



Original Articles

Fast logic?: Examining the time course assumption of dual process theory

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ABSTRACT

Influential dual process models of human thinking posit that reasoners typically produce a fast, intuitive heuristic (i.e., Type-1) response which might subsequently be overridden and corrected by slower, deliberative processing (i.e., Type-2). In this study we directly tested this time course assumption. We used a two response paradigm in which participants have to give an immediate answer and afterwards are allowed extra time before giving a final response. In four experiments we used a range of procedures (e.g., challenging response deadline, concurrent load) to knock out Type 2 processing and make sure that the initial response was intuitive in nature. Our key finding is that we frequently observe correct, logical responses as the first, immediate response. Response confidence and latency analyses indicate that these initial correct responses are given fast, with high confidence, and in the face of conflicting heuristic responses. Findings suggest that fast and automatic Type 1 processing also cues a correct logical response from the start. We sketch a revised dual process model in which the relative strength of different types of intuitions determines reasoning performance.

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1. Introduction

Decades of research on reasoning and decision-making have indicated that educated adult reasoners often violate elementary logical or probabilistic rules. As an example, consider that there is an event with 1000 people, you are told that most people at the event are I.T. technicians, but there are also 5 attendees who are professional boxers. Assume that you are searching for someone you do not know and you are only given one piece of information; the person is described to you as being ‘strong’. What do you think is more likely? Is this person a boxer or an I.T. technician?

On the basis of the base rate probabilities, one might say that the person is an I.T. technician because there are much more I.T. technicians than boxers at the event. However, intuitively people will be tempted to conclude that the person is a boxer based on the stereotypical association (“I.T. technicians are weak”) that the description cues. Many studies have shown that people tend to neglect the base rates in these situations (e.g., Pennycook, Trippas, Handley, & Thompson, 2014; Tversky & Kahneman, 1974). Hence, participants typically base their choice on the stereotypical association and conclude that the person is a boxer.

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Such intuitive or “heuristic” associations have been shown to bias people’s judgment in a wide range of tasks and situations (Gilovich, Griffin, & Kahneman, 2002).

One of the possible explanations for the phenomenon is presented by dual process theories of thinking. According to the classic dual process view, there are two different types of thinking: Type 1 and Type 2 processes. Type 1 processing is fast, automatic, does not require working memory, operates unconsciously and immediately triggers an answer. Type 2 processing puts a heavy load on working memory, operates consciously, controlled and relatively slow. The two types of processes are also often referred to as ‘intuitive’ or ‘heuristic’ vs. ‘deliberate’ or ‘analytical’ (Stanovich & Toplak, 2012). It is important to note that dual process theory is an umbrella term; several types of dual process theories exist (Stanovich & West, 2000). In this study, we focus on the influential, default-interventionist view of dual processes that has been advocated in the seminal work of Evans and Stanovich (2013) and Kahneman (2011).

The standard assumption in the default-interventionist dual process (DI) framework is that the automatic and fast Type 1 process first produces an intuitive heuristic answer. Generation of the heuristic answer might subsequently be followed by a deliberative, slow Type 2 process, which may result in a correction of the initial heuristic answer. Note that in cases – such as the introductory reasoning problem – in which the initial heuristic response conflicts

with the correct logical¹ response, the corrective Type 2 thinking is believed to be critical to arrive at the correct logical answer. In cases where the Type 2 processing fails, the heuristic response will not be corrected and the reasoner will end up giving the erroneous heuristic answer. Thus, the expected time course assumption is that reasoners will first generate a heuristic answer and, if needed, will after additional reflection correct this to arrive at the correct logical response.

To avoid confusion it is important to stress that the DI time-course prediction does not entail that Type 1 processing necessarily results in an incorrect response or that Type 2 processing necessarily results in a correct response. Normative correctness is not a defining feature of Type 1 or Type 2 processing (e.g., it is not because a response is correct that it resulted from Type 2 processing, and Type 2 processing does not necessarily result in a correct response; e.g., Evans, 2012; Evans & Stanovich, 2013; Stanovich & Toplak, 2012). For example, sometimes reasoners might err precisely because their cognitive resources are overburdened by too much deliberation (e.g., Evans, 2010; Stanovich, 2011). Likewise, it is not hard to see that a person who is guessing can end up giving a correct response without engaging in any deliberation. The DI time course prediction concerns the processing of the typical reasoner in the prototypical situation in which a cued heuristic response conflicts with the correct logical response such as it has been studies in numerous classic tasks from the reasoning and decision-making field since the 1960s. In this case the DI model clearly entails that the typical reasoner will need to recruit Type 2 thinking to correct the initial heuristic Type 1 response in order to arrive at a correct response. Indeed, it is precisely the failure to engage in Type 2 processing that DI theorists have put forward as the primary cause of the massive “bias” in these tasks (Evans, 2012; Kahneman, 2011; Stanovich & West, 2000). Nevertheless, it is important to keep in mind that dual process theories do not claim that one can universally equate Type 2 processing with normative correctness.

But unfortunately, and perhaps somewhat surprisingly, there is little evidence in the literature that allows us to directly validate the core DI time course assumption. For example, in one study De Neys (2006a) presented participants with a range of classic reasoning problems in which a cued heuristic response conflicted with the correct logical response and recorded response latencies. Results consistently showed that correct responses were given much slower than heuristic (i.e., incorrect) responses. One might argue that this finding is in agreement with the time course assumption. Giving a (correct) response that is assumed to result from slow Type 2 processing takes more time than giving an (incorrect) response that is assumed to result from fast Type 1 processing. However, although this fits with the claim that Type 2 processing is slower than Type 1 processing, it does not imply that someone who engaged in Type 2 reasoning first engaged in Type 1 reasoning. The latency data does not imply that correct reasoners generated the incorrect answer first, and then corrected it. Reasoners who complete Type 2 thinking might give the correct response without ever having considered the incorrect, heuristic response.

In another illustrative study, Evans and Curtis-Holmes (2005) used an experimental design in which people had to judge the logical validity of reasoning problems under time pressure; one group of reasoners were given only 2 s to answer, whereas a control group were allowed to take as much time as they wanted to give

an answer. A higher percentage of incorrect answers was found in the time pressure group. Hence, this also indicates that giving the correct response requires time. However, this does not necessarily show that individuals who gave the correct response in the free time condition generated the heuristic response first and corrected this subsequently. As with the latency data of De Neys (2006a), it might be that reasoners engaged in Type 2 thinking right away, without any need to postulate an initial generation of a heuristic response.

One might note that there is also some incidental evidence for the DI time course assumption. For example, Frederick (2005) notes that when participants solve his Cognitive Reflection Test (which was designed to cue a strong heuristic response), correct responders often considered the incorrect, heuristic answer first “as is apparent from introspection, verbal reports, and scribbles in the margin” (Frederick, 2005, p. 27). But unfortunately, he gives no further information about the protocol analysis or the precise prevalence of these observations. Frederick also mentions that incorrect responders rate the problems as easier than correct responders and suggests that this presumably indicates that correct responders are more likely to consider both responses. But even when this assumption holds, it does clearly not imply that correct responders considered the heuristic response *before* the correct response.

Arguably, the most direct evidence to evaluate the dual process time course assumption comes from experiments using the two response paradigm (Newman, Gibb, & Thompson, submitted for publication; Pennycook & Thompson, 2012; Thompson & Johnson, 2014; Thompson, Prowse Turner, & Pennycook, 2011). In this paradigm, participants are presented with a reasoning problem and are instructed to respond as quickly as possible with the first, intuitive response that comes to mind. Afterwards, they are presented with the problem again, and they are given as much time as they want to think about it and give a final answer. A key observation for our present purposes was that Thompson and colleagues noted that people spent little time rethinking their answer in the second stage and hardly ever changed their initial response. Note that the fact that people do not change an initial heuristic response is not problematic for the dual process framework, of course. It just implies that people failed to engage the optional Type 2 processing. Indeed, since such failures to engage Type 2 are considered a key cause of incorrect responding, a dominant tendency to stick to incorrect initial responses is not surprising from the classic dual process stance. However, the lack of answer change tentatively suggests that in those cases where a correct logical response was given as final response, the very same response was generated from the start. Bluntly put, the logical response might have been generated fast and intuitively based on mere Type 1 processing (Pennycook & Thompson, 2012; Thompson & Johnson, 2014). This would pose a major challenge for standard dual process theory. However, it cannot be excluded that Thompson et al.’s participants engaged in Type 2 processing when they gave their first, initial response. Although Thompson et al. instructed participants to quickly give the first response that came to mind, participants might have simply failed to respect the instruction and ended up with a correct response precisely because they recruited Type 2 thinking.² Clearly, researchers have to make

¹ Note that we will be using the label “correct” or “logical” response as a handy shortcut to refer to “the response that has traditionally been considered as correct or normative according to standard logic or probability theory”. The appropriateness of these traditional norms has sometimes been questioned in the reasoning field (e.g., see Stanovich & West, 2000, for a review). Under this interpretation, the heuristic response should not be labeled as “incorrect” or “biased”. For the sake of simplicity we stick to the traditional labeling. In the same vein, we use the term “logical” as a general header to refer both to standard logic and probability theory.

² Note that Thompson et al. obviously realized this and tried to control for it. For example, they always asked participants to verify that their first response was really the one that came to mind first, and they discarded the rare trials with negative verification answers. However, there is no way to be sure that participants’ verification answer was true or not. The problem is not so much that people might be intentionally lying but simply that they might have little explicit insight into which thought was generated first. The point here is that a more stringent control is needed.

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