The Central Role of Memory in Expert Management Intuition

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Abstract
Managers are required to make decisions in complex environments and are often under tremendous time pressures. The conditions regularly facing managers create and call for specific psychological mechanisms that have been widely investigated in experimental psychology and in neuroscience. In this paper we consider the psychological theories of expertise offered by Dreyfus (Dreyfus, 1972; Dreyfus & Dreyfus, 1986) and Simon (Chase & Simon, 1973; Simon, 1989); discussing the central tenets of each theory in light of empirical evidence. We then consider Simon’s later work, the template theory of expertise (Gobet & Simon, 1996) and demonstrate how the theory accounts for much of the existing data in a variety of domains, and how its further extension accounts explicitly for the emotional aspects of intuition (Chassy & Gobet, 2011). Through consideration of each contribution to an understanding of expert performance, we expose the central role played by memory in expert intuition. Following examination of the template theory’s accountability for existing chess data, we show how the theory is applicable to intuition in management. We then provide practical advice for management trainers by capitalizing on current knowledge, so that future managers may benefit from effective training, grounded in robust research on the precise mechanisms underlying expertise.

Keywords: intuition, management, memory.

Introduction
Experts make decisions that impact heavily on society, policies, and business companies. The complexities of situations typically do not enable exhaustive analyses of the factors involved in problems, and thus decisions are mostly guided by intuition. Experts in a wide range of domains such as chess (Campitelli & Gobet, 2004), fire-fighting (Klein, 1998), nursing (Benner, Tanner, & Chesla, 1996), and management (Eisenhardt, 1989) demonstrate an unrivalled ability to make correct decisions quickly. Intriguingly, the psychological conditions in which experts have to make decisions are similar across fields of expertise. Two key factors define these conditions. First, situations are complex; rendering exhaustive analysis of all factors highly unlikely. A second key factor is time pressure, which elicits an emotional modulation of the decision-making process. Expert managers face the same cognitive challenges as chess players, fire fighters, and army commanders, and thus require the same psychological mechanisms to cope with the high-level difficulties of tasks. In this article, we expose the main theories of expert intuition (Chassy & Gobet, 2011; Dreyfus & Dreyfus, 1986; Simon, 1989) to highlight the psychological mechanisms underpinning the rapid and correct judgement of situations, enabling accurate decision-making. We then utilise the current knowledge on intuition to provide practical advice for managers to improve intuitive processes, and to thus further sharpen decision-making skills.

The utility of the intuitive judgments of experts in business contexts has been recognised by several authors (Khandelwal & Taneja, 2010; Mintzberg & Westley, 2001; Parikh, Lank, & Neubauer, 1994). Research into expertise has been fuelled by a variety of domains, of which chess is the most prevalent

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Although at first glance, the domains of chess and management may appear at odds, many of the thinking processes underlying top chess performance are likewise applicable to managers. For example, the ability to rapidly recognise patterns in the environment without conscious awareness, upon which quick, effective decisions can be made, is crucial for both the business (Lank & Lank, 1995) and chess (Charness, 1992; Chassy & Gobet, 2005; 2011; Gobet & Chassy, 2008; 2009). A particularly salient difference between these theories is the type of processing thought to underlie expertise. On the one hand, holistic processing of information defines expert performance (Dreyfus & Dreyfus, 1986); whereas the other hand sees the expert as an analytical thinker (Simon, 1989). A third theory, the template theory of expertise (Gobet & Simon, 1996), extends the theoretical basis of Simon to address previous shortcomings; and more recently, the theory has been further refined to account for the emotional aspects of intuition (Chassy & Gobet, 2005; 2011; Gobet & Chassy, 2008; 2009).

For Dreyfus and Dreyfus (1986), the key feature of the expert’s intuition is their ability to perceive situations holistically. Dreyfus described the process of acquisition of expertise as a sequence of five defined stages, where the fully accomplished individual has transitioned from novice to expert within their chosen domain. At the ‘novice’ stage, the individual learns domain-specific, context-free facts. Then, once the individual begins to use situational elements in their learning process, they reach the ‘advanced beginner’ stage. Next, after sufficient learning the individual begins to organise actions hierarchically, prioritising tasks, and is considered to have ‘competence’ in the domain. The competent individual becomes increasingly efficient; however goals are still based on conscious, analytic and abstract thought. Once the individual begins to perceive situations as whole, rather than as disconnected features, they reach the level of ‘proficiency’. The proficient individual still, however, relies on analytical thought in order to make decisions. It is only the individual has enough experience that they are able to process information holistically without analytical thought. Individuals able to process situations in such a way where problem-solving is intuitive and fluid have become ‘experts’ within their domain. The expert is able to draw on their wealth of knowledge when faced with a problem, enabling a deep understanding of a situation which does not require analytic processes to focus on key aspects. Although the theory proposed by Dreyfus is seemingly sensible, it suffers from a lack of support from experimental data, and further, some data directly undermine its contentions. For instance, one of the assumptions of the theory is of a gradual shift from explicit to implicit knowledge during the development of expertise. However, it has been shown that in grammar learning, information can be learned implicitly at the novice stage (Johnstone & Shanks, 2001); refuting the assertion of a shift from explicit to implicit knowledge as a function of expertise. Additionally and crucially, individuals have been shown to still use analytic thought at expert level (Klein, 1998; Robbins, et al., 1995); demonstrating that at least in some aspects within some domains, experts do not necessarily process information holistically.

Simon’s (1989) theoretical approach proposed a mechanistic explanation of how experts learn, understand and recognise information, largely through the chunking theory of expertise (Chase & Simon, 1973). Simon regarded pattern recognition as the foundation of expert performance, where experts are able to recognise patterns in their environment instantaneously, based on prior knowledge, aiding the efficient processing of current information. In management for instance, pattern recognition is akin to the ability of the experienced executive to immediately sense when a problem exists (Isenberg, 1984). Referring specifically to the learning processes of chess players, expertise is acquired via an accumulation of perceptual ‘chunks’, stored within long-term memory. A chunk is a perceptual pattern (i.e. chess pieces in a given position) which, once learned, allows the expert to process any future instances of that same pattern as one whole integrated chunk of information, as opposed to processing each piece separately. This is important for experts since they share the same basic cognitive limits with novices, such as a limited short-term memory capacity (Cowan, 2001; Miller, 1956). Further to this, and crucial to intuition, each chunk serves as a condition of a production (Newell & Simon, 1972). That is, the recognition of a familiar position (chunk) triggers typical solutions (productions) associated with the position, which are placed in short-term memory for examination. Solutions are learned slowly; however, once consolidated, they can be accessed rapidly by
memory lookup. Although much experimental data offers support for the theory (Anzai & Simon, 1979; Gobet & Clarkson, 2004; Larkin, Mc Dermott, Simon, & Simon, 1980), like that of Dreyfus, Simon’s theory suffers from several weaknesses. Research documenting the expert chess player’s ability to resist interferences for example has questioned the weight given to short term memory chunks alone in expert performance (Charness, 1976; Frey & Adesman, 1976). Furthermore, it has been argued that the relatively small size of the chunks involved in pattern recognition is not sufficient to explain the learning of higher-level, abstract conceptual knowledge (Holding, 1985).

Addressing such issues, Gobet and Simon’s (1996) template theory was proposed to account for the problems facing the chunking theory in its original form. Like chunks, templates are constructed through consistent exposure to a pattern of information. However, a template has at its heart a ‘core’ which contains stable information such as a typical opening on the board; and additionally to the core are ‘slots’, into which variable aspects of information about a position can be stored. Templates encode the essential features that characterise complex situations and provide direct access to already available solutions for experts within many fields of expertise. Unlike the constraints of chunks, the flexibility of templates, associated with the slots, enables the perceiver to update the situation and to come up with a satisfactory, if not always optimal, solution to the problem at hand. In the template of a face, the core would be the typical properties of faces such as two eyes, a nose and a mouth; whereas aspects such as eye colour or lip size are variable, and as such would be encoded into slots, depending on the actual face encountered. The presence of chunks and templates stored in memory enable the expert to rapidly attend to the key aspects of a situation. Knowledge-guided perception has been shown to occur in chess masters, as they are able to focus rapidly on the key features of positions (De Groot & Gobet, 1996). Similarly, the expert manager demonstrates an ability to hone in on the important aspects of a situation, ignoring irrelevant features (Clarke & Mackaness, 2001). These structures are crucial to expert performance as the activation of a template following pattern recognition provides access to an immense amount of knowledge, both conceptual and procedural. Access to such a wealth of knowledge enables a highly complex representation of the environment, accounting for the growth of higher-level knowledge, which as mentioned troubled Simon’s theory.

The knowledge activated in memory following template recognition is semantically rich. Chassy (2013) has demonstrated that the recognition of templates by chess experts in complex situations calls upon strategic knowledge, which in turn, provides several procedures to solve the issues at hand. Additionally, the flexibility of patterns in visual memory enables highly complex situations to be encoded quickly, calling for simple solutions. This idea is exemplified in Chassy and Gobet’s (2013) research, where expert chess players display high levels of flexibility and detect target relevant patterns embedded in complex environments much faster than non-experts. It is strongly suggested that it is the link between knowledge and appropriate action which determines the strength of intuition. Supplementary to behavioural accounts of intuition, research conducted with neuroimaging techniques also documents instances of intuitive processes through activation of several areas of the brain. For example, functional magnetic resonance imaging (fMRI) has shown neural activity in the bilateral inferior parietal and right superior temporal cortex, suggesting intuition as unconscious semantic activation (Ilg, et al., 2007). This notion of activating existing knowledge below consciousness is likewise seen in management research, where intuition refers to the rapid performance of a learned behaviour (Isenberg, 1984) by the executive, in the absence of conscious awareness (Barnard, 1938).

Although several authors have recognised the importance of intuition in decision-making, the influence of emotions on such decisions has been largely neglected in much management theory (Sadler-Smith & Burke, 2009). Similarly, the role of emotions was not fully acknowledged in the earlier theories of expert intuition (Dreyfus & Dreyfus, 1986; Simon, 1989). Emotions are brief physiological changes elicited by a stimulus, which prepare the body for a response. Empirical evidence demonstrates the influence of emotions on cognition (LeDoux, 1999, Panksepp, 1998), as emotions modulate the cognitive system (Russell, 2003), and have also been shown to impact on decision-making (Bechara, Tranel, Damasio, & Damasio, 1996). In chess-playing specifically, certain moves in a given context are associated with particular emotions (i.e. reward vs. rejection). During retrieval of information following pattern recognition, the emotional response associated with the pattern becomes simultaneously activated, which in turn modulates the cognitive
response. Emotions are therefore crucial to the cognitions of expert chess players and thus a theory describing the thought processes of any expert should detail the ways in which emotions can influence their cognitions. Accordingly, the template theory has been further extended to include emotions in expert performance (Chassy & Gobet, 2005; Chassy & Gobet, 2011; Gobet & Chassy, 2008, 2009), and in doing so, explains in detail the role of emotions in the decision-making processes of experts. The inclusion of emotions in the intuitions of experts is particularly relevant to management intuition, as the previous omission of the emotional component of decision-making has been criticised in the existing business literature (Sadler-Smith & Burke, 2009).

Intuitive judgment in management is increasingly heralded an ideal skill for business success (Parikh, et al., 1994). A long established, often-replicated finding is that managers at the very top levels of organizations use intuitive reasoning more frequently than those in lower-level positions (Agor, 1986). More recently, a study investigating the decision-making styles of 200 managers has suggested that decision based on intuition is related to organizational effectiveness (Anderson, 2000). Further, that decisions grounded in intuitive judgement are advantageous for business can be seen through positive associations with organizational performance, both financial and non-financial (Ritchie, Kolodinsky, W, & Eastwood, 2007). Despite this, whilst intuition in management has been both acknowledged and investigated (Agor, 1989; Barnard, 1938; Lank & Lank, 1995), little has been done to integrate the phenomenon into the learning techniques of managers (Burke & Sadler-Smith, 2006). Interestingly, the traditional ‘rational-analytic’ paradigm in business and management education typically suggests that executives should carefully weigh up each option separately and consciously before arriving at a decision, referred to as the ‘diagnose, decide, design, and decide’ approach (Mintzberg & Westley, 2001). However, the amount of experimental evidence of intuition as rapid, unconscious processing questions this advice. It is thus important that businesses undertake strategies to improve the intuitive skills of their leading decision-makers, and that strategies are constructed in line with current knowledge. Chassy and Gobet’s (2011) framework describes specific mechanisms which not only adequately account for the rapidness with which managers are able to make decisions, but which can also be utilized to maximise the intuitions of managers and executives. Thus we hereafter provide useful guidance on improving intuition in future managers using the template theory of expertise.

Three essential aspects of knowledge play a key role in expertise development (Chassy & Gobet, 2011). Firstly, there is knowledge of typical situations. Second, once enough knowledge has been learned, the acquisition of concepts that encapsulate the domain-specific information begins to take place. Finally, sufficient situational and conceptual knowledge within a domain enables the successful linking of problem situations to potential solutions, in the form of plans or procedures that the expert can follow. The essential aspects of knowledge and thus expertise increase as a function of deliberate practice; a specific form of training wherein a trainee both engages in a task frequently, and receives relevant feedback from the environment in due time (Ericsson, Krampe, & Tesch-Romer, 1993). It would be beneficial for the training of new managers to utilize this progression effectively in order exploit the learning processes shown to underlie expertise acquisition. Using the current knowledge on expertise, we would suggest that training consists of three principal stages:

- The initial stage of training should involve learning typical cases that drastically differ from one another. During the initial stage, a given situation (pattern) should be solvable only by one specific decision (action). Strong emphasis is laid on accurate and timely feedback from a more experienced manager during the initial stage, since the core of knowledge will form the base of expertise. Importantly, the accuracy of simple facts ensures that intuition will generate correct solutions in future complex situations, and so much care should be taken to ensure that the initial stage of training is carried out correctly.

- The second phase should see trainees facing situations that are slightly at variance with previously learned typical cases. Exposure to such situations will enable the trainee to infer relationships between factors in the environment and their potential solutions. This technique capitalises on the ability of the mind to learn rules in the absence of explicit instruction. The ability of the mind to understand rules in such a way
is known as implicit learning, and its efficiency in learning how to deal with complex situations and solve complex problems is well documented (Broadbent, Fitzgerald, & Broadbent, 1986; Lewicki, 1986; Meier & Cock, 2014).

- The third phase of training should aid the transition from pattern-based to conceptual-based understanding. Empirical evidence demonstrates that experts do not approach problems in the same way as novices. In physics for example, it has been shown that the expert solves problems at an abstract level, whereas the novice attends to more concrete features only (Chi, Feltovich, & Glaser, 1981; Larkin, et al., 1980). Similarly, an expert manager’s attention is not detracted by the surface features of a situation, but is trained to comprehend the problem conceptually. Such a skill is acquired through multiplying the situations for the trainee to solve in the previous phases.

In order to conduct the suggested training techniques successfully, the following points should be considered. Firstly, due to the limited capacity of human memory, it is advisable to limit the number of cases in each training session. Following sessions, feedback should be timely to ensure that correct information is learned only. Tests should be later carried out to determine that learned information has not been subject to any retroactive interference, which may be caused by the learning of new information. That is, to check that the original studied cases are contained in memory, undistorted. Additionally, the trainee should be allowed enough time to process and store information, as sessions that are too close to one another are likely to generate memory interference, and will thus reduce the quality of learning. The distribution of sessions over several days with sleep, to enable strengthening of the memory records acquired through recent learning is optimal. Shorter and more frequent training sessions are preferable to longer and less frequent sessions. For example, 2 one-hour sessions are more beneficial to learning than 1 two-hour session. Finally, it is important that as the complexity of cases increases, the trainee should be given more time to both learn and to absorb the knowledge.

In short, intuition as an aspect of decision-making is the product of much knowledge gained through learning and experience. Training and education should therefore focus on the processes leading to intuition as an effective end-product, in order to maximise the benefits of quick, intuitive decision-making for those in future leadership roles.

References
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