Heuristic Bias, Conflict, and Rationality in Decision-Making

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Abstract Half a century of reasoning and decision-making research has shown that human thinking is often biased. People seem to over-rely on intuitions and gut feelings instead of on more demanding, deliberative reasoning when making decisions. The omnipresence of this bias has led to the questioning of human rationality. In this chapter I clarify that the crucial question for our view of human rationality is whether or not people detect that their intuitions conflict with more normative considerations when they are biased. In the first section I review recent conflict detection studies that started addressing this issue. The second section discusses the implications of the conflict detection work for the debate on human rationality. The key message is that focusing on the conflict detection process shows that people are far more rational and normative than their actual responses show.

1 Introduction

My dad runs a beer store. When buying a case of fancy Belgian beer, customers often ask whether they can buy a couple of matching glasses. My dad usually gets these glasses for free from his suppliers so he actually doesn't mind giving them away. However, he does not like to be easy on his customers and enjoys putting their decision-making skills to the test. When people ask him how much they owe him for the glasses, he tells them he is charging 5 euros for a glass but he also informs them that if they take a full box of six glasses instead of the one or two they asked for, they will get a 100% reduction. From a rational, economical point of view it is pretty obvious what people need to do. Two glasses will cost them 10 euros (2×5 euros $= 10$ euros). Six glasses would normally cost them 30 euros (6×5 euros $= 30$ euros) but thanks to the 100% reduction they will not be paying anything if they take the full box (100% of 30 euros is 30 euros, of course). This is a

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very basic calculation that most elementary school children would have little trouble solving. Nevertheless, what my dad typically observes is that although he is catering to well-educated middle-class families, the vast majority of his customers decide to reject his offer. Even when he warns them that they are missing out on the 100% reduction, they still decide to stick to (and pay for!) the original number of glasses they asked for. Hence, people prefer to pay for glasses they could easily get for free. As my dad puts it, his customers' striking "failure to think" forces one to conclude that humans are ignorant, irrational beings.

Interestingly, the scientific study of human thinking seems to confirm my dad's observations. Since psychological studies of reasoning and decision-making started booming in the late 1950s, numerous studies have shown that in a wide range of reasoning and decision-making tasks, most educated adults are biased and fail to give the answer that is correct according to logic or probability theory (Evans and Over 1996; Kahneman et al. 1982). The general problem seems to be that reasoners over-rely on intuitions and gut feelings instead of on more demanding, deliberative reasoning when making decisions (Evans 2003; Kahneman 2002). Although this intuitive or so-called "heuristic" thinking might sometimes be useful, it will often cue responses that are not warranted from a normative point of view. Consequently, people's reasoning and decision-making is often biased.

It is not hard to see how such intuitive or heuristic thinking is biasing my dad's customers in his store. Intuitively, people's gut feeling might simply be telling them that by offering an additional reduction my dad is trying to persuade them to buy more than they asked for. In general, such a heuristic might be a useful tool to prevent falling prey to sales tricks. However, in my dad's store this mere intuitive reasoning is costing people good money. Hence, the point is not that heuristics or intuitions are necessarily bad. The point is rather that during reasoning and decision-making it is crucial to check whether one's intuitions conflict with more normative considerations. As my dad would claim, the omnipresence of heuristic bias suggests that people are not very good at detecting such conflicts.

The conflict detection process is a key component of any theory of reasoning and decision-making. Unfortunately, the process is poorly understood and there are some quite different views on its efficiency. Consistent with my dad's view, for example, a number of authors have argued that conflict detection during thinking is quite unsuccessful (e.g., Evans 1984; Kahneman and Frederick 2002). According to these authors, the widespread heuristic bias can be attributed to a failure to monitor our intuition. Because of lax monitoring people would simply fail to detect that the intuitive response conflicts with more normative considerations. Bluntly put, people would be biased because they do not notice that their intuition is wrong.

However, others have suggested that conflict detection during thinking is actually pretty flawless (e.g., Epstein 1994; Sloman 1996). According to these authors, there is nothing wrong with the detection process. People do notice that the intuitive response conflicts with more normative considerations. The problem, however, is that despite this knowledge they will not always manage to inhibit and discard the tempting intuitive beliefs. Thus, people "behave against their better judgment" (Denes-Raj and Epstein 1994, p. 1) when they give an unwarranted heuristic

response: they detect that they are biased but simply fail to block the biased response. In sum, in this view biased decisions are attributed to an inhibition failure rather than a conflict detection failure per se (see also Houdé 2007).

Clarifying the efficiency of the conflict detection process and the resulting nature of the heuristic bias is paramount for the development of reasoning and decision-making theories. The issue also has far-stretching implications for our view of human rationality. If the popular bias-as-detection-failure view is right and reasoners do not detect that their heuristic response is wrong, this implies that reasoning errors are indeed quite "dumb." The second view, however, implies that people's errors are less ignorant. If people detect that their intuitive response is not fully warranted, this implies that people did not simply neglect the normative considerations. Contrary to my dad's conclusion, this would suggest that people are no mere heuristic thinkers and might be more rational than their actual responses show.

The problem, however, is that it is hard to decide between the alternative views based on traditional reasoning data (Evans 2007, 2008a,b). Recently, however, there have been some initial attempts to break the stalemate. A number of studies started developing processing measures of conflict detection during reasoning. In the following section I will briefly review this work. In a final section I will discuss the implications of the findings for the debate on human rationality in more detail.

2 Conflict Detection Studies

2.1 To Detect or Not to Detect?

De Neys and Glumicic (2008) recently presented one of the first studies that explicitly focused on an empirical test of the efficiency of the conflict detection process during thinking. They pointed out that the classic claims about the detection process were typically anecdotal in nature. (Epstein 1994; Denes-Raj and Epstein 1994; Epstein and Pacini 1999), for example, repeatedly noted that when picking an erroneous answer his participants spontaneously commented that they did "*know*" that the response was wrong but stated they picked it because it "*felt*" right. Such comments do seem to suggest that people detect that their intuition conflicts with normative considerations. The problem, however, is that spontaneous selfreports and anecdotes are no hard empirical data. This is perhaps best illustrated by the fact that Kahneman (2002, p. 483) also refers to "casual observation" of his participants to suggest that only in "some fraction of cases, a need to correct the intuitive judgements and preferences will be acknowledged." Therefore, in a first experiment De Neys and Glumicic decided to adopt a thinking aloud procedure (e.g., Ericsson and Simon 1993). The thinking aloud procedure has been designed to gain reliable information about the course of cognitive processes. Participants are simply instructed to continually speak aloud the thoughts that are in their head as

they are solving a task. Thinking aloud protocols have been shown to have a superior validity compared to interpretations that are based on retrospective questioning or people's spontaneous remarks (Payne 1994).

De Neys and Glumicic (2008) asked their participants to solve problems that were modeled after Kahneman and Tversky's classic (Kahneman and Tversky 1973) base-rate neglect problems. These base-rate neglect problems are among the most (in)famous tasks in the field. In the problems people first get information about the composition of a sample (e.g., a sample with 995 females and 5 males). People are also told that short personality descriptions are made of all the participants and they will get to see one description that was drawn randomly from the sample. Consider the following example:

A psychologist wrote thumbnail descriptions of a sample of 1,000 participants consisting of 995 females and 5 males. The description below was chosen at random from the 100 available descriptions.

Jo is 23 years old and is finishing a degree in engineering. On Friday nights, Jo likes to go out cruising with friends while listening to loud music and drinking beer.

Which one of the following two statements is most likely?

(a) Jo is a man
(b) Jo is a woman

From a normative point of view, given the size of the two groups in the sample, it is more likely that a randomly drawn individual will be a female. However, intuitively many people will be tempted to respond that the individual is a male based on stereotypical beliefs cued by the description ("Jo is an engineer and drinks beer").

The crucial question for De Neys and Glumicic was whether verbal protocols would indicate that when people selected the intuitive response option ("a. Jo is a man") they at least referred to the group size information during the reasoning process (e.g., " … because Jo's drinking beer and loud I guess Jo'll be a guy, *although there were more women* …"). In this task such basic sample size reference during the reasoning process can be considered as a minimal indication of successful conflict monitoring. It indicates that this information is not simply neglected.

Results were pretty straightforward. People who gave the correct response typically also referred to the base-rate information and reported they were experiencing a conflict (e.g., "… it sounds like he's a guy, *but because they were more women*, Jo must be female so I'll pick option b …"). However, people who gave the intuitive response hardly ever (less than 6 % of the cases) mentioned the base-rate information (e.g., a typical protocol would read something like " … This person is a guy … drinks, listens to loud music … yeah, must be a guy … so I'll pick a … "). Hence, consistent with my dad's claims and the error-as-detection-failure view, the verbal protocols seemed to indicate that people are indeed mere intuitive reasoners who do not detect that they are biased.

De Neys and Glumicic noted, however, that it could not be excluded that conflict detection was successful at a more implicit level. It might be that the conflict detection experience is not easily verbalized. People might notice that there is something

wrong with their intuitive response but they might not always manage to put their finger on it. Such more implicit conflict detection would still indicate that people detect that their response is not fully warranted, of course. To capture such implicit detection De Neys and Glumicic also presented participants with a surprise recall test. After a short break following the thinking-aloud phase participants were asked to answer questions about the group sizes in the previous reasoning task. Participants were not told that recall would be tested while they were reasoning but De Neys and Glumicic reasoned that the detection of the conflict should result in some additional scrutinizing of the normative base-rate information. This deeper processing of the base-rate information should subsequently benefit recall.

To validate the recall hypothesis participants were also presented with additional control problems. In the classic base-rate problems the description of the person is composed of common stereotypes of the smaller group so that the normative response cued by the base-rates and the intuitive response that is cued by the description disagree. In addition to these classic problems De Neys and Glumicic also presented problems in which the base-rates and description both cued the same response. In these *congruent* problems the description of the person was composed of stereotypes of the *larger* group. Hence, contrary to the classic (i.e., *incongruent*) problems the intuitive response did not conflict with more normative considerations and the response could be rightly based on mere intuitive processing. For a reasoner who neglects the base-rates and does not detect the conflict on the classic problems, both types of problems will be completely similar and base-rate recall should not differ. However, if one does detect the conflict, the deeper processing of the base-rates in case of a conflict should result in better recall for the classic problems than for the congruent control problems.

Recall results showed that participants had indeed little trouble recalling the base-rates of the classic conflict problems. People easily remembered which one of the two groups in each problem was the largest. On the congruent control problems, however, recall performance was merely at chance level. Interestingly, the superior recall was obvious even for those people who never mentioned the base-rates while thinking-aloud and failed to solve any of the presented classic conflict problems correctly. Since the only difference between the classic and control problems was the conflicting nature of the base-rates and description, De Neys and Glumicic concluded that people had little difficulty in detecting the conflict per se.

In an additional experiment De Neys and Glumicic examined the conflict detection issue further by introducing a "moving window" procedure (e.g., Just et al. 1982). In the experiment the base-rates and the description were presented separately. First, participants saw the base-rate information on a computer screen. Next, the description and question were presented and the base-rates disappeared. Participants had the option of visualizing the base-rates afterwards by holding a specific button down. Such base-rate reviewing can be used as an additional conflict detection index. De Neys and Glumicic explained their recall findings by assuming that when people detect that the description conflicts with the previously presented base-rates they will spend extra time scrutinizing or "double checking" the base-rates. With the "moving window" procedure the time spent visualizing the

base-rates can be used as a measure of this reviewing tendency. If conflict detection is indeed successful, people should show a stronger tendency to visualize the base-rates when solving classic incongruent vs. congruent control problems. This is exactly what De Neys and Glumicic observed. Once again the stronger base-rate reviewing was present for the least-gifted reasoners in the sample who consistently gave the intuitive response on all presented incongruent problems.

2.2 To the Brain and Beyond

In a further attempt to clarify the nature of heuristic bias (De Neys et al. (2008)) decided to focus on the neural basis of conflict detection and response inhibition during thinking. They noted that numerous imaging studies established that conflict detection and actual response inhibition are mediated by two distinct regions in the brain. Influential work in the cognitive control field (e.g., Botvinick et al. 2004; Ridderinkhof et al. 2004), for example, showed that detection of an elementary conflict between competing responses is among the functions of the medial part of the frontal lobes, more specifically the Anterior Cingulate Cortex (ACC). While the ACC signals the detection, correct responding and actually overriding the erroneous, prepotent response has been shown to depend on the recruitment of the more lateral part of the frontal lobes (more specifically the right lateral prefrontal cortex or RLPFC).

De Neys, Vartanian, and Goel therefore suggested that turning to the brain might help to address the dispute about the nature of heuristic bias. Solving classic decision-making problems that cue a salient but inappropriate intuitive response requires that reasoners detect that the intuitive response conflicts with normative considerations, first. In addition, the intuitive responses will need to be successfully inhibited. If the ACC and RLPFC mediate this conflict detection and inhibition process, respectively, correct reasoning should be associated with increased activation in both areas. De Neys, Vartanian, and Goel reasoned that the crucial nature of the intuitive bias could be clarified by contrasting ACC and RLPFC activation for intuitive and normative responses. The bias-as-inhibition-failure and bias-as-detection-failure views make differential predictions with respect to the activation of the conflict detection region. If De Neys and Glumicic's initial behavioral findings were right and people at least detect that the intuitive response conflicts with more normative considerations, the ACC should be activated whether or not people are biased. However, if biased decisions arise because people fail to detect that the intuitive response is inappropriate, people will not detect a conflict when they give an intuitive response and consequently the ACC should not be activated.

De Neys, Vartanian, and Goel tested these predictions in an fMRI study in which participants were asked to solve base-rate problems while the activation of the ACC and RLPFC was monitored. As expected, results showed that for trials in which people selected the correct base-rate response on the classic, incongruent problem versions, both the conflict detection (ACC) and inhibition region (RLPFC) showed

increased activation. When people were biased and selected the intuitive response on these problems, the RLPFC inhibition region was not recruited. The conflict detection ACC region, however, did show clear activation when the intuitive response was selected. On congruent control trials in which the cued intuitive and normative response did not conflict, the ACC was not activated.

In sum, De Neys, Vartanian, and Goel's crucial finding was that biased and unbiased responses on the classic base-rate problems only differed in RLPFC recruitment. Solving incongruent problems did engage the ACC region but the activation did not differ for intuitive or base-rate responses. Consistent with De Neys and Glumicic's behavioral findings this suggested that the intuitive bias should not be attributed to a detection failure but rather to an inhibition failure.

2.3 The Effortless Nature of Conflict Detection

Taken together the De Neys and Glumicic (2008) and De Neys, Vartanian, and Goel studies (2008) supported the view of authors such as Epstein (1994) who claimed that conflict detection during thinking is pretty flawless. However, the absence of any verbally expressed conflict experience suggested that the popular characterization of this process as an explicitly experienced struggle in which people are actively deliberating between two different options ("I know it's wrong but it feels right") is not very accurate. Hence, Franssens and De Neys (2009) recently argued that the conflict detection process itself might be better conceived as an intuitive process that simply warns people that more deliberate reasoning is required (see also Evans, in press). Although the conflict detection would suffice to inform people that their heuristic conclusion is not fully warranted and needs to be scrutinized, it would not guarantee that further deliberate reasoning is actually engaged in to override and inhibit the heuristic response. Bluntly put, it looks like people intuitively feel that "something" is wrong but, without more demanding deliberate thinking, cannot exactly specify what.

Franssens and De Neys (2009) presented a straightforward experiment to test the claim that conflict detection is an intuitive process. One of the key characteristics of intuitive, implicit processing is that it is effortless and does not draw on people's limited executive working memory resources that are required for controlled processing (e.g., Moors and De Houwer 2006). Franssens and De Neys therefore decided to burden these executive resources during reasoning. In their study participants were asked to memorize spatial dot patterns while they were trying to solve base-rate problems. This dot memorization task had been previously shown to burden the executive resources (Miyake et al. 2001). Franssens and De Neys reasoned that if conflict detection during thinking was indeed intuitive, it should not be affected by the executive memorization load. The efficiency of the conflict detection process was measured by presenting the participants with the surprise base-rate recall task that was introduced in the De Neys and Glumicic (2008) studies. Results showed that reasoning performance per se decreased under memorization load.

Participants gave more heuristic responses when their executive resources were burdened. However, the recall performance was not affected. Even under load base-rate recall was still better for classic incongruent than for congruent control problems and the percentage correct recall for the incongruent problems did not differ under load and no-load conditions. Hence, the study nicely supported the characterization of conflict detection as a flawless and intuitive process.

3 Implications for the Rationality Debate

The studies reviewed above suggest that people are quite good at detecting the conflict between cued heuristic intuitions and more normative considerations when solving classic decision-making problems. Although people's responses are typically biased they do seem to have an intuitive gut feeling that is telling them that their heuristic answer is not fully warranted. Even though it is hard for people to verbalize this intuitive conflict feeling, its flawless manifestation indicates that normative considerations are not simply neglected. If people were not to know the normative principles (e.g., the fact that base-rates matter) or would not consider these normative principles to be relevant, there would simply be no conflict to be detected in the first place and congruent and incongruent problem versions should be processed in the exact same manner. Clearly, conflict can only occur when both the intuitive response and normative considerations are taken into account during thinking. The fact that people are particularly sensitive to the presence of this conflict when solving classic decision-making problems implies that people are no mere heuristic thinkers who simply neglect normative considerations. In this section I will try to clarify that this point has some profound implications for the debate about the rationality of the human species (e.g., Stanovich and West 2000; Stein 1996).

The so-called "rationality debate" has raged through the reasoning and decision-making field for more than four decades without clear solution. In essence, the debate centers around two related questions: (a) whether human reasoning is rational and (b) whether the traditional normative systems (such as logic and probability theory) against which the rationality of our inferences and decisions are measured are actually valid. The initial findings in the 1960's that pointed to the omnipresence of heuristic bias led some theorists to question the rationality of the human species (e.g., Wason 1968, 1983; see Evans 2002, for a nice review). Just like my dad in his store, these theorists concluded that people's widespread failure to reason in line with the logical or probabilistic norm indicated that humans are irrational beings. However, later on this pessimistic conclusion was rejected by theorists who started questioning the validity of the classic norms. Bluntly put, it was argued that if the vast majority of well-educated, young adults fail to solve a simple reasoning task, this might indicate that there is something wrong with the task scoring norm rather than with the participants. The basic point of these authors was that people might interpret the tasks differently and adhere to other norms than the classic ones (e.g., Hertwig and Gigerenzer 1999; Oaksford and Chater 1998; Todd and

Gigerenzer 2000). For example, in the base-rate problems participants might interpret the task as a simple social classification task and would therefore not keep track of the base-rate information. These authors clarified that the rationality of our behavior depends on the goals we try to fulfill. If our goal is making a social classification judgment, neglecting the base-rates is the rational thing to do and cannot be considered a bias. Hence, according to this "alternative norm" view, people's behavior in the classic reasoning and decision-making experiments is perfectly rational but has simply been measured against the wrong standards.

One might note that the opposite rationality views are trading-off rationality and norm validity. People like my dad take the validity of the classic norms for granted and conclude that the failure to reason in line with these norms points to human irrationality. The "alternative norm" view on the other hand saves human rationality but at the cost of the validity of the classic norms. I believe that studying the conflict detection process during thinking presents an opportunity to resolve this debate and unify the two views. The initial conflict detection data that I reviewed suggest that both human rationality and the validity of the classic norms can be saved. If people were really to interpret classic reasoning and decision-making tasks as social classification tasks and were to believe that normative considerations such as sample sizes do not matter, their task processing should not be affected by the presence of a conflict between cued social intuitions and the very same normative principles. Hence, contrary to the "alternative norm" view this indicates that people do not consider the classic norms to be irrelevant. On the other hand, the fact that people pick up this conflict shows that they take normative considerations into account and are no mere intuitive thinkers. In sum, people might not always manage to reason in line with the classic norms but this does not imply that they do not know the norms or consider them to be irrelevant. The initial conflict detection studies suggest that all reasoners are at least trying to adhere to the classic norms and detect that their intuition is not warranted.

4 Caveats and Conclusion

In this chapter I wanted to highlight a new research framework in the reasoning and decision-making field that started focusing on the efficiency of the conflict detection process during thinking. Needless to say, this framework is still in its infancy and the initial findings and conclusions need to be interpreted with some caution. Clearly, the work will need to be validated and generalized in future studies. However, I hope to have clarified the potential and importance of this line of research. The key point is that a failure to characterize the conflict detection process during thinking is bound to bias any conclusions about human rationality or the validity of the classic norms. The initial conflict processing data indicates that people are pretty good at detecting their bias. Contrary to popular views in the decision-making field and the opinion of at least one Belgian beer expert, this suggests that people are far more rational and normative than their biased answers suggest.

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