Cognitive Psychology 63 (2011) 107–140

Contents lists available at ScienceDirect

Cognitive Psychology

journal homepage: www.elsevier.com/locate/cogpsych

Intuition, reason, and metacognition

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ARTICLE INFO

Article history:
Accepted 31 May 2011
Available online 27 July 2011

Keywords:
Metacognition
Reasoning
Dual Process Theories
Intuition
Analytic thinking
Retrospective confidence

ABSTRACT

Dual Process Theories (DPT) of reasoning posit that judgments are mediated by both fast, automatic processes and more deliberate, analytic ones. A critical, but unanswered question concerns the issue of monitoring and control: When do reasoners rely on the first, intuitive output and when do they engage more effortful thinking? We hypothesised that initial, intuitive answers are accompanied by a metacognitive experience, called the Feeling of Rightness (FOR), which can signal when additional analysis is needed. In separate experiments, reasoners completed one of four tasks: conditional reasoning ($N = 60$), a three-term variant of conditional reasoning ($N = 48$), problems used to measure base rate neglect ($N = 128$), or a syllogistic reasoning task ($N = 64$). For each task, participants were instructed to provide an initial, intuitive response to the problem along with an assessment of the rightness of that answer (FOR). They were then allowed as much time as needed to reconsider their initial answer and provide a final answer. In each experiment, we observed a robust relationship between the FOR and two measures of analytic thinking: low FOR was associated with longer rethinking times and an increased probability of answer change. In turn, FOR judgments were consistently predicted by the fluency with which the initial answer was produced, providing a link to the wider literature on metamemory. These data support a model in which a metacognitive judgment about a first, initial model determines the extent of analytic engagement.

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doi:10.1016/j.cogpsych.2011.06.001

1. Introduction

There is much evidence to support the thesis that reasoning and decision-making are accomplished by recourse to two qualitatively different types of processes (see Evans and Frankish (2009) for a recent review), differing in terms of the degree to which they are characterized as fast and automatic (Type 1) or slow and deliberate (Type 2). A variety of Dual Process Theories (DPT) have been proposed to explain the interaction of these two processing systems (e.g., Evans, 2006; Kahneman, 2003; Sloman, 2002; Stanovich, 2004). Although they make somewhat different claims about the extent, degree, and timing of Type 2 processes, they share the basic assumption that automatic Type 1 processes give rise to a highly contextualised representation of the problem and attendant judgments that may or may not be analysed extensively by more deliberate, decontextualised Type 2 processes.

According to DPTs, the outcome of a given reasoning attempt is determined jointly by the content of the information that is retrieved by Type 1 processes (see Kahneman (2003) and Stanovich (2004) for extensive analyses) and by the quality and depth of Type 2 processing. As such, the explanatory value of DPTs depend critically on their ability to predict the circumstances under which Type 2 processes are more or less engaged (Evans, 2009; Stanovich, 2009; Thompson, 2009, 2010). To date, explanations have focussed on global characteristics of the reasoner, such as cognitive capacity (De Neys, 2006a; Stanovich, 1999) or aspects of the environment, such as the amount of time allotted to complete the task (Evans & Curtis-Holmes, 2005; Finucane, Alhakami, Slovic, & Johnson, 2000), the instructions provided to the reasoner (Daniel & Klaczynski, 2006; Evans, Newstead, Allen, & Pollard, 1994; Newstead, Pollard, & Evans, 1992; Vadeboncoeur & Markovits, 1999), or variables that create a global perception of difficulty, such as presenting problems in a difficult-to-read font (Alter, Oppenheimer, Epley, & Eyre, 2007).

Missing from this analysis is an account of item-specific cues that trigger Type 2 thinking. To illustrate, consider the following two items. One is taken from Frederick's (2005) Cognitive Reflection Test (CRT) and the second is an isomorphic version of it (Thompson, 2009):

> If it takes 5 machines 5 min to make 5 widgets, how long would it take 100 machines to make 100 widgets?
> ____ minutes
> If it takes 5 machines 2 min to make 10 widgets, how long would it take 100 machines to make 100 widgets?
> ____ minutes

The first problem strongly cues the response "100", which is, in fact, erroneous but often given as an answer (Frederick, 2005). From a DPT view, Type 1 processes produce an initial response to the first version of the problem (i.e., 100). This answer is then examined by Type 2 processes, determined to be satisfactory, and (incorrectly) given as the answer by a large majority of participants (Evans, 2009; Kahneman, 2003). Less clear is the explanation for why this answer is so readily deemed to be satisfactory and the subsequent Type 2 analysis is so cursory; also missing is the explanation for why the second version of the problem is more likely to suggest that mental effort (Type 2 processing) will be needed to achieve the solution.

Such variability in performance across nominally equivalent problems is common (e.g. Bucciarelli & Johnson-Laird, 1999; Johnson-Laird, 1983; Marcus & Rips, 1979). The question, therefore, becomes this: For a given participant of a given cognitive capacity, operating under a given set of task instructions, in a given environment, what predicts the degree of Type 2 engagement? In the current paper, we propose an answer to this question that is grounded in basic metacognitive processes. Specifically, we posit that a third category of process monitors Type 1 outputs (Simmons & Nelson, 2006; Thompson, 2009, 2010) and determines the extent of Type 2 engagement (see Evans (2009) and Stanovich (2009) for related discussions).

1.1. The Metacognitive Reasoning Theory: the Feeling of Rightness and Type 2 thinking

This proposal draws heavily on the metamemory literature, which has long acknowledged the distinction between the processes responsible for retrieving information from memory and the processes