

Implementation science: a role for dual processing models of reasoning?

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## **Background**

The recent evolution of Evidence Based Practice (EBP) in the 1990s has given cause to reconsider research into decision making in relation to all health and allied health disciplines, but especially the practice of medicine. EBP is the process of using the best available research evidence combined with the practitioner's skills and patient's values to aid clinical decision making. Surprisingly, despite the increasing availability of scientific evidence, there remain wide variations in individual, cross-institutional and international medical practice when compared to agreed best EBP [1, 2], with often slow and haphazard uptake of new evidence [3]. There is now emerging interest in identifying and understanding such variations in practice, the barriers to changing existing clinical behaviour, and effective methods for changing medical practice. This field is referred to as implementation science. It has been argued that failures to implement the best evidence can result from either the lack of understanding, or lack of application, of relevant theories from the social or educational sciences, and many popular strategies to improve the quality of healthcare have been chosen empirically, unguided by theory [2]. Most recently, it has been argued that a better theoretical base for understanding professional behaviour change is needed to support evidence based changes in practice, and that there are a range of theories that need to be considered [3].

Theories relate to the individual (eg, cognitive and educational theories), social interaction and context (eg, social learning theory), and organisational and economic contexts (eg, theories of innovative organisations) [4]. Our interest lies in considering a group of theories from within the psychological research tradition relating to the individual doctor. We suggest that parallel dual processing models of reasoning potentially are useful in identifying factors which influence the uptake of new evidence by individual doctors. We firstly describe the nature of dual processing models of reasoning, then discuss the uptake of best evidence by

clinicians within the context of these, and conclude by summarising some of the individual differences in cognitive processing which may moderate the uptake of evidence by doctors.

## **Discussion**

### Models of Reasoning

Several reviews have found strong support for the existence of dual processing models of reasoning [5-8]. Whilst different models use different terminology, it has been argued that there are strong family resemblances between the various theories [7]. Essentially all such models posit two cognitive modes of information processing that are in constant operation as humans reason. One mode has been described as experiential, unconscious, fast, associative, heuristic, tacit, quick, intuitive, recognition primed, implicit, automatic and acquired via biology, exposure or experience. The other mode has been described as rational, conscious, deliberate, slow, rule based, analytic, explicit, controlled, and acquired by cultural and formal tuition [7]. These two systems have generically been referred to elsewhere as System 1 and System 2 respectively. However, we use the terms ‘experiential’ and ‘rational’ to denote these two modes in our paper [9].

Dual processing models of reasoning have been conceptualised in two ways. First, reasoning can be *either-or*, where experiential processing is chosen in circumstances of low motivation; for example, when a judgement is considered relatively unimportant. Conversely, rational processing is chosen when the stakes are high. The Heuristic-Systematic Information Processing Model is an example of an either-or account, where a decision maker uses either simple decision rules (referred to as heuristic), or a systematic approach, with the choice being mediated, for example, by the degree of involvement the person has with the decision [10]. Second, these two reasoning systems may work in *parallel*. The Cognitive-Experiential Self Theory (CEST) is a parallel account, where both an experiential and rational system operate

continuously in an integrated interaction [9]. Within this model, all behaviour is considered to reflect the joint operation of both the experiential and rational modes. It has been suggested that there are five ways in which a judgement can be made within a dual processing model [11].

- an experiential mode judgement is endorsed by the rational mode;
- an experiential mode judgement is insufficiently adjusted by the rational mode;
- an experiential mode judgement is corrected (possibly over-corrected) by the rational mode;
- an experiential mode judgement is identified as violating a rational rule and is blocked;
- no experiential mode judgement is made, so the rational mode calculates one.

The relationship between these two modes of reasoning has been shown to be influenced by a range of both dispositional (individual) and situational factors. The corrective operations of the rational mode are known to be impaired by time pressure, involvement in a concurrent cognitive task, time of performing tasks compared to being a morning or evening person, and mood. The rational mode of operating has been shown to be positively correlated with intelligence, need for cognition (the tendency to engage in and enjoy thinking) and exposure to statistical training [11]. The experiential mode has been shown to be influenced by faith in intuition [9].

### Implementation of Evidence and Dual Processing Models of Reasoning

If, as Grimshaw and Eccles (2004) conclude, the time has come to consider various theoretical bases from other disciplines for evidence implementation strategies, there would appear to be

a prima-facie case for considering dual processing models of reasoning. Within such models, the uptake of new research evidence can be represented by the activities of the rational mode of reasoning. For example, the decision to include a new treatment regimen based on a newly published evidence based guideline for an individual patient, is conscious, explicit, and intentional. On the other hand, existing clinical practice can be positioned in the 'experiential' mode: well rehearsed judgements based on years of clinical experience may be viewed as unconscious, automatic, reflexive and swift. Changing practice, therefore, would require activation of the rational mode of reasoning to work in certain ways, as suggested by Kahneman (2003) and noted earlier. In other words, *changing* an individual doctor's clinical practice (an experiential mode judgement) would require activation of their rational mode to consciously adjust or override that existing judgment. As well rehearsed judgments over time are thought to change from the rational to experiential mode of reasoning, it may be that more experienced clinicians are likely to be slower to change long standing, oft-practiced judgments.

Whilst our interest is the translation of new evidence into existing clinical practice, it is also interesting to consider *error* within this model, which could reflect the under- or over-correction activities of the rational mode in relation to the experiential mode. More than thirty years of research within the heuristics and biases tradition has demonstrated systematic patterns of error in reasoning and thinking tasks [12]. Recently this body of work, which has focused on cognitive biases which can lead to error, has been reconsidered alongside developments in dual processing models of reasoning. Systematic error has been postulated as reflecting error within the experiential mode [11]. While the theoretical interpretations of this error are controversial [13], the practical implications (of these errors) are most important in terms of improving the quality of clinical decision making. Over 30 cognitive errors and their

implications for clinical practice have been identified, and it has been argued that most diagnostic errors are the result of cognitive errors, given that the process of diagnosis depends on a clinician's thinking [14].

If consideration of new research evidence is positioned as a rational mode function, and current practice as an experiential mode function, then the factors which influence the relationship between these two modes may be of importance in understanding the uptake of new evidence in medical practice. In other words, those factors which have been shown to restrict or facilitate the operations of the rational mode may influence the uptake of new evidence. As noted earlier, research has demonstrated that both situational and dispositional factors are influential. External situational factors such as the social, economic, administrative and organisational context have been widely identified as barriers to the uptake of evidence, as have dispositional characteristics such as knowledge, skills, attitudes, values and personality [4]. However, dispositional factors have been largely ignored in evidence implementation strategies in healthcare. By dispositional factors, we mean characteristics of the individual which are relatively stable over time, such as might be embraced by the words personality, values or attitudes. Despite acknowledging that medical decision making occurs in a complex social environment with multiple influences and decision makers, it remains true that an individual doctor's judgement still retains a key position in terms of diagnostic and treatment decisions for individual patients. How doctors reason, and individual differences between doctors in reasoning, remain relevant considerations in any discussion of medical practice.

Within reasoning research, there has been a predominant focus on intelligence. For example, an extensive review of individual differences in reasoning is dominated by a discussion of research relating to cognitive capacity [7]. In this context intelligence is typically measured by the Scholastic Aptitude Test (SAT) or other measures of general intelligence. However,

intelligence is not of direct interest to our discussion relating this model to doctors and practice change, because we assume that in general all doctors are highly intelligent, and indeed, most probably reflect a small, attenuated range of higher Intelligent Quotient (IQ) scores.

It has been argued however, that reasoning may represent a range of dispositions that are quite distinct from intelligence [15]. Other individual differences in cognitive processing (as opposed to intelligence) may also be important, and are of interest to the present discussion. These have been referred to variously, including thinking dispositions, thinking styles, or styles of epistemic regulation [16], but the differing terms are used in similar ways to denote 'relatively stable psychological mechanisms and strategies' [13]. Whilst cognitive capacity has been associated with an algorithmic level of cognition (ie, computational processes), it has been suggested that individual differences in cognitive processing influence the intentional level of analysis; that is, a particular level of analysis in cognition which is thought to reflect an individual's goals, values and beliefs [13]. This would seem then particularly relevant for any discussion on the explicit use of evidence in medical practice, which by its nature incurs intentional analysis.

There are several candidate constructs that may be usefully considered. 'Actively open minded thinking' [17] (measured by composite scores from scales for constructs such as dogmatism and categorical thinking) has been found to predict biased thinking independent of cognitive capacity [16]. 'Need for cognition' refers to individual differences in the tendency to engage in and enjoy thinking [18]. It has been associated with the rational mode of reasoning, and shown to be related to, but not the same as intellectual ability. As an analogy, a person's motivation to engage in physical activities is related to, but not the same as, physical ability [19]. Need for cognition has also been incorporated into the Rational-Experiential Inventory-Long Form instrument, which additionally includes a related but independent

construct termed 'faith in intuition', which has been shown to influence the experiential mode of reasoning [9].

Cognitive style may be another construct of interest. It refers to the way in which an individual takes note of the surroundings, seeks meaning and becomes informed [20]. One popular measure of cognitive style is an individual's preferred modes of information-intake and decision making, as measured by two of the polar preference scales of the Myers-Briggs Type Indicator (MBTI): sensing-intuiting (S-N), and thinking-feeling (T-F) [21]. The four possible preference types according to these scales (NT, NF, ST, and SF) have been associated with need for cognition [22], and it is therefore conceivable that they too may measure important individual differences in reasoning.

There are likely to be other constructs of interest, but the foregoing have already accumulated some research evidence in support of their independence from intelligence, and possible influence on reasoning modes. Whilst these individual differences can be seen as important in understanding reasoning, they may also be important in terms of attitudes to EBP, which in turn may moderate the uptake of evidence. This may not be in the direction first assumed. For example, someone with higher faith in intuition might have more favourable attitudes to EBP because of the strong emotional appeal of being 'right' and 'proper' to integrate the best research evidence into practice. However a person with higher need for cognition (someone who likes to actively think more), might have less favourable attitudes because they have thought through the limitations of such an approach, for example, of generalising the results of large trials to their individual patient who has different characteristics to those included in the original study.

Whilst there is a considerable amount of research into medical decision making, it is worth noting that there is very little research which investigates the role of individual differences in cognitive processing and clinical decision making. There is some research investigating cognitive style amongst medical students and experienced physicians as measured by the Myers-Briggs Type Indicator, but it is related to specialty choice [23]. More recently, the role of personality type in communication between patients and doctors has been explored [24]. In over 100 studies which have validated need for cognition as a distinct and measurable construct using the Need for Cognition Scale, nearly all used general undergraduate students or community members with no published studies having used medical practitioners as participants [19].

#### Implications for Change Strategies

Empirically-driven strategies to change practice in accordance with new evidence yield some success, but changes are typically modest [1]. There are clearly determinants of practice and behavioural change that have not yet been identified, and individual differences in reasoning amongst doctors may account for some of these. Whilst empirical ‘top-down’ strategies are based on ‘what works’, they still leave an unanswered question of “why does it work?” which ultimately can inform the generalisability of any study investigating the translation of evidence into practice. Researchers need to underpin studies investigating evidence translation with explicit theoretical rationales, something which has been scarcely done to date [3].

Eccles et al (2005) note that theories of relevance to implementation research are most likely to include only modifiable variables. Perhaps this is too narrow. Any theory of behaviour or

cognition potentially will be of relevance to implementation science. Models which fail to include human traits will be limited when it comes to the design of strategies and the interpretation of why and under what circumstances they lead to changed practice. Consider a hypothetical model which effectively predicts what is known as ‘external information search’, such as proactively seeking information from an evidence based guideline on the Internet. We might know, and successfully predict, that a certain percentage of GPs with broadband access (a modifiable variable) will use the Internet to refer to an evidence based guideline (target behaviour) once a week during a patient encounter. We might also know that a 10 minute training session on how to find such guidelines will lead to an increased sustained rate of such behaviour (a second modifiable variable). We could then target both variables (increased broadband access and a brief directed educational intervention) as a strategy to improve compliance with the best evidence, and find that we raise the percentage of those access rates. But let it be assumed that it is true that higher need for cognition (a non modifiable, stable variable) also predicts the percentage of GPs likely to initiate an external information search. Without knowing the influence of need for cognition we would not have an accurate picture of the number of GPs likely to be open to change. Thus understanding stable variables contributes to defining the potential for change, which may be important for considering and comparing implementation strategies. Second, understanding the nature of differences in individual doctors’ traits between doctors, may contribute to the decision to use separate strategies to accommodate the variation. Using need for cognition as an example, different strategies might be designed for those who have a higher need, compared to a lower need, for cognition. Third, in the complex world of thought and behaviour, even relatively stable preferences for cognitive processing may be optimised. Croskerry (2003) argues that humans are capable of meta-cognitive skills (the ability to think about how we think) and that we can create cognitive forcing strategies to inoculate against known biases in our thinking. He

argues, for example, that the most commonly missed fracture is the 'second one' because doctors tend to stop their search for information too early in the diagnostic process. Such premature closure in a search strategy is known as 'satisficing', and can occur in any part of the diagnostic process in clinical practice. He argues this potential pitfall in thinking can be overcome by teaching doctors a generic cognitive forcing strategy in the Emergency Room: once you obtain a positive finding or fail to find an expected result, begin a secondary search. Such a strategy is not just relevant for the one clinical problem of fractures; it is directly applicable to a host of other presentations, such as looking for co-ingestants in self poisoning, failing to look for a second foreign body [25].

### **Summary**

We have initially considered generic dual processing models of reasoning. The next step is the identification of a specific theory which can be evaluated for its relevance and appropriateness to medical practice, such as the Cognitive-Experiential Self Theory. Descriptive information on the type and variation of individual differences in cognitive processing amongst doctors needs to be identified. This may include thinking styles, need for cognition, and faith in intuition. Such differences will need to be predictably related to clinical judgements and real life practice, and attitudes to EBP. Then, effective change strategies based on this knowledge can be contemplated. There may be preferred change strategies depending on the cognitive processing profile for different groups of doctors.

It is imperative that change strategies in healthcare consider relevant research from other disciplines, such as psychology, and look towards identifying an appropriate theoretical basis. Empirical strategies, whilst no doubt necessary, are not solely sufficient. We have considered parallel dual processing models of reasoning and positioned the uptake of new evidence as a rational mode function, and clinical experience as an experiential mode function. By viewing

these two components of medical decision making within this model, we infer that the same influences that have been shown to influence the interaction of both modes of reasoning in other settings, may moderate the uptake of evidence in clinical practice. We have particularly focused on the role of individual differences in cognitive processing. Whilst most research relates to individual differences in intelligence, some emerging research points to other differences in cognitive processing, such as thinking styles, need for cognition, and faith in intuition. A better understanding of individual differences between doctors on these constructs may ultimately contribute to the design of strategies to improve uptake of new research evidence by doctors.

### **Competing Interests**

RS is a PhD research scholar supported by the National Institute of Clinical Studies, Australia's national agency for closing the gaps between evidence and practice in health care.

### **Authors' Contributions**

All authors made significant contributions to the conception of the paper. RS drafted the manuscript, and PP and MB revised it critically for its intellectual content. All authors read and approved the final manuscript.

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