their approach to the field in light of new understanding, and an example is offered here from Klein and Wright (2016), who state "…*we no longer believe that projects must start with a clear description of the goal as many projects involve wicked problems and ill- defined goals. We no longer believe that insights arise by overcoming mental sets as they also arise by detecting contradictions and anomalies and by noticing connections*" (p.3).

Finally, it may be up to the reader to determine if the transferability of the research aligns with their own lived experiences, and if there exists a case for naturalistic and generalisable truths (Thomas, 2019) given the interpretive lens through which the research was conducted. In support of this notion yet in recognition of the specific AS context, the thesis has sought to demonstrate breadth in addition to depth. Namely, that the domains of multi pitch rock climbing, winter mountaineering, and vertical and extended horizontal caving have been investigated, in addition to the work of Chapter 2 which considered the EP and PJDM connections within a Higher Education context.

8.7 Future Research Directions

Studies such as this are bound by factors of time and word count, so it should be considered that this thesis may act as a springboard for further research. Although many of the findings may be transferable across AS domains, the greater proportion of the research to date has been situated within paddlesport (Collins et al., 2013) and now augmented by work in the domains of the thesis. However, the originality of the caving research offers significant strength and a uniqueness to the work. Nonetheless, the domains of AS continue to grow and appear to become progressively separated from the descriptions of 'traditional' adventure sports. Furthermore, the lines have become increasingly blurred between nature sports, action sports and extreme sports, (Collins & Brymer, 2020). When ASs take place in natural, managed, or manufactured environments (Barry et al., 2021), the very presence or omission of 'rules' determines the fabric of that activity. It is posited that this should drive an expertise based PJDM focus within AS settings because multiple options and subsequent chains of consequence exist (Nash et al., 2012). Further, it is contended that the NGBs who maintain certification responsibility for AS will face difficulty in understanding where their accountabilities and spheres of influence lie in relation to the blurring of lines of participation and natural evolution of 'new' activities. There are ample research opportunities here.

In acknowledgment of the research limitations, larger scale studies which track the development of PJDM skills over greater timeframes with ones that balance the gender and ethnic diversity aspects also present opportunities for future studies. The PJDM and Knowledge Framework of Chapter 6 fulfilled a vital role in identifying the differences in the underpinning EPs of the CL and

CIC award holder, but this work can be continued in the mountaineering, rock climbing and paddlesport domains, among others. Further, the work of Chapter 7 specifically offered an applied training resource, which although designed around the epistemological frameworks identified in the sample of cavers, shows high levels of transferability for the development and enhancement of PJDM ability across AS domains.

The exploration of expert reasoning was centered on studying ‘tough case’ scenarios (Cruickshank et al., 2020) with CIs who are arguably at the peak of their profession and therefore it would be beneficial to work with cavers across the proficiency and experience range in order to fully comprehend this applied cognition. The exploration of cognitive reserve management by expert cavers has opened an avenue of research, given that it is not clear how the participants were able to ‘ringfence’ parts of it or were able to access an emergency reserve, analogous to securing a bank overdraft facility.

Further research is required into the PJDM process which found that even in consequential environments, the CIs sampled within this thesis were able to tolerate a series of adequate decisions, rather than fulfilling a need to make excellent ones. Questions remain regarding the personality characteristics of committed cavers; namely, does the accentuated nature of caving develop appropriate personality characteristics or have the participants been drawn to the demands of caving and cave leadership as a result of their existing traits? Finally, the use of heutagogic learning is believed to develop competence in unstructured, unanticipated, or novel situations, which are certainly found in vertical and extended horizontal caving environments, winter mountaineering and multi- pitch rock climbing. However, there is currently little research into this aspect of agency-based adult learning within adventure-based leadership, which offers ample opportunity for further research.

8.8 Concluding Reflections

This research journey has felt long. At various times it has felt invigorating, exhausting, taxing and scary. It has also felt very purposeful and in challenging times where Covid-19 and redundancy met head on, it acted as a valued anchor. This anchor was vital when confronted with the realisation that I was over halfway through the research process yet no longer worked in an academic institution in which the qualification would be relevant and well regarded, coinciding with a timeframe in which I had to commence a search for employment. The thesis always provided me with something that required my attention and offered the satisfaction of completing another section of work, or of organising another aspect of data collection. When friends and colleagues were furloughed and felt that they had temporarily lost direction or focus, I could turn to this thesis and move it along, albeit incrementally. Initially, the sheer amount of reading and tasks to complete felt insurmountable, but in adopting the 'eat an elephant one bite at a time' philosophy, the number of tasks finished began to outweigh the remainder left to complete. Having articles published with more on the way made me feel much more confident about writing at the level required of a doctoral candidate, further bolstered by conference and colloquium presentations, and in utilising the findings to develop a meaningful staff training package.

Overall, commencing this professional doctorate was a good move, and there is little doubt that I will remain proud of the completed work. Personal feelings aside, there is no question that I have learnt lots and feel much more accomplished as both researcher and 'Level 8 thinker' and perhaps provide an example of someone who has shown motivation for, and engagement with, lifelong learning and the development of professional practice. As a result of this learning journey, I now have a greater comprehension of Interpretive Phenomenological Analysis, Applied Cognitive Task Analysis, the organisation and implementation of small scale research programmes, and in using findings to develop concepts and knowledge frameworks. Importantly, I have a significantly greater understanding of the human decision making process, particularly in the consequential environments of the AS domains of the thesis and feel able to offer evidentially informed advice on how to best develop and enhance PJDM expertise in adventure based professional practice.

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Appendices

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Appendix A

Participant Consent Form

The Epistemological Chain across Adventure Sports Domains

(Winter Mountaineering)*

Martin Barry

Please **initial** the boxes only if you agree

1. I have read and understood the participant information sheet.	
2. I have had the opportunity to ask questions about the study and these have been answered to my satisfaction.	
3. I understand that my participation is voluntary, I am free to withdraw at any time, without giving any reason and the use of my data following any withdrawal.	
4. I agree to be observed and videoed coaching students in a (winter mountaineering) context.	
5 I agree to the follow-up interview being recorded and transcribed.	
6. I agree to anonymous quotes and data being used in any publication or presentations produced from this study.	
7. I agree to take part in the above study.	

Participants name: Participant's signature: Date:

*(this changes to multi-pitch climbing or caving as appropriate to study)

Appendix B

Participant Information Sheet

The Epistemological Chain across Adventure Sports Domains

(Winter Mountaineering)*

Martin Barry

Please take time to read the following information carefully and discuss it with others if you wish. If there is anything that is not clear or if you would like more information, please ask a member of the research team using the details provided at the end of this information sheet.

Thank you for reading this.

Who will conduct the research?

This research will be conducted by Martin Barry, a Professional Doctorate student (Elite Performance) at the University of Central Lancashire.

Your involvement will help develop an understanding of the judgement and decision making of expert coaches outdoors. Your contribution will enable us to design coach, leader and teacher education programs that are informed by evidence of expert practice.

What is the aim of the research?

This research project is investigating if the research into the epistemological chain identified in previous research utilising paddlesport activities, transfers to other contexts and domains, namely winter mountaineering, multi-pitch climbing and vertical caving,

Why have I been chosen?

You have been selected as a possible participant based on your qualification and experience.

What would I be asked to do if I took part?

You will be observed and videoed over the course of a coaching session whilst delivering a winter mountaineering, climbing or caving coaching session, which will be preceded by a pre-research and pre-activity interview, followed up by a semi-structured post-activity interview (partially guided discussion). The total interview duration will be approximately 45-60 minutes and will be recorded by smartphone or similar device.

The observed coaching session may be recorded using a discreet body mounted video camera.

What happens to the data collected?

Any collected data, video and field notes will be destroyed at the conclusion of the project. Any raw data (transcripts of interviews) on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed. Video footage will be deleted promptly following the post-activity interview.

How is confidentiality maintained?

Your anonymity will be preserved through the use of a pseudonym; (for example coach X) and the data will remain confidential. Appropriate steps will be taken to avoid identification by deduction.

What happens if I do not want to take part or if I change my mind?

You can withdraw from the project at any point. Your involvement will remain anonymous.

Will I be paid for participating in the research?

Your involvement in this project is voluntary and you are free to withdraw at any point.

What is the commitment and duration of the research?

As noted, an observation of you working in context, with pre- and post-activity interviews. This will take place between at our mutual convenience, commencing summer 2018.

Where will the research be conducted?

The session and interviews will take place at the time and place of the coached session(s) and subsequent interview at an appropriate and convenient location.

Will the outcomes of the research be published?

The results of the project may be published in journal papers, books and related magazines.

Who has reviewed the study?

To ensure that the project is being conducted in a professional and ethical manner, the project has been approved by the University of Central Lancashire BHASS Ethics Committee.

Contact for further information
If you have any further questions regarding your involvement in this research, please ask contact Martin Barry at MBarry1@uclan.ac.uk or my doctoral supervisor David Grecic, at1DGrecic1@uclan.ac.uk

Who can you contact if you have a complaint about the project?
If you have any complaints about the study you may contact the University Officer for Ethics (OfficerforEthics@uclan.ac.uk).

*(this changes to multi-pitch climbing or caving as appropriate to study)

Appendix C

Group Member Information Sheet

The Epistemological Chain across Adventure Sports Coaching Domains

(Winter Mountaineering) *

Martin Barry

Please take time to read the following information carefully and discuss it with others if you wish. If there is anything that is not clear or if you would like more information, please ask a member of the research team using the details provided at the end of this information sheet.

Thank you for reading this.

Who will conduct the research?

This research will be conducted by Martin Barry, a Professional Doctorate student (Elite Performance) at the University of Central Lancashire.

Your involvement will help develop an understanding of the judgement and decision making of expert coaches outdoors. Your contribution will enable us to design coach, leader and teacher education programs that are informed by evidence of expert practice.

What is the aim of the research?

This research project is investigating if the research into the epistemological chain identified in previous research utilising paddlesport activities, transfers to other contexts and domains, namely winter mountaineering, multi-pitch climbing and vertical caving,

Why have I been chosen?

You form part of the group that your coach is being observed working with.

What would I be asked to do whilst taking part?

Essentially nothing that would not happen naturally as part of the coaching process. The researcher will observe and take notes and will not intervene or interfere in the session in any way. Parts of the session will be video recorded on a discreet body mounted camera, but once the interviews with the coach are finished, the footage will be deleted.

What happens to the data collected?

Any collected data, video and field notes will be destroyed at the conclusion of the project. Any raw data (transcripts of interviews) on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed. Video footage will be deleted promptly following the post-activity interview as noted.

How is confidentiality maintained?

Your anonymity will be preserved through the use of a pseudonym; for example, 'group member X' and the data will remain confidential.

What happens if I do not want to take part or if I change my mind?

You can withdraw from the project at any point or ask that the session is not observed or recorded.

Will I be paid for participating in the research?

Your involvement in this project is voluntary and you are free to withdraw at any point.

What is the commitment and duration of the research?

The intended duration of the session with your coach.

Where will the research be conducted?

At the normal / intended location chosen by your coach for the activity.

Will the outcomes of the research be published?

The results of the project may be published in journal papers, books and related magazines.

Who has reviewed the study?

To ensure that the project is being conducted in a professional and ethical manner, the project has been approved by the University of Central Lancashire BHASS Ethics Committee.

Contact for further information
If you have any further questions regarding your involvement in this research, please contact Martin Barry at MBarry1@uclan.ac.uk or my doctoral supervisor David Grecic, at DGrecic1@uclan.ac.uk

Who can you contact if you have a complaint about the project?
If you have any complaints about the study, you may contact the University Officer for Ethics (OfficerforEthics@uclan.ac.uk).

*(this changes to multi-pitch climbing or multi-pitch caving as appropriate to study)

Appendix D

Group Member Consent Form

The Epistemological Chain across Adventure Sports Domains

***(Winter Mountaineering)**

Martin Barry

Please **initial** the boxes only if you agree

1. I have read and understood the group information sheet.	
2. I have had the opportunity to ask questions about the study and these have been answered to my satisfaction.	
3. I understand that my participation is voluntary, I am free to withdraw at any time, without giving any reason and the use of my data following any withdrawal. I also understand that I can ask not to be recorded or for the session observation to be concluded.	
4. I agree to be observed and videoed whilst being coached in the activity of (winter mountaineering) *	
5. I agree to anonymous quotes and data being used in any publication or presentations produced from this study.	
6. I agree to take part in the above coaching session.	

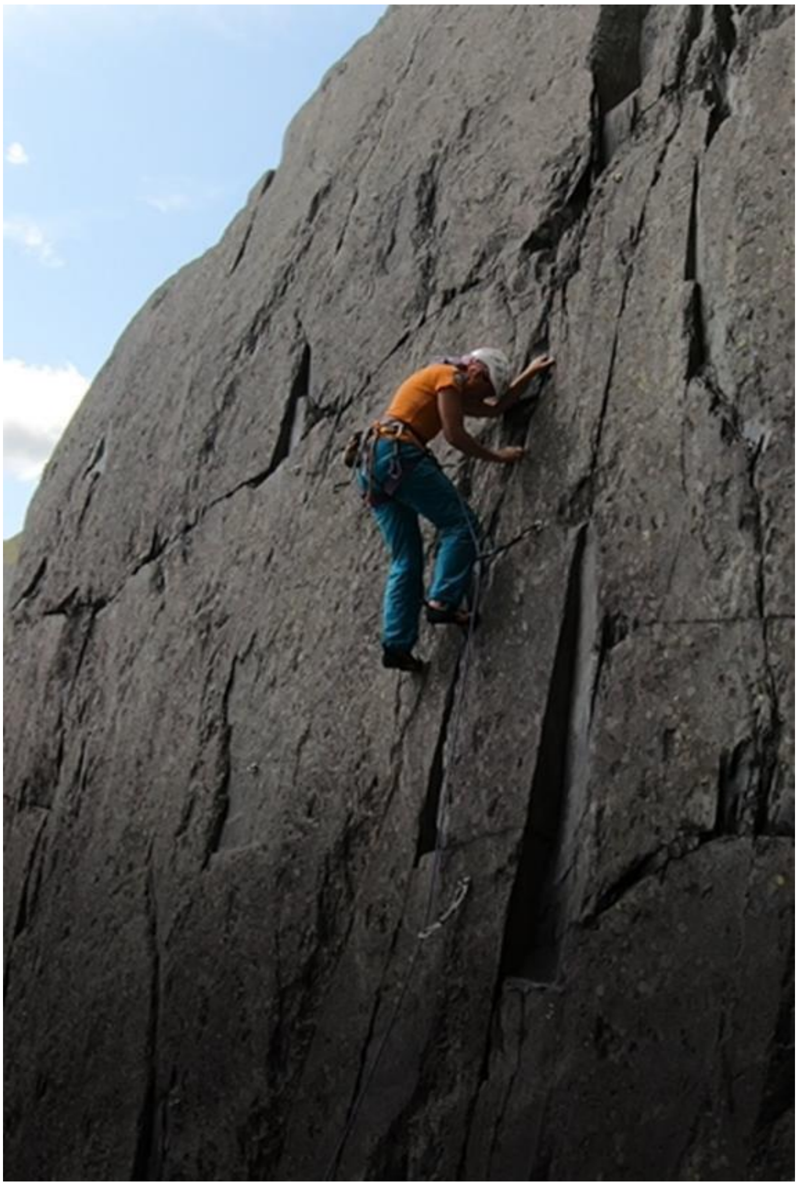
Participants name: Participant's signature:

Date:

*(this changes to multi-pitch climbing or multi-pitch caving as appropriate to study)

Appendix E

Climbing ASP on the 'sharp end'



Appendix F

Student cavers working in small, self-supporting groups

Appendix G

Cavers working independently with accessible guidance

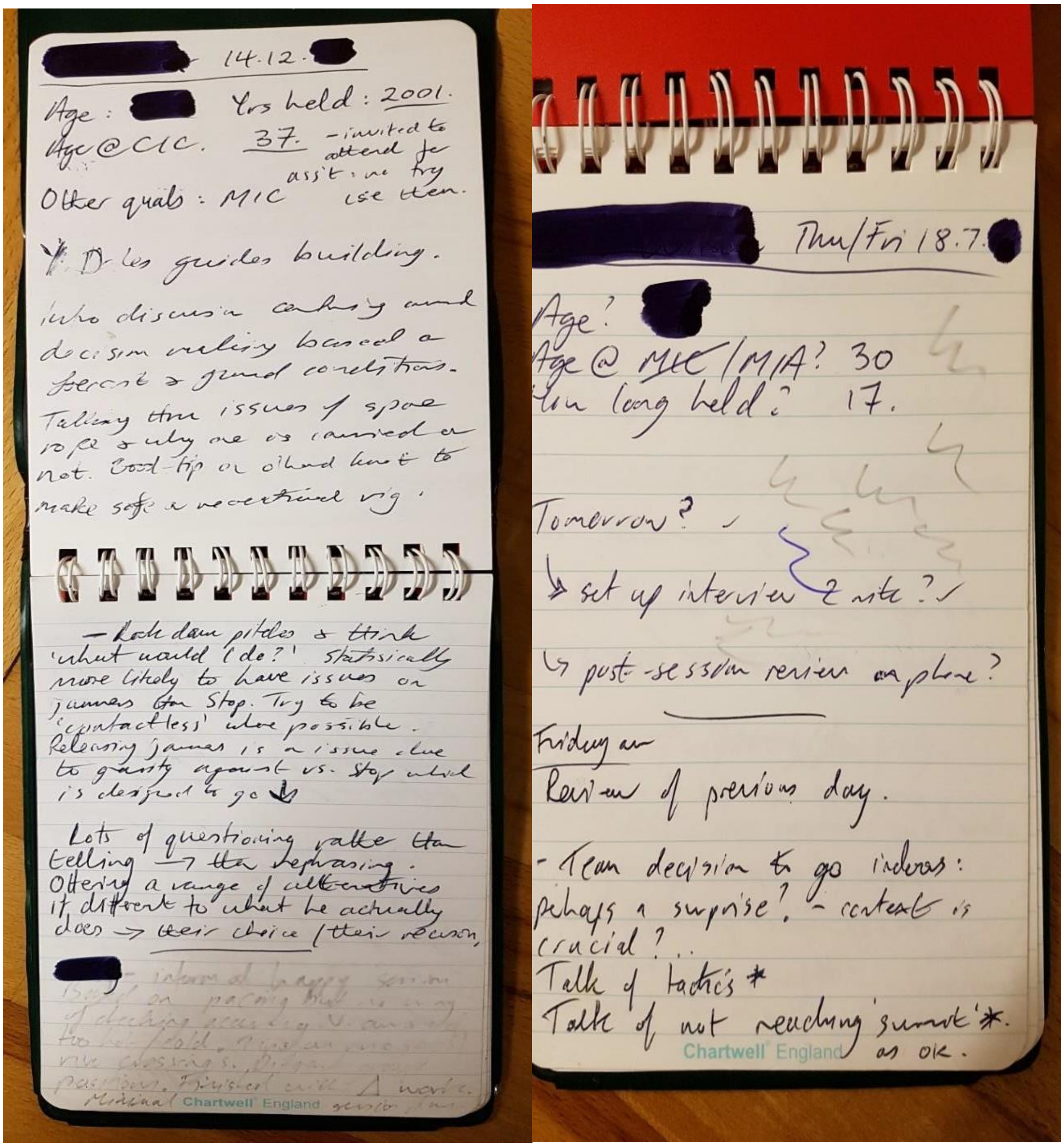
Appendix H

Setting the scene for the forthcoming cave journey

(leader at the back)

Appendix I

Example notes from primary data collection in
the field



[redacted] 14.12.[redacted]

Age : [redacted] Yrs held : 2001.
Age @ CIC. 37. - invited to attend for assit: we try use them.
Other quals : MIC

D- les guides building.

into discussion conditions and decision making based on forecast & ground conditions.
Talking thru issues of spare rope & why one is carried or not. Cord-tip or other knot to make safe a necessitated rig.

- Look down pitches & think 'what would I do?' Statistically more likely to have issues on jammers than Stop. Try to be 'contactless' where possible. Releasing jammers is an issue due to gravity against vs. Stop which is designed to go

Lots of questioning rather than telling → then rephrasing. Offering a range of alternatives if different to what he actually does → their choice / their reason,

[redacted] [illegible]

[redacted] Thu/Fri 18.7.[redacted]

Age? [redacted]
Age @ MIC/MIA? 30
How long held? 17.

Tomorrow?

↳ set up interview 2 nite?

↳ post-session review on plane?

Friday am
Review of previous day.

- Team decision to go indoors: perhaps a surprise? - context is crucial?..
Talk of tactics *
Talk of not reaching 'summit' *. as OK.

[redacted] 13.8.19: Slate.

- Loads of options offered based on client needs/aspirations, allied to weather & also tides (Gogarth).
- Discussion on subtle but effective actions as she noticed weather coming in yesterday (lots more gear on harness, e.g.).
- Tarp → slate/rope/sharp edges issues addressed.

Use of chalk to identify & focus on small footholds.

- Checking quickdraw orientation based on likely direction of fall/load, esp. in sport climbing contexts/unclipping consequences.
- Working on maximising foot work on slate ⇒ "soft hands."

- Avoid anxiety-led movements → phases of precision & balance.
- Decision making & planning a few moves ahead.
- Use of arms = NO_2 in car: if you use 'em ⇒ go!!
- Careful choice of routes & venue to work to needs of client (precision footwork).

- Coaching based on movements to promote safe climbing whilst not 'burning out'.
- Very much looking after the client, even on scree at bottom of crag (harness on!) ⇒ over-did this & ended up pissing Rob off (too child-like).

- Very direct - asking Rob to move 'lm closer to bottom of crag to lower, even though he is significantly heavier & stable. ⇒ quite proceduralised rather than making Rob aware of potential issues for his future consideration.

(- harness 'drop'. - different on men's/women's harnesses as women's waists higher).

- Narrative from fell-running risk taking ontology/epistemology ⇒ long used to ideas of managing/engaging risk + practising the consequences of decision making.

[redacted]

- All about the client - whatever they need.

— Alpine stuff: showing them how to look after themselves - [redacted] in the past but more recently otherwise, it's for specific objectives.

- Looking after G. by setting him up with pre-info. Where to gear up etc. Outline of the day, what's being taken up etc.
- Spotted the harness issue before commencement of climbing. Neat & neat.
- Verbalising what he's doing for the client. Referring back to yesterday's climbing -

Chartwell England

Appendix J Example of Enhanced Field Notes

[redacted] – notes from session at Yorkshire Dales Guides building / Gaping Ghyll trip – [redacted]

- Overview discussion of what was covered in last training session (split weekend CIC course), with particular stress on the **context** of a given rescue.
- Obvious dynamic thinking process regarding changing the plan against the forecast and the actual observable conditions. The lack of certainty in forecasts and the vagaries between them was an issue.
- Decision not to go caving outdoors based on geographical location – all forecasts agreed a windchill of -20c and there are no caves where it is possible to quickly get inside, as there are in Derbyshire. Into GG tomorrow as it has a sheltered walk-in for the wind direction, and capacity to quickly get down out of the breeze given potential wind-chill.
- This thinking was discussed with the group – letting them understand his logic and rationale as to what is behind it, the windchill on the walk-in and inability to get out of it promptly the main thing.
- Discussed notion of recreational rigging vs. professional rigging (as in a working context > power pocket for rescues). Discussion became laboured so grabbed a piece of rope to show visually.
- Stressed the need to be able to make judgements about specific issues, rather than learning a bunch of rescue tricks, given the variability of the context.
- Topic centred on rescues with spare rope. as outdoor caving professionals, normally a spare rope is carried, but there are reasons why one would not be, and typically, recreational cavers do not, so the CIC needs to be able to offer coaching in rescues where none is available. If that pool of knowledge about the non- spare rope rescue is not held within the CIC scheme, where is it? Ability to think well and to work things out is very important.
- Not about copying a technique, more the depth of knowledge and understanding, and the **associated judgement** – this will be looked at on assessment (**why** is something being done deemed as important as the ability to do it).
- Zooming out (**gain space**)– where would you actually be more likely to have an issue – in descent or ascent? – A caver spends more time on jammers than a descending device, so probability suggests on jammers. Issue here though is jammers are hard to release with gravity, whereas descending devices are designed to do just that.
- Lots of questioning rather than telling (**good coaching practice evident**). Gets the information and asks them to think about it before sometimes rephrasing for them to clarify understanding. It's a more lengthy process but Phil knows it aids in the understanding and longevity.
- Discusses a range of alternatives from which to choose, and never suggests that his way is better than the (clients, **(loose parts theory / principles based practice)** although notably different (e.g. having lightweight footloop / safety cord on hand jammer, instead of having spare rope built into the setup). Their choices based on their decisions, informed by their judgement.
- Discussion about practicing complex things (rescues) before you teach them or feel you might need them – offering cognitive space for other variables. "Don't launch into complex things without preparation or practice – that would be foolish".

Tailor what is taught or imparted according to where they are going – keep context accurate otherwise it becomes complex and very ropey / confusing. Teach them what they need to know once you have observed them, so set a little task up (observe, analyse, set task, feedback and adjust

Enhanced writing based on field notes – cave (3) MB

Appendix K

Models which were considered for resource development

within Chapter 7

The Cognitive Apprenticeship (CA) is fundamentally a social learning process with a long history of helping beginners transition towards expertise in fields as diverse as medicine, construction and teacher education. At the centre of any apprenticeship progression is the concept of more experienced (and expert) people assisting less experienced ones, who offer cogent examples of practice and a structure which is designed to support the completion of goals or tasks (Dennen, 2004).The CA utilises methods such as mentoring, scaffolding, modelling and coaching and which promotes learning through social interaction in the accurate and authentic context of the specific learning environment, namely in this context, whilst journeying and leading underground, and has been explored somewhat in Chapter 2 as an approach to developing decision making expertise specific to adventure sports environments. Although the CA approach has been discounted here for future progression, it remains a valuable mentorship tool and one which has a high level of fit for developing decision making expertise in the novice cave leader. In-context, the approach would follow progressive steps in which the mentor leads the group through the cave and then reveals to the apprentice what clues and signals led to the leadership being enacted as it was. The next step is to ask the novice to lead whilst they explain their decision making strategy and then compare it to the strategy that the expert may have used. The final steps include the novice working in tandem with the expert whilst leading underground, sharing their thoughts on approaches which offer the best balance of pedagogy, welfare and independence appropriate to the specific situation. Although the CA approach has been used for some time, it has not seen wide uptake in training and development of ASP's within NGB programmes and educational events, as evidenced by my longstanding involvement in coach education across four main adventure sports schemes. Although not included here for resource development, its use for developing expertise in the adventure sports professional is advocated.

The Big 5 (Collins & Collins, 2021) is a reflective model designed to enhance PJDM and situated expertise as a result of interrogating the series of decisions taken before, during and after a coaching or leadership episode. It has roots in critical reflection (Schön, 1983), coach and leader development through social interaction (Stoszkowski & Collins, 2012), involvement in communities of practice and the generation of shared mental models (Lave & Wenger, 1996) and elements of the cognitive apprenticeship widely used in a range of coaching contexts (Cassidy & Ross, 2006). However, it has not been included for resource development in the context of this study because the relatively inexperienced cave leader may struggle with the reflective process, given that by default, the novice has little experience on which to draw, reflect and make comparisons. This was evident in the data collection of Chapter 6 where three out of the four participants laboured to match the reflective process to a meaningful experience of their own selection. For this reason, although a positive, adaptable and useful model, The Big 5 is not included for further development in the context of this thesis.

The ShadowBox approach was considered but ultimately not selected for further development in the context of cave leadership. The original shadowing approach was designed to help trainees perceive the world through the eyes of the more expert practitioner, in order to accelerate their learning and ability to make better decisions. It was originally considered by Bloom and Broder (1950) as a way of offering strategic advice to students to enable them to become more adept at succeeding in multiple choice high school tests through improving skills in logically orientated decision making. More recently Hintze (2008) developed a specific technique which allowed learners to shadow the thinking of experts, through the use of scenario based materials, where their answers and reasoning were compared to that of experts, hence the use of the word 'shadow' in these approaches. The most recent ShadowBox approach was developed approximately 10 years ago by Klein and Borders (2016) and has since expanded to become a range of largely facilitator-free online training tools which offer speedy access to decision making scenarios and progress in cognitive skills development. This digitally orientated approach has been considered to be particularly valuable given that access to experts for discussion on their own thought processes and decision making is typically difficult. One of the main challenges for the ShadowBox method and the reasons for its non-inclusion, is to ascertain whether the scenarios developed would be sufficiently characteristic and representative of the caving domain and context, and to subsequently access an efficient way of encapsulating the knowledge of caving experts. As noted, the number of highly qualified, active caving experts in the United Kingdom is relatively few and the only way to design, develop and seek consensus on a range of cognitively challenging decision making scenarios is to have full and open discussions face to face, facilitated via a training conference. This would be a difficult task at any time, but during a global pandemic, it is less likely but certainly suited for future consideration.

Situational awareness (SA) can be considered as an internalised mental model of the state of that environment and domain, at a specific temporal and spatial point. Research exists in many fields, given the importance of SA in comprehending the situational demands (SD) of a given state of affairs, which therefore acts as a catalyst for specific action and behaviour. For example, the extant literature in the field of aviation decision making (Stammers & French, 2005), within the fields of emergency response (Dow, Garis & Thomas, 2013), group management outdoors in adventurous environments (Mees, Toering & Collins, (2021) and specifically within the adventure sports domain of sea kayaking (Collins, Giblin, Stoszkowski & Inkster, 2020).

The caving environment is one where safety critical decision making is repeatedly required, where those decisions must be of a sufficiently high standard to obviate most risks, most of the time. SA development utilises a 3 step approach (perception, comprehension and then projection relating to future time events), and it may be argued that for the relative novice cave leader, there is a necessity for a pre-step 1, which requires the neophyte ASP to engage in 'active looking' and information gathering by maintaining an inquisitive eye about the group and environment, before it is possible to describe what can be seen

The Delphi Method or 'approach' (Brady, 2015) was originally designed by Dalkey and Helmer in 1963 to generate structured and anonymous expert consensus on scenarios which presented an existential threat to the national security of the United States of America, during the period of Cold War hostility with Russia. It presents as an excellent approach to identifying the behaviours, decision making strategies and courses of action taken to specific and challenging leadership demands in a caving context. However, it can be considered as a large scale methodology in its own right and has not been selected for reasons similar to those of rejecting the ShadowBox method, namely that to get consensus from expert cave instructors would require significant time and would best be facilitated via a conference or training event. Caving instructors are notoriously busy and industrious, and during Covid times, many have promptly retrained in all manner of roles whilst it has been impossible to work underground with groups due to social distancing measures (which have been in place at the time of writing). The Delphi approach is a powerful tool for generating consensus from expert practitioners and decision makers, but from a pragmatic perspective, it would not work as well as the approaches and models which have been chosen.

Decision Training methods which have been successfully used in a variety of sporting settings (Vickers, 2014) utilise a specific 3 step process in conjunction with 7 tools. Although valuable in the context of traditional sports and within the arenas of competition, this stepwise process does not match the hyperdynamic practice environments of the adventure sports professionals to which the thesis refers. Nevertheless, the main aim of the decision training approach is to allow athletes to make more effective decisions in conditions of (competitive) stress and uncertainty, and therefore there is value in any approach which allows the adventure sports professional to be more practiced and prepared in this crucial cognitive skill. Common ground is noted in that this decision training process advocates the creation and recreation of micro-plans, which shares the 'strawman' approach of the ASP in constructing a series of plans which are expected to be reconfigured and recreated as more information is collated or verified. However, the steps and tools present as so specifically sports orientated, as not to be fitted to the natural and consequential professional environments of the ASP, which are associated with pedagogy, welfare and a move toward independence in such settings, rather than performance. The literature base supports decision training in sport (cf. Renshaw et al., 2019), but there is scant literature available on how the approach relates to the more consequential environments and professional practice within AS. Furthermore, the 3 steps and 7 tools bear similarities to some aspects of both good coaching (use of different feedback, variety in practice scheduling for example) and elements of the cognitive apprenticeship (modelling, sharing the decision making process in action and in context), which have been selected to provide the underpinning framework and paradigm of the resource development.

Problem Based Learning (PBL) was designed to allow students to have access to real-life problem based scenarios which built upon the knowledge and skills already present, and to ‘stress’ the learning in realistic, although scenario based contexts, certainly valuable for the adventure sports professional in this respect. For the purposes of this thesis and exploration of the development of potential resources, a PBL approach has not been specifically advocated simply because it is considered that PBL requires the facilitator to select the right tool at the right time for the right task in order for it to be successful, which are the elements of any good coaching or leadership behaviour *per se*. Consequently, it is contended that PBL forms a small but constituent part of the PJDM approach and that successful applications of PBL demonstrate a requirement for judgment and decision making, noting that leadership and coaching within the professional practice of the adventure sports professional is a known PJDM based activity. In short, PBL does not need highlighting as it already represents a small component of the PJDM approach already present, and one which works for some of the people, some of the time and in specific contexts which are not always present nor manageable. Furthermore, Morgan, Jones, Gilbourne and Llewellyn (2013) stressed that unskilled students can often experience insecurities, overload and anxiety until fully familiar with the processes of PBL. Although stresses are part of the transitional process from surface to deeper learning (Marton & Säljö, 1976) and development of decision making performance, it highlights that ontological and epistemological differences are a source of challenge, and that cultural perceptions of professional development (in this case the culture of the caving community) are important considerations.

Appendix L

Example of Feedback (1 of 2)

Developing PJDM Resource – feedback form- EPM 4

This feedback was socially distanced face to face and as such it took the format of a free flowing conversation, only partially guided by the structure of the feedback form.

1. Do you think this resource may be useful in aiding novice outdoor professionals understand and develop their decision making?

> Its highlighted a real need and a real gap in training. My experience is that practice can be copied and then allocated by another to a situation which is actually quite different, and this can actually be dangerous or lead to unplanned incidents. Trying to get folk to understand the 'it depends' factors can be quite hard, especially when they have mimicked others who they feel they can trust. For me it's the old iceberg principle thing.
>
> I see folk hybridising processes, which is fine providing they can understand and verbalise their reasons for doing so – I think quite a few of relative novice outdoor instructors cannot do that!

2. Is it too complex or does it lead the reader / participant through the epistemology and PJDM processes in an approachable way?

> For me its tends to be about gathering quality information and then doing something with it. Pretty important to keep refreshing this information in what I think you may have called an 'audit' which then refreshes the decision making. It feels like a fine tuning approach which can be adjusted as needs be perhaps.

3. Is it sufficiently clear that there is a role for PJDM in professional outdoor practice?

> Yes as above – bit number 1.

4. Does it make sense how a person's philosophy (coaching / epistemological chain) underpins their decision making?

> Yes it does and the PowerPoint explains it well. What may not be in there although you undoubtedly know this, is the difference between experience and expertise… They don't necessarily follow each other.

5. Do you think the tasks are appropriate and would aid in the learning process?

Tasks are really good in terms of the learning, although I think some folk would really need them to be adjusted very much to their context of working, i.e. nothing to do with caving!

I tend to be quite neat and tidy when working outdoors, but I'm not necessarily like that at home for example. I'm a bit of a neat freak for a reason with groups working so that I can see quite promptly if anything is unusual. I can scan around quite subtly and quickly and then I find that it gives me thinking space and I can kind of decide how much concentration needs to be given to a thing, place or person.

The small things can add up…!

6. Would you feel comfortable delivering it, using the tutor notes provided?

Generally speaking, no – it's pretty complex and in some ways it might be doing you a disservice if I could if this is from lots of your work (*MB – although it is designed to be reasonably accessible).* Yes, but some things are just a bit complicated and need quite a bit of thinking about and reading which I haven't done. I would end up fluffing it or blagging!

7. Where could you see a place for this learning resource ?

This could be used anywhere where decision making enhancement is required and where it isn't already included within training. I think lots of NGB courses include very little of this, and as you've indicated it can be the source of incidents rather than the technical bits. Staff training morning in an outdoor centre, with apprentices perhaps?

8. Any further comments are welcome

Judgements are really key aren't they – an easy slippery slab with a drop off at the side gives me more anxiety than a steep wall with lots of incut holds - guess you get this scenario in caving quite a lot, so a novice instructor may not realise the difference, and this is definitely a judgement situation where to spot (when it's steep) and when to use a rope (when it's not steep but slippery)…

Appendix M

Example of Feedback (2 of 2)

Developing PJDM Resource – feedback form- EPM 5

This feedback was socially distanced face to face and as such it took the format of a free flowing conversation, only partially guided by the structure of the feedback form.

1. Do you think this resource may be useful in aiding novice outdoor professionals understand and develop their decision making?

Really indicates a need for this – you seem to have discovered a hole that others have missed for quite some time, especially in relation to caving where rescue can be very hard to sort, or even just a bit of assistance for a tired caver. This will be great in some form but at the moment it's too complex for me and therefore for trainees etc. Distil this down to be more accessible, or portion it out and add the required examples to smaller segments perhaps?

2. Is it too complex or does it lead the reader / participant through the epistemology and PJDM processes in an approachable way?

Too complex and wordy for me – does it need to be so complicated? Keep forgetting the terms, although there is a glossary there, but I think it's because the words are new to me. Might be worth changing 'fatigue' to 'energy levels' as fatigue as connotations of exhaustion and fitness. Concept is good but not for L1 cavers – needs hints and tips and a bit of an idiots guide!

3. Is it sufficiently clear that there is a role for PJDM in professional outdoor practice?

Yes, before / up to this point there has been a real focus on skills rather than judgements.

4. Does it make sense how a person's philosophy (coaching / epistemological chain) underpins their decision making?

Yep, no problem. Interesting to identify the training gaps between novice and expert traits and that not much is included in courses to begin filling them! The course demands only get harder and more complicated too!

5. Do you think the tasks are appropriate and would aid in the learning process?

Vignettes are brilliant, and the tasks are fine too to bring the learning alive a bit. Would need case studies to be made more relevant to different contexts, e.g., mountaineering or rock climbing.

Think filling in the box tasks for the PJDM framework is too complex perhaps as a task only because lots may not know what some of the words mean. However, understanding where the gaps seem to be in novice vs. expert traits is quite revealing. I'd like to make it clearer that novice traits are limited, but expert traits may purposefully include some of the novice behaviours.

Really liked the case study of slide 26 which felt like it was just really realistic and indicates the number of jobs that need doing…

6. Would you feel comfortable delivering it, using the tutor notes provided?

Basically, no, not at all. Would need to be changed into accessible language for practitioners to understand. It would best be delivered by you as you have dome the research, or you train folk up so they really begin to understand it more.

The PowerPoint itself is pretty impressive, but also a tad overwhelming. The case studies and scenarios are great though and would really help in the learning.

7. Where could you see a place for this learning resource ?

You delivering it at workshops and coaching type conferences and back at the university as a leadership module support, but as far as caver leader courses go, there is too much to cover as it is. The message must get across though because without decent levels of judgment and decisions by the cave leader, everything will get completely softened down so that any adventure is minimised or removed. That would be a shame because caving can be an excellent adventure and cave s are great places to spend time with young people and (novice) adults.

8. Any further comments are welcome

You've definitely seen a gap and provided something good to fill it – I guess now it will be a case of making a few versions of it for different applications and levels of understanding and experience base or course level. I found the concept map to be amazingly eye opening especially with the number of decisions that need to be made on the hoof even if lots of pre-prep, which In tend to do, has been done ahead of time.

Thank you

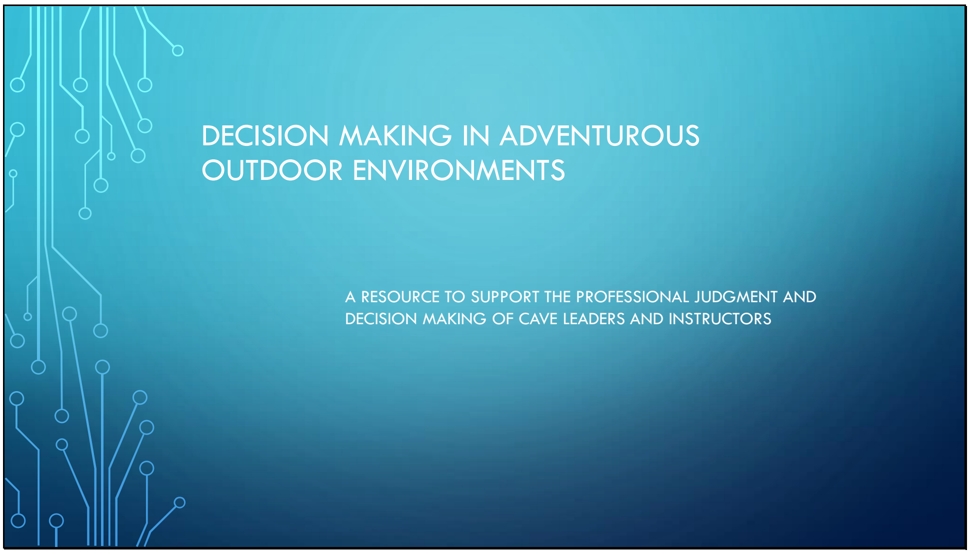
Appendix N

Developing Professional Judgement and

Decision Making in Caving resource and

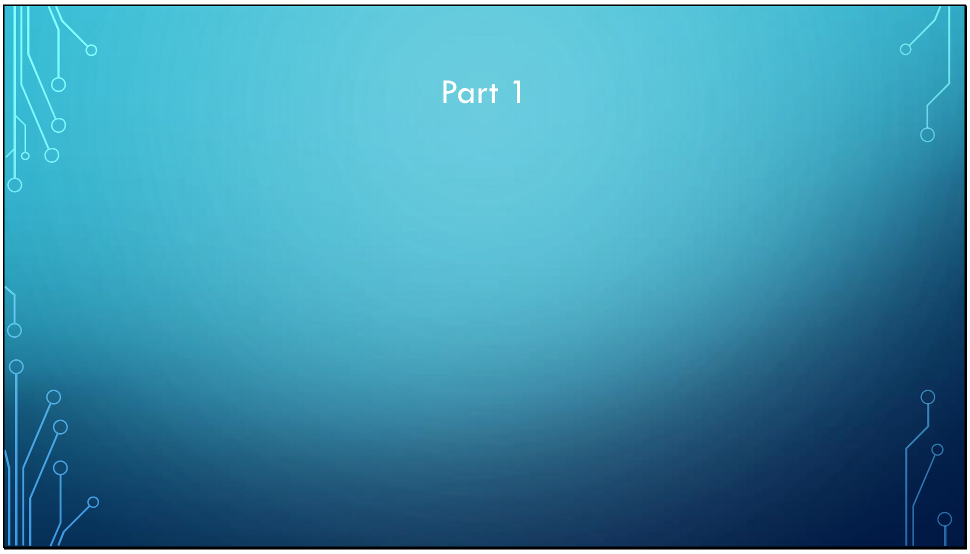
support notes

Slide 1

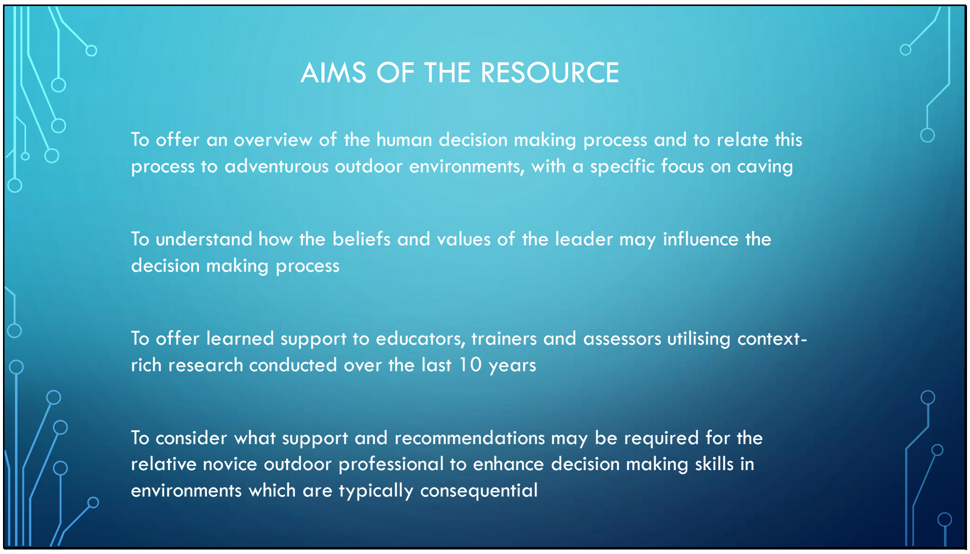


Tutor note:
The resource is in 2 parts but would be best delivered over multiple sessions (3 or 4) or take from it as appropriate to context and audience.

Slide 2

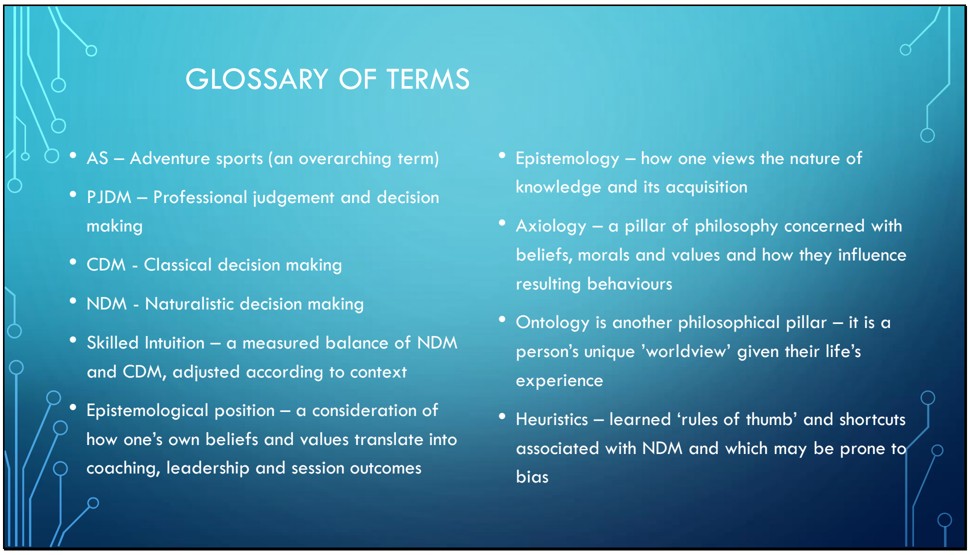


Slide 3

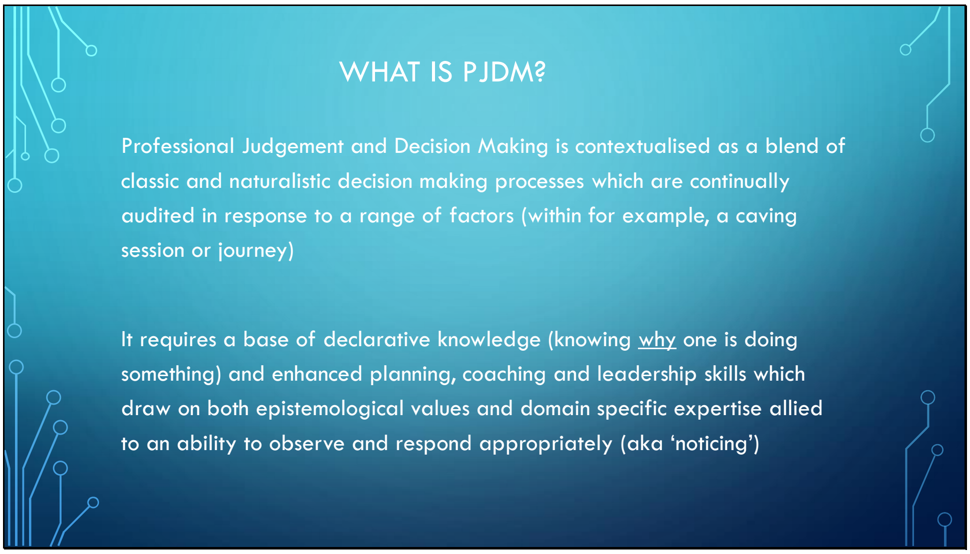


Tutor note:
The resource is based on developing decision making expertise in cavers, but is transferable to many other outdoor adventurous domains (earlier research in decision making was in mainly military, rescue, emergency response and medical contexts, latterly in competitive (mainstream) sports)

Slide 4

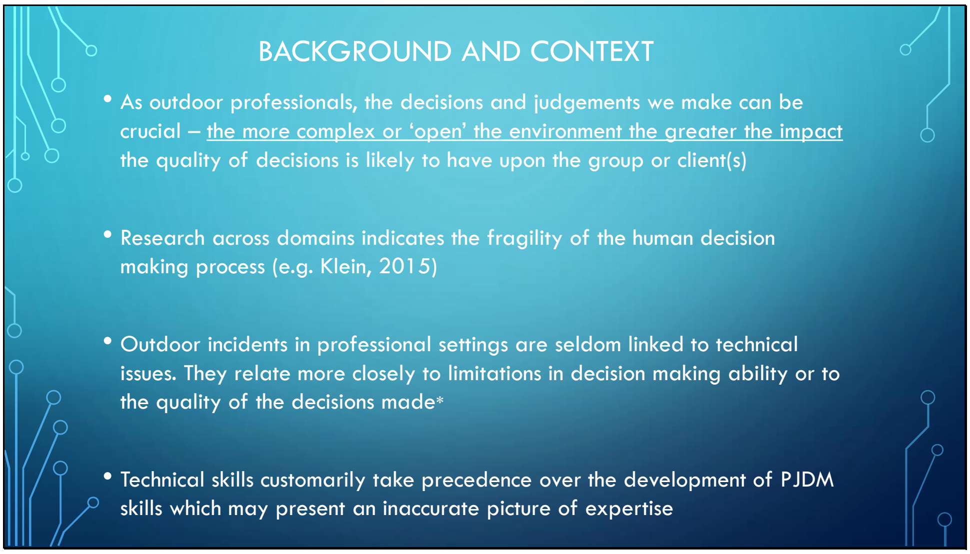


Slide 5



Tutor note:
Demands, for example, are the interactions of tasks, conditions, client capability, safety requirements, outcomes, rate of skill acquisition, fatigue, interactions with other cavers, etc

Slide 6



Tutor note:
Klein, G. (2015). A naturalistic decision making perspective on studying intuitive decision making. *Journal of Applied Research in Memory and Cognition, 4(3),* 164–168. https://doi.org/10.1016/j.jarmac.2015.07.001

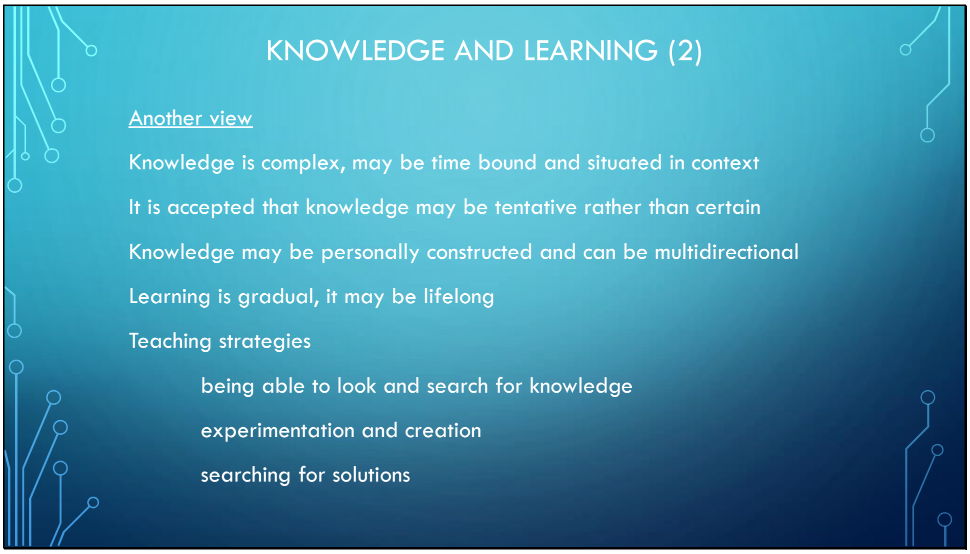
(try the counting in 7's task…)

* Mangatepopo Gorge in 2008, Cairngorms in1971 (which gave rise to the Winter Mountain Leader Scheme), Lyme Bay in 1994 (which prompted the establishment of AALA), Mares Tail Gorge, 2010, Porth yr Ogof drowning in 2002, Everest 1996, and closer to home, the spate of flooding related incidents in the Dales across 2003-2007. These were related more closely to lack of judgement expertise and decision making by the leader in one form or another, rather than technical deficiency.

Slide 7


WHAT DO WE KNOW ABOUT KNOWLEDGE AND LEARNING?
One view
Knowledge is simply structured
Knowledge is certain
The 'coach' is the font and source of knowledge which is unidirectional
Knowledge is just knowledge
Teaching strategies:
- texts or manuals to read and learn
- movements to copy, practice and repeat
Decision making processes (PJDM in action) are underpinned by our own views of knowledge and learning (epistemology)

Slide 8



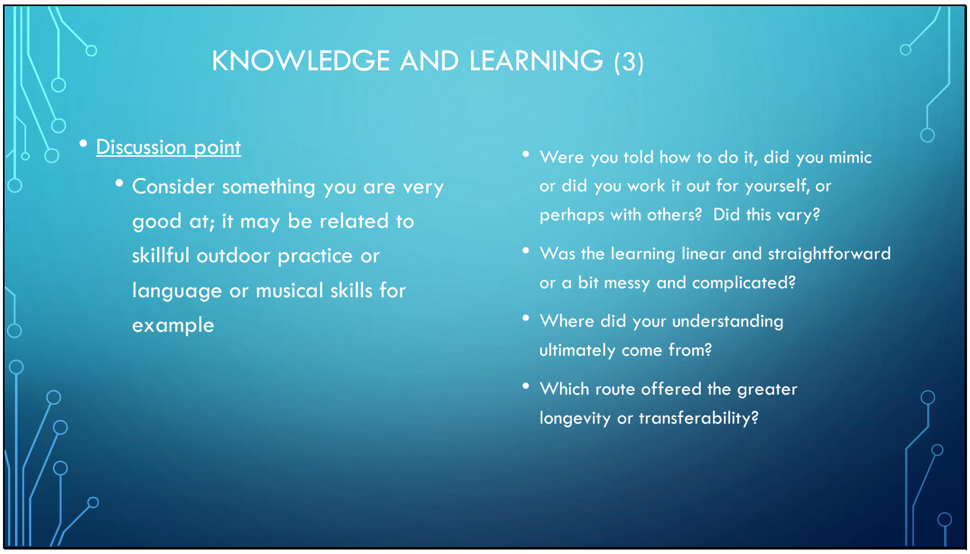
Tutor note:
These two views should be considered as positions along a spectrum, where there are good reasons for choosing either position. For example, a trait of decision making expertise is that a simple position may be adopted for specific reasons. The expert may be able to travel back and forth along this spectrum to cope with the demands of environment, pedagogy and client welfare, the novice much less easily...

…Importantly, a factor of expertise is knowing when it is necessary to adhere to procedures, and when there are times when this is not necessary or is actually advantageous (e.g., Captain Sullenberger / airplane ditching in Hudson River). This presents as an interplay of *procedural* knowledge (knowing how to do something) and *declarative* knowledge (knowledge 'about' something). This interplay is referred to as *conditional* knowledge, which is the awareness of how, when, and where (or not) to use certain strategies.

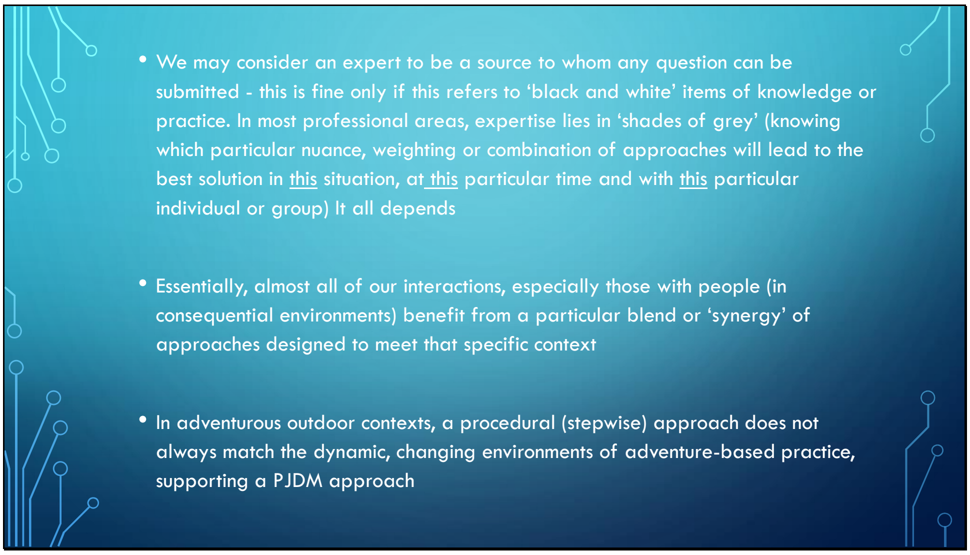
The term 'one view' and 'another view' has been purposefully used to avoid bias. One of the original authors to discuss these views of knowledge (epistemology) was Marianne Schommer – she offers a spectrum with '*naïve*' at one end,, '*sophisticated*' at the other, but *simple* to *complex* would work equally well.

Schommer, M. (1994). Synthesizing epistemological belief research: Tentative understandings and provocative confusions. *Educational psychology review*, *6*(4), 293-319.

Slide 9

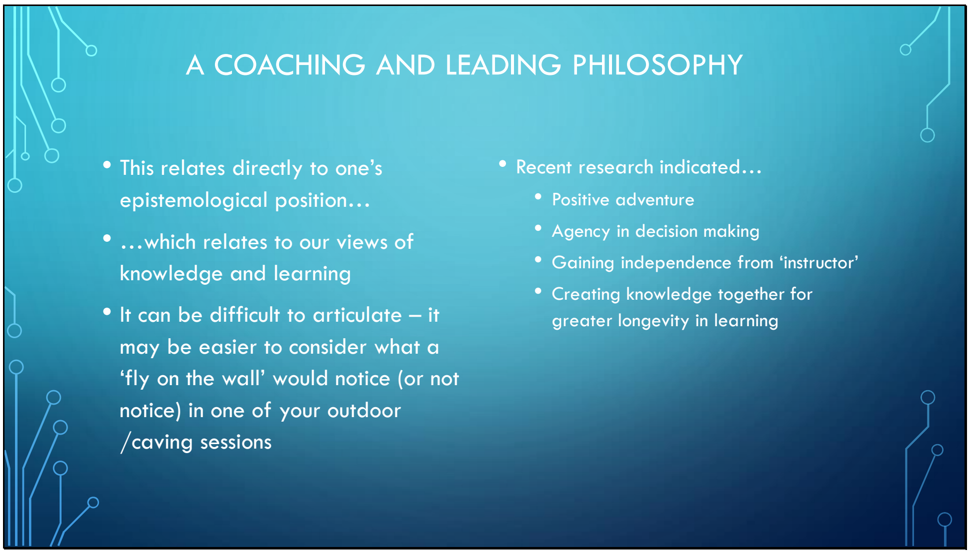


Slide 10



Tutor note:
A good example of the last point relates to the flooding incidents across the Yorkshire Dales 2003-2007 where some caving trips continued on a 'reasonable enough' forecast, but the actual conditions on the ground on the day were significantly different, yet the 'procedures' continued to be followed…

Slide 11



Tutor note:
Positive adventure refers to utilising adventure and harnessing / exploiting the risk-benefit process for purposes of human growth and learning. For example, risk in many contexts changes as skills develop allowing group management strategies and the specific involvement and roles of individuals to change

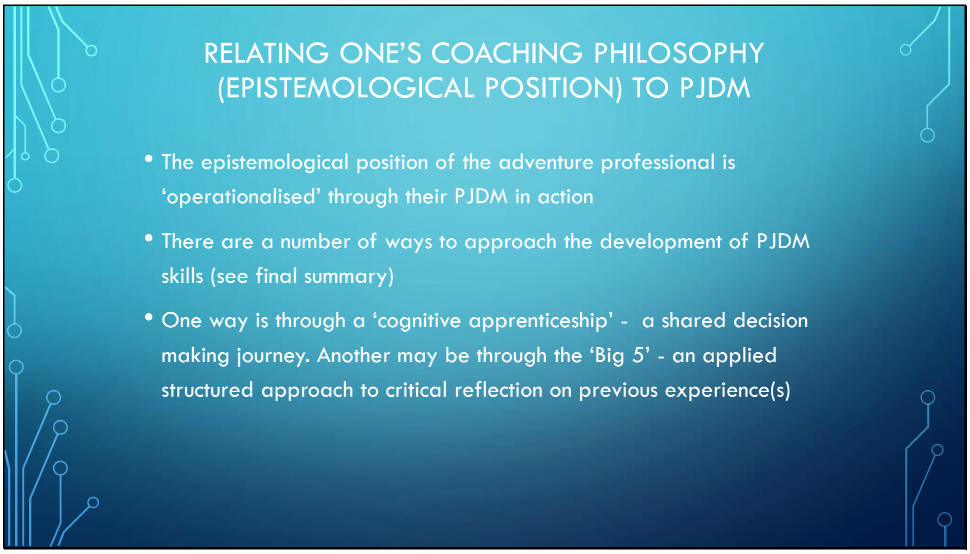
Agency refers to autonomy, or freedom to contribute or make decisions, rather than it being only in the ownership of the instructor / coach

Slide 12

Tutor note:
Picture 1 – Rock Climbing Instructor award candidates working things out for themselves with safe, distanced supervision (Shepherds Crag, Lake District, UK)
Picture 2 – Young person independently progressing on steep Italian Via Ferrata (Passo Ballino, Trentino) - *if Carlsberg did Via Ferrata…*

[Both photos author's own]

Slide 13



Tutor note:
A coaching and leading philosophy derives from the epistemological underpinning, and which is enacted via the outdoor professional's PJDM in-action.

In the adventure environment, the epistemological position is one of recognising and valuing positive adventurous experiences, the need for individualised coaching, and a focus on independent participation as an end goal.

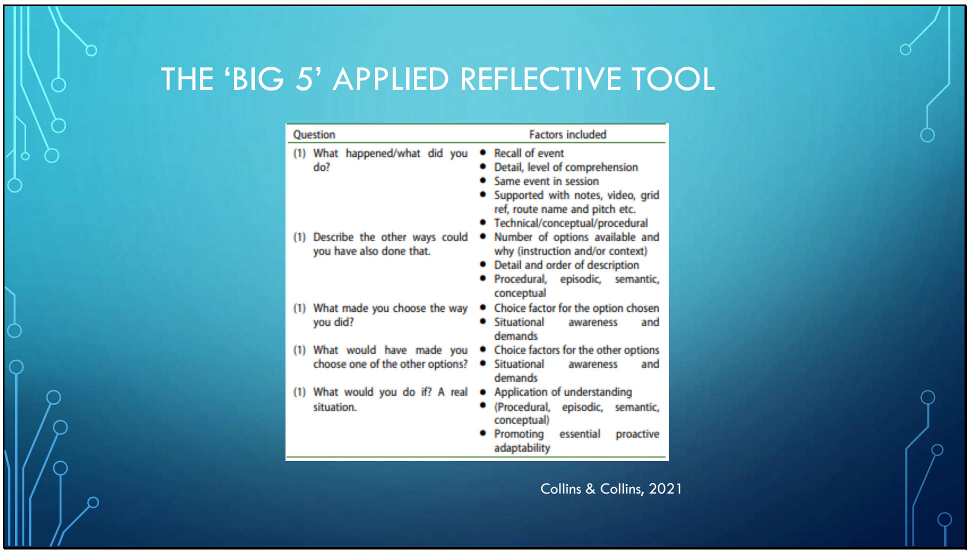
Collins, D., & Collins, L. (2021). Developing coaches' professional judgement and decision making: Using the 'Big 5'. *Journal of Sports Sciences*, *39*(1), 115-119.

Slide 14

Tutor note:

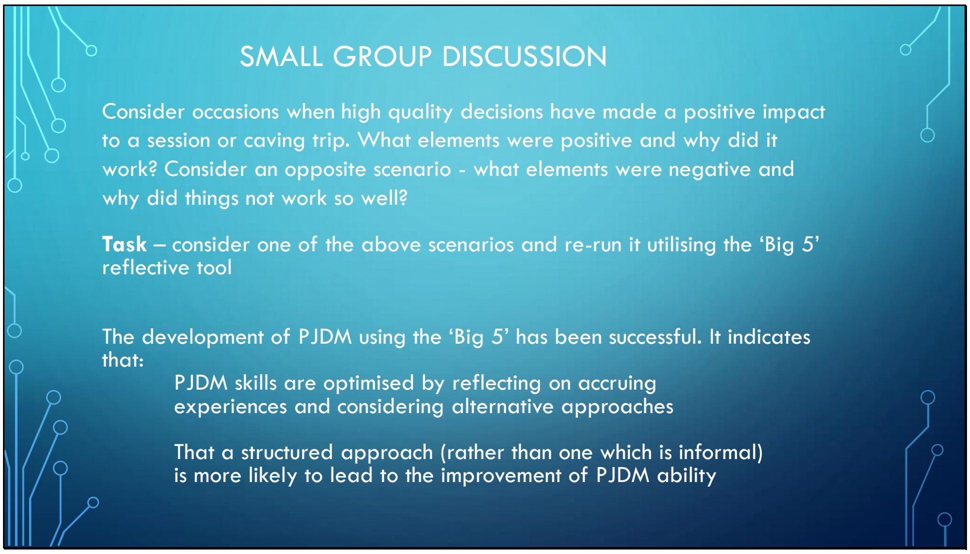
Larsen, C. E. (2015). *A case study of the cognitive apprenticeship model in leadership education* (Unpublished doctoral dissertation). University of Missouri, Columbia.

Slide 15



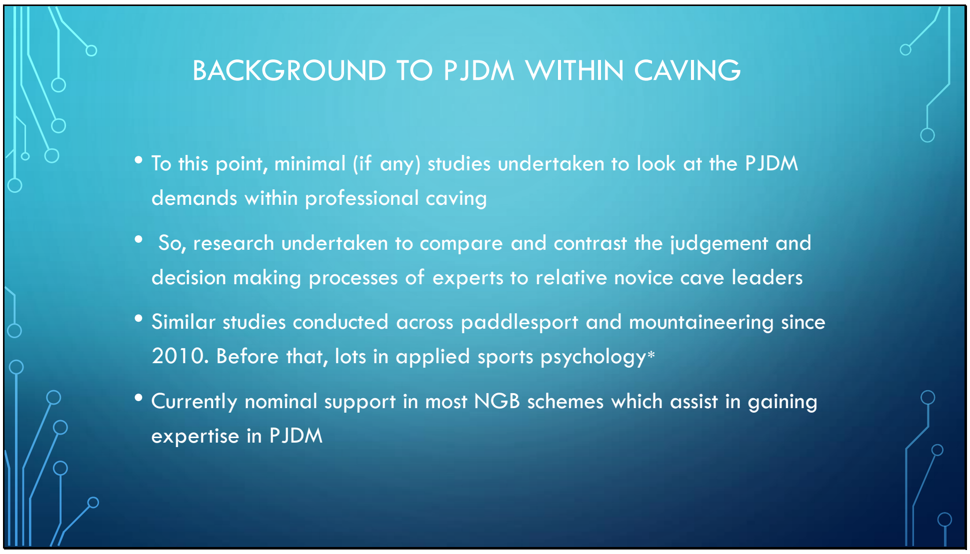
Tutor note: This tool has been extensively tested and found to be valuable in developing PJDM skills (trialled at OB)

Slide 16



Tutor note:
The Big 5 model is not revolutionary, but it does help to reinforce the PJDM development process

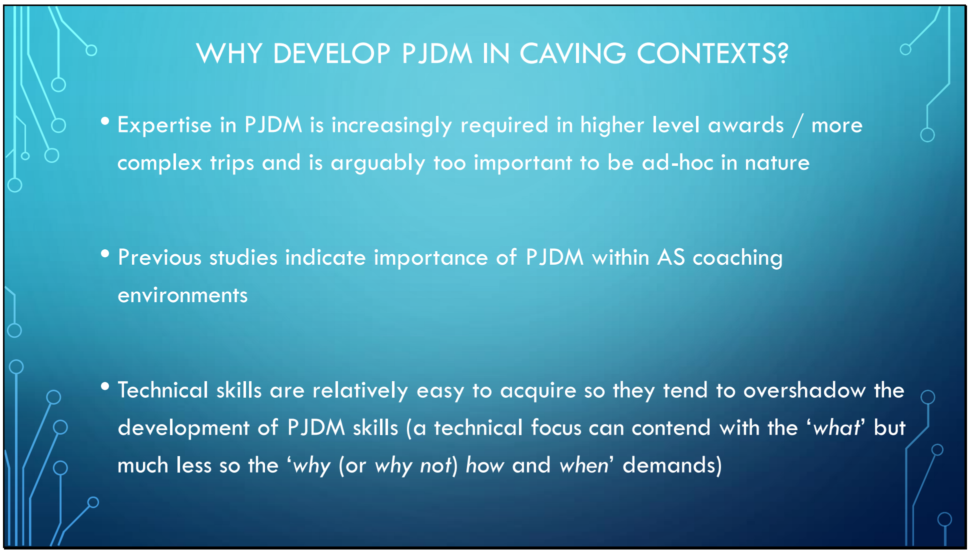
Slide 17



Tutor note:
* In sports psychology, the emphasis has been on performance to achieve medals, where 'failure' has resulted in disappointment / withdrawal of funding etc.
In adventure sports, failure can lead to loss of life or significant physical or emotional trauma.

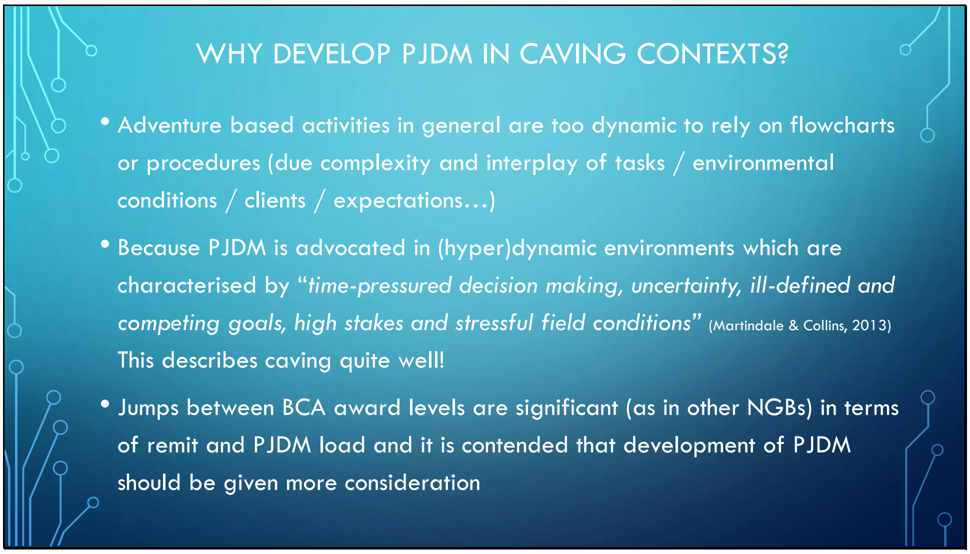
Experts in the caving studies were a group of CICs with a minimum of 10 years' experience post accreditation.
Relative novice cave leaders were a group who had recently passed (within 1 year) their Level 1 award

Slide 18



Tutor note: Reminder - AS = adventure sports

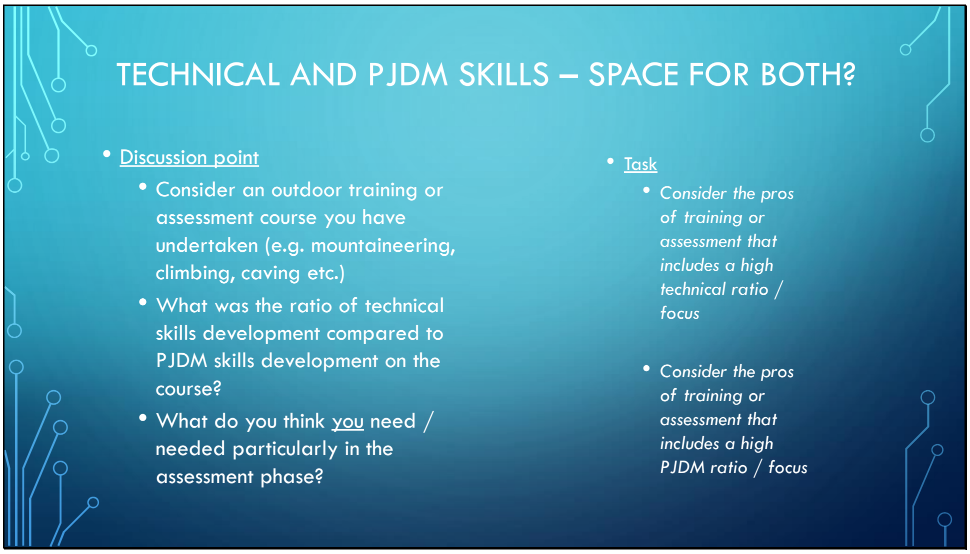
Slide 19



Tutor note:

Martindale, A., & Collins, D. (2013). The development of professional judgment and decision making expertise in applied sport psychology. *The Sport Psychologist, 27*, 390–398. https://doi.org/10.1123/tsp.27.4.390

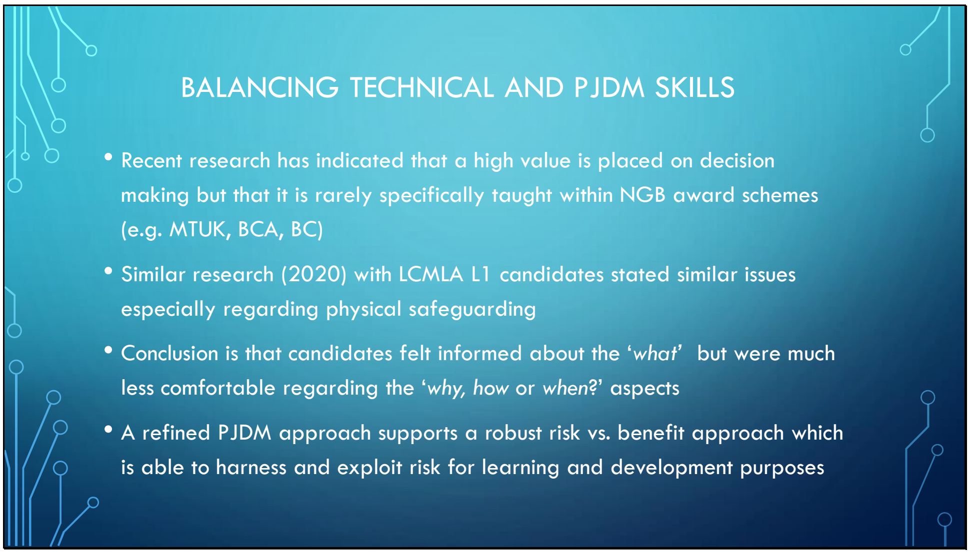
Slide 20



Tutor note:
Useful extra task especially as many are aware of the emergency Hudson River ditching – normal levels of pilot technical skill combined with higher order PJDM!

Q. Think of a CIC or WMCI / Guide who you consider to be expert. Is this higher performing caving / mountain instructor better at the technical aspects, or the PJDM aspects in comparison to other professional colleagues who you consider to be less expert than the one chosen? Where do the key differences lie? (consider the air emergency / ditching in the Hudson River (USA) - the pilot's skills (Sullenberger) were not exceptional, but his PJDM skills certainly were).

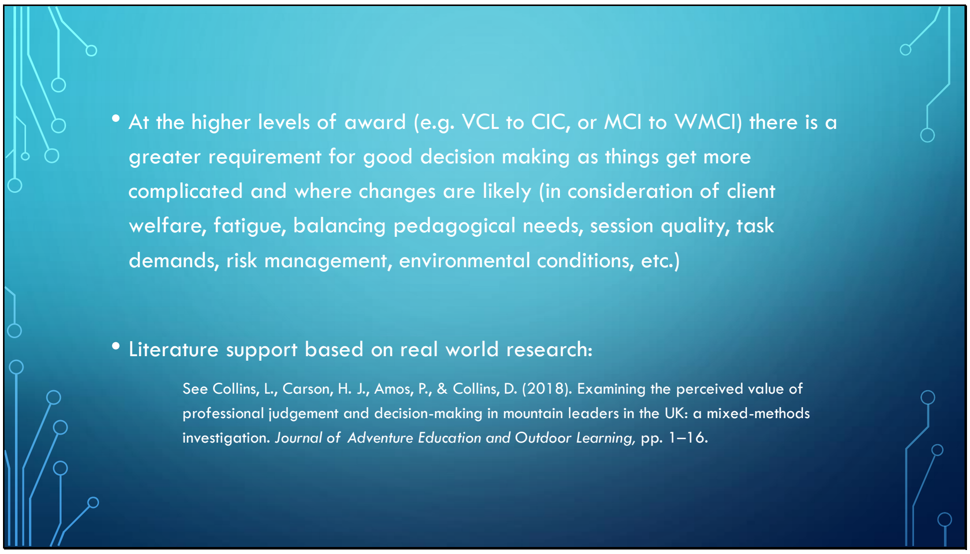
Slide 21



Tutor reminder:
LCMLA L1 = Local Cave and Mine Leader Award (Level 1) - [introductory stage]
MTUK – Mountain Training UK – the umbrella organisation for National Governing Awards in climbing / mountaineering.
BC – British Canoeing
BCA – British Caving Association

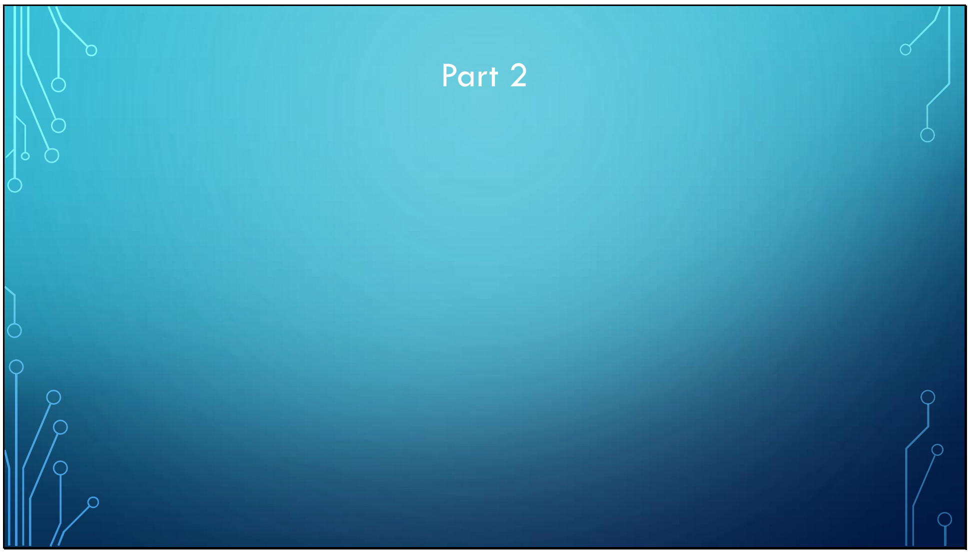
Physical safeguarding in this context refers to spotting, belaying etc.

Slide 22

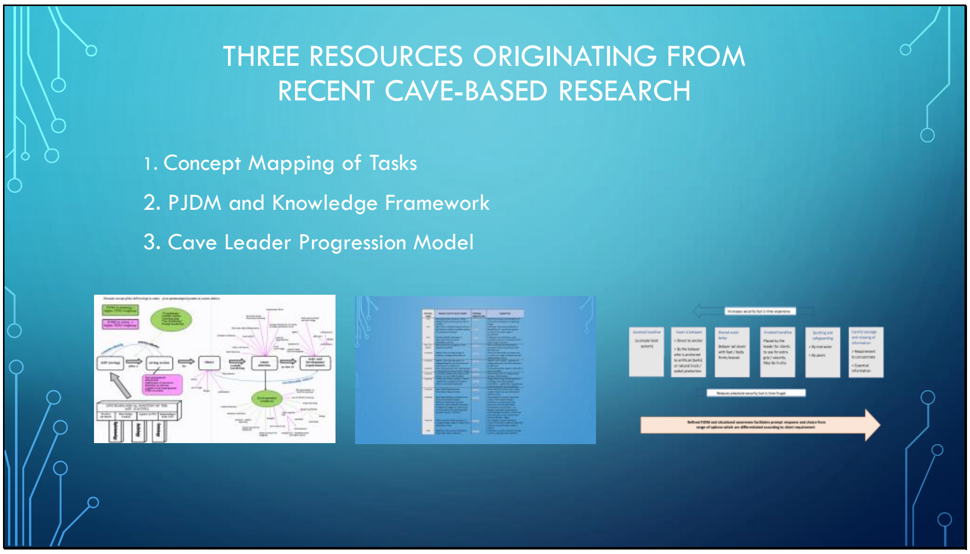


Tutor note:
Newer caving awards terms implemented (Sept 2019) to reflect the remit of the award to the layperson (as Mountain training did with MIA to MCI for example, in April 2019))
VCL = Vertical Cave Leader
CIC = Cave Instructor Certificate
MCI = Mountaineering and Climbing Instructor (W = winter)

Slide 23

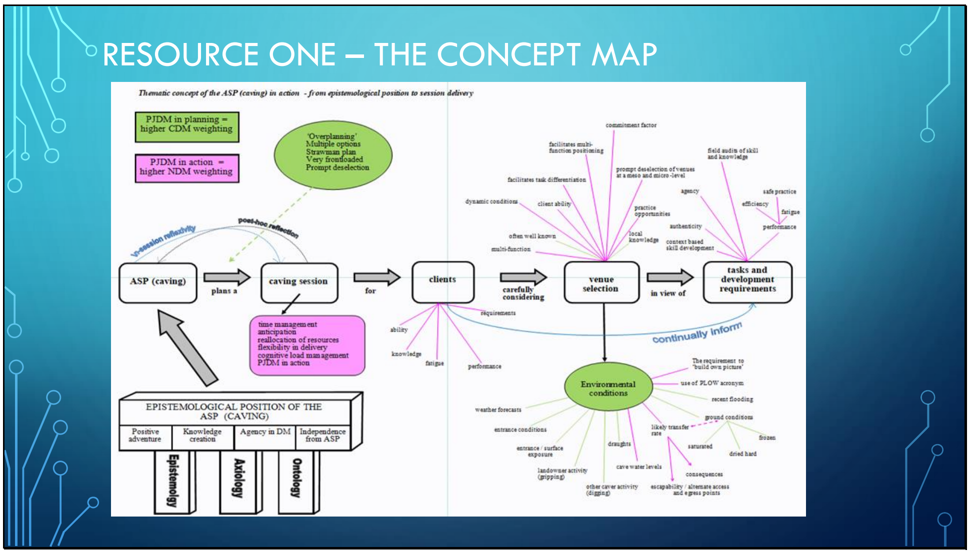


Slide 24



Tutor note:
More detail on each follow

Slide 25

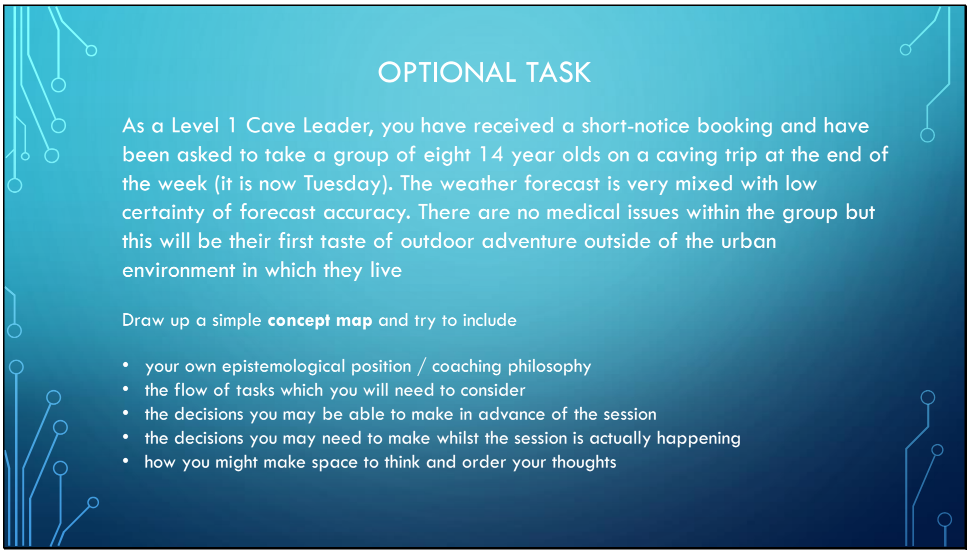


Tutor note:
The concept mapping of tasks highlights the range of PJDM and organisational demands placed upon the Cave Leader – this does not include the vertical elements!

Reminder Glossary
Epistemology, axiology and ontology are the three main pillars of philosophy, which essentially underpin all our values, beliefs and behaviours, whether we like it or not.

Epistemology is how you view the nature of knowledge; for example, if you think repetitive learning or practice is better than working things out for oneself, or if it is felt that knowledge only comes from ‘the teacher’ in one direction, or that it can be shared and be multidirectional.
Axiology is concerned with your beliefs, morals and values and how they influence your resulting behaviours. This could range from picking up a piece of litter on the street or not, to intervening when someone is being bullied, or not.
Another word used for ontology is ’worldview’ and this is exclusive for each person – essentially we have all developed under unique conditions (parents, jobs, education, places lived etc. etc.). Therefore, this aspect influences our behaviour and viewpoints too and can be quite powerful.
CDM on the concept map refers to Classical Decision Making (logical, planned, the pre-planning that occurs in resource rich environments – may be the night before with guidebooks and topos, with coffee or beer to hand).
NDM refers to Naturalistic Decision Making which is ‘seat of the pants’, in a hurry, often with incomplete information – sometimes referred to as intuition, (although technically it isn’t – it’s speedy access to NDM processes).
The blending of aspects of CDM and NDM in varying ratios according to the demands faced is occasionally termed skilled intuition, which sounds about right.

Slide 26

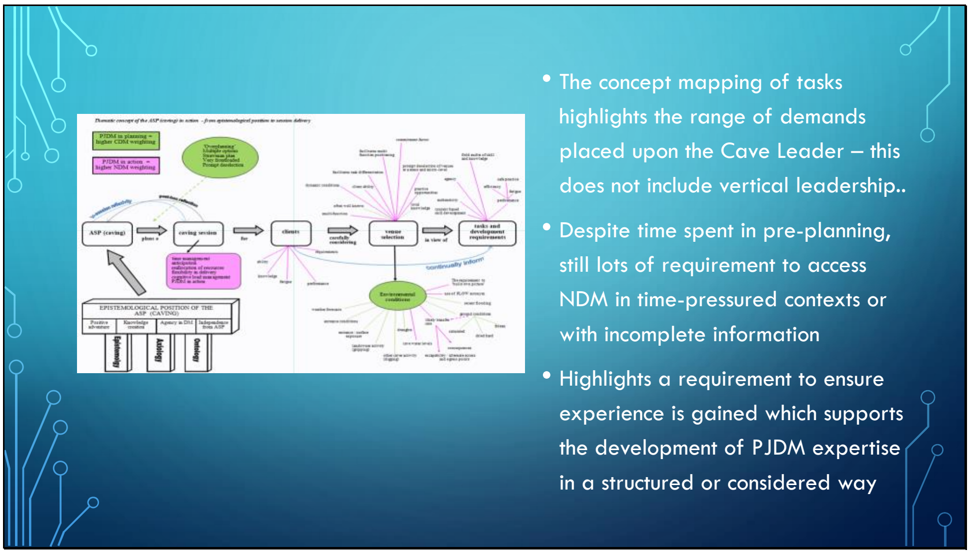


Tutor note:
At this point I would looking to see if this task brings some of the learning of Part 1 to life – for example are the terms coaching philosophy and epistemology making sense? It may also help leaders take time to comprehend the range of tasks and demands made on them (which seldom occurs).
If there is limited caving experience for some, the scenario could easily be transferred into a mountaineering or paddlesport domain.

This is a great chance to cement learning and open up discussions - flip chart and big pens for this one!

Working in pairs or small groups that then check back in with the whole group is advocated.

Slide 27

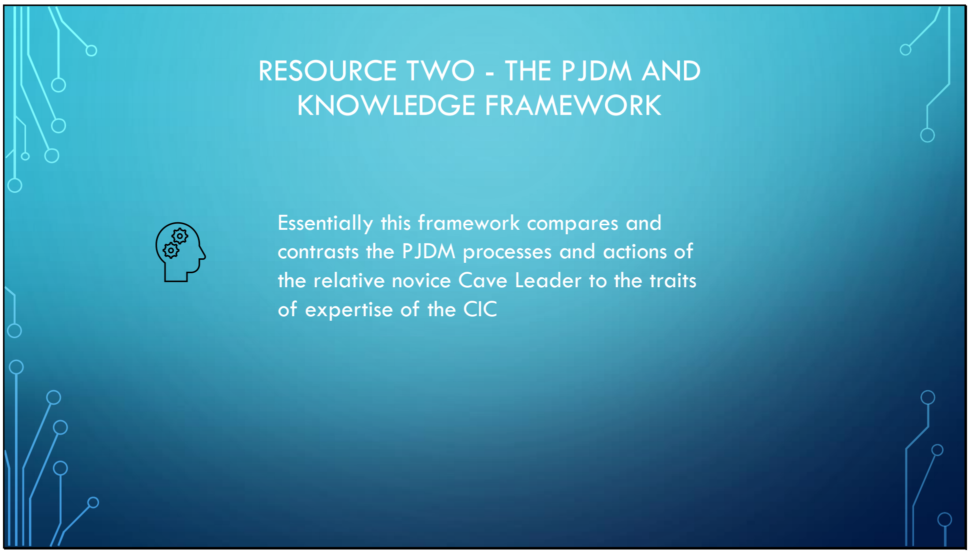


Tutor note:
This may help in comprehension that despite lots of high quality pre-planning, there are still many decisions to make in time pressured / incomplete information situations.

Situating decision making - within PJDM the balance, ratio or weighting of CDM and NDM is dependent on context. For example, planning and review is more weighted (or biased) to CDM, in action it is more weighted (or biased) to NDM, and…

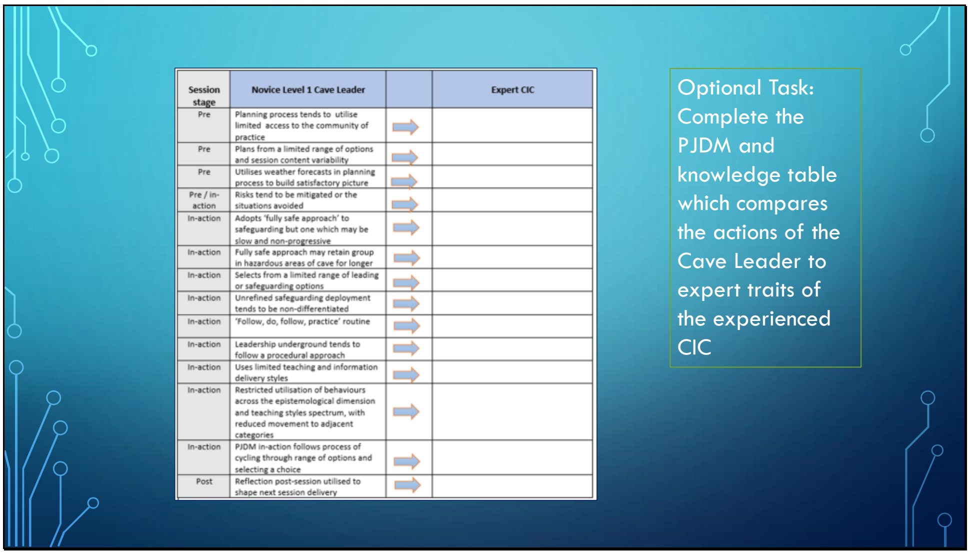
…a factor of expertise seems to be that there is a continual audit / review of a thinking process that self-checks through in-action reflection, which generates the rhetorical questions of "*Have I made the call in the right way?*" *Can I go with my gut feel here?* (higher NDM bias) or *should I create time and space for a more logical approach?* (higher CDM bias)

Slide 28



Tutor note:
This next section begins a compare and contrast processes based on recent pragmatic research undertaken ‘in the field’. It also includes an indication about what expert decision makers generally do (i.e., surgeons, firefighters etc.)

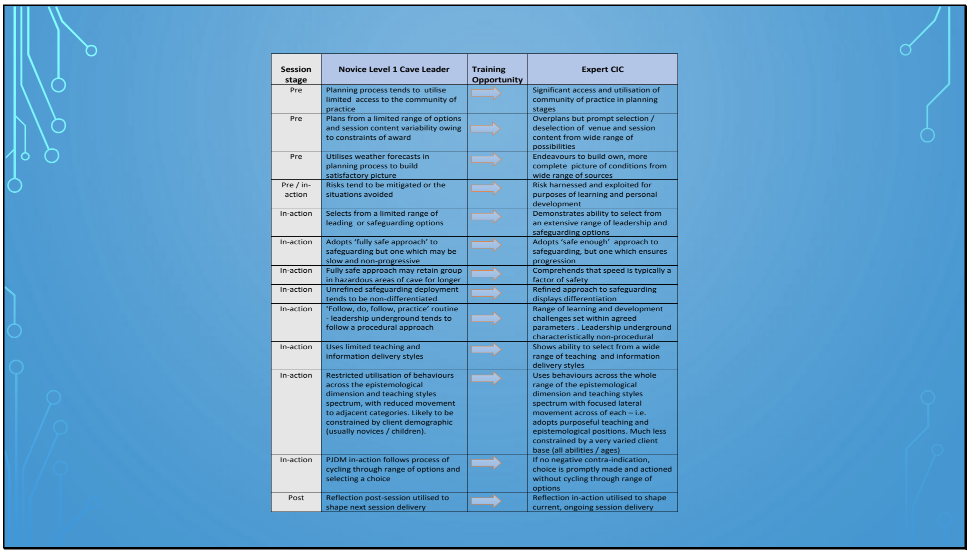
Slide 29



Session stage	Novice Level 1 Cave Leader		Expert CIC
Pre	Planning process tends to utilise limited access to the community of practice		
Pre	Plans from a limited range of options and session content variability		
Pre	Utilises weather forecasts in planning process to build satisfactory picture		
Pre / in-action	Risks tend to be mitigated or the situations avoided		
In-action	Adopts ‘fully safe approach’ to safeguarding but one which may be slow and non-progressive		
In-action	Fully safe approach may retain group in hazardous areas of cave for longer		
In-action	Selects from a limited range of leading or safeguarding options		
In-action	Unrefined safeguarding deployment tends to be non-differentiated		
In-action	‘Follow, do, follow, practice’ routine		
In-action	Leadership underground tends to follow a procedural approach		
In-action	Uses limited teaching and information delivery styles		
In-action	Restricted utilisation of behaviours across the epistemological dimension and teaching styles spectrum, with reduced movement to adjacent categories		
In-action	PJDM in-action follows process of cycling through range of options and selecting a choice		
Post	Reflection post-session utilised to shape next session delivery		

Tutor note: Recommend splitting down into small groups and tackling specific sections which the small groups / pairs relate back to one another.

Slide 30

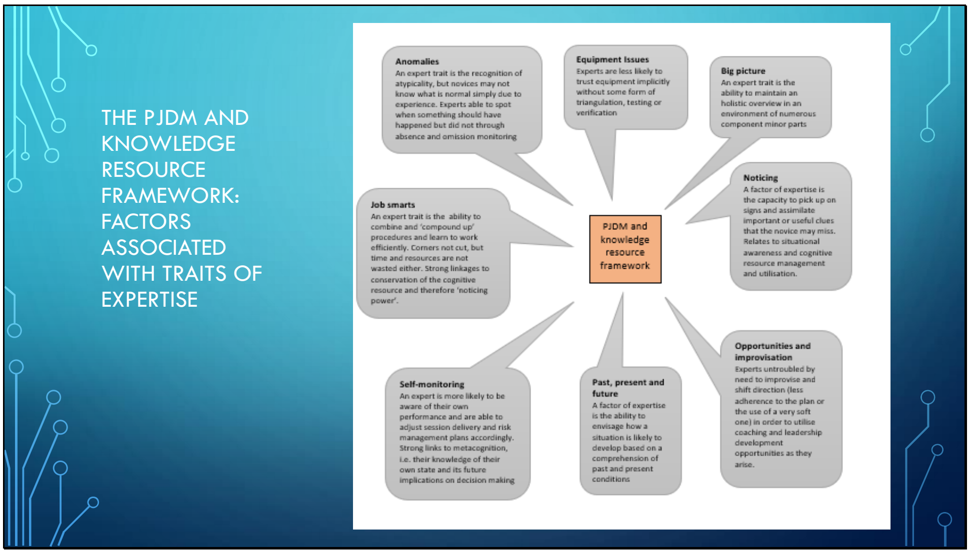


Session stage	Novice Level 1 Cave Leader	Training Opportunity	Expert CIC
Pre	Planning process tends to utilise limited access to the community of practice		Significant access and utilisation of community of practice in planning stages
Pre	Plans from a limited range of options and session content variability owing to constraints of award		Overplans but prompt selection / deselection of venue and session content from wide range of possibilities
Pre	Utilises weather forecasts in planning process to build satisfactory picture		Endeavours to build own, more complete picture of conditions from wide range of sources
Pre / in-action	Risks tend to be mitigated or the situations avoided		Risk harnessed and exploited for purposes of learning and personal development
In-action	Selects from a limited range of leading or safeguarding options		Demonstrates ability to select from an extensive range of leadership and safeguarding options
In-action	Adopts 'fully safe approach' to safeguarding but one which may be slow and non-progressive		Adopts 'safe enough' approach to safeguarding, but one which ensures progression
In-action	Fully safe approach may retain group in hazardous areas of cave for longer		Comprehends that speed is typically a factor of safety
In-action	Unrefined safeguarding deployment tends to be non-differentiated		Refined approach to safeguarding displays differentiation
In-action	'Follow, do, follow, practice' routine - leadership underground tends to follow a procedural approach		Range of learning and development challenges set within agreed parameters . Leadership underground characteristically non-procedural
In-action	Uses limited teaching and information delivery styles		Shows ability to select from a wide range of teaching and information delivery styles
In-action	Restricted utilisation of behaviours across the epistemological dimension and teaching styles spectrum, with reduced movement to adjacent categories. Likely to be constrained by client demographic (usually novices / children).		Uses behaviours across the whole range of the epistemological dimension and teaching styles spectrum with focused lateral movement across of each – i.e. adopts purposeful teaching and epistemological positions. Much less constrained by a very varied client base (all abilities / ages)
In-action	PJDM in-action follows process of cycling through range of options and selecting a choice		If no negative contra-indication, choice is promptly made and actioned without cycling through range of options
Post	Reflection post-session utilised to shape next session delivery		Reflection in-action utilised to shape current, ongoing session delivery

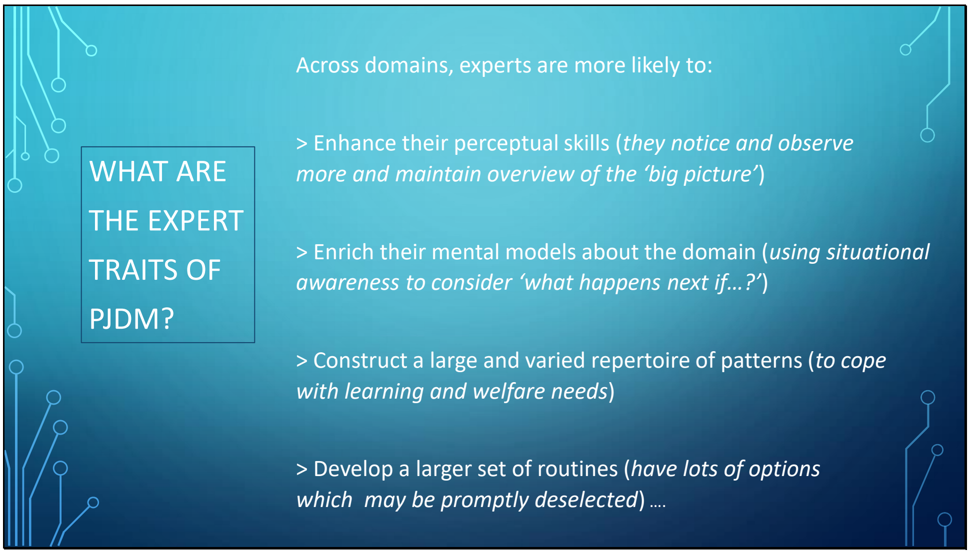
Tutor note:

- This not the 'answer' sheet, but an indication of expert traits of the sample of experienced CICs, but it should serve as a solid benchmark.
- Perhaps identify 2 or 3 areas to explore that are relevant to yourself or the group.
- Are any differences that are noted due to experience levels, technical competence or the epistemological stance of the participants?
- Ask if this table serves to identify the differences in PJDM capability and coaching expertise and consider how the training gaps (indicated by the arrows) may begin to be bridged.
- Do the 'training gaps' need to be bridged?

Slide 31

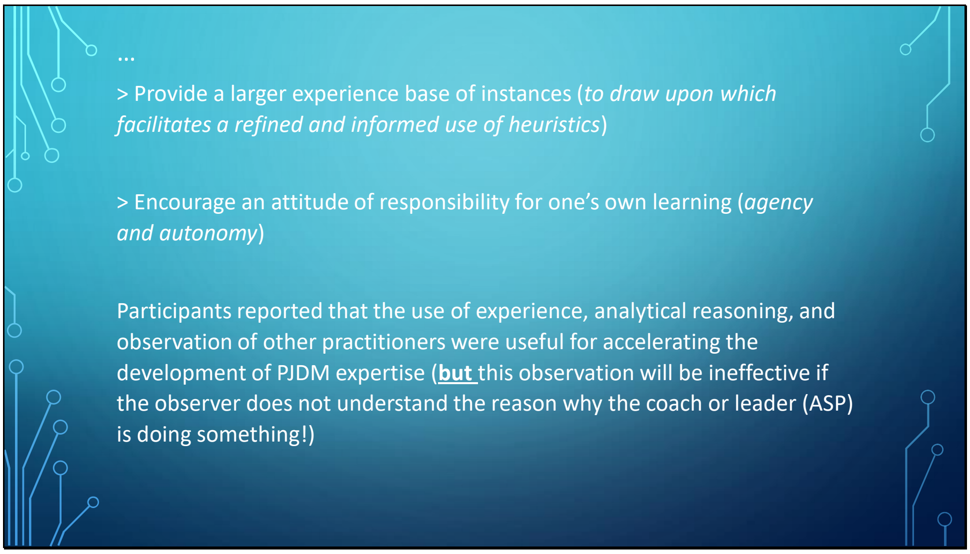


Slide 32



Tutor note:
The standard text indicates the generalised traits, the italics reference to caving / outdoor contexts specifically

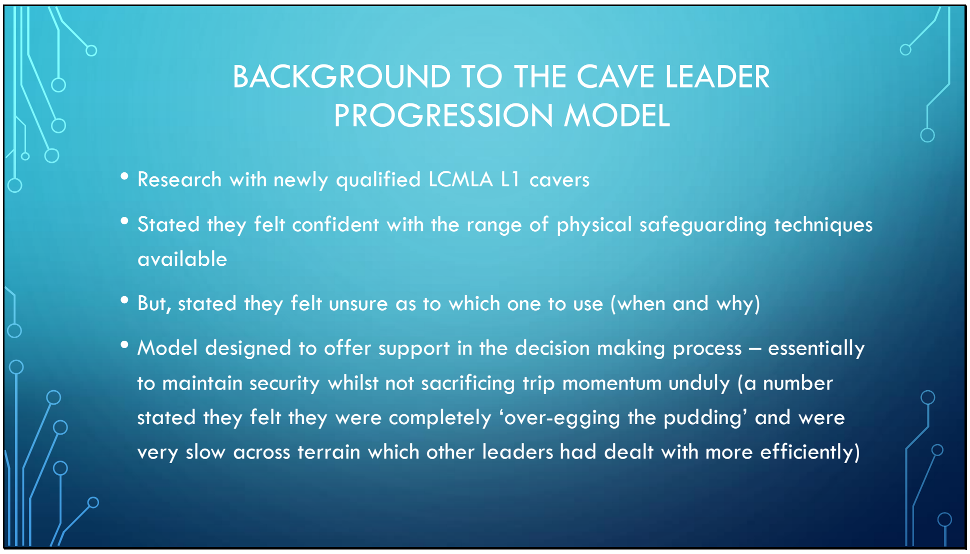
Slide 33



Tutor note:
For more detail see Phillips et al., (2004)

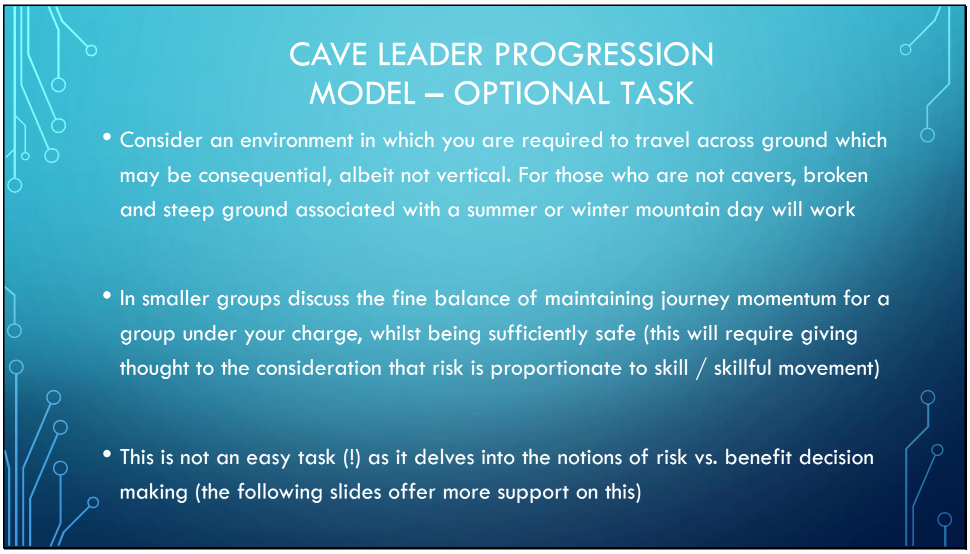
Phillips, J. K., Klein, G., & Sieck. W. R. (2004). Expertise in judgment and decision making: a case for training intuitive decision skills. In D. K. Koehler and N. Harvey (Eds.). *Blackwell Handbook of Judgment and Decision Making*. Wiley-Blackwell

Slide 34



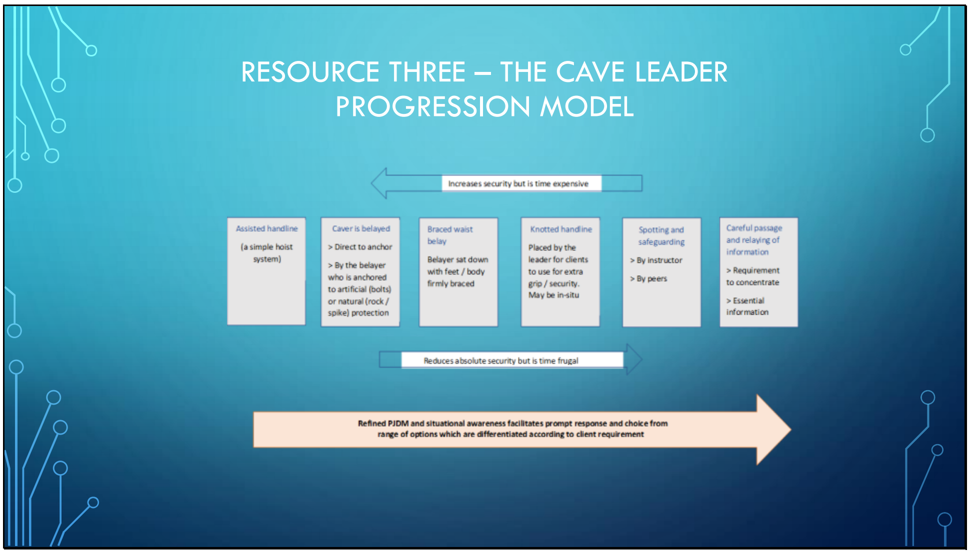
Tutor note:
Research conducted in 2020/1

Slide 35



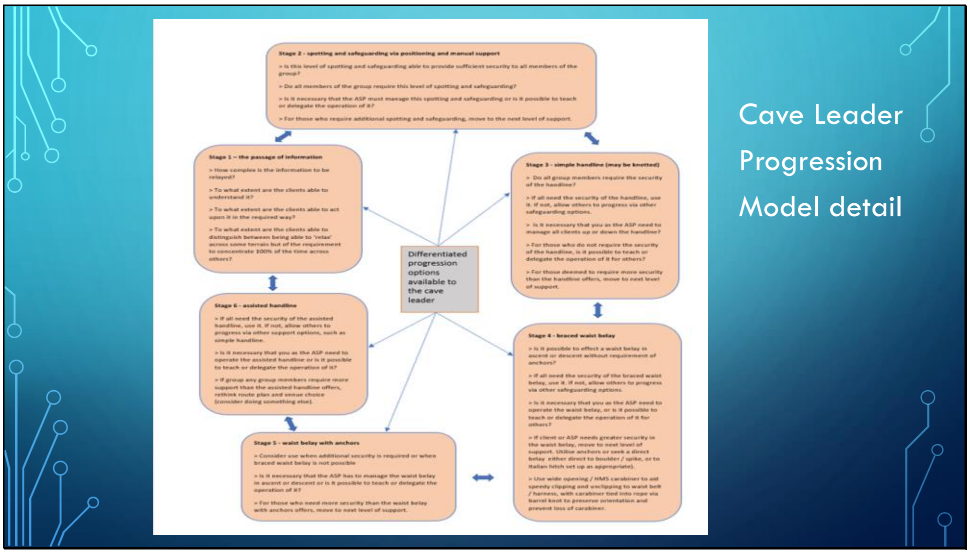
Tutor note:
This looks at the *grey area* of 'broken ground' – not quite safe enough to just walk across, but not necessarily requiring immediate deployment of the rope

Slide 36



Tutor note:
This model is not designed to encourage cave leaders to become less safe or to rush, more to consider their practice in the realistic environments of underground leadership where being too slow can also be problematic (for example participants getting cold). The practically based research indicated that all participants received the same level of physical safeguarding regardless of individual competence and that as PJDM expertise develops, a more differentiated approach can at times be beneficial

Slide 37



Tutor note:
These notes included if text too small for some

Stage 1 – the passage of information
> How complex is the information to be relayed?
> To what extent are the clients able to understand it?
> To what extent are the clients able to act upon it in the required way?
> To what extent are the clients able to distinguish between being able to relax across some terrain but of the requirement to concentrate 100% of the time across others?
> For those who are not comfortable with any aspects of the above, move to the next level of support.
Stage 2 - spotting and safeguarding via positioning and manual support
> Is this level of spotting and safeguarding able to provide sufficient security to all members of the group?
> Do all members of the group require this level of spotting and safeguarding?
> Is it necessary that the ASP must manage this spotting and safeguarding or is it possible to teach or delegate the operation of it?
> For those who require additional spotting and safeguarding, move to the next level of support.
Stage 3 - simple handline (may be knotted)
> Do all group members require the security of the handline?
> If all need the security of the handline, use it. If not, allow others to progress via other safeguarding options.
> Is it necessary that you as the ASP need to manage all clients up or down the handline?
> For those who do not require the security of the handline, is it possible to teach or delegate the operation of it for others?
> For those deemed to require more security than the handline offers, move to next level of support.
Stage 4 - braced waist belay
> Is it possible to effect a waist belay in ascent or descent without requirement of anchors?

> If all need the security of the braced waist belay, use it. If not, allow others to progress via other safeguarding options.
> Is it necessary that you as the ASP need to operate the waist belay, or is it possible to teach or delegate the operation of it for others?
> If client or ASP needs greater security in the waist belay, utilise anchors or seek a direct belay (either direct to boulder / spike, or to Italian hitch set up as appropriate).
> Use wide opening / HMS carabiner to aid speedy clipping and unclipping to waist belt / harness, with carabiner tied into rope via barrel knot to preserve orientation and prevent loss of carabiner.
> For those who need more security than the handline offers, move to next level of support.

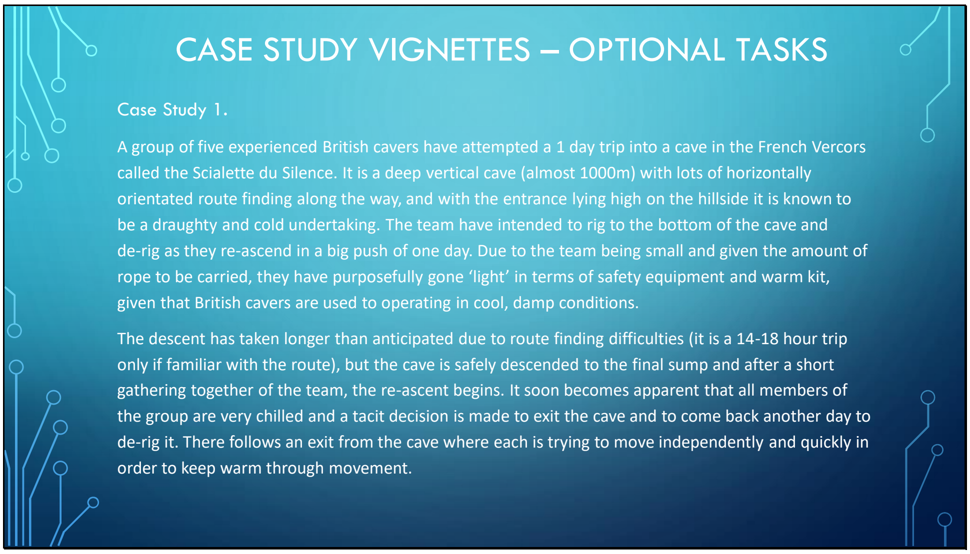
Stage 5 - waist belay with anchors

> Consider use when additional security is required or when braced waist belay is not possible
> Is it necessary that the ASP has to manage the waist belay in ascent or descent or is it possible to teach or delegate the operation of it?
> For those who need more security than the waist belay with anchors offers, move to next level of support.

Stage 6 - assisted handline

> If all need the security of the assisted handline, use it. If not, allow others to progress via other support options, such as simple handline.
> Is it necessary that you as the ASP need to operate the assisted handline or is it possible to teach or delegate the operation of it?
> If group any group members require more support than the assisted handline offers, rethink route plan and venue choice (consider doing something else).

Slide 38

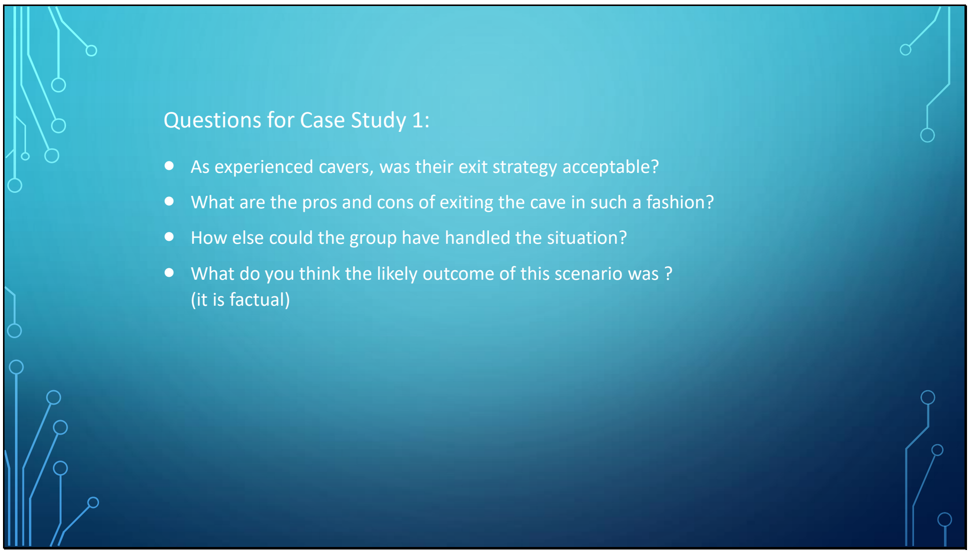


Tutor note:
There are two vignettes – both are based on real, factual events

Perhaps take care not to reveal the outcomes and reflections which are stated within the notes section under the slides until the group(s) have had the opportunity to work things through.

Use of critical incident review for purposes of learning has found to be very beneficial in developing decision making. (see Hickman, M., & Stokes, P. (2016). Beyond learning by doing: An exploration of critical incidents in outdoor leadership education. *Journal of Adventure Education and Outdoor Learning*, *16*(1), 63-77).

Slide 39



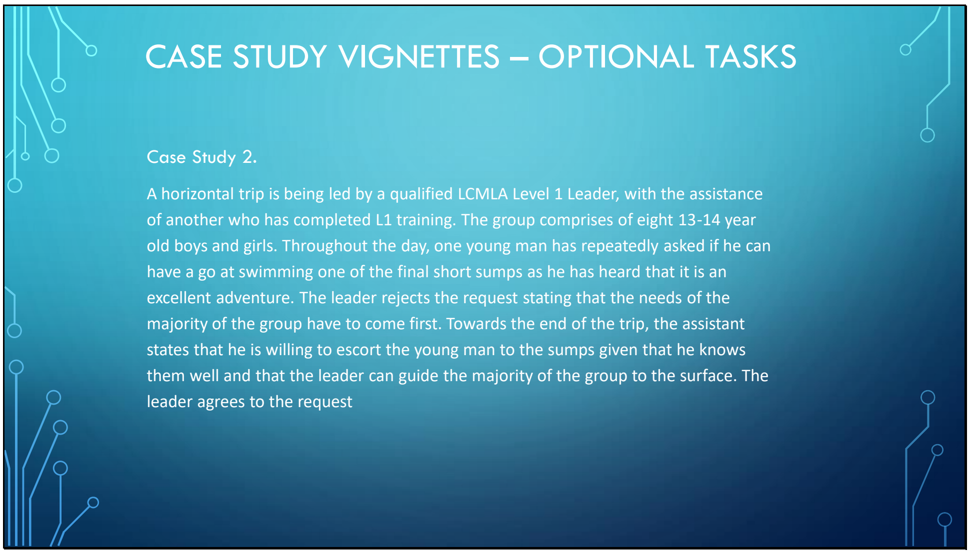
Tutor note:
<u>Outcome</u>

(On the surface, four tired and cold cavers begin to reflect on their trip but soon realise that the fifth is missing. The team decide to wait to see if their colleague emerges. After approximately 2 hours they get ready to descend back into the cave, only to find their colleague shaken but unhurt on the final pitch coming to the surface. It transpires that he had taken a wrong turn on one of the horizontal sections and progressed along a cave passage which became tighter and tighter until he felt himself becoming stuck. He realised his error and had to slowly inch his way backwards to the junction that had been missed. Completely alone, he had a harrowing experience, coming close to becoming completely stuck in a tight and unmapped side passage).

<u>Reflection and learning</u>

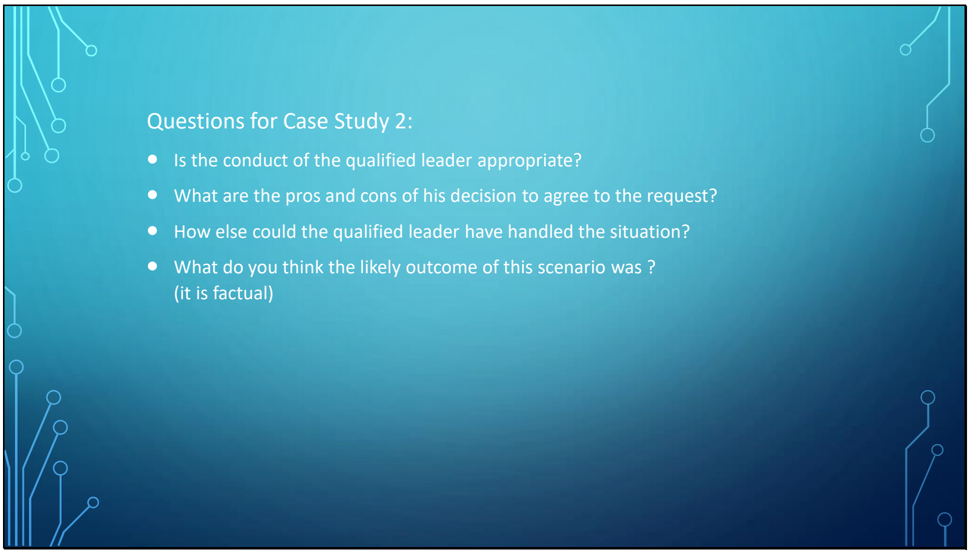
(One of the team is a CIC trainer and assessor, is very competent and among the most experienced of British cavers. Following the incident, he has completely revised his way of working so that such scenarios and ones similar cannot happen again. For example, caving in pairs, putting marker tape on junctions which can be missed when tired / stressed, making space for a group shelter and making time to re-warm rather than rushing out).

Slide 40



Tutor note:
This was based in the Mendips, Somerset, UK.

Slide 41



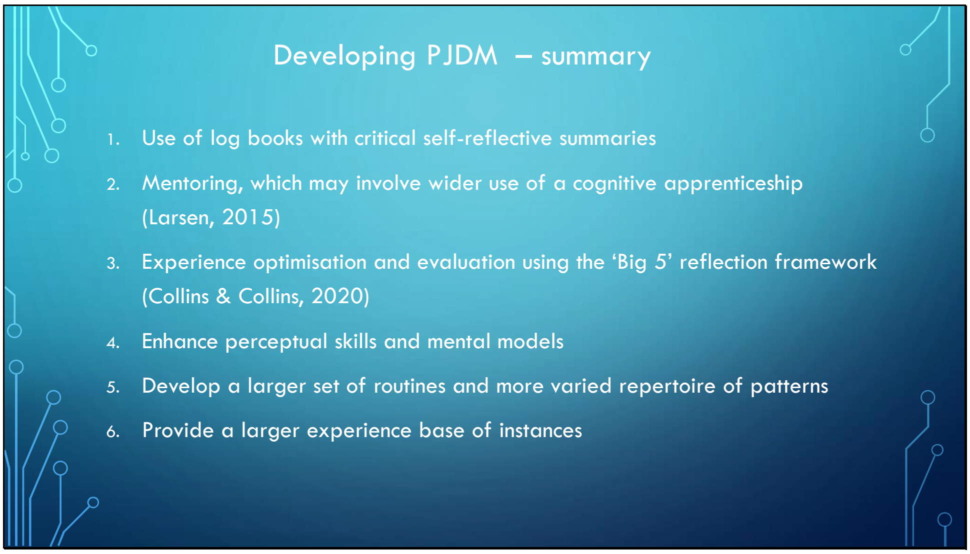
Tutor note:
<u>Outcome</u>

(Once at the sumps, the assistant leader and young man enter the water but after a short while the youngster realises that he is not up to the challenge of being fully submerged, but both are now soaked from chin to toes. On travelling away from the sumps to re-join the group at the surface, the assistant leader realises that the young man is exhausted and becoming hypothermic – no contingency plans are in place and nor is any spare equipment or first aid being carried. Eventually the two re-join the group to anxious faces, given the delays in returning and the fact that both are obviously exhausted – the young man from his day of caving and immersion, the trainee leader from supporting him back to the surface).

<u>Reflection</u>

(The qualified leader reflected on his own part in this situation and is very disappointed by his decision making. He admits that he acceded to the requested partly through peer pressure and knowing the assistant to be generally quite competent. He later openly recorded the incident as a near miss and has given serious thought to his decision making processes in terms of setting the session up with regards to roles, outcomes and expectations. For the assistant leader this was a significant 'wake-up call' with regards to the fact that he had supported a plan which involved a sub-party to be going in exactly the opposite direction underground of the main group. The assistant was alone with an under 16 year old, with no spare lighting, 1st aid kit or group shelter etc. Both received a formal warning from the outdoor education centre manager under whom they were both working).

Slide 42

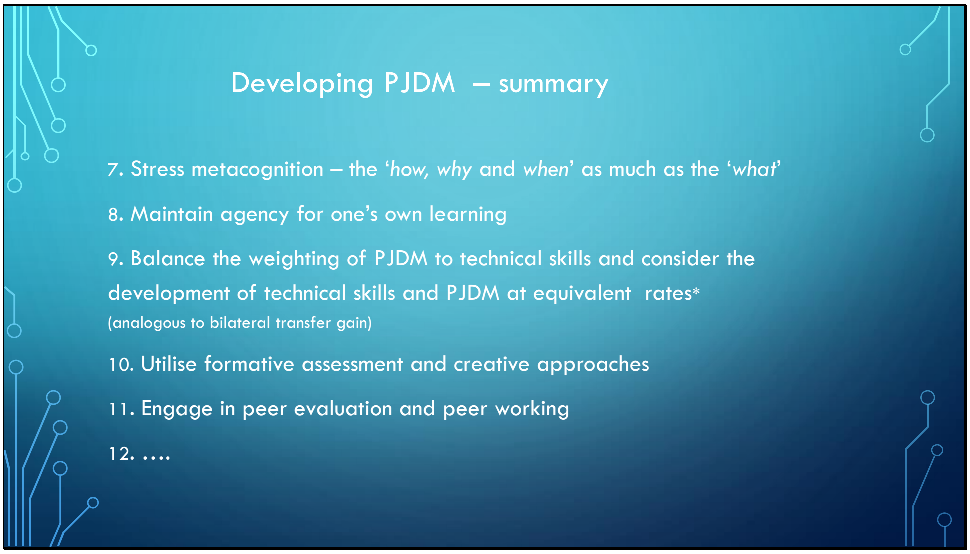


Tutor note:

Collins, D., & Collins, L. (2021). Developing coaches' professional judgement and decision making: Using the 'Big 5'. *Journal of Sports Sciences*, *39*(1), 115-119

Larsen, C. E. (2015). *A case study of the cognitive apprenticeship model in leadership education* (Doctoral dissertation, University of Missouri--Columbia)

Slide 43



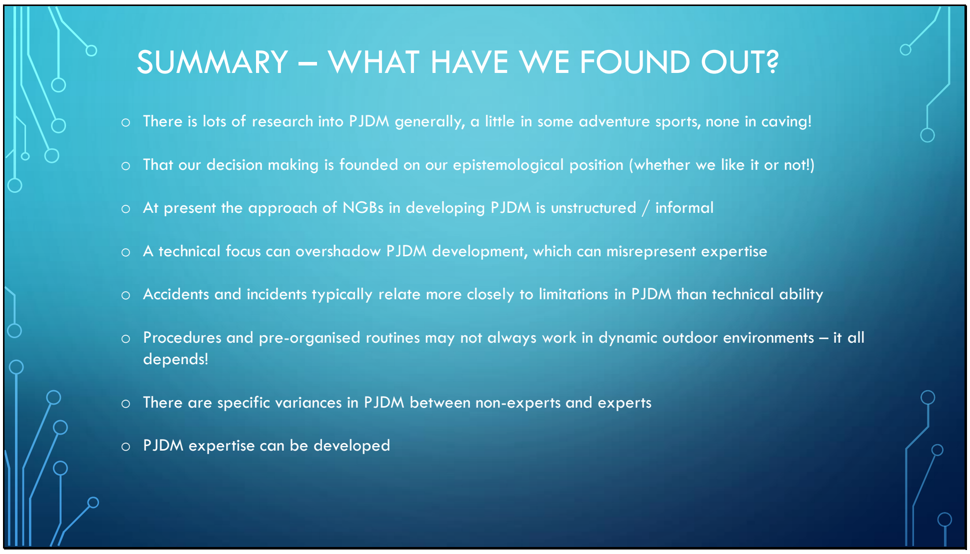
Tutor note:

- *Bilateral transfer gain is when skills are practiced on both sides equally, rather than becoming proficient initially on a preferred side (for example when learning to roll a kayak) – this is a more efficient way to gain linked skills, rather than 'one then another'.

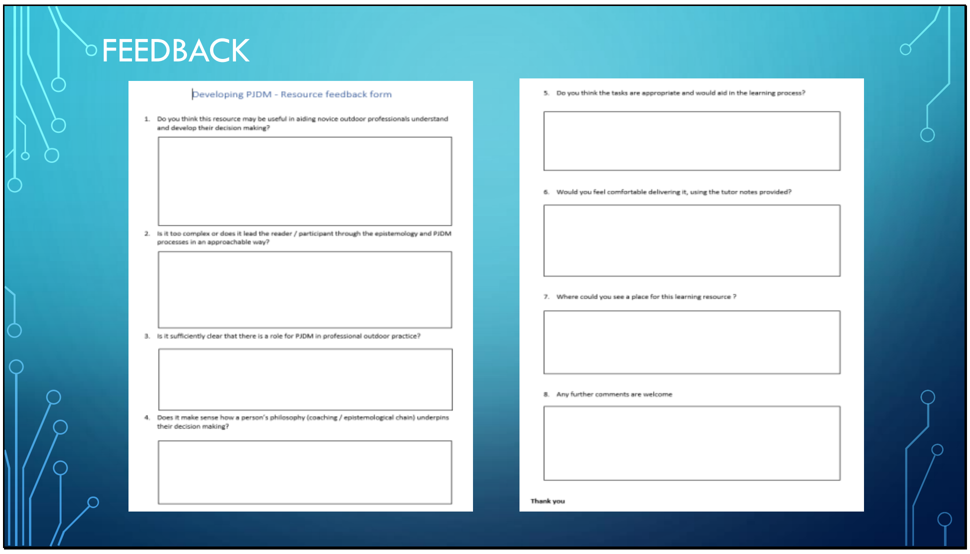
- Collins, L., & Collins, D. (2013). Decision making and risk management in adventure sports coaching. *Quest, 65(1),* 72–82. https://doi.org/10.1080/00336297.2012.727373

- Barry, M, & Collins, L. (2021). Learning the trade – recognising the needs of aspiring adventure sports professionals. *Journal of Adventure Education and Outdoor Learning.* https://doi.org/10.1080/14729679.2021.1974501

Slide 44



Slide 45



Resource support notes

Background

It has become evident that there appears be minimal support available within many NGB schemes to novice outdoor leaders who need to develop the professional judgement and decision making (PJDM) capability typically required in professional outdoor adventurous activities, not least of all in caving. The further through the awards and qualification process one goes, the greater the requirement for expertise in this judgement and decision making. The requirements of the NGB's for candidates to gain the necessary underpinning experience which act as the foundation for the development of PJDM presents as informal and unstructured.

Within the PowerPoint and additional notes, outdoor adventurous activities are given the term adventure sports (AS) and for those working within them, adventure sport professionals (ASP). This is in an attempt to reduce the confusion surrounding the terms of coaching, leading, teaching, instructing, guiding, facilitating etc. (for example, within the British Caving Association (BCA) scheme of *leadership* awards, although there are 'L1 and vertical' cave *leaders,* the final output is the caving *instructor,* and within elements of the assessment process of the CIC they become referred to as *coaches)*. The following notes are offered as a 'heads up' and to aid in interpreting some of the terminology involved.

Over the last 3 years or so, I have undertaken practically based research with multi-pitch rock climbers, winter mountaineers and cavers (L1 and CIC's) to help understand the decision making processes of outdoor professionals in complex environments. Recently the work has become more focused on caving as currently there is a lack of research into coaching and leading within caving generally, but also into decision making underground, although lots has been done in paddlesport and mountain walking, and notably within non-adventurous sports. The research has focused on how the philosophy of the ASP influences session design and outcomes, with a particular focus on the decision making processes at the higher levels of operation and how, in this case, inexperienced cave leaders can enhance decision making expertise. The L1 Cave Leaders of the most recent study stated that following from their training courses, they felt quite secure in the '*what*?' considerations of their cave leading and group management, but significantly less so in the '*when, where* or *how*?' aspects. Namely, that tying knots and deploying the techniques (belaying for example) was not the source of difficulty, it was developing the judgement to know which one to apply (or not) in a given situation and comprehending why the resulting actions were taken.

Findings show that becoming technically proficient in ropework, rigging or navigation for example has not proved to be an issue to beginner cavers and inexperienced cave leaders. This is partly due to the simple availability of online video tutorials and the like, and access to forums which discuss expert practice which becomes imitated. It is also because skills can be practiced and improved with access to good coaching and experienced peers.

Although many technical skills can be developed quite promptly, the important PJDM skills are often overlooked in favour of this technical focus. The problem with this approach is that when a cave leader progresses to work within more demanding remits (VCL > CIC for example) there may be an insufficient foundation to their decision making, which typically takes place in environments where ease of rescue or access to outside support is difficult. This is reflected in other NGB award schemes, for example in the steps between RCI and MCI / WMCI within MTUK. The more complex and 'open' an adventure sport environment is, the greater the requirement for a PJDM approach, rather than one which relies on procedures or checklists. (e.g., consideration of snow conditions, quality of ice anchors, wind strength in sailing or open canoeing and water levels for whitewater paddling, among others). Notably, a focus on technical skills can offer an inaccurate picture of expertise in a professional environment of few rules. Therefore, this resource is focused on the development of professional judgement and decision making (PJDM) skills for novice leaders working within outdoor adventurous contexts but has been centered on caving. It is designed to offer greater security in decision making and to provide a practical and theoretical foundation which will support practice as the relative novice outdoor professional progresses through their awards.

Within the PowerPoint there are three resources. The first is the **Concept Mapping of Tasks.** This was done at the outset in order to get a theoretical grasp of the range of demands that are typically faced by the cave leader. In terms of some of the words on the concept map, *epistemology*, *axiology* and *ontology* are the three main pillars of philosophy, which essentially underpin all our values, beliefs and behaviours, whether we like it or not. A glossary of terms is included.

Completion of the concept map made evident that not only does a cave leader or instructor have much think about, but that their epistemological position (which is underpinned by the three philosophical pillars) significantly influences the session design, intended outcomes and aims. The beliefs and values that become incorporated into session design and delivery has been referred to as the epistemological chain (EC). Examples of differences due to epistemological position could include whether a session revolves around fast-fix techniques which have little longevity, or an approach which fosters agency and transferability over a longer term, or to what extent independence from the ASP may be valued or not. The concept map indicates the significant range of decision making tasks, one which does not include working in vertical domains…

Following on from this first stage of mapping the tasks, the second was to chart these differences in approach in what has been termed **The PJDM and Knowledge Framework**. In essence, it identifies how the different epistemological positions direct and influence likely session design and expectation, and also how these may change according to the experience and / or qualification of the leader. The epistemological position appears to 'mature' as knowledge and experience develops. For example, if the ASP values greater independence and agency for the learner or client, their own technical skillset is a factor – this skillset may need to develop to facilitate this approach and therefore the process becomes a positive developmental cycle.

The third resource builds on the first two and was developed in response to specific work with a group of newly qualified L1 Cave Leaders. They had enjoyed and valued their training course, and each had a different trainer, but all felt that they wanted more support in the decision making processes, especially when travelling over slippery and steep (but non-vertical) terrain underground. This issue also was raised when working with the winter mountaineers and climbers of previous studies, who used the term '*the grey area',* noting that on vertical terrain when the rope and belays were utilised, everyone was relatively safe, and when walking on flatter ground, they were also quite safe. Therefore, the third resource, termed the **Cave Leader Progression Model** sought to offer some clarity on maintaining safety and momentum underground. The contention is that the leaders felt they were safe but too slow, and perhaps (in their own words) were guilty of 'over-egging the pudding'. A situation analogous to belaying every pitch on an Alpine route and then becoming benighted (i.e., being competent in a range of Alpine ropework techniques but using them in the wrong places or at the wrong times according to the demands of the people, task or environment).

The purpose of the resource creation is threefold. The first being that in identifying a training gap (namely where technical skills progression may take precedence over the development of decision making expertise), this is the first stage in attempting to bridge it and bring to the fore information which gives guidance on decision making, showing similarities to the way in which the term *heuristics* was introduced some years ago and began to be understood within professional practice. It may stand as an NGB resource, the foundation for an undergraduate university coaching and leadership module, or for staff training within larger outdoor organisations.

The second purpose is that the resources may be useful to trainers and assessors who can offer some background to their trainees in understanding that developing expertise in PJDM is beneficial. Most incidents involving led groups have not been due to technical failures or the like, more to poor judgment on the part of the instructor / ASP, and that a focus on the technical aspects should be matched at a comparable rate by a progression in PJDM. Notably, incidents such as those in the Mangatepopo Gorge in 2008, Cairngorms in 1971, Lyme Bay in 1994, Everest in 1996, Grey Mares Tail in 2010 and closer to home, the spate of flooding related incidents in the Dales across 2003-2007 were all based on lack of judgement expertise by the leader in one form or another, not technical deficiency.

The third purpose considers the fact that at the moment under most NGB guidelines, the necessary experiences (and reflection on them) which underpin the development of expertise in PJDM are acquired in somewhat an ad-hoc manner. In mountaineering there is the requirement to gain 20 QMD's, and a similar pattern exists in caving. Recently Mountain Training have introduced a mentor scheme which begins to address this informal situation, where the trainee mountain leader, MCI or WMCI is mentored not necessarily in the technical skills, but in the decision making and judgement strategies required in the changing and dynamic environments in which adventure professionals operate. This has elements of what is referred to as the *cognitive apprenticeship* approach.

Although the resource is in PowerPoint format, it should not be seen as something to present in one go; more it is a collection of research and ideas which can be used as appropriate. It is produced in two parts to help identify this and there is supporting text in the notes section of some slides where relevant. There are a range of tasks which are designed to further understand, explore and gain expertise in PJDM which may be used as applicable. It is envisaged that this resource will undoubtedly be significantly revised before deployment, but it is a start in addressing the voids in decision making training within adventurous outdoor leadership, coaching and participation.

Thank you.

Martin Barry

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Appendix P

Scialette du Silence Account

During a caving trip with a small group of peers to the Vercors, CI 6 recounts an incident which could easily have had very poor outcomes, but which he considers a constructive learning experience, one allied to a positive mindset (Dweck, 2015) which reflects a sophisticated epistemological position. Due to a number of factors, the group attempted a deep, multi-pitch cave named the Scialette du Silence at the end of the season, such that the cave itself was frigid. In short, the cavers became so cold whilst underground that they found it impossible to wait for one another on ascent due to the need to keep moving to maintain body heat, but the cave route itself was complex in nature. The caving trip took much longer than anticipated and as part of the overall anxiety generated, hydration and nutrition became ignored. Once all back at the surface, it quickly became apparent that one of the team was missing. He states

> "…there was this one passage where you had to stand up and access a parallel crawl – if you carried on without going up this slot, the crawl just become tighter and tighter and very sinuous. Unfortunately, one of the lads did not notice the up-slot and just carried on. He got stuck and blew his whistle, but no one came. Eventually, he realised he had to back-track up this constricted twisting crawl realising he was on his own and with the potential for his torch batteries to run out. The stuff of nightmares, really".

CI 6 recounts the events in positive terms partly because there were so many "…heuristic traps to learn from" but confides that he felt very guilty about them all hastening out of the cold cave, especially given that he was the informal leader of the team. He affirms

> "… following the near miss in Scialette du Silence I make sure that now I never break my bubble of control and working comfort – I maintain myself so that I am always capable mentally and physically. I really think we could have lost xxxx down there and I don't easily forget that. It was because we let the main things get away from us and there was no need".

Appendix Q

Multiple fatality accounts

In the Cairngorms tragedy of November 1971 (Allen, 2019), six people died (5 young people and their inexperienced instructor) when they decided to 'dig in' and attempt to sit out a winter snowstorm. Had they attempted to descend rather than sit still, it is likely that most if not all would have survived the storm. It is acknowledged that other compounding factors leading up to that point made movement and descent difficult, yet vital.

By contrast, in the New Zealand multiple fatality of April 2008 (Brookes, 2011) a group of 6 young people and their teacher drowned in the Mangatepopo Gorge during a rise in water levels, where remaining in position would have seen the high water pulse come and go in a relatively short time frame. Unfortunately, the inexperienced instructor chose to attempt to evacuate the group using the flow of water, which led to the drownings.