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RESEARCH ARTICLE

Multidisciplinary Team Practitioners Working in High Performance Sport: Skilled Intuitive 'Doers' or Novel Problem-Solving Innovators

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ABSTRACT

Practitioners operating in performance sports are required to problem solve, enabling them to offer tailored performance solutions while making expert decisions with high precision. Problem-solving and decision-making are intertwined and tangled in practice. However, the reality is that practitioners require two independent skill sets. This study aims to investigate performance practitioner's approaches to problem-solving and decision-making, analysing the meta-cognitive skills required by multidisciplinary team (MDT) practitioners to be effective in their daily practice. Using a 71-statement Likert scale survey, 115 performance- and medical-related MDT practitioners were surveyed to gain insight into their strengths and perceptions of how they think about problem-solving and decision-making in their work. We tabulated descriptive data and created heat maps to visualise correlations between responses. Findings suggest that practitioners rely on a mixed bag of approaches, cognitively toggling between problem types, approaches, and decision styles. In this study, practitioners preferred skilled procedural doing and intuitive expertise to overcome simple problems over rationalistic, logical innovation to address complex problems. Findings suggest the need for MDT practitioners to differentiate between problem types, problem-solving approaches, and decision-making styles while deepening our comprehension of practitioners' expertise. It offers insight into the cognition that forms the foundation of their approaches, providing a valuable perspective.

Keywords: Critical thinking, decision-making, intuitive expertise, problem-solving.

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1. Introduction

Sporting organisations covet practitioners with critical thinking skills, the capacity to make effective decisions and the ability to problem solve while delivering highly specialised expertise and technical skills (Collins *et al*., 2015). Practitioners who are critical thinking problem solvers require a cognitive repertoire of skills (Fiore *et al*., 2017; Mello & Rentsch, 2015) that extend beyond their ability to deliver with high technical proficiency. Delivering a series of empirically informed technical processes, procedures, and checklists might neatly align with evidence-based protocols or skills learned through formative education; however, does the ends justify the means (Collins *et al*., 2015), and is simply doing what you know as a practitioner good enough? Alongside the 'doing' procedural-based knowledge (Nokes *et al*., 2010) that practitioners possess, they are expected to apply this knowledge to situations in unique, novel contexts requiring individualised and considered solutions. For this reason, the ability to apply cognitive skills to dynamic, environmentally derived problems becomes necessary. However, to date, research exploring how practitioners think about how they work, what they do, and why is slim.

1.1. Problem-Solving Type (PST)

Several approaches to problem-solving from different industries could be borrowed to extend our vocabulary in elite sporting contexts. Kitchener (1983) historically explored cognitive processing and defined a solution to a problem as either 'well' (singular guaranteed solution) or 'ill-defined' (multiple–nonguaranteed solutions). These solutions sit at opposite ends of a continuum in which the complexity of the problem increases as we move towards the ill-defined end (Shraw *et al*., 1995). Edmondson (2012) similarly reviews problem-solving through a process-knowledge continuum where practitioners can engage in routine or innovative operations where the uncertainty of the outcome increases as we move towards more innovative solutions.

We must differentiate between tame/simple problems, those with an available, obvious, and tested solution, and those that are wicked/complex (Childs & McLeod, 2013; Vaughan *et al*., 2019; Walinga, 2017), where the problem requires deep analysis, deliberation and the solution might not be effective and is certainly not guaranteed. The Cynefin Framework discussed by Greenberg and Clubb (2021) enables us to plot problems into clear, complicated, complex, and chaotic quadrants based on levels of coupling between systems, processes and/or operations. When a problem is clear or complicated, solutions can be applied and tested, and success can be measured. With complex and chaotic problems, establishing clear solutions is a far more challenging endeavour due to the multifactorial nature of these types of problems and the interdependencies between systems, people, departments and/or organisations (Vaughan *et al*., 2019).

Much of the MDT practitioners' work is previously thought to be informed through data, protocols and procedures either learned through specific technical training, research-based evidence or practice (Hales & Pronovost, 2006). There is a dearth of applied training to prepare practitioners to work as part of a cross-disciplinary team through higher education courses and professional training. The ability of a practitioner to integrate their skills and expertise into a multidisciplinary approach to overcome complex problems is currently overlooked. That said, practitioners are often expected to be able to solve complex multifactorial performance problems quickly and efficiently. This requires solutions that might not fit the processes practitioners (or the team) deliver in their day-to-day work. MDTs having clear strategies to recognise problem types will enable them to consider whether a different approach is required.

1.2. Problem-Solving Approach (PSA)

When a problem is 'simple/tame', there is likely an obvious, ready-made solution that will simply and quickly address the issue. Evidence-based protocols, procedures, routines, and checklists lend themselves to overcoming simple problems through structures that support, automate and speed up decision-making (Hales & Pronovost, 2006; Mosier & Skitka, 2018). Wicked or complex problems are sometimes defined as VUCA, which stands for volatile, uncertain, complex, and ambiguous (Johansen & Euchner, 2013). No clear solution exists in the world of VUCA problems; therefore, novelty, creativity and or innovation are required to find an answer.

There may be multiple solutions available; however, addressing the ambiguous, ever-changing nature of the problem means that it is hard to judge whether any one solution is ever effective. Due to the integrated complexity and coupling that exists between elements of a problem, for example, in sports, different professional disciplines working together, the various tools and skills at a practitioner's and team's disposal and all the variables that must be weighed and considered when making performance-related decisions, there might be further unintended consequences to our actions. It is hard to see how affecting change at one point in the system affects other interdependent elements (Rijpma, 1997).

Charles Perrow's Normal Accident Theory (Weick, 2004) argues that the greater the interdependency between systems and the tighter they are coupled, the more complexity exists, presenting a greater challenge in identifying problems and exploring viable solutions to address them. With complex problems, the MDT needs to take stock of the problem, taking time to ensure they have identified the correct problem to be solved and understood. Analysing problems, identifying contributing factors, considering systemic dependencies, and anticipating the unseen components make VUCA problem-solving difficult. Set against the backdrop of coaches' dynamic and reactive decision-making (Collins *et al*., 2015; Lyle & Muir, 2020), practitioners are tasked with making good decisions quickly and providing considered solutions with immediacy.

1.3. Decision-Making Approach (DMA)

Practitioners often use the terms decision-making and problem-solving interchangeably. It is important to differentiate between the process of problem-solving and the act of choosing from a series of options, i.e., decision-making. These skills are intertwined and often become tangled, making it hard to differentiate between the decision, the problem, and vice versa.

1.3.1. Types of Decisions

Lyle (2010) describes non-deliberative decisions as being subconscious, automated, and happening without 'rationalisation' or awareness. Semi-deliberative decisions require conscious choice where the practitioner will be aware of weighing decision options; however, the processes underpinning them are fast, tacit, and 'intuitive.' The final decision-making type is deliberative decision-making (Kahneman, 2011). This type of decision-making requires time; it is slow, logical, and rational and requires weighing multiple options without time constraints (Kahneman, 2011). Humans must be able to make decisions in various timeframes in different situations and contexts with magnitudes of constraints (Lipshitz *et al*., 2001) and varying levels of conscious awareness. Decision-making is well explored within the literature and recognised as an important differentiating characteristic of novice and expert practitioners and coaches (Lyle & Muir, 2020; Vergeer & Lyle, 2009). Martindale and Collins (2013) have convincingly argued that Professional Judgement and decision-making (PJDM) is an important quality of expert coaches and practitioners. Through this research, we have extended beyond naturalistic decision-making research paradigms and lifted the lid on the cognition of decision-making in sporting contexts.

1.3.2. Dual Systems Theory

Kahneman and Tversky's novel prize-winning work in behavioural economics introduced the concept of Type 1 and Type 2 thinking styles (Kahneman, 2011). This body of work argues that humans can engage in fast, intuitive, energy-conserving type 1 thinking but can also operate in deliberate, slow, methodical, and rational type 2 methods. System 1 enables us to operate and interact in the world without rationalising and purposefully weighing decisions. System 1 is fallible as it is reactive to our beliefs and emotions and is susceptible to cognitive thinking errors (Crosskerry, 2003; Kahneman & Tversky, 1984; Tversky & Kahneman, 1974) and biases. Our Type 2 systems enable us, with the affordance of time, to problem solve, rationalise, and apply logic levels to complex and unpredictable situations before deciding. Type 2 thinking is less susceptible to emotion, but it is energy-hungry, saps our resources and depletes our cognitive capacities. System 2 is, however, inherently lazy and reluctant to be utilised, favouring its reactive energy-saving counterpart (Kahneman, 2011).

Performance sports organisations have moved towards adopting technology, innovation, and data to gain a competitive advantage or a performance edge. Sports practitioners are expected to engage with various technologies to be data-informed and led by evidence suggesting a reliance on rationalistic and logical decision-making approaches. However, the proliferation of data, the use of bespoke technologies and the inherently dynamic and reactive nature of decision-making within the context of the moment raises significant challenges and pressures for practitioners. How confident or certain a practitioner can be in any one solution must be (at best) guesswork when we consider how much information a practitioner and the team have access to and how much any individual can know and rationalise at any given moment (Gigerenzer, 2004).

1.3.3. The Practitioner as a Rational Actor

The Nobel Prize winner Herbert Simon argued that humans are bound in that they are fallible to thinking errors, emotional and limited in their ability to be rational and rationalise (Gigerenzer, 2008; Simon, 1959). The idea of 'unbounded rationality' still permeates our beliefs about how practitioners should operate in high-performance elite sports. However, practitioners must operate in complex environments, with complex interactions across a complex spectrum of hierarchical relationships with high stakes and under high pressure (Alfano & Collins, 2023; Simon, 1990). Practitioners need to have the ability to make decisions that are contextual and idiosyncratically derived (Gigerenzer & Gaissmaier, 2011). As decision-makers, we satisfice and often select the 'best fit' or 'less than perfect' solution that enables us to move forward (Gigerenzer, 2008). Optimising would suggest that practitioners can weigh every data point relating to a decision, calculate the correct option and make the optimum decision. This view, when considered through the lens of our emotions, computational abilities, and socially derived contexts, makes this unrealistic and conflicting with the expectations placed upon practitioners.

1.3.4. How Do We Cope with Complexity?

Heuristics (Tversky & Kahneman, 1974), speedy heuristics (Lyle, 2010), fast and frugal heuristics (Bennis & Pachur, 2006; Raab, 2012) can be thought of as cognitive shortcuts, rules of thumb or learned reactions that when applied allow practitioners quick response times with minimal draw on cognitive resources. Heuristics are highly effective in helping decision-makers make accurate decisions when weighing multiple options with or without time constraints (Gigerenzer, 2008; Gigerenzer & Gaissmaier, 2011; Raab, 2012; Raab & Gigerenzer, 2015). Practitioners are encouraged to be evidence-based and literature-informed, which steers much of their work towards unpacking procedural approaches and working through processes. In practice, a practitioner must adapt to the ever-changing and evolving demands of coaches, colleagues, athletes and the environment. There has been very little exploration to date of whether practitioners use heuristics and fast intuitive decision-making in their practice.

Heuristics are considered adaptive and have been argued to be a key neural 'adaptation' that has enabled us to operate and interact within a complex world (Ullén *et al*., 2018). Heuristics are intricate knowledge bundles comparable to compressed computer files. Once stored in long-term memory, they can be retrieved by working memory without decompression. Kahneman and Tversky (1984) led the systematic errors and cognitive biases programme and, along with others (Blumenthal-Barby & Krieger, 2014; De Martino *et al*., 2006; Epley & Gilovich, 2006; McCloy *et al*., 2010) have discovered many heuristics and cognitive biases, both mathematical and situational (Page, 2017). Heuristics and their sometimes-unintended biases and errors appear to be part of our neurophysiology, aiding and supporting learning and our ongoing development, and are characteristic of our cognitive and neural apparatus (Sanfrey & Stallen, 2015). They enable us to execute complex operations, carry out cognitive tasks, attend to multiple stimuli and execute skilled functions quickly and efficiently. They are characteristic of expertise (Larrick & Feiler, 2015) that sits within the Type 1 dual processing theory of fast thinking. There is no doubt that practitioners rely on fast heuristic style decision-making within their practice due to the complex dynamic environments in which they work, and consequently, it would be reasonable to assume that it is a characteristic of their expertise (Collins *et al*., 2016; Lyle, 2010).

1.4. *Skilled Intuition as the Trademark of Expertise*

Gary Klein has contributed significantly to our understanding of expertise (Kahneman & Klein, 2009; Klein, 1993, 1997, 2004) and has underscored the importance of observing decision-makers in natural real-world contexts outside of a lab setting (Lipshitz *et al*., 2001). Klein (2004) has observed military personnel, medics, paramedics, air traffic controllers and firefighters to understand real-world decision-making in high stakes time-pressured situations (Hotaling *et al*., 2015). What some professionals initially thought of as a remarkable Extra Sensory Perception (ESP) has subsequently been investigated and better understood. Whilst the expertise of MDT practitioners is understood from their specific skills, service provision and intervention perspective, it is lacking in the cognition that underpins this. Given that practitioners must overcome problems and make a range of decision types both in the moment and in real-time, Klein's (2004) work can shed light on a facet of the expertise of Practitioners working in sports.

1.4.1. *Pattern Recognition*

Klein has defined and articulated expertise through pattern recognition (Klein, 1993) and mental simulation (Klein, 1993, 2004). These skills enable practitioners in real time to observe, identify and recognise an unfolding scenario by extracting cues, triggers, and catalysts from the environment through cognitive mental structures called schemas and scripts instantaneously (Klein, 1993). These knowledge structures are built up through exposure, experience, and reflective practice (de Oliveira *et al*., 2014) and then, when needed, can be accessed and unpacked 'intuitively' by the decision maker without purposeful deliberation, rationalisation or the benefit of time. Klein has been able to cast light on the tacit, rapid, and detailed computations of decision-makers in high-stakes situations and has also been able to show that this intuitive, recognition-primed decision-making is reliable in a naturalistic setting and a vital component of fast decision-making (Klein, 1993; Lipshitz *et al*., 2001; Lyle, 2010).

Where Kahneman has argued against the reliability of fast System 1 thinking (i.e., intuition and heuristics), citing its fallibility to systematic cognitive thinking errors, biases, and mistakes (Kahneman & Tversky, 1984), Klein (1993) previously argued that intuition is a crucial requirement of skilled expert practitioners in the field. Bringing this academic debate closer to the realities of MDT practitioners operating day to day in sporting contexts: Do practitioners utilise fast thinking, heuristics, and Intuition within their discipline (Kahneman & Klein, 2009) relying on skilled intuitive expertise to provide unpackable solutions to simple problems? Alternatively, do practitioners leverage technology, data, and logic to identify complex problems, presenting precise solutions through purposeful decision-making models and problem-solving processes? Therefore, this study examines the correlation between cognitive theories (PST and DMA) and the practices (PSA) of MDT professionals engaged in high-performance sports. The objective is to understand how practitioners in high-performance sports perceive and navigate their work and, by doing so, open new avenues for novel research.

2. Method

2.1. Participants

For inclusion in the study, individuals needed to be working in a professional capacity as part of an MDT in performance sport at either a development or senior level. A variety of MDT Practitioners (n = 115) took part in the study (Table I). Four survey submissions were removed as they did not fulfil the participation criteria stated above, and/or there were issues with the information provided in the submission, resulting in (n = 111) responses being analysed. A range of practitioners participated in both performance (n = 85) and medical (n = 26) related disciplines (Table II). Additional information was gathered as part of the survey, including the level at which the practitioner was working, the sport, their tenure in their current role, and their overall experience level.

2.2. Instrument

A survey was designed to collect data on the views of MDT practitioners (see Appendix for the survey questions). The survey design utilised Likert scales to measure the strength of perceptions on facets of problem-solving and decision-making. The survey statements were evaluated and modified as required through an initial review and piloting process. The survey was split into 5 sections, with the statements distributed across them. The sections were split into (1) problem-solving type (PST), (2) problem-solving approach (PSA), (3) decision-making approach (DMA), (4) data and insight and (5) climate and team working. A closing section asked whether participants would like

TABLE I: Frequency of Survey Respondents by Discipline and Professional Domain

Discipline	Performance	Medical	Other	Total
Bio-mechanist	1			1
Coach	8			8
Doctor		1		1
Head of athletic development	1			1
Head of medical		7		7
Head of performance	25	1		26
Institute people and services lead *			1	1
Nutritionist	2			2
Performance analysis	5			5
Performance lifestyle	3			3
Performance psychologist	1			1
Physiologist	1			1
Physiotherapist		11		11
Sports science	10			10
Sports therapist		5		5
Strength and conditioning	28	1		29
Grand total	85	26	1	112

Note: *This survey response was removed from the analysis as it was not clear how this role works within the multidisciplinary context.

TABLE II: Practitioner Level, Sport Type, Tenure, and Experience by Professional Domain

		Performance	Medical	Total
Practitioner level	World class podium	21	8	29
	World class potential	8	7	15
	Talent development	15	1	16
	Senior/first team	29	8	37
	Academy	12	2	14
Sports	Olympic/multi-sport	41	12	53
	Professional team sport	44	14	58
Tenure in role	1<	19	8	27
	2–4	43	8	51
	5>	23	10	33
Overall experience	5<	12	6	18
	6–9	21	8	29
	10>	52	12	64

to contribute to further elements of this research programme and were given the option to leave an email address. The statement responses were scaled from 1–(Strongly Disagree) to 5–(Strongly Agree). Each statement is plotted across our 'cognitive styles' continuums as outlined. PST 1–(Tame/Simple) to 5–(Complex/Wicked); PSA 1–(Procedural/Doing) to 5 (Creative/Innovating) and DMA 1–(Fast/Intuitive) to 5 (Slow/Rationalistic).

Statements were worded such that in some cases, responses needed to be inverted, for example, when a respondent rated, "My working day/week is made up of stable routines-5 (strongly agree)." This score was inverted to 1, which was then plotted to be procedural in the analysis.

2.3. *Procedure*

The BAHSS Ethic Review Panel at the University of Central Lancashire granted ethical clearance to conduct this study (BAHSS2 0385). The survey was conducted online using Microsoft Forms®, meeting current GDPR requirements. Participants were recruited for the study through various routes. Initially, emails outlining the study expectations and eligibility were sent to individuals across several high-performance sports organisations, asking them to distribute the survey across their workforce, whilst a social media campaign using LinkedIn and Twitter also invited participation in the study. All participants were provided with information on the study methods and, if eligible, signed electronic consent prior to completing the survey. All data captured as part of this study was encrypted and stored on both the university's secure network and an encrypted laptop computer.

2.4. *Data Analysis*

The data was exported from Microsoft Forms® and analysed in Microsoft Excel® and further analysed due to the size of the data set in Python using the NumPy (v1.20.3) and pandas (v1.1.4) packages for analysis and Matplotlib (v 3.3.3) and Seaborn (v 0.11.0) for data visualisation. Likert scale statements were grouped into three sets (PST, PSA, and DMA). Data were summarised as descriptive statistics (Tables I and II). Frequency analysis was conducted, and the results were presented as percentages of respondents and frequency counts (Figs. 1–4).

2.4.1. *Heat Maps*

Heat maps were created to display correlations between response values, specifically the joint distribution of the aggregated responses within each cognitive style set (Figs. 1–3). This has created a visual representation of the practitioner's strength of perceptions. To build the heat maps, each individual participant's response to a statement within a set was compared with their response to a statement from another in Python. We then counted the frequency of participant responses that were the same, for example, how many times participants both agreed to each statement, how many times they agreed to the first but disagreed with the second, and so forth.

The heat map for a doublet (2 statement sets) was formed by plotting the responses in a grid and shaded according to the number of counts in each block. Where participants rated a response as a 1 or 2, these scores were grouped and were considered positive (or agreement), 4 or 5 were also grouped and were negative (or disagreement) and finally, 3 was neutral, creating our 9 blocks.

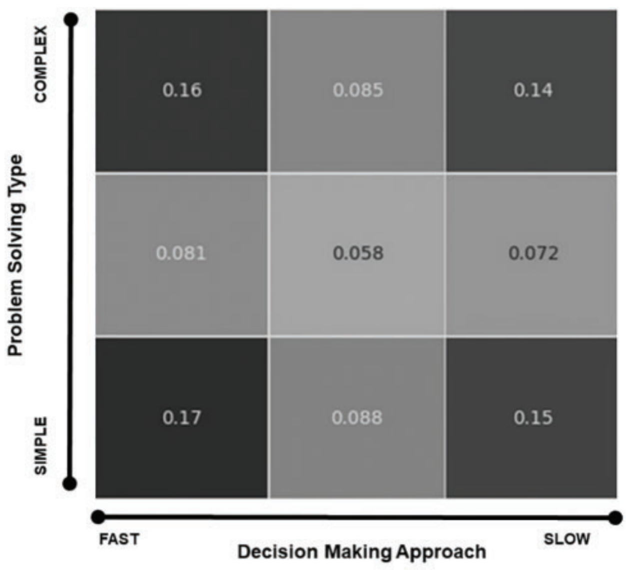

Fig. 1. Heat map illustrating MDT practitioners' responses to decision-making approach (DMA) and problem-solving type (PST).

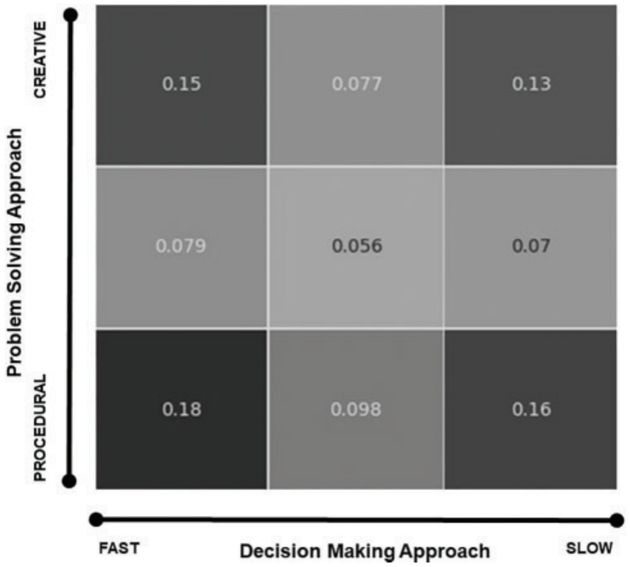

Fig. 2. Heat map illustrating MDT practitioners' responses to the decision-making approach and problem-solving approach.

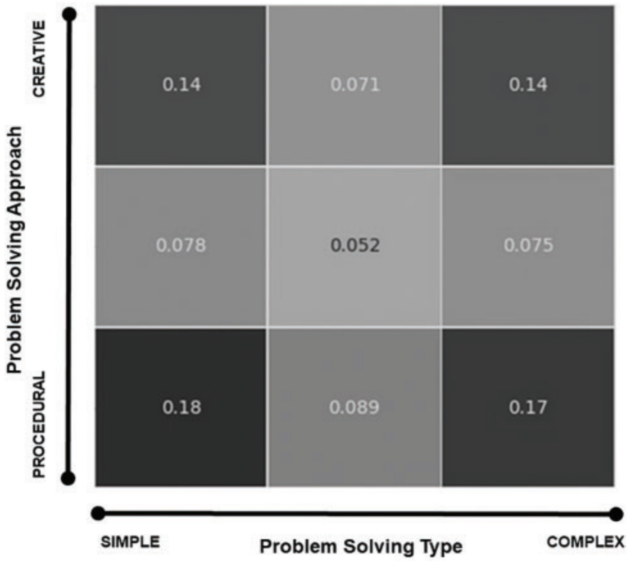

Fig. 3. Heat map illustrating MDT practitioners' responses to problem-solving type and problem-solving approach.

To create aggregated heat maps, we grouped statements that assessed characteristics of PST, PSA or DMA. As described above, for every combination of question pairs (PST n = 28; PSA n = 25; DMA n = 25 statements), we summed the frequency of response permeations across all the statements in the two statement sets being compared. The sum of all these was processed and normalised by dividing by the totals across all combinations (e.g., $28 \times 25 \times 111$) to arrive at the aggregated heat map. The aim of taking this approach was to determine an estimate of the average joint distributions across the groups. We acknowledge that a heat map may enhance the ability to identify particularly strong and weak correlations. That said, we appreciate that correlations should not be interpreted as causative.

2.4.2. Root & Branch Result Tree

All statements were assigned into one of our three sets depending on whether they shed light on the PST, PSA, or DMA faced by practitioners. Each statement in a set is assumed to be an equal representative sample. This assumption means that we would expect respondents to be consistent in their answers, e.g., if a respondent strongly agreed with the statement that "The solution required when working with an athlete or team is usually obvious," then they would also disagree or strongly disagree with the statement that "I frequently have to find new solutions to be effective."

For each triplet of questions, one from each set, we mapped out the different response permutations, e.g., PST is Tame/Simple, PSA is Procedural, and the DMA is Fast, and counted how many respondents fell into each. We summed the counts for each permutation across all unique triplets and mapped them across our root and branch figures (Fig. 4).

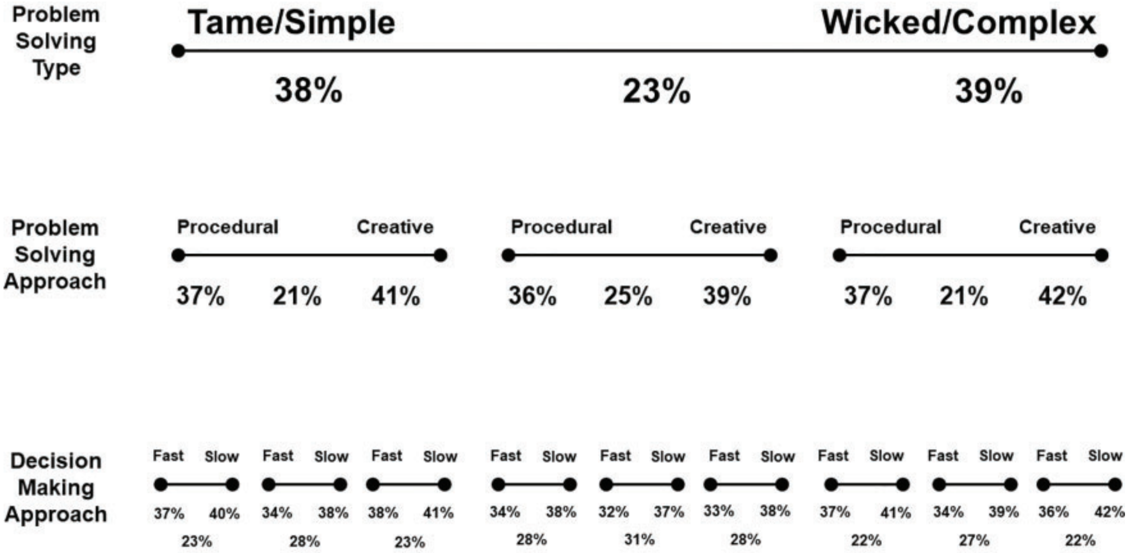

Fig. 4. Root and branch response tree illustrating the percentage of MDT practitioners who report thinking about how they approach their work gathered through the likert scale survey responses.

3. Results

There were 115 respondents to the survey, of which 111 were analysed. 76.5% of respondents were performance practitioners, and (23.4%) were self-classified as medical-related practitioners. Practitioners' characteristics ranged over sixteen disciplines. Strength and Conditioning (25.2%), Head of Performance (22.5%) and Physiotherapy (9.9%) were the highest represented in the study.

Practitioners taking part in this study are working at various levels of high-performance sports: Senior/First Team (33%), World Class Podium (26%), Talent Development (14%), World Class Potential (13%), and Academy (12%). Of the sample, 48% are working in Olympic or Multi-Sport, and 58% are in Professional Team Sports. A substantial proportion of practitioners completing the survey have been in their current role for 2–4 years (45%), with (57%) having accrued ten or more years' experience.

3.1. Heat Maps

3.1.1. DMA–PST

Practitioners report a varied DMA whilst working with different PSTs. Practitioners rate making fast decisions whilst working with both simple (17%) and complex (16%) problems most frequently. 15% of practitioners agreed with statements where slow, rational decision-making was the preferred style whilst facing simple problems. 14% of responses accounted for logical, rational decision-making whilst working with complex or wicked problems. When summed, 26% of statements were rated as neutral.

3.1.2. DMA–PSA

Statements regarding DMA were compared with practitioners' PSA. When making fast/intuitive decisions, practitioners preferred way of working was procedural/doing (18%), whilst others reported (15%) creative/innovative. When DMA was slow/rationalistic, 16% reported procedural doing, whereas 13% worked creatively/innovating. When summed, those that reported neutral to DMA and/or PSA statements were 38%.

3.1.3. PST–PSA

Where practitioners (18%) rated working with tame/simple problems, they had a procedural/doing approach, a further 14% of respondents preferred creative/innovative with these types of problems. 17% of the practitioners working with complex/wicked problems reported a procedural/doing approach, with 14% suggesting that creativity and innovation were required when facing these types of problems. 36% of responses were rated neutral across the heat map.

3.2. Root and Branch Response Tree

We investigated how practitioners solve diverse types of problems and what their preferred approach of problem-solving and decision-making. Fig. 4 presents the results obtained from the survey responses about these issues.

3.2.1. Tame/Simple Problems

When the PST statements were aggregated, 38% had a tendency towards agreement with tame/simple problem types. Of those practitioners, 37% took a procedural/doing, and 41% took a creative/innovating approach. Those who were procedural/doing appeared to make both fast/intuitive (37%) and logical/rational (40%) decisions, whereas those who were being creative/innovative also made fast/intuitive (38%) and logical rational (41%) decisions. There was an average of 23.7% (+ or – 4.3%–2.7%) who responded neutral to PSA and DMA.

3.2.2. Complex/Wicked Problems

39% of practitioners tended to agree with statements that suggested complex/wicked problem-solving types. Of those, 42% and 37% took creative/innovating and procedural/doing approaches, respectively. Of the 42% of practitioners that took a creative/innovative approach, 42% reported towards logical/rational and 36% agreed with fast/intuitive decision-making approaches. Those who adopted a procedural/doing approach to complex/wicked problems appeared to make logical/rational (41%) decisions, with 37% favouring fast/intuitive decisions. Those that rated neutral were, again, on average, 23% (+ or – 4–1).

4. Discussion

This study examined the correlation between theories (PST and DMA) and the practices (PSA) of MDT professionals engaged in high-performance sports. The objective was to understand how practitioners in high-performance sports perceive and navigate their work through a Likert Scale survey. Practitioners working in high-performance sports apply various cognitive styles and approaches. This study shows differences in problem-solving and decision-making styles and approaches, and no clear, prevalent working methods emerge. The picture was inconsistent when we compared practitioners who work in different sporting contexts and professional disciplines and have different tenures and experiences. A diverse array of cognitive approaches and methods emerged, demanding toggling between simple and complex problems, procedural and creative approaches, and quick 'intuitive' versus deliberate decisions.

In each heat map, DMA-PST (Fig. 1), DMA-PSA (Fig. 2), and PST-PSA (Fig. 3), practitioners favoured simple problems-fast decisions, fast decisions-procedural work, and simple problems-procedural work, respectively. Although these were the highest-scoring distribution pair responses, the results were equivocal. For a certain amount of practitioners' daily work, they operate through processes, procedures, and protocols where they rely on technical skills and their intuitive expertise (Salas *et al*., 2010) to make fast 'in the moment' decisions selecting from an array of available 'heuristic' solutions. Depending on the practitioner and the MDT they operate, the individual might be expected (or asked) to take on a broad range of tasks, some of which might sit outside their recognised scope of expertise. In asking practitioners to deliver against a broad remit, for example, the sports scientist is also the strength and conditioning coach, nutritionist and an additional technical coach leading warmups, cooldowns and managing drill intensities. Fractionated expertise (Kahneman & Klein, 2009) and limited time availability might stifle the practitioners' ability to move beyond simple-procedural delivery in favour of fast-available solutions. This could significantly dilute their ability to solve complex performance problems because they lack both the expertise, the required cognitive diversity (Page, 2007, 2014, 2017) and time.

In the current study, practitioners report working with simple and complex problems. Compared to whether they make fast or slow decisions, the picture is messy as, in both cases, fast decision-making is slightly preferred to slow decision-making. This might suggest that practitioners rely on skilled intuitive expertise (Martindale & Collins, 2013) to recognise what needs to be done through mental simulation (Klein, 1993, 2004) or prediction and acting with a level of automation. When the problem type is simple, and the practitioner must apply slow, rational decisions, it might suggest they have less experience or limited expertise (Lyle, 2010) from which to draw. However, when compared by practitioner experience, there were no significant differences. There may be an onus on Practitioners to utilise data and justify their methods and approaches, and this is what comes through in the responses. If this is the case, then this will be either anticipatory, therefore drawing on skilled intuition or procedural knowledge (Nash & Collins, 2006; Nokes *et al*., 2010) to predict based on 'knowing' or retrospective, in that the justification is created through data visualisation based on what has happened (Milkman *et al*., 2009). Either way, this would suggest that practitioners rely on procedures, unpacking ready-made solutions through pre-determined processes to familiar problems. This reinforces the need to provide experiential and problem-based learning (Gillette, 2011) opportunities for practitioners in applied practice.

The findings of this study suggest that practitioners appear to rely more heavily on procedural problem-solving approaches. Given the routine, process-orientated nature of the work of MDT practitioners, this makes sense. Working to schedules and through checklists and procedures would suggest a level of automation in much of the work (Collins *et al*., 2015). This working style would hint at practitioners needing to be technically skilled doers over critical thinking problem solvers. However, practitioners must be creative and do this on the fly (fast) and in more planned and purposeful ways (slow). These slower styles of creativity may emerge to overcome training monotony where athletes have training fatigue and need a change of stimulus or when athletes are injured and need creativity and variation in programming, prescription, and planning.

Undoubtedly, changes to an athlete's training routines and schedules due to (for example) transitions in season, fatigue, underperformance, fixture congestion, training monotony or injury could be considered simple or complex problems to overcome depending on the practitioner or MDT perspective. It was noted that Practitioners still favour procedural-based approaches to what they report as both simple and complex problems. This would suggest that practitioners work in the process of 'doing' following procedures and protocols that align with how performance sport tends to operate (i.e., through routines and schedules) and how practitioners are trained (i.e., through procedural knowledge and technical skills).

When practitioners face complex problems, we might expect them to generate novel or innovative solutions to overcome them (Fiore *et al*., 2017). In some cases, this was reported and is to be expected, especially if problems are truly complex and difficult to solve (Nokes *et al*., 2010). Where problems are simple and yet creativity is applied, this might suggest the practitioner has a level of freedom, lower risk in deploying different strategies or low accountability to the result (Proudfoot *et al*., 2007). Practitioners deploying creative/innovative solutions to simple problems when routines and processes must be followed might suggest a high-risk strategy. It is much harder to predict the outcome when deploying novel solutions (Page, 2017) in predictable training environments where results are demanded. Practitioners might have low 'objective' accountability to show impact within their performance processes. Regardless, practitioners, MDTs, or those who lead them must initially consider the problem type and problem-solving approach and how they intend to overcome them. Afterwards and throughout, review and reflection will offer insights into the effectiveness of the approach and outcomes.

When we analyse the triplet 'root and branch' cognitive styles tree, the picture that emerges is one where practitioners are required to cognitively toggle between different problem-solving types, problem-solving and decision-making approaches. In tracking the practitioner's responses hierarchically and through discrimination via PST, we can see how practitioners report approaching problems and their decisions. We asked practitioners to remain zoomed out when responding to the Likert scale statements and not zoom in on specific examples or events. This was an effort to get a broad sense of how practitioners think about approaching their work. Fig. 4 tracks (across the continuums) how the individual practitioners report working with simple or complex problems.

Of note is that the emerging pattern is similar across each of the continuums. There appears to be a split between the simple and complex PST practitioners work with, a pattern that follows through each branch of PSA and DMA continuums. Where problems are simple, there is a split between procedural and creative problem-solving approaches that then equally split again between fast and slow DMA; this is almost mirrored when we follow those practitioner responses who favoured the complex PST. This would suggest that practitioners do not have strong, consistent ways of working and due to the highly dynamic environments in which they work, one cognitive style or approach is not adequate for all eventualities. An alternative consideration would be that Practitioners do not apply or are not aware of the metacognitive approaches they could deploy across their practice to enhance their processes and rationales (Kitchener, 1983). Final considerations might include acknowledging the environment and its climate (Proudfoot *et al*., 2007), the organisational structure, and how practitioners are expected or instructed to work. In each of these cases, there could be rigid or flexible structures, low or elevated levels of freedom and weak or strong processes and procedures, all of which would influence how practitioners approach their work.

5. Limitations

Effort was made to match the Likert scale statements to the behaviours we were looking to assess across the survey. With any Likert scale survey, there is a risk of acquiescence bias (Winkler *et al*., 1982) in which fast clicking, a lack of attention to the question being asked by the respondent and/or unintended bias in how the statement is presented by the researcher can skew the results. The survey captures a general sense of how practitioners think about and approach their work, which is what we set out to achieve, and yet we must be aware that further investigation is required to understand the nature of a practitioner's work across the breadth of their role and their approaches to this.

6. Conclusion

The objective of this study was to unravel the interwoven aspects of problem-solving and decision-making, aiding practitioners in consciously applying critical thinking and their cognitive skill set with precision when tackling daily challenges in their practice through a survey-based approach. We sought to verify whether critical thinking and performance problem-solving are imperative in high-performance sports. We wanted to understand whether practitioners differentiate between problem-solving types (PST) and purposefully deploy diverse problem-solving approaches (PSA) or if they primarily rely on intuitive, heuristic-based methods grounded in expertise. Additionally, we explored whether performance sports professionals function as creative innovators, employing logical reasoning to devise novel solutions for challenging problems.

What emerged was a diverse array of cognitive approaches and methods, demanding toggling between simple and complex problems, procedural and creative approaches, and quick 'intuitive' versus deliberate decisions. This study prompts reflection on the metacognitive skills essential for practitioners to excel in performance sports environments and challenges the narrative that sporting organisations require problem-solving 'data-driven' innovators. The findings would imply that scenario and problem-based experiential learning approaches acquired through applied practice and purposeful reflection are critical to the development of the intuitive expertise of practitioners.

7. Practical Implications

- Practitioners in high-performance sporting contexts face a range of problem types and problem-solving approaches in their work.
- Practitioners rely on skilled 'intuitive' expertise, adopting fast, heuristic-based semi-deliberative decision-making and leverage more rationalistic, logical-based approaches.
- When problem type, problem-solving approaches and decision-making approaches are detangled, no clear, compelling picture of how practitioners work emerges, suggesting practitioners must toggle between cognitive styles and skills.
- Practitioners could benefit from developing meta-cognitive strategies to differentiate and discriminate between their critical thinking skills and apply them purposefully based on the environment, context and need.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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