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Highly reflective reasoners show no signs of belief inhibition

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ABSTRACT

The processes underlying individual differences in reasoning performance are not entirely understood. What do people who do well on reasoning tasks where beliefs and logic conflict do differently from other people? Because abundant evidence shows that even poorer reasoners detect these conflicts, it has been suggested that individual differences in reasoning performance arise from inhibition failures later in the reasoning process. The present paper argues that a minority of highly skilled reasoners may deviate from this general reasoning process from an early stage. Two studies investigated signs of belief inhibition using a lexical access paradigm (Study 1) and a negative priming paradigm (Study 2). Study 1 showed that while other people exhibited signs of belief inhibition following a belief–logic conflict, people with the highest disposition for cognitive reflection did not. In Study 2, this finding was replicated and similar results were also obtained when comparing groups with higher and lower general cognitive ability. Two possible explanations are discussed.

The reasoners with a highly reflective cognitive style or high general cognitive ability may have engaged and inhibited belief processing but if so, they may have been exceptionally efficient at recovering from it, wherefore no belief inhibition effects were found. An alternative account is that these reasoners started Type 2 processing directly, without first engaging in and then inhibiting belief-based processing. Under either explanation, the results indicate that individual differences in reasoning may partly arise from differences that occur early in the reasoning process.

1. The fast lane to logic: highly reflective reasoners bypass belief processing

People differ tremendously in their ability to reason logically. In particular, when a reasoning situation calls for a conclusion that is against one's own beliefs, few are able to make that conclusion. In the psychology of reasoning, this is known as the belief bias effect (Evans, Barston, & Pollard, 1983). Despite decades of research on the interplay between intuitive (heuristic, belief-based) and analytical (rational, logical) thinking, the processes underlying the belief bias effect are not yet clear. One possible reason for this is that research has not paid enough attention to possible differences in the processes underlying the performance of subgroups of reasoners. To this end, the present paper hopes to reveal what distinguishes those reasoners who most easily overcome belief bias from other reasoners.

Conflicts between beliefs and logic can be explained in terms of dual-process theories, which consider human reasoning to be the result of an interplay between two kinds of processes, namely contextual, intuitive processes, and decontextualized, analytical processes (Denes-Raj & Epstein, 1994; Evans, 2008; Stanovich & West, 2000). For simplicity, these may be termed Type 1 and Type 2 processes (Stanovich, 1999). According to the default-interventionist view of dual-processing, effortless Type 1 processes dominate thinking, and effortful Type 2 processing may intervene upon these when reasoning is leading to outputs that conflict with one's better judgment (De Neys, 2006; Evans, 2008; Evans & Curtis-Holmes, 2005; Stanovich & West, 2000). A general assumption has been that belief processing takes place intuitively, and that logical reasoning is a form of Type 2 processing (Stanovich, 1999). Thus, overcoming belief bias requires that belief processing is inhibited in favor of logical processing.

Stanovich (1999, 2009b) has argued that choosing to take Type 2 processing into use is a distinct concept from the ability to do so, and has presented compelling evidence that this disposition predicts avoiding belief bias over and beyond the influence of general cognitive ability (Macpherson & Stanovich, 2007; Toplak, West, & Stanovich, 2011). Accordingly, a person with ample cognitive ability may nevertheless not reason logically, if he or she is not disposed to do so. The disposition to favor Type 2 processing has been termed cognitive reflection, and evidence suggests that it can be assessed using the Cognitive Reflection Test, a simple test that invites intuitively appealing responses that, upon reflection, turn out to be incorrect (Frederick, 2005). Correct responding requires that one withholds the heuristic response long enough to calculate the correct solution. In other words, the test seems to tap into an ability that is similar to the one needed to overcome belief bias. Therefore, to understand the kind of processing that leads to avoiding belief bias, success on this test may be a prime criterion by

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which to identify the individuals on whom to focus research. As discussed by Thompson, Prowse Turner, and Pennycook (2011), reasoning task responses alone are inadequate indicators of the quality of the underlying processing, because logically correct responses may be reached by guessing, and failing to give the correct response does not imply that the person has not attempted to reason logically.

Recent developments in the reasoning field have emphasized that dual-process theories need to incorporate a separate process that determines when intuition is insufficient; after all, without analytical processing, how could one ever know when something is conflicting with it? Thus, several scholars have suggested the existence of a process that detects when beliefs and logic conflict, and determines whether proper Type 2 processing is to begin (Bonner & Newell, 2010; De Neys & Glumicic, 2008; Evans, 2009; Thompson et al., 2011). Abundant evidence suggests that this conflict detection functions outside of awareness and that it is effortless and fast. Comparing tasks with conflict to tasks without conflict, the presence of conflict has been found to affect numerous indicators, from autonomic nervous system reactions to improved recall of task details (review: De Neys, 2012). De Neys (2012) has put forward the idea that this conflict detection process entails "logical intuitions", that is, a light Type 1 process which is able to quickly recognize whether a task follows simple rules of logic that the individual has internalized. An important finding is that these effects have been found in all study participants, including those who fail to follow through on logical reasoning. That is, even poorer reasoners do implicitly detect when they are giving illogical responses (De Neys & Glumicic, 2008).

Based on the above research, current understanding has it that the reason why people so often fail to reason logically is not that they neglect to detect that their responses are illogical. Relating available evidence to a timeline of the reasoning process, De Neys and Bonnefon (2013) have has concluded that the evidence seems to exclude an early origin of belief bias. That is, those who exhibit belief bias do not differ from those who respond logically in the norms they strive for, or in the types of processes that they initiate. Instead, the authors suggest that everyone detects belief-logic conflicts and attempts to inhibit belief processing. However, the Type 1 response may still be "more strongly activated, salient, or appealing" (De Neys, 2012, p. 35) than the logical response, and engaging Type 2 processing to reach a logically correct response therefore requires effortful belief inhibition (De Neys, 2012). By this account, logical reasoning falters if people fail in this inhibition. Thus, individual differences in reasoning arise from differences in the effectiveness of belief inhibition, which occurs late in the reasoning process.

Adding to this discussion, the present paper examines the possibility that for some advanced reasoners, the path to logical processing might be smoother. Specifically, the suggestion is that while most people's processing is a struggle between belief processing and logic, the people who are most inclined to favor Type 2 processing may be able to overcome or avoid the struggle at an earlier stage. This suggestion is based on the results of two studies on samples of exceptionally skilled reasoners. While the samples in reasoning studies typically consist of undergraduates participating for course credit, the present samples were self-selected through advertisements for reasoning experiments that offered no compensation. Consequently, the present studies came about to attract individuals who were older and who had more completed education than is typical in reasoning studies, and who were perhaps more motivated than average to volunteer for studies which they knew would involve effortful reasoning tasks. These samples thus allowed analysis of a population that has so far not received much attention in the literature. The experiments examined indicators of belief inhibition and found that the belief inhibition effects were absent from the reasoners with the strongest tendency for Type 2 thinking. Thus, the present paper suggests that for this minority of individuals, logical reasoning is less disrupted by belief inhibition than for other people.

2. Study 1

Study 1 replicated Experiment 1 from De Neys and Franssens (2009), in which syllogisms were followed by a lexical decision task requiring participants to rapidly distinguish words from nonwords. De Neys and Franssens found that poorer and better reasoners alike were slower to respond to words that were related to the topic of the preceding syllogism if it had involved a conflict between beliefs and logic than if it had not. These results were interpreted as evidence that all participants had detected when a conflict was present, and attempted to inhibit it. In the present study, this effect was compared between reasoners with higher and lower dispositions towards Type 2 thinking. Following the account that those who are most inclined to use Type 2 processing are less disrupted in their reasoning by belief–logic conflicts, the lexical inhibition effect was expected to be weaker or absent among participants with a high reflective disposition than among others (Hypothesis 1).

2.1. Method

2.1.1. Participants

Fifty-six Finnish volunteers (45 females, mean age 27 years, age range 19–49) participated in the study. The participants were recruited through invitations distributed through several student mailing lists for a study on "the way people distinguish real words from nonwords when these are presented in conjunction with reasoning problems" and through opportunity sampling. The majority of the participants were university students.

2.1.2. Measures

The participants were presented the eight syllogisms from De Neys and Franssens (2009, exp. 1) and another set of syllogisms on moral topics for a study not reported here. Half the syllogisms were logically valid and half were invalid, and half had believable conclusions and half had unbelievable conclusions, resulting in four syllogism types. The syllogisms were presented individually on a computer. Each premise was shown for 3 s, followed by a screen showing both premises and the conclusion, which stayed visible until the participant responded. The participants were given standard instructions to assume that the premises are true and to assess whether the conclusion follows logically from the premises (Evans et al., 1983). Each syllogism was followed by a lexical decision task. In this task, 24 strings of letters were presented individually and the participants were asked to classify whether the strings represented real words or nonwords. Out of the 24 strings, 12 were nonwords, 6 were target words related to the topic of the syllogism and 6 were words unrelated to the topic. The materials were translated into Finnish, and the lists of target and unrelated words were slightly modified after piloting showed that some of the associations between topics and words among the Finnish speakers differed from the associations in Dutch (e.g. while Dutch speakers associate the word 'canal' with boats, the Finnish word for 'canal' is the same as 'channel', and the pilot subjects associated it with television, not boats; thus, it was replaced with the word 'oar'). The participants were instructed to take the time they needed on the syllogisms, and to respond as quickly as they could on the lexical decision task. The participants were given three practice sets of syllogisms and lexical decision tasks before the experiment began. The order of presentation was randomized for each participant. Responses were given using the buttons of a computer mouse.

To assess the disposition favoring Type 2 processing, the participants completed the Cognitive Reflection Test (CRT; Frederick, 2005) at the end of the experimental session. The test consists of three questions such as "A bat and ball cost $1.10. The bat costs one dollar more than the ball. How much does the ball cost?" that require the participant to refrain from giving the heuristic response (10 cents) and to think the problem through before responding (correct response: 5 cents).