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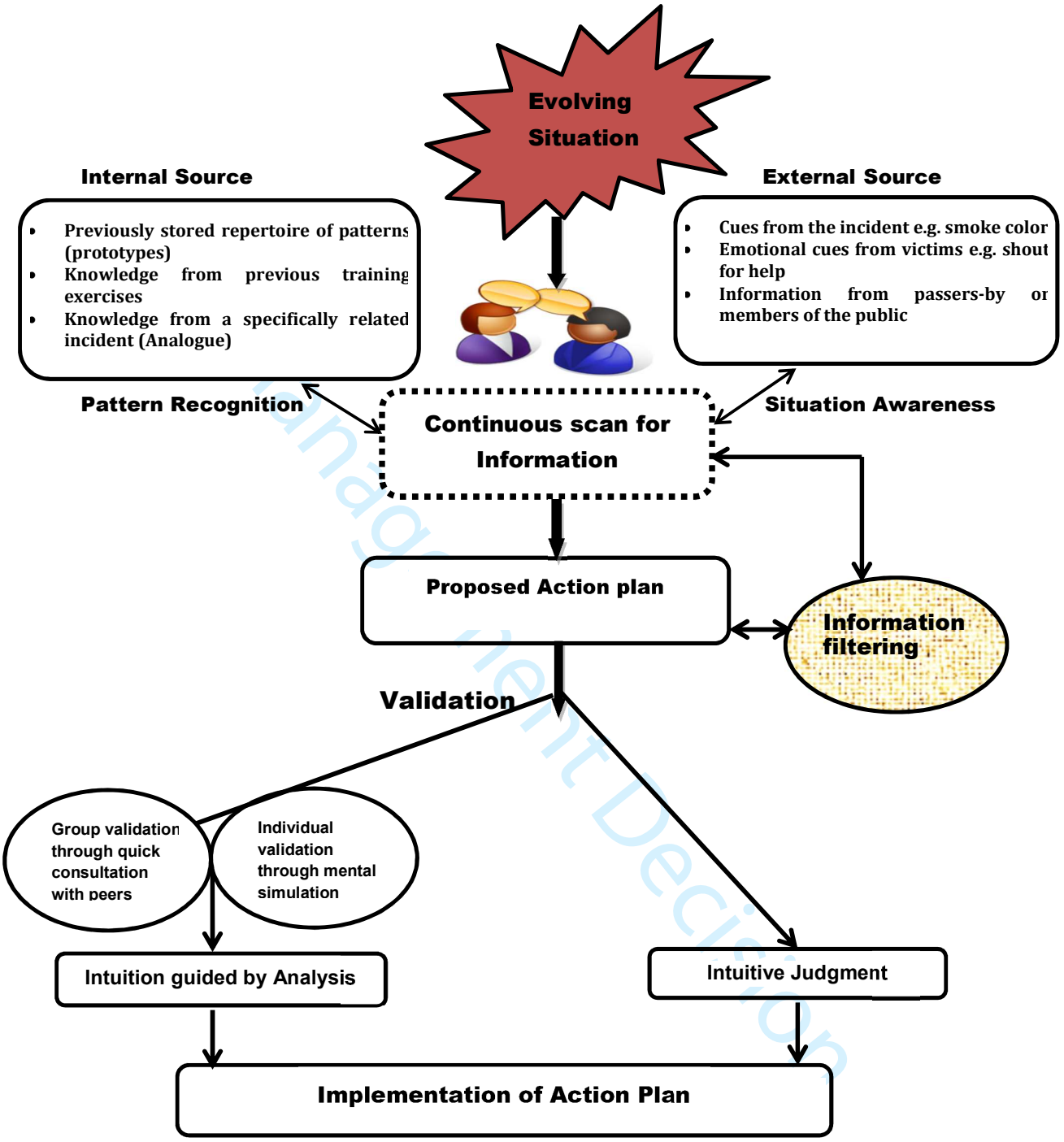

Crisis decision-making: the overlap between intuitive and analytical strategies

Abstract

Purpose: The paper draws on the naturalistic decision making (NDM) and cognitive science literature to examine how experienced crisis managers utilize the intuitive and analytical strategies when managing complex incidents. A cognitive model that describes the interplay between strategies is presented and discussed, and the specific role that intuition plays in analytical decision making is addressed.

Design/methodology/approach: Designed as a conceptual paper, the extant literature is reviewed to advance discussions on the theme of intuitive and analytical decision making in the naturalistic environment. A new model of expert intuition — the information filtering and intuitive decision model — is presented and evaluated against existing cognitive models from the wider literature.

Findings: The paper suggests that experts' ability to make intuitive decisions is strongly hinged on their information processing skills that allow irrelevant cues to be sifted out while the relevant cues are retained. The paper further revealed that experts generally employ the intuitive mode as their default strategy, drawing on the analytical mode only as conditions warrant.

Originality/value: Prior research has shown that experts often make important task decisions using intuitive or analytical strategies or by combining both, but the sequence these should typically follow is still unresolved. Findings from our intuition model reveal that although intuition often precedes analytical thinking in almost all cases, both strategies exist to offer significant values to decision makers if the basis of their application is well understood.

Keywords: Intuition, intuitive judgment, experts, decision making, crisis management, information processing

Introduction

The traditional (classical) decision making theory dominated common understanding of how experts make decisions for decades. It assumes that people have unfailing memory and possess large computational abilities required to run complex decision calculations (Satz and Ferejohn, 1994; Scott, 2000; Bonabeau, 2003). Similar to the concept of *unbounded rationality* the theory suggests that people are generally exposed to a great deal of information which allows them make the 'best' decision. It is also assumes that decision makers are aware of most, if not all, available choice options alongside their potential impacts. The common prescription by the rational choice theorists is that professionals should avoid making intuitive decisions wherever possible and instead think more deliberately. However, with the emergence of a body of knowledge known as naturalistic decision making (NDM) in the early 80's, researchers began to re-conceptualize the subject of expert decision making across a range of domains (Zsambok, 1997; Kahneman and Klein, 2009; Salas, Rosen, & DiazGranados, 2012; Kermarrec and Bossard, 2014; Klein, 2015; Gore and Conway, 2016). Consequently, these studies began to identify inherent flaws in some of the assumptions underpinning the rational choice theory. Firstly, the views of 'rationality' and 'optimality' were criticized for being unrealistic in real-life crisis environments as prior evidence consistently demonstrated the difficulty in maintaining an open mind, particularly when officers have very

limited thinking time for which to make high stake decisions (Tversky and Kahneman, 1973; Kahneman, 2003; Dunning *et al*., 2003; Tsoukas, 2003; Klein, 2003 p.21; Waroquier *et al*., 2010). The prediction here is that operators are always likely to tweak the decision criteria, albeit unconsciously, to fit their pre-conceived and pre-determined notions. Secondly, the fact that in recent years crisis environments have become increasingly fast paced and relatively more dynamic than previously assumed has meant that it appeared unlikely that people would have the time to make complex calculations that evaluated different options (Tissington and Flin, 2005; Sinclair and Ashkanasy, 2005; Ingham, 2007; Salas *et al*., 2012; Sadler-smith, 2016).

Although prior evidence suggests that decision making involves more than one reasoning strategy, at least in practice i.e. the intuitive and analytical approaches, the debate regarding the dominant thinking mode and the preferred sequence these should follow has continued to garner strength in the current literature (Dane and Pratt, 2009; Hodgkinson *et al*., 2009; Evans and Over 2009; Kahneman and Klein, 2009; Hoffrage and Marewski, 2015; Okoli *et al*., 2016a; Gore and Conman, 2016). Should people first draw on their intuition before engaging in analysis or is it the other way round? In what ways do the task environment influence the choice of a dominant thinking strategy at any given time?

In addressing these issues, the current paper is structured as follows. Firstly, the paper begins with contextualizing and conceptualizing intuition from a naturalistic decision-making perspective: a body of knowledge concerned with understanding how operators make decisions when performing real tasks using their experience. Intuition is then discussed as a scientific concept, exploring and synthesizing a range of existing theoretical models in relation to the subject. Next, the relationship between intuition, intuitive judgment and expertise is discussed, including how expert intuition differs from that of novices. Finally, a cognitive model developed from a recent study with expert firefighters — the information filtering and intuitive decision-making model — is introduced and evaluated against other notable intuitive models in the wider literature. The IFIDM captures and articulates some of the nuances and connections that exist between the analytical and intuitive constructs from a naturalistic viewpoint. The model examines, in particular, the role of intuition in the so called analytical thought process. By exploring and synthesising a wide range of literature in naturalistic decision making, cognitive science, management learning, and decision psychology, the current paper is aimed at expanding existing debates around intuitive and analytical thought processes and examining how both constructs interact when performing high staked tasks under time pressure. Detailed methodological discourse, including the expert qualitative reports that aided the development of the IFIDM model has been covered elsewhere in the first output of an ongoing series (See Okoli et al., 2016a for details) and will therefore not be discussed in this conceptual paper. For reference purposes, however, a brief summary of key methodological insights is presented later.

The concept of intuition

It is no longer new that the modern society has been taught to mistrust intuition, preferring instead explicitly articulated expressions, theoretical or codified knowledge (Lamond and Thompson, 2000; Hodgkinson *et al*., 2009). The early work of Albert Einstein voiced a criticism of society's quest for excessive deliberation at the expense of intuition. In his words:

> *"The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honours the servant and has forgotten the gift" (Albert Einstein, 1879–1955 cited in Klein, 2003, p.3).*

The application of intuitive knowledge has undoubtedly generated a great deal of controversy in the scientific literature, perhaps unsurprisingly, since intuition operates in the sub-conscious and deals with *tacitly* held knowledge that is difficult to verbalize and articulate. There is also widespread belief that intuition and intuitive judgement may promote cognitive biases and heuristics, which in turn distort rational thinking (Tversky and Kahneman, 1973; Meehl, 1986; Kahneman, 2003; Dana and Dawes, 2004; Evans and Over, 2010).

Intuition has been studied from diverse perspectives, what Redekop (2009) broadly categorised into "cultivated" and "hard-wired" dimensions, each with equally compelling evidence. For the purpose of clarity, however, the epistemology of the current paper is underpinned by the former dimension. We build on Klein's (2003) definition of intuition as the act of translating one's experience into action, a definition consistent with the assumption that every individual is embedded, either consciously or unconsciously, in a continuous flow of experience throughout their lifetime. Thankfully, the scientific measurement of intuition and how it can be taught continues to burgeon with the emergence of new tools and frameworks that have successfully modelled intuition as a valid form of knowledge across disciplines such as psychology, cognitive science, business and management, education, sports, healthcare and even engineering (Sinclair and Ashkanasy 2005; Dane and Pratt, 2009; Hodgkinson *et al.*, 2009; Kermarrec and Bossard, 2014; Klein 2015; Gore and Conway, 2016; Okoli *et al*., 2016a). According to Dane and Pratt (2009) intuition represents 'affectively charged judgments that arise through rapid, non-conscious, and holistic associations', while Sinclair and Ashkanasy (2005) viewed it as a non-sequential information processing mode that comprises both cognitive and affective elements and results in direct (tacit) knowing. Regardless of how it is defined, a general consensus is that intuitive judgment incurs little or no information processing costs and enables individuals to quickly integrate multiple reasons into their decisions with little mental energy (Hoffrage and Marewski, 2015). Essentially, making intuitive decisions involves integrating and processing information rapidly, which often results in direct 'knowing without knowing how' — implicit learning. In other words, people learn on daily basis without knowing when, how or where such learning took place yet applying what was learnt to solve future problems in clearly novel ways.

One of the ways to describe the *modus operandus* of intuition is to think of it as an advanced *pattern recognition* mechanism where the subconscious mind somehow finds a link between a current problem and the various patterns that had been stored in memory e.g. from past experiences. The sub-conscious mind then rapidly projects the new problem onto pre-stored patterns and sends a 'message of wisdom' to the decision maker. This message comes as an inner voice and is frequently expressed in the language of one's feelings, in the form of calmness or relief, or as a burst of enthusiasm and energy, although this generally works differently for every operator (Khatri and Ng, 2000)

Therefore, whilst intuition could potentially betray a decision-maker, successful leaders hardly ignore their instincts — albeit with a clearer sense of when (or not) to trust it. Evidence from experimental studies also show that subjects who frequently ignored their intuition subsequently made poorer decisions compared to their counterparts (Johnson and Raab, 2003; Waroquier *et al*. 2010).

Intuition, intuitive judgement and expertise

Not all intuitive judgment come from skills, and although incorrect intuitions just like the valid ones tend to arise from the operations of memory, the mechanisms that produce the former only operate in the absence of skills (Dunning *et al*., 2003; Dijksterhuis, 2004; Evans and Over, 2010). The difficulty

is that people have no clear-cut way of knowing where their intuition comes from, neither is there any objective marker that distinguishes correct intuition from those produced by highly imperfect heuristics. Hence, attempts to differentiate between expert intuition and other forms of intuition have been well documented in the literature (King and Clark, 2002; Dane and Pratt, 2009; Kahneman and Klein, 2009; Rosen, Shuffler and Salas, 2010; Salas, Rosen and DiazGranados, 2012). This is based on the notion that the former is extensively rooted in domain-specific knowledge acquired through considerable years of consistent and deliberate practice.

King and Clark (2002) investigated how nurses across four levels of expertise (advanced beginners, competent, proficient and expert levels) made use of their intuition to perform a range of domain specific tasks. The decision points identified in the study revealed, perhaps unsurprisingly, that nurses across all levels of expertise solved difficult problems using both intuitive and analytical styles. Further analysis, however, showed that the frequency with which intuitive decisions were made and the level of confidence associated with intuiting increased progressively with expertise. This outcome was similarly echoed by Baylor (2001) in her U-shaped model. Baylor noted that although both novice and expert operators generally understood what intuition and intuitive decisions entailed, the former tended to display less confidence in the way they recalled and implemented their intuitive knowledge — something she termed *immature* intuition.

The type of expert intuition described in this paper extends beyond the knowledge type that emerges from mere simplification of thoughts, rather it refers to a form of tacit knowledge that is developed through years of dedication, hard work, consistent and deliberate practice. For example, studies on chess (e.g. Chase and Simon, 1973) suggest that at least 10,000 hours of dedicated practice is required to attain the highest level of performance (which is equivalent to playing chess five hours a day for about 6 years). The more patterns people acquire over their years of active practice the more the possibility of them matching a new situation to one of the pre-stored patterns. This is the principle that helps experts to recognize, almost instantaneously, the possible cause of a fire just by looking at the smoke colour or flame texture. The main doctrine of the NDM community across domains of sports, medicine and midwifery, education, aviation, military, ambulance and firefighting is that intuition results from experience which in turn produces experts (Zsambok, 1997; Tissington and Flin, 2005; Klein *et al*., 2010; Rosen, Shuffler and Salas, 2010; Okoli *et al*., 2014; Kermarrec and Bossard, 2014; Hoffrage and Marewski, 2015). Experienced commanders rely on their rich domain knowledge to describe, explain and predict events better. As it becomes obvious that generating and evaluating large sets of options would likely cause an incident to grow out of control, expert commanders tend to leverage on their experience to generate a workable option, which is usually the first and possibly the only option they might consider. The quality of people's intuition is therefore only as good as the experience(s) upon which it was built.

There is little doubt that performance could be improved if conditions allowed sufficient processing time or provided decision makers with all the relevant information when needed, but this is rarely the case in a crisis environment typically characterized by uncertainty, time pressure, ambiguity, continuously changing conditions and ill-defined goals — all of which necessitates the making of swift and rapid decisions. And whilst having sound domain knowledge about the cognitive rules associated with various tasks may be a good starting point, this could subsequently prove insufficient if an officer is unable to act intuitively and decisively under extreme conditions. We therefore argue that in addition to building a repertoire of technical skills, crisis responders must also give equal, if not more, attention to developing their intuitive skills.

Some philosophical and theoretical perspectives of intuition as a scientific construct

Michael Polanyi, a chemist turned philosopher, was the first to use the term *tacit knowledge* — a term that has now become popular in the knowledge management literature (Tsoukas, 2003). In discussing the dichotomy between intuitive and theoretical (codified) knowledge, Polanyi's philosophy is largely based on the doctrine that intuition is often the dominant form of knowledge, and that what is generally referred to as rationality (or objectivity) is largely underpinned by personal knowing. His main line of thought is that creative acts (or acts of discovery) are imbued with strong personal feelings and commitments, and that knowledge is highly dependent on human action. He refuted the then dominant belief that science was value-free, arguing instead that the informed guesses, gut-feelings and intuitions which are part of exploratory acts are motivated by 'passions'. The assumption that theoretical knowledge is totally objective was the major bone of contention for Polanyi, who argued instead that all forms of knowing are *personal* (Polanyi, 1966). A closer look at how the so called codified knowledge is used in practice reveals it is grounded on personal judgments and tacit commitments, implying therefore that theoretical or codified knowledge is not as objective, explicit, or self-sustaining as it was assumed. All forms of knowledge contain what Polanyi (1962, p.17) termed *personal coefficient* or intuitive knowledge, exactly what makes the interpretation of facts and application of knowledge unique from one individual to another — since individuals acquire and utilize skills in unique ways.

Another theoretical framework that has been widely referenced in the NDM literature is the recognition primed decision making model (RPDM), originally developed by Gary Klein and his colleagues (Klein, Calderwood and Clinton-Cirocco, 1986). Recognition primed decisions, according to this model, are decisions for which actions are directly derived from recognition of critical information (cues) and prior experiential knowledge. The initial study that led to the development of this model stemmed from an attempt to describe and analyse the decision making strategies used by fireground commanders who were required to make decisions under conditions of uncertainty and time pressure. The authors' initial hypothesis was that the commanders would restrict their analysis to only a pair of options, but contrary to pre-conceived beliefs all that the commanders generated was a single choice option without the need to compare several alternatives. This was possible because the officers could draw upon the repertoire of *patterns* (a collection of cues that has been chunked in memory) which had been compiled over more than a decade of experience to identify a plausible option that was considered first. Simply put, the RPD model describes how recognized patterns could be efficiently used to solve current problems. One of the key insights from the RPD model is that intuition has a higher capacity than analysis, not necessarily because the latter is in itself a wrong thing to do but because too much deliberation tends to disrupt the naturally flowing first impressions that support intuition.

Subsequently, the recognition/metacognitive (R/M) model was developed by Cohen *et al*. (1996) to describe how naval officers made critical decisions in novel and largely unpredictable circumstances. Whereas the RPD model assumes that proficient decision makers will often rely on recognized patterns to solve a current task, the R/M model identified a possible flaw in this line of thought, namely the likelihood of encountering new events that could altogether defy existing knowledge. The model suggests that in high novel situations where recognizing patterns might prove quite difficult, experienced officers will have to rely on their metacognitive skills. In such circumstances officers are better poised to employ a story building strategy — developing useful "stories" from several unrelated events to make a workable action plan. The R/M model involves a two-tier process:

- An activation stage where action plans are developed through pattern recognition

- The *critiquing* and *correcting* stage where the workability of the outcome from the first stage is quickly assessed and deliberately checked for faults.

Three types of faults can be identified in an action plan through critiquing (i) incompleteness — information required to formulate the action plan is missing (ii) unreliability — information required to support potential actions or goals is subject to erroneous interpretations (iii) conflict — a lack of alignment between available data and actor's mental model. The correcting stage immediately follows the critiquing stage; here attempts are made to fix the gaps identified in the proposed action plans. This could entail making further observation, generating additional information, revising current assumptions, or all of the above.

Intuitive versus Analytical decision making: two sides of the same coin?

It is well known that experts are likely to approach problems using both intuition and analysis, switching between both styles as conditions warrant (Goldstein and Gigerenzer, 2002; Evans and Over, 2010; Gigerenzer and Gaissmaier, 2011) — but the sequence of operation these should follow has remained rather unclear. Do experts draw on intuition and analysis as separate 'inputs' when making critical decisions or do they firstly make intuitive decisions and analyse a bit more afterwards? One important observation from our research on expert cognition is that the debate regarding the preferred thinking mode continues to point to an inherent difficulty, at least in practice, of separating intuition from analysis. Dörfler and Ackermann (2012) used the analogy of the functioning of the human eyes to exemplify how intuitive and analytical systems generally tend to operate. As with *peripheral vision,* the intuitive mode ensures that operators have good awareness of their surrounding environment, implying that other informational cues in the environment could be tracked alongside performing a main task. In contrast, the analytical mode, similar to the foveal functioning of the eyes is designed to focus on one element at a time i.e. the particular element the decision maker is conscious of. Arguably, this lack of flexibility explains why the analytical mode is generally seen as a less viable option in a crisis environment that is characterised by high stakes, constantly changing conditions and time pressure.

Although intuition operates in the sub-conscious, it does not necessarily contradict analyses, nor is it the opposite of analyses. This assertion is evident in the words of Simon (1987, p.63):

> "*intuition is analyses frozen into habit and into the capacity for rapid response through recognition*".

Simon viewed intuition and analyses as dual mental processes distinguished notably by their speed of operation and ease of application. Prior evidence also gives credence to the notion of intuition and analysis being complementary rather than competitive (Sinclair and Ashkanasy, 2005; Gore and Conway, 2016). For example, in his book entitled "*Thought and choice in chess"* de Groot (1965) reported how grand masters used their intuition to recognize some promising moves that required close examination, allowing them switch to a more analytical mode as conditions warrant. This transition from intuitive to analytical mode gave the chess players a little extra time to reflect on their moves as the game progressed. Through a process known as *mental simulation*, the chess players were then able to analyse their game-plan such that moves perceived to be less rewarding were screened out, leaving a single move that was considered playable. As with the chess study, many NDM scholars have favoured an intuition-driven approach to decision making over the analytical style (Klein, 2015). The logic behind this is that, with intuition being the default thinking

mode, actors are able to free up extra mental energy which can then be used to perform the more difficult (non-routine) tasks. The analytical mode is thus best invoked when the former struggles to solve a problem at hand, or when decision makers are obliged to justify their chosen course of action.

The cognitive continuum theory (Hammond *et al*., 1987) has also proved of worth in explaining the interplay between the intuitive and analytical systems, and how they combine during task performance. The theory classifies task characteristics into "analysis-inducing" and "intuition-inducing" tasks, and suggests that the nature of the task environment (e.g. scale of incident, level of risk, available time) will usually determine the dominant decision making strategy. According to the theory, deliberating on possible options does not necessarily translate into incompetence, what matters is understanding the circumstances that warrant a particular decision style. Goldstein and Gigerenzer (2002) used the term *adaptive toolbox* to explain how people adapt their decision-making styles to environmental structures and the degree to which various decision strategies fit into different conditions. The adaptive toolbox is thus based on the assumption that no universal tool can possibly solve all tasks — simple and complex ones alike.

The remainder of this paper is focused on evaluating a cognitive model that was developed from our recent study with firefighters, and highlighting its implications for practice. Based on a thematic analysis of retrospective incident reports, the model describes how expert participants used intuition, or analysis, or a combination of both to arrive at important judgments.

Information filtering and intuitive decision model

In a recent study involving thirty experienced firefighters across selected fire stations in the UK (n=15) and Nigeria (n=15), we developed a cognitive model that describes how experts made difficult fire ground decisions under time pressure (Fig. 1). Detailed description of the study and coding process have been discussed elsewhere (see Okoli *et al*., 2016a; Okoli *et al*., 2016b), only an evaluation of the model is done in this paper. Using the critical decision method as knowledge elicitation tool, the study examined how experienced actors made intuitive but largely accurate decisions in conditions of moderate to extreme task constraints. The study followed a rigorous thematic analysis protocol, and the coding frames generated were cross examined by three investigators to enhance the reliability of results. Interview excerpts were first coded and abstracted into sub-categories and then into categories, subsequently leading to the emergence of themes and subsequently the IFID model. A total of 134 decision points was identified from the incident accounts. We defined a decision point as a particular spot on the incident timeline where participants admitted following a course of action even when other potential options had been envisaged e.g. employing a hose reel as opposed to a main jet.

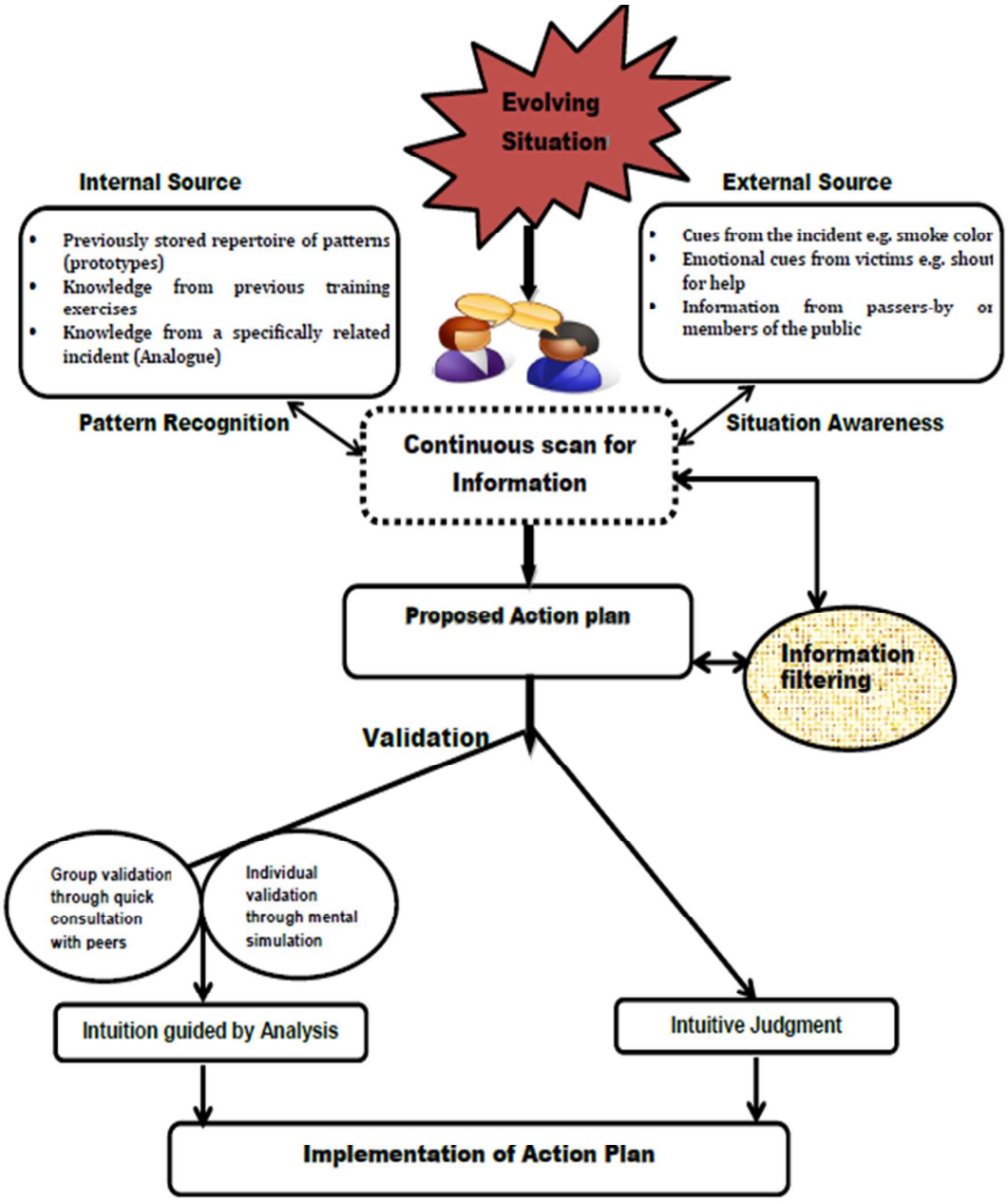

Fig 1: Information filtering and intuitive decision making model

Discussion and implications for practice

The IFID model is a conceptualization of the way that thirty experienced firefighters managed to deal with the complexities generated from managing non-routine incidents through the iterative stages of information scanning and information filtering. The *first stage* of the model is the *information scanning stage*. At this point several questions automatically come to the mind of an officer, who must immediately assess the situation and determine what key hazards are in the environment e.g. whether people are trapped in the building or whether the response crew have enough resources to manage the incident. The officer will also need to consider the safest and most effective way to

manage the incident and predict how the external environment is likely to affect task performance. When scanning for useful task related information, officers seem to rely on information from both internal and external sources as shown in the model. On the internal side, expert operators will scan their memory in search of previously stored patterns, with the hope that insights drawn from pre-stored knowledge will prove effective in solving a current problem. Pre-stored knowledge could emerge from key learning points picked from past training exercises, or from new skills gained from previously managed incidents. On the external side, officers rely on information generated from observing the various cues associated with a particular incident such as flame intensity, smoke colour, smoke texture, cracked walls, or from verbal, physiological or psychological cues observed in victims or passers-by.

The second stage of the IFID model is the *information filtering stage*. For the purpose of clarity, we define information filtering as the cognitive ability to discriminate between relevant and irrelevant informational cues. The relevance of the information filtering stage is the possibility that decision makers are left with fewer options to choose from as irrelevant cues get filtered out. This generally creates additional working memory space to help with performing more difficult tasks, since the extra unnecessary information, which Klein (2003) termed noise, tends to add to the complexity of existing chaos. Noise comprises irrelevant data or cues that competes with, or even overlaps the relevant ones; these intersections eventually add to existing complications as more possible ways of interpreting a problem start to emerge. The caveat here, however, is understanding that the term 'irrelevant' does not necessarily mean 'useless', irrelevant here simply represent information that do not fit the purpose of a current task. Extra care must therefore be taken to ensure that important informational cues are not screened out or explained away at this stage.

As shown in the model, once the information filtering process is deemed complete and all necessary information obtained, incident commanders then proceed to the *third stage* — the validation stage. The validation process ensures that all missing gaps in current data are identified and that all potential sources of post-decision regrets are envisaged. Overall, the decision to validate, including the length and depth of the validation process is often influenced by certain factors such as the level of stakes involved, available time, team composition and ease of information retrieval. The process usually takes one of two major forms: (i) mental simulation — the commander uses their experience to project the status of the current environment into the future, allowing potential cognitive pitfalls as well as opportunities in a potential action plan to be pre-empted (ii) quick consultation with peers — this occurs when a commander perceives the need to 'pick the brain' of other team members prior to implementing an action plan. In conditions of high uncertainty or conflicting goals, some officers feel more confident when they run their proposed action plans through other experienced crew members. We termed these two validation processes 'intuition guided by analysis', a term that serves to caution managers on the need to regulate their natural tendencies to intuit, particularly in high-staked and extremely uncertain task conditions. It is also pertinent to clarify that the term 'intuition guided by analysis' is conceptually different from the extreme analytical thinking mode, but similar to what Hogarth (2003) termed imposing 'circuit breakers' or what Cohen *et al* (1996) described as conducting a 'quick test'.

According to the IFID model, the implementation of proposed action plans begins once officers are satisfied with the outcome of the validation process i.e. when there is no perceived need to validate further. One of the cues that triggers this decision is that officers begin to experience a significant level of congruity between their mental model and the way events are proceeding at each decision point. More so, all sources of information must have been duly checked for clarity and reliability

before officers generally begin to experience what Sinclair and Ashkanasy (2005) termed 'a sense of confidence that precedes intuitive judgement'.

In contrast to some cognitive models that largely attribute expert intuition to actors' ability to recognise previously stored patterns in memory (e.g. RPD model, Klein, 2008) or in models where expert intuition has been linked to actors' metacognitive ability to spot gaps in action plans (e.g. R/M model, Cohen et al., 1996), the IFID model, in addition to these, purports that intuitive decision making is strongly hinged on being able to process multiple informational cues efficiently. Building on the "less is more" principle (Hertwig and Todd 2003) and the cognitive load theory (Paas *et al*. 2004), the model links intuitive decision making to experts' efficient information processing ability, which allows irrelevant cues to be sifted out and the relevant ones retained. Regardless of the proceeding of events in an external environment, officers must ensure their working memory, which by definition is only able to process between 7-9 elements at any given time, is not overloaded (Paas *et al.,* 2004). Within this context, one would argue that whilst having very little information about an incident could prove less productive, absorbing too much information could also be counter-productive and ultimately result in cognitive overload. The need to effectively manage both the amount and quality of information absorbed by officers across an incident timeline is therefore key to effective response.

Another contribution of the IFID model lies in its attempt to clarify the role of intuition in analytical thinking. Whist we agree that intuitive and deliberative modes, although conceptually different, often complement each other — at least in practice — we also wish to acknowledge that the decision to deliberate on a course of action is an intuitive function in the first place. According to the IFID model, intuition is perceived as a precursor to analytical thinking and essentially indicates where the analytical effort should focus. The model thus embodies our observation that intuition will often precede the so called analytical thinking in almost all cases i.e. actors would first run a 'quick test' based on available evidence to determine whether to act instantaneously (based on recognised patterns) or to deliberate a little further. Thus, the IFID model does not just give credence to the synergy that exist between the intuitive and analytical modes, it further demonstrates how decision makers are often provided with a quick opportunity to assess their expertise and gauge the boundaries of their skills prior to implementing any proposed action plan (see earlier discussion on the *validation stage*). Asking where and how one is likely to be betrayed by intuition and whether further deliberation might prove more appropriate is an important step to preventing post-decision regrets.

Having said this, it would be somewhat misleading to ignore the conception that intuitive skills are often difficult to acquire in practice. The good news, however, is that the process of gaining them can be propelled through training and deliberate practice (Kahneman and Klein, 2009; Okoli, Weller and Watt, 2014). If intuition is understood as "pattern recognition based on experience and learning that is especially useful in complex situations that require instantaneous actions or behaviours" (Redekop 2009, p.400), then training novices or 'pseudo-experts' to become better intuitive decision makers will mostly entail strengthening their experience base through relevant learning tasks. Modelling what experts do as described in the IFID model and teaching such to novices is thus envisaged as a useful framework for such training purposes. Frankly speaking, developing a reservoir of experiential knowledge takes several years of dedication and hard work. For example, the study of Chase and Simon (1973) showed that at least 10,000 hours of dedicated practice is required to attain the highest level of performance in chess — this is equivalent to playing chess five hours daily for at least six years. Tellingly, the more patterns people acquire over their years of active practice the more likely they are able to match a new situation to one of pre-stored patterns. The model offers

insight into improved methods of designing curricula that will enable novices to focus more effectively on the key elements of the situations they study and participate in.

Conclusion and future research

Overall, this paper has revisited a long standing debate regarding the dominance and sequence of operation between the intuitive and analytical modes. In doing so, the paper reviewed prior beliefs attributing analytical thinking to purely objective and rational constructs, and discussed why such theory generally appears unrealistic in a crisis environment. Our own investigation revealed that experienced crisis managers usually employ the intuitive mode as their default strategy, but also draw on intuition and analysis as separate inputs as conditions warrant. When confronted with choice dilemmas, experienced commanders utilise their extensive experiential knowledge to determine the most plausible option through a 'quick test'.

Future work could attempt to test and validate the assumptions of the IFID model across other domains of practice such as military, ambulance services and intensive care units. It will be useful for researchers and practitioners within the decision-making community to continue to develop effective training or learning tasks for novices that focus on developing certain aspects of their expertise (e.g. situation awareness). Further studies could then explore how novices might be supported to become more reliant on, and more confident in their intuitive judgments, particularly in conditions of considerable time pressure and high stakes. Hopefully, the insights presented in this paper provide a useful starting point to drive research in this direction. Regardless of how intuition is perceived, the fact remains that a paradigm shift is needed in the field of crisis management if operational commanders are to become fast thinkers.

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