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Towards an alternative to Benner's theory of expert intuition in nursing: A discussion paper

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Abstract

Several authors have highlighted the role of intuition in expertise. In particular, a large amount of data has been collected about intuition in expert nursing, and intuition plays an important role in the influential theory of nursing expertise developed by Benner [1984. From Novice to Expert: Excellence and Power in Clinical Nursing Practice. Addison–Wesley, Menlo Park, CA]. We discuss this theory, and highlight both data that support it and data that challenge it. Based on this assessment, we propose a new theory of nursing expertise and intuition, which emphasizes how perception and conscious problem solving are intimately related. In the discussion, we propose that this theory opens new avenues of enquiry for research into nursing expertise.

Keywords: Care; Decision-making; Expertise; Intuition; Memory; Nursing; Pattern recognition

What is already known about the topic?

- While the role of intuition in nursing has been the topic of considerable debate, studies have established that this is a genuine phenomenon.
- Definitions of experts' intuition emphasize five features: rapid perception, lack of awareness of the processes engaged, presence of emotions, holistic understanding of the situation, and overall good quality of the proposed solutions.
- The literature often refers to Patricia Benner's theory of nursing expertise, which proposes that the road to expertise encompasses five stages.

What this paper adds

- A detailed discussion of Benner's theory, which leads to the conclusion that the theory is too simple to account for the complex pattern of phenomena that recent research on expert intuition has uncovered.
- A new theory of expert intuition in nursing, which provides mechanisms for explaining how intuitive, perceptual decision-making is linked to more analytical problem solving.
- The suggestion that standard research on expertise (mostly based on the natural sciences) and that on nursing expertise (often based on phenomenology) should start a constructive dialogue.

1. Introduction

Intuition is often proposed as one of the defining characteristics of expertise. From chess masters able to

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understand a position nearly instantaneously, to physicists automatically seeing the deep physical implications of a problem, to nurses having a gut feeling about the prognosis of a patient, what impresses the bystander is the suddenness and nearly magical nature of these behaviours. While this last characteristic has sometimes led critics to doubt the psychological reality of intuition, there is currently good evidence that this phenomenon is genuine. Indeed, empirical support comes from several domains including games (De Groot, 1965), sciences (Simon, 1995), the military (Klein, 2003), business (Prietula and Simon, 1989), and nursing (e.g., Benner, 1984; Benner et al., 1992; McCormack, 1993; McCutcheon and Pincombe, 2001; Polge, 1995). Given the pervasiveness of the phenomenon, not the least in fields where intuitive decisions may be a matter of life or death, it is crucial to understand the mechanisms underpinning it.

There are some differences in the way intuition is defined in the literature, but there is also a fair degree of agreement in that most definitions include rapid perception, lack of awareness of the processes engaged, concomitant presence of emotions, and holistic understanding of the problem situation. It should be noted that emotions have long been emphasized as part and parcel of intuition, even in domains that may seem to engage only "cold cognitions" such as chess (Tikhomirov and Vinogradov, 1970); the key role of emotion in intuition has recently been buttressed by investigations with neurological patients showing how the lack of emotions negatively affects intuitive decision-making (Bechara et al., 1997). To these four features, one can add the idea that intuitions, while not necessarily always correct, must be correct more often than not (De Groot, 1965, 1992). This last definitional requirement, which was developed by de Groot so that intuition can be seen as an adaptive and rational process yielding behaviour better than chance, implies that novices' gut feelings are unlikely to count as intuitions.

The essential role of perception was identified just after World War II by the Dutch psychologist Adriaan de Groot in the domain of chess (De Groot, 1965). He hypothesized that the crucial difference between grandmasters and amateurs would be in the way they search the maze of possible positions, with grandmasters expected to search more deeply and consider more moves. To test this hypothesis, he collected verbal protocols where players had to try to find the best move in an unknown position while thinking aloud. Contrary to his expectations, De Groot found that there were only small differences in the structure of search, but that grandmasters, in a matter of seconds, were able literally to "see" potentially good moves and grasp the meaning of the position. The importance of perception, even in a game such as chess that many would describe as logical and intellectual, was supported by grandmasters' ability to memorize nearly perfectly a position that had been presented for a few seconds. It was also supported later by the detailed analysis of the eye movements of strong and weaker chess players looking at a novel position (De Groot and Gobet, 1996).

The goal of this paper is not so much to review the extensive literature dealing with intuition and expertise in nursing (for pointers to this literature, see Field, 2004; King and Appleton, 1997) as to discuss two theories of expert intuition critically. We start by briefly considering the role of intuition in nursing practice. Then, we discuss Benner's (1984) influential theory, highlighting its strengths and weaknesses. We then argue that the template theory of expertise (Gobet and Simon, 1996b) presents the basis for a theory of expert nursing intuition that explains all the key phenomena. In the discussion, we provide a direct comparison between Benner's theory and template theory.

2. Intuition in nursing practice

The role of intuition in nursing has been the topic of considerable debate, with some authors (such as English, 1993) considering that this concept should be subjected to critical scrutiny at best and rejected at worst, while others (such as Darbyshire, 1994; Effken, 2001; King and Appleton, 1997) considering it central to our understanding of nursing expertise. In particular, the work of Patricia Benner and her colleagues (Benner, 1984; Benner et al., 1992, 1996) has done much to convince the field of nursing of the importance of intuition.

A number of studies have established that intuition in nursing is a genuine phenomenon (e.g., Benner, 1984; Benner et al., 1992; McCormack, 1993; McCutcheon and Pincombe, 2001; Polge, 1995). These studies have used methods such as group interviews, personal history interviews, surveys, and detailed observation, and have often been carried out within the frameworks of grounded theory and phenomenology. A striking characteristic of this research, in comparison to research on expertise in general (see for example the contributions in Chi et al., 1988; Ericsson, 1996), and a fortiori into medical expertise, is the dearth of experimental studies. While researchers into medical expertise have used standard experimental and quantitative methods to study the perception, memory, and decision-making ability of novice and expert physicians (see for example Norman et al., 1992; Patel et al., 1990; Rikers et al., 2002), researchers into nursing expertise have limited themselves to qualitative methods. Whether this reflects only a difference in the general research philosophy of these fields, or whether this is also due to the empirical difficulties of measuring nursing intuition per se, remains to be established.

3. Benner's theory of skill acquisition in nursing

Benner's influential theory of nursing expertise closely follows the skill acquisition theory developed by Dreyfus and Dreyfus (1986). It proposes that the road from novice to expert nurse encompasses five stages. In the "novice" stage, beginners learn through instruction; they acquire domain-specific facts, features, and actions. An important aspect of this stage is that the rules that novices learn are "context-free"; that is, their application ignores the nuances of the situation, which results in an inflexible and limited performance. After a large amount of concrete experience within the domain, novices move to the "advanced beginner" stage. At this stage, individuals start to use and make sense of "situational elements," and commence employing overall characteristics of the situation when their previous experience makes it possible. Attributes start to depend on the context. In the "competence" stage, individuals organize their actions in terms of hierarchical long-range plans. This stage sees an increased level of efficiency, although planning is still conscious, abstract, analytic, and deliberate. In the "proficiency" stage, situations are perceived as a whole rather than as unconnected aspects, and certain features are perceived as salient while others ignored. Thus, proficient individuals can organize and understand problem situations intuitively, but still require analytical thinking to choose an action. Finally, in the "expertise" stage, not only the understanding of the task, but also the decision of what to do next, is intuitive and fluid. Given their deep understanding of the situation, experts act naturally without explicitly making decisions and solving problems. This is the case at least in routine situations. Experts may revert to analytic thinking—that is, revert to a previous stage—with situations for which they have no experience or in situations in which the "intuitive grasp" turned out to be incorrect. They may also reflect on their whole intuitions and try to improve them, a process Dreyfus and Dreyfus (1986) call "deliberate rationality." Benner et al. (1996) also emphasized the importance of knowing the patients and of being emotionally involved in the development of nursing intuition. While beginners' emotions are characterized by anxiety, which impedes their practice, more advanced nurses can rely on a larger repertoire of emotional responses, which they use as informative and guiding cues. These cues not only amplify nurses' perceptual awareness, but also shape their clinical know-how, ethical comportment, and emotional involvement with patients and their families.

3.1. Strengths of the theory

Benner's theory is simple, and, at least as a first approximation, captures some aspects of experts' development fairly well, in particular the progression from slow and hesitant to fast and fluid problem solving behaviour. It provides important insights on the complex interaction between nursing theory and practice. In addition, the role of emotions is emphasized, which is rarely the case in expertise research. From an educational point of view, the emphasis on learning in context counterbalances the habitual focus on theoretical instruction (English, 1993). Finally, it is worth mentioning that Benner (1984), while mostly using interpretive phenomenology as her main tool, also refers to objective measures such as patient outcome.

3.2. Weaknesses of the theory

In spite of its popularity, Benner's theory does not account for the development of expertise and intuition well, when compared to empirical data. A key aspect of the theory is the presence of stages in expertise development. However, these stages are poorly documented in the literature, and some of the evidence from nursing practice explicitly adduced to support their existence is rather weak. For example, even in Benner's most extensive empirical study of nursing practice (Benner et al., 1996), the criteria used for assigning nurses to stages (number of years of experience and supervisors' judgements) are not reliable and in fact have been shown not always to correlate with expertise (Ericsson and Smith, 1991a, b). Moreover, it is well known from research in developmental psychology that empirically establishing the reality of stages is a difficult matter, requiring complex mathematics such as catastrophe theory (van der Maas and Molenaar, 1992) and a wealth of quantitative data, which are lacking in this case. A related point is that the very status of these stages is unclear. If they are meant to imply that individuals can be categorized unequivocally in one stage, then there is plenty of evidence showing that individuals, while fluent in one sub-field, may perform much less fluidly in another sub-field of the same domain (Rikers et al., 2002). Indeed, Benner makes this point repeatedly in her 1984 book. But, if the other interpretation is true—that the stages refer to behaviours rather than individuals—then the theory loses much of its explanatory power. In particular, discussions of how long it takes to reach a stage (see for example Benner, 1984) do not seem to be particularly relevant (see Effken, 2001; English, 1993, for related points).

According to the theory, becoming an expert requires that a person's knowledge moves along two dimensions: from explicit to implicit, and from abstract to concrete. We agree that this description accounts for some aspects of expertise, but this is only part of the story. Consider the explicit–implicit dimension. The theory assumes that, in the first stage, learning mostly occurs through

explicit instruction; however, there is ample evidence in a variety of domains that skills are sometimes learned implicitly, without the mediation of verbal instruction (Johnstone and Shanks, 2001; Reber, 1993). Thus, the theory is at best incomplete on this issue. But the theory has difficulties at the other end of the novice–expert range as well. The list of competencies identified by Benner (1984) contains items that clearly require access to explicit knowledge. Among the numerous examples, one can mention: "Providing an interpretation of the patient's condition and giving a rationale for procedures" (pp. 86–89)[1]; "Getting appropriate and timely responses from physicians" (p. 142); and "Contingency management: Rapid matching of demands and resources in emergency situations" (pp. 113–116). These competencies relate to explanation, communication, and organization skills, respectively, which all go beyond intuitive and implicit recognitional ability. Some of the exemplars provided by Benner (1984) also clearly indicate that nurses have a great deal of explicit knowledge, and that they use it (for example, see Benner, 1984, pp. 124–125, and 128). Finally, the emphasis on implicit knowledge at the expert stage raises a paradox—if knowledge is intuitive, perceptual, and ineffable, some of the methodology used by Benner and her colleagues (in particular narrative interviews in small groups of nurses) does not seem the most appropriate, as it uses a channel of communication that is essentially limited to the verbal modality.

The abstract-concrete dimension does not stand empirical scrutiny either. The theory emphasizes that expertise is characterized by a decrease of abstract thought parallel to an increase of concrete thought. Although this may be true in some domains, there are also many domains where this is not the case. A classic example is physics, where experts, contrary to the prediction, solve problems employing deep and abstract constructs, while novices solve them at a superficial and concrete level (Chi et al., 1981; Larkin et al., 1980). In nursing, Benner (1984) provides a few exemplars that clearly indicate the importance of abstract theoretical knowledge (e.g., pp. 116–117).

Benner and her colleagues, based on previous work by the Dreyfus brothers (Dreyfus and Dreyfus, 1986; Dreyfus, 1965), strongly argue that intuition and holistic perception are necessary for performing at expert level. However, by doing so, they underestimate the role played by analytic and conscious problem solving at the expert level. For example, Dreyfus and Dreyfus (1986, pp. 31–32) state that, "while most expert performance is ongoing and nonreflective, when time permits and outcomes are crucial, an expert will deliberate before acting. But […] this deliberation does not require calculative problem solving, but rather involves critically reflecting on one's intuitions". In support of this view, they cite an informal experiment where a chess international master was able to maintain a good level in spite of having to carry out an interfering task (adding dictated numbers). Dreyfus and Dreyfus (1986) conclude that, although adding numbers interfered with his ability to carry out search and construct plans, this player was still able to produce the fluent and integrated play that is typical of expert level. We do agree that pattern recognition plays an important role in chess, and that limiting thinking time affects the quality of play less than would be the case if search and analytic thinking were the only ingredients of skill. However, empirical results also show that limiting thinking time does affect performance (Gobet and Simon, 1996a). In addition, well-controlled experiments using interfering tasks similar to that described by Dreyfus and Dreyfus have shown that the quality of play is substantially impaired (Robbins et al., 1995). Thus, the information provided by rapid perceptual recognition must be seconded by other thinking mechanisms that appear to be analytic in nature—for example, in chess, generating sequences of moves and evaluating them.

Benner (1984) does mention the necessity for experts to use analytic thinking in some circumstances, for example when there was no previous experience with the situation, or when intuitions were wrong. But, in these cases, she does not provide any explanation of how holistic intuition can be combined with analytic thinking. This is a regrettable omission, as it is well established empirically that, in many domains, expert decision-making is made possible by a combination of rapid perception and slower problem solving (Gobet, 1997; Klein, 1998; Prietula and Simon, 1989). In the literature on decision-making in nursing, Cader et al. (2005), who use as framework Hammond et al.'s (1987) cognitive continuum theory, discuss how humans alternate between an intuitive and analytical mode of processing depending on whether the task is ill-structured or well-structured.

Finally, although we agree with the importance of perception and pattern recognition in intuition and expertise, we believe that current evidence from neuroscience does not support the notion that pattern recognition is holistic. The bulk of the evidence seems to support the hypothesis that perception proceeds sequentially engaging specialized modules (Eimer, 2000; O'Rourke and Holcomb, 2002), which must count against holistic processing.

To summarize, Benner's theory is too simple to account for the complex pattern of phenomena linked to expert intuition in nursing. In the following sections, we present a recent theory of expertise and show how, with minor extensions, it can offer a good explanation of both the phenomena explained by Benner's theory and those that are beyond its scope.

[1]The page numbers refer to the 2001 edition of the book.

4. A template theory of expert intuition

The introduction has indicated the features that must be explained by a theory of expert intuition. It should account for the suddenness and perceptual nature of intuition, its holistic character, as well as the lack of awareness of the processes involved. It should also provide mechanisms explaining how emotions relate to intuition, and how, at least with experts, intuitions lead to decisions that are generally suitable. We develop such a theory, using as a starting point the template theory (TempT) proposed by Gobet and Simon (1996b, 2000).

In line with previous theories of expertise, such as the chunking theory (Simon and Chase, 1973), a key assumption of TempT is that experts are hampered by the same cognitive limits as novices. For example, attention can be focused to only one thing at a time, and visual short-term memory is limited to just four items. Similarly, it is proposed that experts and novices essentially use the same problem-solving methods; these methods include means-end analysis, progressive deepening, and heuristics that limit the number of situations to search. To improve to the point that they become experts, novices have to learn a large number of perceptual patterns, known as chunks (Simon and Chase, 1973). For example, this enables stronger chess players to perceive the board as chunks of pieces, and not as individual pieces. These chunks are both units of perception and meaning, and can be built recursively. Data from chess (Gobet and Clarkson, 2004; Simon and Chase, 1973) provide strong evidence for the psychological reality of chunks; for example, it has been shown that different ways of defining chunks, either using the latencies in replacing pieces on the board or the pattern of relations between the replaced pieces, yield essentially the same results.

Some patterns that recur often in the environment may lead to the construction not only of chunks, but also of more complex data structures known as templates. Templates possess both a "core," which encodes stable information, and "slots," which encode variable information. Templates are thus similar to the schemata proposed by Bartlett (1932) and Minsky (1975). However, an important difference is that, while previous schema theories were rather vague as to how schemata are acquired, template theory proposes detailed mechanisms for the acquisition of templates (see Gobet and Simon, 2000; Gobet and Waters, 2003, for details). Both chunks and templates may be linked by "similarity links" if they share enough elements. Learning a new chunk is relatively slow (about 8 s), but information can be stored rapidly in a slot (about 250 ms). The construction of chunks, templates, and similarity links is not unique to expertise, but engages basic mechanisms that are used in other domains, such as verbal learning, concept formation, and acquisition of language (Gobet, 1996; Gobet and Lane, 2005; Gobet et al., 2001).

Chunks and templates can be associated with long-term memory information. In particular, they can be associated with possible actions, forming what Newell and Simon (1972) call "productions." For example, a chess player may learn that, given an open line, a rook should control this line. Thus, according to TempT, expertise is made possible by the acquisition of a large number of chunks and templates that are linked to possible actions. Amongst these actions are instructions of where attention should be directed next, that is, where the next eye fixation should land (De Groot and Gobet, 1996; Gobet and Lane, 2005). In other words, the knowledge acquired through experience within a domain determines where attention will be focused and thus what will be perceived. Conversely, what is being perceived determines what will be learned.

Aspects of the theory have been implemented as computer programs. The simulations have centred on chess, as it is the domain of expertise where most data are available. The CHREST (Chunk Hierarchy and REtrieval STructures) program has closely simulated several phenomena related to novice, intermediate, and expert perception and memory. These include the detail of eye movements during the brief presentation of a position; how players memorize positions that have been briefly presented; how the structure of the position affects recall (for example, how recall of game positions compares to the recall of positions randomized in various ways); the effect of presentation time, ranging from 1 to 60 s, on recall; and how novices acquire chunks and templates as a function of practice (De Groot and Gobet, 1996; Gobet and Jackson, 2002; Gobet and Simon, 2000; Gobet and Waters, 2003). Another computational model, called SEARCH, provides mechanisms showing how pattern recognition and search interact during look-ahead search (Gobet, 1997). This program makes a number of predictions about how problem solving variables, including average depth of search and rate of search, change as a function of skill. While developed primarily on chess data, the theory is general and explains the development of expertise in domains such as science, engineering, and sports (Gobet et al., 2001; Simon and Gobet, 2000).

Whether the template theory can explain the phenomenon of expert intuition in nursing is an important theoretical question with serious practical implications, for example for training. In particular, it is far from obvious that mechanisms developed for explaining chess and scientific expertise are suitable for nursing, where human relations and emotions play a much larger role.

5. Applying TempT to expert intuition in nursing

In the introduction of this article, we mentioned a definition of expert intuition comprising five key features. We first show how TempT mechanisms

account for these features, focusing on the domain of nursing practice, before providing a direct comparison of Benner's theory and TempT.

5.1. Rapid perception

The perceptual nature of intuition is explained by pattern recognition. Chunks and templates, which have been honed during concrete practice in a domain, play here the key role in enabling relevant long-term memory information to be accessed rapidly. When chunks and templates give access to a relevant link in long-term memory, a production is fired. In other words, a pattern similar to one met during previous experience is recognized, and thus an action, possibly a solution to the problem at hand, is automatically elicited.[2] During the early stages of expertise, this solution could be obtained only through instruction or slow, explicit problem solving mechanisms; with experts, it can be accessed automatically through memory lookup. This mechanism is similar to that proposed by Simon in several publications (Simon, 1969, 1995; Simon and Chase, 1973). To some extent, intuition is just one heuristic among others to cope with the complexity of the search space. We make it clear that, while the pair pattern-action can be considered as a (micro-) rule, it is *not* a direct and truthful implementation of whatever explicit rule was used during non-intuitive problem solving.[3] Rather, it is a rule that has been contextualized by adding concrete information about the problem, both on the side of the perceptual pattern (e.g., what is the shade of the patient's skin?) and on the side of the action to carry out (e.g., what is the precise timing of the intervention to carry out?).

5.2. Lack of awareness of the processes engaged

According to TempT, the mechanisms enabling the access to long-term memory are unconscious; only the end product of recognition, which is placed in short-term memory, is conscious (see also Ericsson and Simon, 1993). Conscious thought can affect pattern recognition through attention: directing one's gaze to a specific part of the visual scene, perhaps to fulfil a given goal, will lead to the recognition of slightly different patterns than if another part is fixed.

5.3. Holistic understanding of the situation

A weakness of earlier theories based on chunking, such as that proposed by Simon and Chase (1973), was that they assumed that chunks were relatively small (at most five to six pieces with chess). As a consequence, they had difficulty in explaining the type of holistic understanding of a situation shown by experts in many domains such as nursing (Dreyfus and Dreyfus, 1986). The presence of templates, as well as mechanisms explaining how templates are acquired, removes this weakness. Templates tend to be larger than standard chunks; for example, in the domain of chess, a single template could in principle cover the entire position (up to 32 pieces), although the templates identified empirically and by computer simulations tend to be smaller, storing between 10 and 15 pieces. In addition to explaining how experts can construct a rapid internal representation of the environment and use high-level representations (De Groot and Gobet, 1996; Freyhoff et al., 1992), templates explain how experts can sometimes rapidly imagine the possible development of a situation, what Klein (1998) calls a "mental simulation." In the domain of nursing practice, Benner (1984) calls this phenomenon "future think." A mental simulation is made possible by carrying out search using high-level representations (templates) and using variable information, rather than using only chunks, which are relatively inflexible bits of information (Gobet, 1997).

5.4. Experts' intuitions are normally correct

Anybody can rapidly make decisions based on some perceptual feature of the situation. Of course, with most people, the decisions will be of poor quality, and the chosen actions at best useless for addressing the issue at hand, and at worst dangerous. Instances of advanced beginners' intuitions can be found in the literature on nursing (McCormack, 1993), but it is unclear whether these intuition led to appropriate decisions. Nor does the methodology used by Benner and her colleagues (Benner, 1984; Benner et al., 1996) make it possible to estimate how often decisions based on intuitions turn out to be incorrect.

To reach de Groot's criteria that intuitions should be generally correct, or at a minimum correct more often than chance (De Groot, 1965, 1992), one apparently has to be an expert. That experts' intuitions are not always

[2] Benner and Tanner (1987) criticize cognitive models as failing to capture the fuzziness and ambiguity of real situations. However, this criticism does not apply to the class of models discussed here, which not only can deal with noisy and imperfect perceptual inputs, but also improve their behaviour as a function of learning. See De Groot and Gobet (1996) for a detailed discussion.

[3] The literature on nursing intuition (e.g., Benner et al., 1996; Darbyshire, 1994; Dreyfus and Dreyfus, 1986) sometimes considers that all cognitive psychologists reject the role of intuition *en bloc* and propose that experts use solely rules. This view is simply incorrect, as exemplified for example by Simon and Chase's (1973) chunking theory, which highlights the importance of perception and indeed intuition. In particular, while Simon was interested in the role of rules, goals, plans, and representations in human cognition, he also recognized the prominence of intuition, acquired through concrete and situated interactions with the environment.

correct can be explained by assuming that not all relevant features can possibly be learnt, even with years of practice; that the environment is changing, so that cues that were useful in the past are now misleading; that not all pertinent features can be taken into account, for example because of time pressure; and that, in some domains such as clinical diagnosis in psychology and prediction of stock markets, the environment offers so few regularities that it is simply impossible to extract reliable patterns (e.g., Dawes, 1994; Meehl, 1954). The latter explanation would suggest that nurses working in different specialisms (e.g., neonatal care, intensive care units, psychiatry) show different propensities to act intuitively.

5.5. Intuitions are coloured by emotions

Several authors have noted that emotions are part and parcel of intuitions (Benner, 1984; De Groot, 1965, 1992; King and Appleton, 1997). The original version of TempT does not include mechanisms accounting for emotions, but Chassy and Gobet (2005) have recently proposed biological mechanisms showing how emotions can be linked to memory in general and, in particular, how they modulate the use of chunks and templates.

There is now strong evidence that cognitions (both simple and complex) can be linked to emotional responses (both simple and complex) (LeDoux, 1999; Rolls, 2003). Chassy and Gobet (2005) proposed that chunks and templates get associated to emotional responses during the activities taking place in the practice and study of a domain. Later, when a chunk or a template is retrieved from long-term memory, it may activate one or several emotional responses. These responses are analysed by an emotional processor that determines which emotional response takes precedence. The emotional processor not only triggers the body changes but also instigates modulation of cognitive processing. It is worth noting that cognitive and emotional modulation is submitted to huge personal variability, known as affective style (Davidson and Irwin, 1999), which may be partly explained by different histories of learning that have been crystallized in long-term memory structures.

6. Comparison between Benner's theory and template theory

The previous section has shown that TempT, with slight additions for dealing with emotions, can explain all the central features of expert intuition that we had identified in the introduction of this article. Just like Benner's theory, TempT is a general theory of intuition, with applications not only to nursing, but also to domains such as business, chess, and physics. Indeed, computer simulations have been carried out in the latter two domains, showing how chunks and templates—the essential components of pattern recognition and thus of intuition—are acquired (Gobet and Simon, 2000; Gobet and Waters, 2003; Lane et al., 2000). Given the claims of generality made by these two theories, it is of considerable interest to compare them closely, listing the points of agreement and disagreement.

6.1. Points of agreement

A first point of agreement is that the authors of both theories concur that intuition is a genuine phenomenon, worth studying. As noted in the introduction, this is not an opinion necessarily shared by all scholars in nursing research. There is also agreement that intuition is characterized by rapid perception, grasp of the situation as a whole, lack of awareness of the mechanisms leading to an action, and participation of emotions.

Both approaches acknowledge the predominant role of perception in expert intuition. In this respect, important questions are how experts know where to look at and what are the salient features in a particular situation. Here, the answer differs somewhat. Benner et al. (1996) reject the idea that internal representations guide attention, while these are essential in TempT. The latter theory proposes that it is knowledge that explains how experts perceive key features of a situation rapidly (De Groot and Gobet, 1996; Gobet and Lane, 2005). Novices rely on slower and more error-prone heuristics for directing their attention. In the case of nursing, the knowledge that experts (unconsciously) use for focusing attention include not only theoretical knowledge, but also clinical/practical knowledge acquired through direct interaction with patients, as these contextual cues are learnt automatically and unconsciously in nurses' daily activities. On this last point, the two approaches seem in agreement (see for example Benner, 1984; Benner et al., 1996). There is also consensus about the necessity of having a variety of examples during learning for enabling a fine discrimination of perceptual skills (Benner, 1984; Gobet, 2005). A final point of agreement is that intuition enables rapid selection from alternatives, without conscious awareness, although the two approaches diverge somewhat here. According to Benner's theory, the link between conscious problem solving and intuition is tenuous for experts: intuition is the way experts make decisions. By contrast, TempT continues the tradition started by De Groot (1965) and Simon (1969) and considers that this link is very strong with experts. In particular, a substantial amount of the information used during slow problem solving is accessed by pattern recognition, and is thus intuitive in nature. We believe that the lack of an explicit link between pattern recognition and

more analytic decision-making processes is currently a weakness in Benner's account of nursing expertise and intuition.

6.2. Points of disagreement

The research philosophies behind Benner's theory and TempT differ considerably, and it is therefore not surprising that the two approaches are at variance on several counts. TempT approach can be located in standard cognitive science and cognitive psychology, with an emphasis on collecting experimental data and developing computer models simulating the behaviour under study. Benner's approach is based on phenomenology, which precisely challenges the methods of traditional science, including the use of experimental data and computer models (Benner et al., 1996; Darbyshire, 1994; Dreyfus and Dreyfus, 1986). In a nutshell, the former approach is based on mechanisms, while the latter relies on descriptions. The former emphasizes that the holistic nature of cognition can be explained by local mechanisms, the latter challenges this view.

These differences in emphasis clearly affect what each approach considers to be the best way to carry out empirical research on intuition in nursing and in other domains. The TempT approach calls for experimental data to be collected—not only descriptive data such as narratives. To the objection that this is not possible, we reply that such data have been collected in other domains, and that phenomenologists do not always reject experimental data. For example, Dreyfus (1996) refers to studies using Air Force instructors' eye-movement recordings during simulated flight to refute the hypothesis that experts follow rules. A similar reticence to use experimental methods can be observed when it comes to the study of care. Benner (1984, p. 171) has argued that, "to examine 'care,' we cannot rely on purely quantitative, experimental measurements based on the natural science model." However, research within the framework of Rogerian theory, focusing on humanist person-centred therapy and empathy, shows that topics such as care can be studied with rigorous quantitative methodology (Rogers, 1961). We suggest that a combination of "soft" and "hard" methods should be used to study these questions, to the benefit of all parties. For example, to what extent do commitment and care impact on intuition by directing attention and increasing motivation, and can this be captured in a formal model?

7. Additional issues

It is unfortunate that research into nursing intuition and expertise is isolated from similar research in other fields. For example, Benner et al. (1996) do not refer to any of the extensive studies on expertise in psychology (for overviews, see Chi et al., 1988; Ericsson and Smith, 1991a, b). This is particularly regrettable with respect to medical expertise, as several themes have been studied in both fields, such as the developmental stages between novice and expert, the role of perception in expertise, and the difficulties in integrating theoretical/biomedical and clinical knowledge (Norman et al., 1992; Schmidt et al., 1990).

Although its importance is acknowledged by both theories, the role of individual differences in the development of intuition has been barely touched upon in scientific research. Empirical evidence suggests that some students are more inclined than others to use intuitive understanding (McCormack, 1993). De Groot (1992) has called for research being carried out on this question, and nursing seems an ideal domain for such an endeavour.

A final issue that warrants attention, as noted by Paley (1996), concerns cases where intuition is counter-productive, perhaps because it invites experts to choose sub-optimal solutions. Saariluoma (1992) as well as Bilalić et al. (in press) have shown that such situations can be induced experimentally in chess. Studying this question in nursing could help obtain a deeper understanding of intuition.

8. Implications for education

It is beyond the scope of this article to discuss in detail the implications of the two theories on nursing education and practice. We limit ourselves to a few remarks about education. In spite of important differences in their focus, both theories share a number a features that are important for designing education and training programmes: the role of perception (e.g., the importance of being able to discriminate between subtle perceptual differences), the importance of acquiring skills in situ, and the importance of taking individual differences into account. However, there are also clear differences in emphasis. Benner (1984) recommends that analytical and abstract methods should be taught to beginners, but not at later stages, where instruction should focus on developing intuitive skills though direct interaction with concrete examples of patients. According to TempT, domain-specific analytic methods are also important at later stages of learning (including expert level), and thus should be taught at all skill levels.

More critically, Benner's theory emphasizes holistic understanding, which in her definition means that such understanding cannot be decomposed into smaller parts. TempT suggests a different approach: while it acknowledges the importance of understanding a patient as a whole, it also proposes that this whole is decomposable

into parts and their relations. Thus, in principle, instructional methods can be developed for teaching these components incrementally (Gobet, 2005). A related implication is that TempT proposes—unlike Benner's theory—that human knowledge can be approximated as chunks and templates, and that instructional methods can be developed to foster the acquisition of these knowledge structures (Gobet and Wood, 1999). Another implication is that analysis can identify efficient ways in which these elements can be taught in the curriculum. The use of patient narratives, which is seen as essential in Benner's approach, does not play such an important role within the framework of TempT; narratives may offer valuable cases studies, but may be replaced by other methods less based on phenomenology. Thus, while agreeing that "expertise takes time to develop", we disagree that "it is neither cost-effective nor practical to try to 'teach' it in formal educational programs" (Benner, 1984, p. 184).

9. Conclusion

In this paper, we have briefly reviewed evidence on intuition in nursing practice, and then discussed Benner's (1984) influential theory at some length. Although the theory has strengths, we have also argued that it suffers from a number of weaknesses. This has led us to consider Gobet and Simon's (2000) theory of expertise as an alternative explanatory framework. We have argued that TempT, which is a general theory of expertise, accounts for the key features of intuition, both with nursing and other domains. We have also identified a regrettable methodological chasm between the two approaches. Our approach, which continues the tradition of "standard" research on expertise started by De Groot, is based on the natural sciences; Benner's approach, continuing the work of Dreyfus and Dreyfus, is based on phenomenology. While the different scientific philosophies make it hard for the two sides to communicate, the benefits of such a dialogue would be considerable and would include new research questions and methods.

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