

# Observational Heuristics in a Group of High Level Paddle Sports Coaches

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Observation of performance forms a critical part of the complex coaching process. A professional judgment and decision making (PJDM) framework enables optimum decisions to be made under time pressure and with limited information that derive from that observation. Observation and the associated decision making can be particularly affected by heuristic bias. We extend the work on PJDM via a greater focus on its relationship with observation within the coaching process. After revisiting PJDM and observation, we introduce and explore heuristics as a “tool” within the observation process. Specifically, we propose that observation is prone to heuristics built on a coach’s experience and understanding. We report on a small scale preliminary investigation with a group of high-level paddle sport coaches. We identify heuristics that both restrict and enhance the effectiveness of the observation in an effort to promote discussion and further research.

**Keywords:** Professional Judgment and Decision Making (PJDM), high performance sport, heuristics, observation

Effective profiling of an individual performer sits at the heart individualized coaching (Collins & Collins, 2016; McGarry, 2009). Observation and questioning provides the primary mechanism for gathering information (Giblin, Farrow, Ball, & Abernethy, 2015) on which the profile of a performer is built and the coaching process is individualized. The gathered information forms the basis for the decisions that facilitate the coaching process. Observation is continuous within coaching and enables auditing of the process and its adaptation. Observation contributes to ongoing refinements in goal setting, feedback provision, direction, pacing and timing of the session.

At a macro level, observation allows the coach to recognize the performance level of an athlete (i.e., the start point of coaching process) then, during the coaching process, to recognize when a goal has been met (the potential end-point or indication of development). At the meso level, observation allows the effectiveness of a

given coaching intervention to be assessed or modified. At the micro level, observation (with questioning) allows the athletes’ understanding of a performance to be perceived. Observation acts as a catalyst for adaptability and flexibility, enabling the rate of performers’ development to be gauged and the effectiveness of the coaching intervention to be measured. This, in turn, allows the coach to manage the corresponding individual differences in rate of development.

Understanding the constraints that effect the coach’s ability to make good judgments based on observation appears paramount. Reflecting this importance, this initial scoping study examines the extent to which heuristics play a part in the observation of performers and the professional judgments and decisions that are derived from that observation. We critically discuss the role of heuristics in observation, before we consider heuristics application, reflecting the advantages and disadvantages inherent in their use.

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## Heuristics and Observation

Observation as an in-action process may suggest a bias toward naturalistic decision-making (NDM) processes (Harvey, Lyle & Muir, 2015; Johnson, 2006). This entails the coach going with fast, intuitive, gut feelings in response to the time pressure and incomplete availability of knowledge to inform their decisions (SCUK, 2015). This contrasts with the slower, more rationalistic classic decision making (CDM) processes (Collins & Collins, 2015, 2016). A synergy of these two processes forms the basis of professional judgment and decision making (PJDM) explored by Abraham and Collins (2011). Indeed, Cruickshank, Collins and Minten, (2014), and Collins and Collins, (2016), suggest that decision-making may take place on a continuum between the CDM and NDM processes with heuristic and recognition-primed decision-making, lying toward the NDM end of the continuum. Therefore, different decisions will use different proportions of CDM and NDM as the coach makes sense of the unfolding situation. The effectiveness of the PJDM process is then audited by the coach and decisions enacted (Collins & Collins, 2016). The audit and nesting operate at a meta-cognitive level allowing complex and high cognitive load on the coach to be managed (Collins, Collins, & Carson 2016).

The heuristics that form part of the NDM process influence PJDM as the coach simplifies the complex and time-pressured problem utilizing their experiences and reflective skills. Employing heuristics in observation may reduce the numbers of observations required before a speedy workable though suboptimal conclusion can be reached. In addition, heuristics also act to reduce cognitive load on the coach by providing short cuts derived from the coaches' experiences. It seems logical that the information gathering and associated decisions may *also* be susceptible to heuristic as described in Figure 1. In summary, heuristics would appear to have an important role to play but may bring both positive and negative consequences.

Fast and frugal heuristics (Gigerenzer & Goldstein, 1996; Gigerenzer & Todd, 1999) provide an example of the kind of heuristic that could be effective in observation where the coach has incomplete information and uncertainty. Such heuristics appear suited for coaches making decisions based on minimal criteria within complex situations-in action (Oliviera, Lobinger & Raab, 2014). It may be reasonable to expect coaches to be prone to this kind of heuristic.

## Pros and Cons of Heuristics

There is a need to balance these suggestions against the potential negatives of heuristic usage. Collins and Collins (2016) suggest that these heuristics may be susceptible to generic decision-making traps that could affect the whole PJDM process (given its nested nature) and comment on the weakness of these NDM approaches if used in isolation. Bar-Eli, Plessner and Rabb. (2011) also comment

that these "judgements are often constructed on the spot, and thus are prone to reflect the properties of the judgement context that can lead to the wrong direction in certain circumstances" (p. 24). This impact is further complicated by the potential for traps to interrelate (see also Klein, 2015). Collins et al. (2016) make explicit the link between the robustness of NDM and the experience of the decision maker, highlighting the experience of the activity and the context of decision-making in relation to that activity as important factors in the quality of NDM. Klein (2008) comments on recognition primed decision-making as being the domain of experts because of its link with expertise as a product of experience.

The weighting of information gained from observation depends on the experience of the observer (cf. Bar-Eli et al., 2011). This representative heuristic (Tversky & Kahneman, 1982), inherently contains bias because of its relation to the experience of the observer. Miss-weighting leads to a misscalibration of the actors in the decision-making process. Representative heuristics may be further complicated by familiarity heuristics (Mussweiler, 2003) in which judgments are comparative, and assume that the circumstances that lead to a particular behavior hold true in all contexts. Coaches encountering novel situations may be prone to this miss-calibration as a result of the combination of heuristics. Indeed, increased cognitive effort may itself generate an escalation heuristic (Cialdini, 2001) in which increased value is placed on certain elements of information because of the cognitive or physical effort associated with them. The "affect" or feeling heuristic as described by Bennis and Pachur (2006), may become open to a negative bias in situations that are time pressured or where incomplete information is available.

Reflecting these challenges the coach may select from personally constructed observation cues that are based on a coaches' experiences and reflections. This may provide suboptimal results because key information is missed, ignored or negated. Bar-Eli et al. (2011) comment that this is due to a cognitive capacity constraint. Heuristics may become interrelated and generate a highly complex problem for the coach.

So, reflecting this potential challenge to the veracity of the PJDM framework built around observation in the coaching process, we examined the extent to which heuristics play a part in observation within a small group of coaches, in an effort to expose the complexity and nature of heuristics within observation.

## Method

A purposive sample of six UK based coaches (1 female and 5 male ( $M_{age} = 42 \pm 5$  years) from competitive ( $n = 3$ ) and adventure paddle sport ( $n = 3$ ) domains were interviewed. Coaches were selected on the basis; (1) minimum of 10 years coaching experience since accreditation ( $M = 14.3$  years), (2) currently working with internationally competitive and/or higher-level performers or holding the highest level coaching qualification within their respective discipline and (3) a willingness to discuss their

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

**Figure 1** — Heuristics and Bias in Individual Judgments. Adapted from Cox, (2007), Girgerenzer, Todd, & ABC Research Group, (1999), Hammond, Keeney & Raiffa, (1999), McCammon (2004), Plouso, (1993), Renfrew, Martin, Micklewright, & St Clair Gibson, (2014), and Russo & Schoemaker, (1989).

practice (see Table 1.). The corresponding and second author are qualified and active practitioners within these two high-level sporting domains. This pilot study was carried out in accordance with the recommendations of the University of Central Lancashire’s ethics committee in accordance with the Declaration of Helsinki. Pseudonyms have been used and steps have also been taken to avoid deductive disclosure.

A qualitative methodology was adopted utilizing focused semistructured interviews conducted at a convenient time and location. Participants received an information sheet one week before the interview.

Following consent, the interview flexibly covered the lines of questioning shown in Table 2. Participants were encouraged to consider and explore the process through which they gathered information when coaching, how it was analyzed and applied in action. Interviews lasted approximately 30–45 min ( $M = 42$ ). Data were recorded using a digital Dictaphone and stored electronically in an mp3 file format in a secure encrypted external hard drive.

Interviews were transcribed verbatim using a transcription service. Data were analyzed using an interpretive phenomenological approach (IPA; Smith, Flowers, & Larkin, 2009) to comprehend the personal meanings

**Table 1 Coach Experience and Qualification**

Coach	Highest qualification held	Coaching Experience
1	UKCC Level 4 certificate in paddle-sport	15 years
2	British Canoeing level 5 coach	18 years
3	Multiple British Canoeing level 5 coach	23 years
4	UKCC Level 3 coach—British Canoeing Olympic programme	10 years
5	UKCC Level 3 coach—Home Nation programme	10 years
6	British Canoeing level 5 coach	24 years

**Table 2 Interview Prompt Guide****Prompting Question****Administration and Background**

Do you have any questions?  
 What do you understand of the process?  
 What do you consider makes you high performance?  
 What are your key qualifications and skills?  
 What are your key roles?  
 What are your key Experiences?

**Repertoire**

What does a normal coaching performance look like for you?  
 What challenges do you face within your normal coaching environment?  
 What factors influence your coaching?  
 What other options could you take?

**Observation Strategies**

What tools do you use to profile performers?  
 How do you observe your performers throughout their performance?  
 What do you look for?  
 What options/strategies to you choose?  
 Why do you look for this?  
 Do you use any aids?  
 How long do you have to observe in your normal coaching episodes?

**Analysis Strategies**

How do you analyse the performance?  
 When does this differ?  
 What aids this analysis?  
 How do you make time to analyse the performance?  
 What informs this process?  
 How have these strategies developed?  
 How do your strategies vary depending on the context/environment?  
 How does this impact on the next action taken?  
 How do you apply information gathered?  
 What drives the next intervention?



behind lived experiences (i.e., why certain actions are taken) and the involvement of individuals within the coaching environment. IPA lends itself well to situations that are individualized, complex, process-driven, and novel (Smith & Osborne, 2007) by focusing on the perception of the situation and “sense-making” processes of individuals in their world. Each transcript was reread several times before analysis to fully comprehend the interview features (Sandelowski, 1995). Annotated commentary was used on the transcription (i.e., case familiarization). Notes were codified before an iterative analysis of clustering into lower, medium, and high order themes. The process was extended across the remaining participants’ data.

## Results and Discussion of High-Order Themes

Initial analysis identified 262 codified units, which were subsequently grouped into 58 low-order themes. These were collated into 7 midorder themes and then combined into 3 higher-order themes. These have been presented as a hierarchical network in Table 3. In line with Braun and Clarke (2006), we have provided examples of the themes from the data samples and have varied the length of quotes to demonstrate the depth and richness found in the data.

### Reflection Based Practice

The participants articulated their own philosophies and beliefs in relation to their observation suggesting high levels of self-awareness, implying a high level of reflective skill. These reflective skills allowed the coaches to manage the complexity of the in-action observation by constructing contextual frameworks for their own observation that are built upon an intimate knowledge of their discipline its context and their own cognition. These constructs allow the coach to anticipate, react to, and manage the pedagogic processes. The in-action reflective processes *and* on-action/in-context reflective processes (Schön, 1983), integrated with the coaching process drive the PJDM derived from the observation within the specific coaching context. A cyclical on-action process contributes to the constant construction of the contextual framework that informs the coaches’ understanding of the context, their epistemology, philosophy, and declarative skills (Collins & Collins, 2012).

In practical terms, this experience and reflection constructs the coaches’ mental model for their own observation and underpins a more specific technical template for the performance itself.

I guess I will add my own opinions about what is right and wrong. I definitely in terms of technical performance, I wouldn’t describe me as black and white, this is how it needs to be done. I’m definitely, I have a few things I would say are a must, a whole heap of things that are moveable depending on the individual, the physique, the boat they’re in. (Coach 2)

It is this mental model, and technical template constructed through shared and personal experience that the coach applies to the performance being observed. The coach’s mental model and technical template are critically appraised against set models for observable performance that are presented from expert sources within the coaches’ community of practice. These experts appear to be selected by the coach based on skill level, qualification, reputation, success, and a personal rapport. The coaches identified their own expert models, Coach 4 commented, “I spent a lot of time quizzing them [the expert] about the good bits about what they did as well as recognizing the bits I thought I could do better”. The expert influence was, however, viewed with a questioning skepticism by the coaches. Such pragmatism allowed adaptability and flexibility by allowing a synergy of their own mental model and technical template with that of the experts’ model.

These expert models act as a starting point for the inexperienced coach and as a reference for the more experienced. The value of the expert model appeared to lessen as the coaches’ experiences grew. These personally constructed models and templates can be referenced against those of other coaches within the community of practice or against those of the experts identified by the coaches themselves as a fall back if novel problems are identified in observation.

Coach 4 commented, “I’ve been lucky enough to work alongside a lot of good coaches and discussing things through, a lot of good coaches”, and cited this as an influential factor upon his observational practices. Coach 3 describes this process of development as “based on experience...what I’ve seen before, models, memories. With quite a few years of coaching there’s quite a few memories in the head.” This process appears akin to a social knowledge generation cycle (cf. SECI model; Nonaka, Toyama, & Konno, 2000) and allowed the coaches to create meaning, interpret, contextualize the experiences and, ultimately, to reapply that generated knowledge.

Consequently, these shared mental models and technical template retain a degree of consistency within the wider community of practice, though this requires further study. This may imply a socioconstructivist development of these models. The influence of these coach-acknowledged experts was key in the development of the mental model and technical template. The experts also acted as a source of technical knowledge and example of coaching. Coach 2 reflected as follows:

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

Direct replication of the expert practice out of context was recognized negatively by the coaches. The coaches articulated an ability to appraise and interpret the

**Table 3 Higher, Mid and Low Order Themes**

Higher Order Themes	Mid-Order Themes	Low-Order Themes
Reflective-Based Practice	Knowledge of Self	Reference of personal philosophy Decision-making in own practice Continued education Role (Guiding, coach, performance coach, coach education, education) Currency of practice (familiar/unfamiliar) Broad repertoire within domain Explicit, Tacit Decision-making (see meta process) Reflective process (see Reflective skills) Community of Practice
	Reflective Skills	Coaches' skill as reflective practitioner In-action (intuitive basis to reflective practice) On-action (classic basis for reflective practice) On-action in context (create time to think, pedagogic and practical strategies) Preaction (aspect of planning, creation of contextual framework for decisions in action)
Learning Environment	Knowledge of Performance	Knowledge of student/athlete needs and wants (observation, questioning)  Knowledge of student/athlete ability (observation, questioning) Goal setting and long term aims Profiling of student/athletes (short- and long-term) Learning/performance outcomes (Needs and wants, syllabus constraints) Individualization Group/squad needs (competing performance/development needs) Syllabi delivery—working from scripts Measurement of student/athlete skill progression (within session or series) External pressure (Ego/Social/Environmental/Performance)
	Knowledge of Environment	Weather (past, present and future) External constraint (Time/Environment) Conditions (water grade, wind, competition, inter relationship) Performance outcomes required, (selection/qualification) Expectation of success, (from athlete/performer/manger) Real risk perceived by coach and by student Replication of Observation, (One off performance)
Managing Complexity in Observation	Aspect of Observation Process (selecting options)	Considered process, planning (preaction, on-action, creating time) Intuitive process (on action/in-context, creating time, selecting options)  Replication of observation (actual or video review) Observation and analysis intuition present (NDM) Observation and analysis structure present (CDM) Condition for NDM Attractors described

*(continued)*

Table 3 (continued)

Higher Order Themes	Mid-Order Themes	Low-Order Themes
		In session (In-action and on-action in context, nested)
		Adaptability, Flexibility
		Preplanned intervention strategy
		Recognition of previous success strategies
		Commitment to the course of action (little deviation)
		Creativity
		Educated Guess / Hunch
	Analysis—Audit (interpretation of observation)	Meta-decision, how best to make the decision
		Time to think (RDM/NDM)
		Understanding of technical templates
		Time to think (pedagogic, practical strategies)
		Prioritizing most effective coaching interventions
		Benefits of proposed action
		Adaptation of technical performance template variables for the context, (individual/environment/equipment)
	Decision-Making (application of coaching intervention)	Application of previously successful intervention strategies, (applied to similar athlete/learner/context)
		Meta-decision, Check and challenge of decision
		Evidence-led (measurement of long-term progress)
		Optimal performance outcome selected
		Suboptimal performance outcome selected (to achieve success)
		Personal Preference, pros and cons (macro and micro process)

observed performance that was unfolding in front of them. However, time pressures and social factors could create conditions in which the coach failed to fully appraise the sources of information (own observation or borrowed model) being shown in a new context (Williams & Ward, 2003). Misplaced reliance on models has the potential for the coach to apply proceduralized approaches, as illustrated in the Body, Body and Blade model (Ferrero, 2006, p. 29) out of context. Coach 4 comments:

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

McCammon (2004) identified the influence of experts as traps (*the expert halo*), impacting the perceptions and conformity of others. The positive impression of the expert, as described above, may result in less experienced coaches ascribing skills, abilities and competencies that they may not necessarily possess.

## Learning Environment

The nature of the observation and its desired outcome was linked closely to the "learning environment". Knowledge of the performer and learning context were key in the coaches' focus and allowed them to create individualized coaching interventions. Coach 4 described how the observation worked in structured synergy with the other parts of the coaching process:

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

The adventure paddle sports coaches discussed performers' goals and aspirations before observation or intervention and attempted to meet and exceed the performers aspirations with these interventions typically lasting between one and two days. As a result the observation was time pressured. In addition, an

element of risk associated with repeated observations also increased pressure on the coach. The exposure to risk was managed by facilitating rapid development of the student, potentially at the expense of longer-term skill retention or acquisition. A pragmatic observation of the athlete's/performer's needs was felt to be significant by all of the coaches. Coach 3 described this process happening in an adventure sport context as follows:

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

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

It comes from race analyses because you maybe, look at data during races, if a question of analysis. You are not reading because you have a fast time, where does it come from, I would be much more focused on the outcome of the athlete, and looking at the gap during the key events as that's focused on the athletes. (Coach 5)

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

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

During the observation, awareness of the "affordances" (Chow et al. 2016, p. 55) of a given environment allowed the coach to consider how to manipulate variables and construct practices. Attention was paid to performer and environment. However, coaches were unable to effectively profile performance deficits when the environment was highly dynamic resorting to a more holistic observation approach that may be more prone to heuristics bias. To this end, Coach 3 stated the following:

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

The athletes' perceived wants influences the coaches' observation, prioritizing outcome (wants) above observed needs. This reflects the paradox highlighted earlier. In the initial stages, the observation process may require a rapid skill development; for safety reasons, we assume that approach changes once a suitable level of skill has been developed though this warrants further study. This prioritizing of wants over needs may illustrate a misunderstanding of individualized coaching or independent performance and represents an epistemological gap between the coaches' views and expectations (Lyle, 2002) and certainly challenges the epistemological chain identified by Collins et al. (2014), in a similar group of adventure sports of coaches. This also illustrates a perception of control, saliency, anchoring and miss-calibration heuristics, as the wants may not be achievable without addressing the needs.

## Managing Complexity in Observation

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

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

This is an area that we suggest, is particularly fraught with heuristic bias, as it is the coaches' interpretation, and not the athletes' perception that is often acted upon. The complexity of the observational task can create "environmental noise" (Renfrew et al., 2014, p. 157). It is this 'noise' that detracts from the coaches' ability to



effectively select the optimum intervention. The ability to manage the noise suggests a collaboration and higher level of thinking (cf. meta-cognition) and may serve to filter or prioritize distracting 'environmental noise', implicitly addressing a potential misrepresentation heuristic.

Outwardly naturalistic in nature, these real world decisions under real world conditions (Harvey, Lyle, & Muir, 2015) drew upon previous decision-making strategies in action while also drawing on the mental models and technical templates that were developed via a CDM process. This is illustrative of a meta-cognitive component to the nesting aspect of the PJDM process. However, this was described by the coaches as intuitive in nature. Coach 1 testified, "I don't think too much about it so I guess it must be fairly intuitive? Based, based on experience I guess?" In describing this, coach 3 said, "I'm definitely, whether you want to call it intuition, system 2, whatever gobbledygook you wanna call it, but that's where those short cuts come in, which is just experience."

We conjecture that the amount of post hoc thinking might question the validity of this assertion of intuition (consider Harts & Billett, 2013). This appears to reflect comments by Collins et al. (2016) who suggested that this post hoc rationalization bore relation to a CDM-like process that is operationalized via NDM supporting the notion of nested PJDM processes in relation to the observation of performance. (Abraham & Collins, 2011; Collins & Collins 2015). Outwardly, intuition allows the coach to balance the complexity inherent in the observation process without apparent conscious thought. This ability to "perceive better" (Rabb & Johnson, 2007), is a characteristic of expert performance and, we assume, allows the coaches who were studied to make better choices. However, the capacity to post hoc rationalize suggests the ability to select from a set of options. What is perceived as intuitive may, in fact, be ease of access to relevant mental models and may be constructed through on-action reflection of experience. A rich repertoire of mental models or templates is stored within the subconscious in such a way as to facilitate easy access and utilization that allows the nested PJDM process derived from observation to operate in complex, novel, and chaotic environments (Abraham & Collins, 2011; Collins & Collins, 2016; Martindale & Collins, 2007, 2012).

However, the observational models and technical templates seem logically susceptible to availability, representativeness, and anchoring heuristics within the decision-making process. Crucially, the weakness of such heuristics appear to be recognized by the coaches; Coach 3 states "I'll take a punt? It's reality? But I'll accept it's a calculated punt based on what's worked before. I chose the word tongue in cheek but I'll accept it's a punt and punts aren't always right." This is suggestive of a meta-cognitive aspect in relation to the decision-making process and the management of the complexity in observation. When prompted to elaborate, Coach 3 described the process as follows:

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

## Conclusion

The preliminary findings of this initial pilot study support our suggestion that coaches use heuristics in their observations and, presumably, that observation is therefore susceptible to the advantages and disadvantages of this association with heuristics. Heuristics appear vital for the coaches studied to act in an effective way, given the time pressures and the risks associated with observation in these contexts. The inclusion and development of these processes may have positive and negative impacts on observation yet appears crucial within coach development and education and is worthy of further research.

In addition it seems probable that heuristics play a role in managing the complexity of the coaching process, particularly auditing and decision making elements derived from that observation. It therefore seems likely that the coaches' mental models and technical templates may be themselves susceptible to heuristics as the in-action auditing creates high cognitive load, as the coach attempts to manage complexity. A further scoping study in which the complexity of the coaching process is explored and managed without the availability of a clear mental model or technical template may provide more detail regarding the nature of observational complexity and appears valuable as a direction for future research.

## Do Heuristics Play a Part in the Observation of Performance?

Heuristics do play a part in the observation process of coaches. These heuristics appear to work both in isolation and in combination to influence the decision derived from the observation process and warrant further investigation. The coaches frequently referred to these speedy decision-making processes as intuitive, although we doubt these are truly intuitive and believe that they are more naturalistic in nature, given the coaches' reliance on experience to guide that aspect of the decision-making process. The ability to post hoc rationalize those decisions, and the use of the coaches' own mental models for observation and technical templates (Oliveira et al., 2014) derived from accepted knowledge both suggest a higher cognitive aspect than the term intuition implies. The heuristics act both positively and negatively on the coaching process. First positively, by speeding up the observation process and in some cases reducing exposure to risk, but also by enabling the potential to act negatively, leading to poorer decisions based on miss-calibration that evolves from

either a limited experience or from poor learning from a broader experience. The later exposing a potential weakness in a coach's ability to learn from such experience.

### What Is the Nature of Those Identified Heuristics Against Existing Definitions From the Literature?

The coaches appeared to be susceptible to the fast and frugal heuristic as a mechanism to manage complex, dynamic, and time-pressured situations, in line with the findings of Bennis and Pachur, 2006, and Oliveira et al. (2014). The fast and frugal heuristic appears to be linked to a "bounded rationality" or recognition process and relates to the mental models and technical templates highlighted earlier. The risk of an illusion of control and miss-calibration can also be identified with coaches (Cox, 2007). The outcomes that coaches attended to and observed were developed through experience and reflection based upon the beliefs held by the coaches. The personally constructed observational cues and mental models of technique and were fallible to "framing effects", "representativeness" and familiarity bias. However, the desire to meet the performer's needs was strong and steered the observation process.

Finally, the influence of the athletes' perceived wants appeared to guide the coaches' observation, prioritizing outcome (wants) above observed needs. This represents a coaching paradox (Barnston 2014) as the coach in an effort to provide a performance outcome or in meeting a learner's expectation may prioritise these wants above needs and illustrate a misunderstanding of individualized coaching or independent performance. The possibility of this coaching paradox may represent an epistemological gap at best or signify a 'force multiplier' of overlapping heuristic bias and would merit further research.

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