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"I KNOW THE RULE, BUT I'LL JUST GO WITH MY GUT": PEOPLE EXPLICITLY AGREE WITH THE USE OF A HEURISTIC DESPITE NORMATIVE KNOWLEDGE

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Resumo

Meio século de investigação em julgamento e decisão demonstrou que o pensamento humano é frequentemente enviesado por julgamentos heurísticos (e.g., Kahneman & Frederick, 2005). De acordo com a perspectiva de monitorização lassa (e.g., Kahneman & Frederick, 2002), as pessoas falham na detecção do conflicto entre considerações intuitivas e normativas, não se apercebendo de que as suas intuições estão enviesadas. Teorias contrastantes (e.g., Epstein, 1994; Sloman, 1996) assumem que a via heurística e analítica são simultaneamente activadas e as pessoas experienciam este conflicto. Evidência existente sugere que as pessoas detectam, pelo menos implicitamente, este conflicto apesar do enviesamento generalizado (ver De Neys, 2012). Evidência empírica que sugere que a preferência heurística pode mesmo atingir um nível explícito (Denes-Raj & Epstein, 1994; De Neys & Glumicic, 2008), suportou a nossa hipótese de que quando os dois modos de processamento são colocados em conflicto, apesar de conscientes da regra normativa, as pessoas respondem de acordo com julgamentos intuitivos. Direccionámos a nossa abordagem para cenários em que o conflicto entre respostas heurísticas e normativas foi conscientemente percebido pelos participantes e analisámos os níveis de concordância e confiança para com estas respostas. Os resultados demonstraram maior concordância com respostas heurísticas mesmo quando contrastadas com regras normativas, apesar da tendência para lhes atribuir menor confiança nesta condição. Tal sugere que uma das maneiras pelas quais as pessoas poderão resolver este conflicto é sustentando as suas respostas nestes atalhos cognitivos, evidenciando processamento heurístico explicito apesar de conhecimento normativo. Implicações para as teorias de duplo processamento são discutidas.

Palavras-Chave: Heurísticas; Julgamento e Decisão; Conflicto; Duplo Processamento

Abstract

After half a century of research on reasoning and decision-making, it is well established that human thinking is often biased by heuristic judgments (e.g., Kahneman & Frederick, 2005). According to the lax monitoring perspective (e.g., Kahneman & Frederick, 2002), people fail to detect the conflict between intuitive and normative considerations, not noticing that their intuition is biased. Contrasting theories (e.g., Epstein, 1994; Sloman, 1996), assume that heuristic and analytic routes are simultaneously activated, through a parallel activation, and people experience this conflict. Available evidence suggests that people detect, at least implicitly, this conflict despite the widespread bias (see De Neys, 2012). Empirical evidence suggesting that heuristic preference may ultimately reach an explicit level (Denes-Raj & Epstein, 1994; De Neys & Glumicic, 2008), supported our hypothesis that when two modes of thinking are put into conflict, although aware of the normative rule, people respond in accordance with intuitive judgments. We directed our approach to scenarios where conflict between heuristic and normative responses was consciously perceived by participants and analyzed agreement and reliability levels towards these responses. Results showed greater agreement towards heuristic answers even when explicitly contrasted with normative rules, despite the tendency to accredit them lower reliability in this condition. These data suggest that one of the ways through which people might be resolving conflict is by sustaining their answers on these cognitive shortcuts, evidencing an explicit heuristic processing despite normative knowledge. Implications for Dual-Process theories are discussed.

Key-Words: Heuristics; Judgment and Decision; Conflict; Dual-Process

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Introduction

"Conclusions arrived at through reasoning have very little or no influence in altering the course of our lives."

Carlos Casteneda (1984)

Knowing that most of the common decisions we make are based on uncertain information, a simple but key question is: "What is the role of intuition in your daily life?" In a recent interview, when asked about the role of intuition in his job, Tim Cook, the new Apple CEO, referred to its critical role, suggesting an idea already advanced by Herbert Simon (1955), by stating that "You can do a lot of analysis. You can do lots of things that are quantitative in nature. But at the end of it, the things that are most important are always gut calls" (Businessweek, 2012). This position seems to suggest that in presence of information supporting a rational, analytic reasoning, people may "choose" to anchor their judgments and decisions on their intuitions.

This paper focuses on judgments that rely on simple rules of thumb, heuristics, in conditions that favor the computation of more deliberative, rational responses. In order to show that to be possible, we review the literature about decision and judgment and develop an empirical study that directly focuses this hypothesis. We hope to provide some clues for the answer to the question: "Do people consciously choose to rely on their intuitive feelings even when knowing that they contradict reasoning rational principles?"

Reasoning and judgments processes

After half a century of research on reasoning and decision-making, it is well established that human thinking is often biased by these intuitive judgments (for a review see Kahneman & Frederick, 2005). In fact, since psychological research on reasoning and decision-making thrived in the late 1950s, the economic view that human inference follows from normative models, such as probability and statistics (Peterson & Beach, 1967), has faded. This view was gradually replaced by the psychological perspective that in a great range of reasoning and decision-making tasks, most decisions are imperfect and deviate from logic or probability theory (Evans & Over, 1996; Kahneman, Slovic, & Tversky, 1982).

To that, much contributed the research program conducted by Tversky and Kahneman (1974) known as the heuristics and biases approach. This program began with the study of statistical intuitions in experts (Tversky & Kahneman, 1971). Through a series of questions

about the robustness of statistical estimates and the replicability of research results, Tversky and Kahneman (1971) found that these experts did not employ statistical principles with which they were fully familiar. Specifically, these experts showed an excessively confidence in the replicability from small samples, evidencing a notable lack of sensitivity to the effects of sample size.

The general hypothesis that guided the early research on judgment heuristics was that when confronted with a difficult question, people may answer an easier one instead, and are often unaware of this substitution (Kahneman & Frederick, 2002, 2005). Consider the example given by Kahneman & Frederick (2005, p.269): "A professor who has heard a candidate's job talk and now considers the question *«How likely is it that this candidate could be tenured in our department?»* may answer the much easier question: *«How impressive was the talk?»".* This is an example of one form of the representativeness heuristic. According to this heuristic, some probability judgments (e.g., the probability that object A belongs to class B) are evaluated ("substituted") by the degree to which A is representative of B, that is, the degree to which A resembles B (Tversky & Kahneman, 1974). In order to explain the results obtained in the experts study, Tversky and Kahneman (1971) conjectured that people expect the statistics of a sample to resemble ("represent") the corresponding population parameters, even when the sample is small (Kahneman & Frederick, 2002).

We can infer that a judgment is mediated by a heuristic when a person assesses a judgmental object (the target attribute) by substituting another property of that object (the heuristic attribute), which comes more readily to mind, i.e, which is more accessible (Kahneman & Frederick, 2002). Many probability judgments are based on this process of attribute substitution. Attributes such as similarity (e.g., Tversky & Kahneman, 1983), cognitive fluency (e.g., Jacoby & Dallas, 1991; Schwarz & Vaughn, 2002; Tversky & Kahneman, 1973), causal propensity (Heider, 1944; Kahneman & Varey, 1990; Michotte, 1963), surprisingness (Kahneman & Miller, 1986), mood (Schwarz & Clore, 1983), and affective valence (e.g., Bargh, 1997; Cacioppo, Priester, & Berntson, 1993; Kahneman, Ritov, & Schkade, 1999; Slovic et al., 2002; Zajonc, 1980, 1997), are routinely evaluated as part of perception and comprehension, and are therefore permanent candidates for attribute substitution, due to their high accessibility (Tversky & Kahneman, 1983).

The systematicity of this attribute substitution implies that intuitive judgments may be driven by processes other than the slower and more deliberate computations we learn to perform (Kahneman & Frederick, 2005). As so, the heuristics and biases program was, since early, guided by the view that these intuitive judgments occupy a position between the

automatic, fast operations of perception, and the controlled, serial operations of reasoning (Kahneman, 2003; Kahneman & Frederick, 2002, 2006). Presently, the distinction between intuition and reasoning is widely accepted under the general label of dual-process theories (Kahneman & Frederick, 2006).

Regardless the "many flavors" (Kahneman & Frederick, 2005, p.267) of dual process theories (e.g., Chaiken & Trope, 1999; Epstein, 1994; Hammond, 2000; Jacoby, 1991, 1996; Sloman, 1996, 2002), they all relate to the operation of two systems, labeled by Stanovich and West (2000) as System 1 and System 2, that contribute to an answer. Whereas System 1 quickly proposes intuitive and automatic answers to judgment problems, System 2, an effortful and rule-governed cognitive system, monitors the quality of these proposals (Stanovich & West, 2000), and may approve, correct, or override them (Kahneman & Frederick, 2002, 2005).

Conflict contexts: how to react to them?

Despite the agreement about the nature of responses furnished by different systems, there are different views on how conflict between these two systems are processed and resolved, and how these systems operate sequentially (e.g., Kahneman & Frederick, 2002) or in parallel (e.g., Sloman, 1996).

According to Kahneman and Frederick (2002), the widespread heuristic bias can be attributed to a failure in the monitoring of intuition, i.e., the lightness with which System 2 monitors the outputs of System 1. As they state, "people are not accustomed to thinking hard, and are often content to trust a plausible judgment that quickly comes to mind." (Kahneman and Frederick, 2002, p.58). According to this lax monitoring perspective, people fail to detect the conflict between their intuitive and normative considerations, therefore not noticing that their intuition is biased, or wrong. As so, when people make these intuitive judgments, they "normally know little about how their judgments come about and know even less about its logical entailments" (Kahneman & Frederic, 2006, p.274). As a consequence, when people become aware of this bias, they correct their judgments and may even overcorrect (Kahneman, 2003).

Contrastingly, the work of Epstein (1994) and Sloman (1996) provides a different view on conflict monitoring. For instance, they assume that a heuristic and analytic routes are simultaneously activated, through a parallel activation (e.g., Epstein, 1994; Sloman, 1996), and people do experience this conflict between their intuitive responses and normative considerations. This way, people "simultaneously believe two contradictory responses"

(Sloman, 1996, p.11), but despite noticing this conflict they not always manage to override their intuitive beliefs, and therefore "behave against their better judgment" (Denes-Raj & Epstein, 1994, p.1). This way, rather than resulting from a monitoring failure, this view assumes that biased judgments are attributed to an inhibition failure (De Neys, Vartanian, & Goel, 2008).

Available evidence suggests that people do detect, at least implicitly, this conflict despite the widespread bias and logical errors (see De Neys, 2012 for a review). Evidence to this assumption, is supported by gaze and eye-tracking studies (Ball, Philips, Wade, & Quayle, 2006), neuroimaging studies (De Neys, Vartanian, & Goel, 2008), longer response latencies, surprise recall (De Neys & Glumicic, 2008), subjective certainty (De Neys, Cromheeke, & Osman, 2011), and memory probing (De Neys & Franssens, 2009). Also, through the resolution of traditional base-rate problems, De Neys and Glumicic (2008) showed that participants tend to review the paragraph with the base-rate information, after they have read the personality description, more often when compared to congruent versions, in which both base-rate information and personality descriptions cue the same answer. Based on this data, De Neys (2012) proposes that despite people's errors, there is an implicit knowledge of the logical and probabilistic principles evoked in classic reasoning tasks, and a consequent automatic activation of this knowledge, which contrasts with the biased tendency to respond.

The assumption of a simultaneous activation of an intuitive response and normative principles when faced with a reasoning problem, turns interesting on contexts where individuals still choose their intuitive responses. This may happen because they lack motivation or resources to use normative principles, or they may actually be considering their intuitive judgments to be the ones they can trust the most. In this last case, they are not actually "behaving against their better judgments", but instead, following the ones they feel are their better judgments.

Although no empirical work have directly focused this issue, we believe that a response to this question may already be found in the literature. That is, we believe that there is already some empirical evidence that suggests that the implicit preference (heuristic use) may ultimately reach an explicit level being accepted as the "better response". Through introspective self-reports in a ratio-bias task, Denes-Raj and Epstein (1994) have shown that when offered a chance to win money by drawing a red jelly bean from one of two bowls, participants frequently chose to draw from a bowl that contained a greater absolute number, but smaller proportion, of red beans (e.g., 7 in 100) than from a bowl with fewer red beans but

better odds (e.g., 1 in 10). What's interesting, for our goals, about this study is the great number of participants who chose the bowl with worse odds, despite showing an explicit knowledge of the probabilities corresponding to each bowl. Participants commonly commented that although they *knew* the probabilities were against them, they *felt* they had a better chance of winning when there were more red beans (Denes-Raj & Epstein, 1994).

Other evidence that shows an explicit preference for a judgment based on a heuristic, despite the normative knowledge, comes from a study conducted by De Neys and Glumicic (2008). In this study, participants solved classic base-rate neglect problems while thinking aloud. Verbal protocols indicated that, when the base-rates were explicitly and spontaneously verbalized, there were still 15% of times when participants preferred the heuristic, intuitive judgment, instead of an accurate answer. These results are similar to those obtained by Kahneman and Tversky (1973), which documented almost complete neglect of the base-rates even when these were explicitly stated in the response options. The difference, however, is that in De Neys and Glumicic (2008) study, some participants show explicit statistical inferences about the base-rates, and still prefer the heuristic response: "According to the statistics there is a greater chance he is a lawyer but because of the things he does (…) it makes more sense that he is an engineer so...I don't know I will go with that." (De Neys & Glumic, 2008, p.1258).

This explicit conflict and lack of normative resolution has also been reported in the well known Stephen Jay Gould (1991) anecdote, in which he states that, "I know that the [conjunction] is least probable, yet a little homunculus in my head continues to jump up and down, shouting at me – 'but she can't just be a bank teller; read the description'" (Gould, 1991, p.469).

In our view it is clear that both two experiments described (Denes-Raj & Epstein, 1994; De Neys & Glumicic, 2008) suggest that heuristics may be used explicitly and as a kind of "conscious arguments" used to convince, if not others, the self "against" the normative rules, if people feel them as the best response. So, there is already evidence supporting the hypothesis that when two modes of thinking will be put into conflict, most people, although fully aware of the normative rule, will elect to respond in accordance with their intuitive judgment. Just as Tim Cook puts it when referring to his job, you can actually do a lot of analysis and quantitative estimates, but at the end, the most important calls will always be intuitive (Businessweek, 2012). Evans (2009) has pointed the possibility that type 2 processes can too be heuristic, i.e., that a heuristic could also refer to a consciously learnt and applied

rule, based on the intuitive aspects of chess that he considers are actually rational, in the sense that actions can be justified.

Intuitive responses on contexts of full awareness of violation of normative principles

Approaches that frame system 1 and system 2 as being simultaneous activated ((e.g., Epstein, 1994; Sloman, 1996), offer us the proper context to assume that people give intuitive responses on contexts of full awareness of violation of normative principles. Aiming to directly test this hypothesis, we should, however, not disregard the fact that these approaches concur with other with alternative views.

The lax monitoring view (Kahneman & Frederick, 2002; Kahneman, 2003), would suggest us that people will not consciously choose to use their intuitions when in presence of a conflict context. This approach assumes that people will make intuitive decisions only and because they fail to detect the conflict between their intuitive and normative considerations, not noticing that their intuition is biased or wrong. Therefore, according to a pure lax monitoring hypothesis, when people become aware of the normative rule, they will correct their judgments and respond accordingly, overriding their intuitive judgments (Kahneman, 2003). The assumption that they would not do that, and would still rely on their intuitions would imply the theorization of a new assumption, a new mechanism, to be added to the general hypothesis, which would assume the continued use of their intuitions.

A hypothesis that could be considered when the two modes of thinking are put into conflict, is that people will not simply continue to use their initial activated response but trust it even more. This could happen because normative information would act as counterarguments regarding the intuitive response. Tormala and Petty (2004) for example, have found that when people resist persuasion, they can perceive this resistance and become more certain of their initial attitudes. Because people have to take those normative principles into account, and overcome them in order to make an intuitive decision, they will be more confident in it. That is, this conflict could have a paradoxical effect by reinforce the "disconfirmation" of the normative considerations, based on the intuitive judgments.

So, in order to test these hypotheses, in this study we will direct our approach to scenarios where the conflict between both responses, heuristic and normative, is clear and consciously perceived by participants. This way, we will be able to test if one of the ways through which people solve this conflict is by sustaining their responses on the shortcut, showing evidence of explicit heuristic processing, despite normative knowledge.

Method

Overview

Experimental testing of the hypothesis that people may rely on heuristic based judgments, even when made conscious of normative principles that could support their response, is anchored in four different problems known to be able to dissociate heuristic from rational judgments and decisions. The first three tasks presented bellow have been considered the "fruit flies" (De Neys, 2012, p.28) of the reasoning and decision-making field. Since the development of this field, literally hundreds of studies have used these tasks, being the basis for most of the theorizing in the field (Bonnefon, 2011). The Ratio-Bias task was also employed in order to replicate Denes-Raj and Epstein's (1994) results through our paradigm.

Base-Rate problems:

These problems were originally developed by Kahneman and Tversky's (1973) and have supported the idea that people tend to neglect base rates in their responses. In these problems, people first get information about the composition of a sample (e.g., a sample with 995 lawyers and 5 engineers). People are then presented a short personality description of a randomly picked person associated with the smaller population tested on the basis of common stereotypes (e.g., engineers). After the presentation of this description, people are asked to indicate from which of both samples the person picked is more likely to belong to. This way, if people respond on the base of the group size information, they'll be giving a normative answer. On the other hand, if people respond on the basis of the representativeness heuristic beliefs cued by the description, they should support their response on the stereotype. In all problems used, the stereotype description and the base rates conflicted.

Conjunction Problems:

These problems gave support to studies that identified the conjunction-fallacy (e.g., the "Linda-Problem", see Tversky and Kahneman, 1983). Again they are evidence of the representativeness heuristic, because the mach of a description to a category imposes itself to the subjects in the way that they violated the logical principle of conjunction being smaller than a single category.

Syllogism Problems:

These problems supported the research tradition within cognitive psychology demonstrating how prior belief biases the evaluation of arguments and of data (Baron, 1995;

Evans, Over, & Manktelow, 1993; George, 1995; Klaczynski, Gordon, & Fauth, 1997; Klaczynski & Narasimham, 1998; Moshman & Franks, 1986). Syllogism tasks are the classic paradigm for demonstrating this phenomenon (e.g., Evans, Barston, & Pollard, 1983; Markovits & Nantel, 1989). In this paradigm, the bias occurs when there is an intuitive tendency to judge the validity of a syllogism through its conclusion believability (Oakhill, Johnson-Laird, & Garnham, 1989). This tendency often produces a non-normative answer because the believability of the conclusion conflicts with the logic of the syllogism.

Ratio Bias Problems:

The ratio bias phenomenon occurs whenever people prefer to bet on odds expressed as a ratio of large numbers, compared to betting on equivalent or superior odds expressed as a ratio of small numbers. A typical ratio bias experimental paradigm is a game of chance in which participants are asked to indicate from which of two trays containing red and white jellybeans (e.g., one containing 1 red out of 10 jellybeans, and the other containing 10 red out of 100 jellybeans) they prefer to draw in order to obtain a red jellybean. Denes-Raj and Epstein (1994) showed that people frequently preferred to draw a red jelly bean from a bowl containing a greater absolute number but smaller proportion of red beans (e.g., 8 in 100) than from a bowl containing fewer red beans but better odds (e.g., 1 in 10).

Participants

91 undergraduate students (70 woman and 21 men) aged between 18 and 56 years (M=22.86 , SD=7.08) (Output 1) participated in this study, in return for credit in a psychology course at the Higher Institute for Applied Psychology (ISPA-IU) in Lisbon, Portugal.

Design

In order to test the proposed hypothesis, this study employed a 2 (*Response*: Heuristic vs. Normative) x 2 (*Conflict*: conflict vs. no conflict) x 4 (*Reasoning Task*: Base-Rate vs. Conjunction vs. Syllogisms vs. Ratio-Bias) design, with *Conflict* as a between-subjects factor.

Material

For each of the four types of heuristics identified in the literature (Base-Rate vs. Conjunction vs. Syllogisms vs. Ratio-Bias) we developed 4 problems, to which a response was furnished. To each response, we constructed a justification that called attention to the cue that supports the heuristic response (e.g., for a base rate problem, the presentation of

stereotype characteristics: *"Jack is an engineer, because he likes reading science fiction and writing computer programs"*) or the cue that supports the normative response (e.g. "*Jack is a lawyer, because there are more lawyers"*).

In *conflicting* material, justifications focused both cues presented in the heuristic and normative justifications, *conflicting* in the same explanation (*conflict* condition). This aimed to make both heuristic and normative information explicitly and simultaneously made available. All 16 problems (see Annex B for all reasoning tasks descriptions), were presented on a computer monitor using E-Prime v1.2.

Base-Rate problems:

The 4 base-rate problems used were adapted from De Neys and Glumicic (2008). The four problems were conflict problems (description and base rates conduce to different responses) that were translated and adapted in order to excluding items composed by concepts not suitable to the Portuguese population (e.g., *"Kurt works on Wall Street"*).

These problems are based on a broad range of stereotypes, including age, gender and job related groups and stereotypical features. An example is:

> In a study 1000 people were tested. Among the participants there were 6 engineers and 994 lawyers. Jack is a randomly chosen participant of this study.
>
> Jack is 36 years old. He is not married and is somewhat introverted. He likes to spend his free time reading science fiction and writing computer programs.
>
> What is most likely?
>
> a. Jack is an engineer
>
> b. Jack is a lawyer

The problems presented slightly varied base-rates, specifically, with a 997/3, 996/4, 995/5 and a 994/6 base-rate ratios. These extreme base-rate ratios were used in order to maintain consistency with De Neys and Glumicic (2008) study. The stereotype descriptions used on the base-rate problems justifications were selected on the basis of a content analysis of the verbal protocols resulting from the De Neys and Glumicic (2008) study. From this analysis, two stereotypical cues were identified as prevalent for each base-rate problem. This analysis is presented in Annexes (Annex G). In this task, as for the other three, the order of the two response options was counterbalanced.

Conjunction Problems:

The conjunction problems used in this study were adapted from De Neys *et al.* (2011) adaptation of the "Linda-Problem" developed by Tversky and Kahneman, 1983. In this task people read a short personality description, for example, *"Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in antinuclear demonstrations."* (Tversky & Kahneman, 1983, p.297). After, participants are asked to rank statements according to their probability, for example, "(A) Linda is a bank teller", and "(B) Linda is a bank teller and is active in the feminist movement".

Syllogisms:

The syllogism problems used in this study were adapted from De Neys *et al.'s* (2010) use of Sá, West and Stanovich (1999) studies. The problems here used correspond to the conflict versions of De Neys *et al.* (2010), hence, the syllogistic problems presented conclusions in which logic conflicted with believability. Two of these problems had an unbelievable, but valid conclusion, and the other two, a believable, but invalid conclusion. Each problem consisted of a major premise, minor premise, and a conclusion. Bellow follows an example of this type of task:

Invalid/Believable conclusion

Major premise: All flowers need light
Minor premise: Roses need light
Conclusion: Roses are flowers
Does conclusion follows logically?

a. Yes
b. No

Ratio-Bias Problems:

The ratio-bias problems used in this study were based on the Denes-Raj and Epstein (1994) paradigm. In their study, people chose from which of two bowls they wanted to draw a bean. People would win $1 for every red jelly bean drawn from a bowl that contained a greater absolute number, but smaller proportion of red beans (e.g., 8 in 100) or a bowl with fewer red beans but better chances of picking (1 in 10). This last bowl always contained 1 red and 9 white jelly beans.

In the present study, participants were told that a person, Mary, went to a TV show and that she would have to chose between several sets of options in order to win money in 4 games. In each game, Mary's choice was presented, as for the reasons of her choice. Bellow follows an example of this type of task:

> In this game, Mary will have to choose between two urns containing several balls. In urn A, there are 100 balls, 8 of which are red. In urn B, there are 10 balls, one of which is red. Mary will win 1.000€ if she draws a red ball from one of the two urns.
>
> Mary chose to:
>
> a. Draw a random ball from urn A
> b. Draw a random ball from urn B

As in the Denes-Raj and Epstein (1994) study, all the sets in this task were arranged in pairs consisting of a higher probability but lower number of awarded items (e.g., balls) (always containing 10 items, one of which awarded), and a lower probability but higher number of awarded items set. These last sets always contained 100 items, and anywhere between 5 to 9 of them, depending on the problem, were awarded.

Procedure

Upon arrival at the Psychology Laboratory, each participant was escorted to a computer. Instructions given to participants explained that they would be participating in a study in which they would be asked to indicate their agreement towards a set of answers that other people had given to a list of problems in previous studies. First, participants were presented with the reasoning tasks described. After reading them, participants were told that in the subsequently screen it would appear an answer given to that problem. Participants were asked to indicate, as fast as they could, whether they agreed or not with each answer, by pressing a green (S) or a red (L) keyboard key for agreement and disagreement, respectively. Right after indicating their dis/agreement, participants indicated how reliable they considered the justifications given to each answer. Next, participants completed a checking measure of response time towards the two different keys[1].

After indicating their agreement towards the response presented, participants were then asked to indicate through a 6-point rating-scale, anchored at 1 (not all reliable) and 6

[1] This checking measure did not reveal significant differences in response time between the two keyboard keys, $t(1,48)=1.31$, $p=.198$ (see Output 2).

(very reliable), the level of reliability of the justification. These measures were used for all reasoning tasks, and constitute the dependent variables in study, together with latency times.

Next, participants completed the Need for Cognition and Faith in Intuition Scales, in counterbalanced order[2]. Finally, participants completed the Bias Blind Spot Questionnaire and waited in their places, until everyone in their session had finished. The data from this study were collected over 6 experimental sessions.

Control Measures:

Participants completed the Need for Cognition and Faith in Intuition Scales, which are both subscales of the *Rational-Experiential Inventory* (REI) (Epstein *et al.,* 1996), based on the Cognitive-Experiential Self-Theory (CEST) (Epstein, 1973, 1990, 1994), and the Bias Blind Spot Questionnaire (West, Meserve, & Stanovich, 2012).

Need for Cognition:

We computed the mean of responses given in 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) to the 18-item Need for Cognition Scale (Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984), adapted to the Portuguese population by Silva and Garcia-Marques (2006) (Annex C).

Faith in Intuition:

We computed the mean of responses given on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) to the agreement to the 5-item Faith in Intuition Scale (Epstein, Pacini, Denes-Raj, & Heier, 1996), adapted to the Portuguese population by Silva and Garcia-Marques (2006) (Annex D).

Bias Blind Spot Questionnaire:

West, Meserve and Stanovich (2012) developed a bias blind-spot measure in which seven specific cognitive biases (outcome bias, base-rate neglect, framing bias, conjunction fallacy, anchoring bias, myside bias, and a brief statement concerning the danger of cell phone use while driving) are described to participants (see Annex E for all bias blind spot descriptions).

[2] No effects of order were found (see Output 3).

Participants responded to the likelihood questions on a 6-point scale anchored at 1 (not at all likely) and 6 (very highly likely). A composite measure of the bias blind spot was computed by summing the differences between the ratings for the average person and the self for each item. Higher scores on this variable represent higher bias blind spots, that is, a greater tendency to see other as more biased than the self.

The order of the likelihood questions was counterbalanced, so that half the participants rated themselves first, and the other half rated themselves second[3].

Experimental conditions:

As mentioned, all participants rated all 16 reasoning tasks, across the 4 different types of problems. Participants were presented with only one of two types of responses (Heuristic vs. Normative) for each type of problem (e.g., for the Base-Rate items, participants either saw only Heuristic or Normative answers). Half the participants were assigned to a Conflict condition and the other half was assigned to a No-Conflict condition. In order to do so, participants were assigned to one of eight different experimental conditions. For ease of consultation, the Table 1, bellow, presents the 8 different group trials[4]:

Table 1

Description of the 8 group trials created in order to assure all experimental conditions

	No-Conflict			
	Heuristic (H)	**Normative (N)**	**Heuristic (H)**	**Normative (N)**
Group 1	(1st) Base-Rates	(2nd) Conjunctions	(3rd) Ratio-Bias	(4th) Syllogisms
Group 2	(1st) Conjunctions	(2nd) Ratio-Bias	(3rd) Syllogisms	(4th) Base-Rates
Group 3	(1st) Ratio-Bias	(2nd) Syllogisms	(3rd) Base-Rates	(4th) Conjunctions
Group 4	(1st) Syllogisms	(2nd) Base-Rates	(3rd) Conjunctions	(4th) Ratio-Bias
	Conflict			
	H|N	**N|H**	**H|N**	**N|H**
Group 5	(1st) Base-Rates	(2nd) Conjunctions	(3rd) Ratio-Bias	(4th) Syllogisms
Group 6	(1st) Conjunctions	(2nd) Ratio-Bias	(3rd) Syllogisms	(4th) Base-Rates
Group 7	(1st) Ratio-Bias	(2nd) Syllogisms	(3rd) Base-Rates	(4th) Conjunctions
Group 8	(1st) Syllogisms	(2nd) Base-Rates	(3rd) Conjunctions	(4th) Ratio-Bias

[3] The order of self↔other ratings had no significant influence on the ratings. The composite of the seven bias blind spot items resulted in $t(87)=-1.14$, $p=.258$ (see Output 4) for the order comparison.

[4] A multiple regression analysis, controlling for all independent variables, showed no significant effect of the order by which participants rated the different types of reasoning problems on agreement and reliability (see Output 5).

Results

Preliminary analysis of Dependent Variables

We first analyze the variables distribution features and perform transformation to guarantee that they meet the analysis assumptions (see Table 2 and Outputs 6-37).

Table 2

Variables distribution features and performed transformations

	Normality (Shapiro-Wilk test)	**Homogeneity** (Levene's tests)	**Transformation performed**
Agreement:	Assumption not met (see Outputs 6-9).	Assumption met (see Outputs 10-13)	Rank transformation (e.g., Conover & Iman, 1976; Iman; 1974; Iman & Conover, 1976)[5]
Reliability:	Assumption met only for Base-Rates (see Outputs 14-17)	Assumption met (see Outputs 18-21)	Rank transformation (e.g., Conover & Iman, 1976; Iman; 1974; Iman & Conover, 1976)[5]
Agreement Latency Time:	Assumption not met (see Outputs 22-25)	Assumption met for all tasks except Syllogisms (see Outputs 26-29)	Logarithmic transformation (e.g., Fazio, 1990; Newell & Rosenbloom, 1981)[6]
Reliability Latency Time:	Assumption not met (see Outputs 30-33)	Assumption met only for Base-Rates and Syllogisms (see Outputs 34-37)	Logarithmic transformation (e.g., Fazio, 1990; Newell & Rosenbloom, 1981)[6]

All log-transformed data from agreement and reliability latency times met the normality assumption (Output 38-45).

[5] Given the distribution features of our dependent variables, both Agreement and Reliability variables were rank-transformed before entered in an Analysis of Variance on Ranks, in order to test our hypothesis. The ANOVA on ranks is a statistical analysis designed for situations when the normality assumption is violated, using rank-transformed data (e.g., Conover & Iman, 1976; Iman; 1974; Iman & Conover, 1976). The ANOVA on ranks is not recommended when the assumption of homogeneity of variance is violated, which was not the case for agreement and reliability variables.

[6] Regarding agreement and reliability judgments latency times, a logarithmic transformation was performed on these variables to normalize the distributions (see Fazio, 1990). Logarithmic transformations are commonly used to normalize reaction-time data (e.g., Newell & Rosenbloom, 1981).

Hypotheses were tested across all type of problems and regarding each reasoning task, individually. In order to test our hypothesis across all problems we created composite measures of heuristic and normative agreement by averaging the responses across those tasks. Composite measures of agreement reliability and reaction times were also created. The normality and homogeneity assumptions were met for these variables (see Output 45-46).

Agreement with Heuristic vs. Normative answers

Composite analysis. This measure was enter in a 2 (Heuristic vs. Normative) x 2 (Conflict vs. No-conflict) repeated measures ANOVA. Results (see Output 47) showed that participants agreed significantly more with heuristic compared to normative answers, regarding the agreement composites, $F(1,87)=28.54$, $p<.001$, $\eta^2_p=.247$. Relevant to our hypotheses, this higher agreement was not moderated by the presentation of conflicting information, $F(1,87)=.90$, $p=.346$, $\eta^2_p=.010$. This supports the hypothesis that when the two modes of thinking are put into conflict, people still trust a response that is in accordance with their intuitive judgments. In fact, as we can observe in the graphic from Figure 1, there is an increasing tendency of the general agreement when conflicting information is presented, $F(1,87)=5.63$, $p=.020$, $\eta^2_p=.061$.

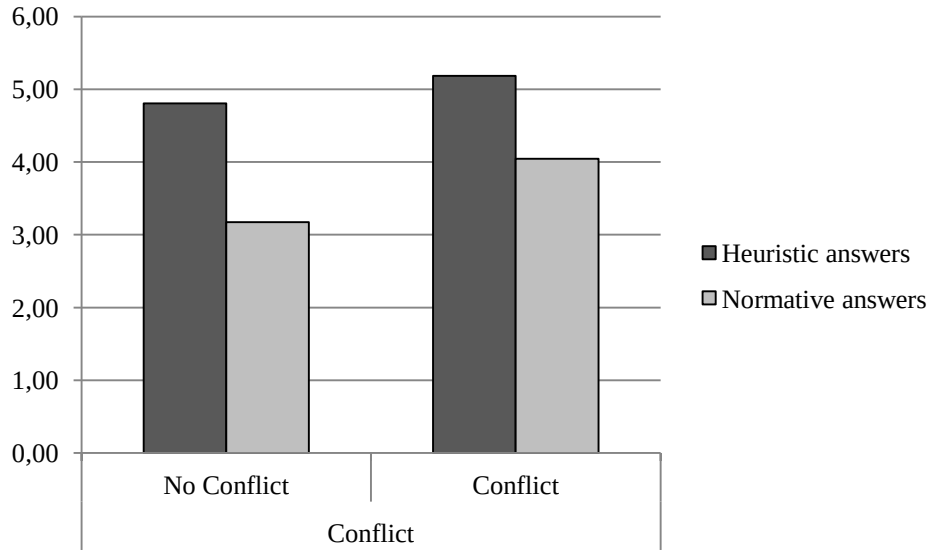


Figure 1 – Agreement Composite (ANOVA Response x Conflict)

Analysis by problem (see Outputs 48-51 and Table 3). The higher agreement towards heuristic answers was prevalent across three sets of problems: Base-Rates, $F(1,85)=115.27$, $p<.001$, $\eta^2_p=.576$, Conjunctions, $F(1,85)=23.23$, $p<.001$, $\eta^2_p=.215$ and Syllogisms, $F(1,85)=6.00$, $p=.016$, $\eta^2_p=.066$. The exception was the Ratio-Bias set, where participants agreed significantly more with normative answers, $F(1,85)=24.39$, $p<.001$, $\eta^2_p=.223$.

As observed across all problems, the agreement towards heuristic answers was not moderated by the presentation of conflicting information, across Base-Rates, $F(1,85)=.66$, $p=.419$, $\eta^2_p=.008$, Conjunctions, $F(1,85)=.66$, $p=.417$, $\eta^2_p=.008$, Syllogisms, $F(1,85)=1.58$, $p=.212$, $\eta^2_p=.018$ and Ratio-Bias tasks, $F(1,85)=.21$, $p=.649$, $\eta^2_p=.002$. So, even when presented with normative counter posed information, participants indicated the same agreement towards heuristic answers, thus supporting the hypothesis that even through explicit conflict, people still prefer a heuristic judgment.

The hypothesized main effect of the conflict variable that proposed an increasing tendency to agree with an answer when conflicting information is presented, was only observed regarding the Syllogism tasks, $F(1,85)=5.65$, $p=.019$, $\eta^2_p=.062$. For Base-Rates, $F(1,85)=.646$, $p=.424$, $\eta^2_p=.008$ (Output 48), Conjunctions, $F(1,85)=.10$, $p=.752$, $\eta^2_p=.001$, and Ratio-Bias, $F(1,85)=1.91$, $p=.171$, $\eta^2_p=.022$, this main effect was non-significant.

Table 3

Descriptive statistics of the Agreement variable (Ranked) across Conflict and Response variables, for all tasks

Task	Conflict	Response	
		Heuristic	**Normative**
Base-Rate	**No conflict**	M = 63,21 SD = 15,31 N = 24	M = 22,77 SD = 17,10 N = 22
	Conflict	M = 63,18 SD = 15,63 N = 22	M = 28,43 SD = 17,98 N = 21
Conjunction	**No conflict**	M = 58,20 SD = 23,38 N = 22	M = 31,15 SD = 24,32 N = 24
	Conflict	M = 55,81 SD = 22,41 N = 21	M = 36,59 SD = 19,97 N = 22
Syllogism	**No conflict**	M = 48,80 SD = 24,09 N = 22	M = 30,13 SD = 24,36 N = 24
	Conflict	M = 54,43 SD = 19,96 N = 21	M = 48,43 SD = 25,84 N = 22

Ratio-Bias	**No conflict**	M = 29,54 SD = 24,32 N = 24	M = 54,98 SD = 20,52 N = 22
	Conflict	M = 38,20 SD = 22,77 N = 22	M = 59,33 SD = 20,74 N = 21

Analysis of Ratio-bias specificity. We analyze more in detail the particular case of Ratio-Bias tasks, since it was the only set of problems to which participants tend to agree more with normative answers.

Exploring this results we further analyze if they were moderated by the type of problem, defined by the ratio probabilities used. Figure 2 turns evident the main effect that suggests a higher agreement with the normative responses and that it is not moderated by the type of problem. Whereas conditions associated with normative responses did not promote a sensibility to the different percentages considered in the problems, those associated with heuristic answers were dependent of those probabilities. 9% and 7% proportions induced more agreement towards the heuristic response comparing to the other percentages, $t(1,85)=4.38$, $p<.001$ (Output 52). This effect was moderated by the level of conflict, $t(1,85)=4.26$, $p<.001$ (Output 53), suggesting that this sensibility to the proportions is clearer when conflict is promoted.

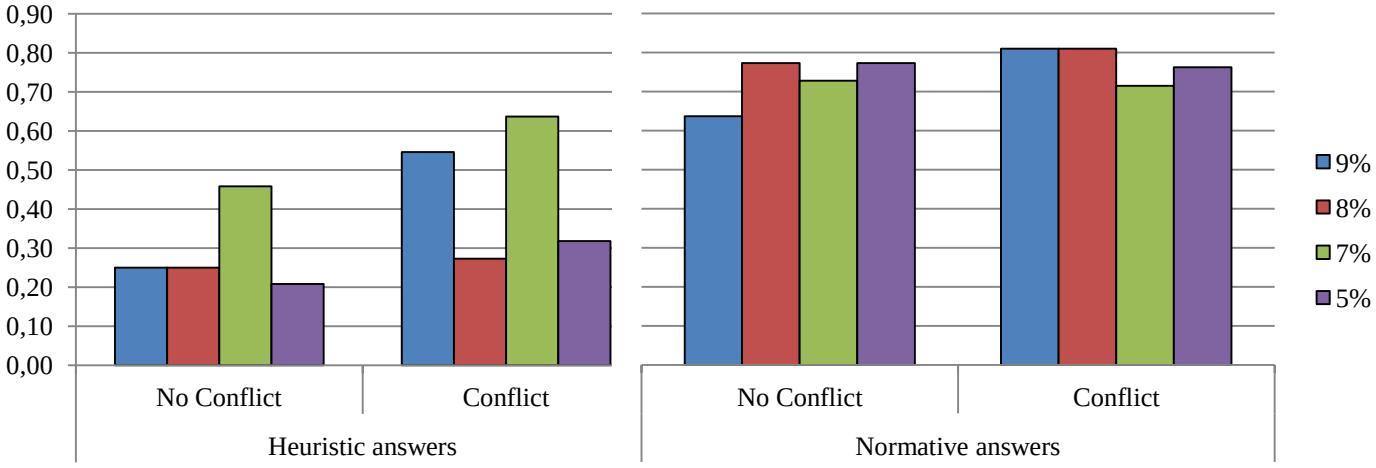


Figure 2 – Ratio-Bias Agreement by percentage (ANOVA Response x Conflict)

Thus, although participants agreed significantly more with normative answers, they increased their agreement with heuristic answers when confronted with the probabilities (normative information) as justification for disagreement, in some type of problems. This may justify why Denes-Raj and Epstein (1994) had different results from our global ones regarding this type of problems. In their study, participants were explicitly told the probabilities involved in the different choices (like in our conflict condition). When problems offered a 9% probability of winning, 61% and 54% of participants in their experiments 1 and 2, respectively, responded heuristically. In our 9% problems, 55% of participants agreed with the heuristic answer (Output 54). In their study, when the problems offered a probability of winning of 5%, 23% and 34% of participants chose heuristic responses. In our study, 32% of participants still agreed with the heuristic response (Output 55). Thus, although our focus of analysis and methodology calls attention to different aspects of the data, it is relevant to understand that data fits previous one.

Agreement latency times

Agreement latency times may inform us about the direct accessibility of the heuristic response (less time to agree with heuristic responses), and about the level of conflict experienced when the opposite cue is furnished.

Composite analysis (see Output 56). As expected, the general mean of these latencies for all problems suggest that participants took significantly longer to indicate their agreement towards normative answers, $F(1,87)=13.22$, $p<.001$, $\eta^2_p=.132$, and answers in conflicting conditions, when compared to no-conflict conditions, $F(1,87)=5.38$, $p=.023$, $\eta^2_p=.058$. The interaction effect obtained was only highly marginal, $F(1,87)=2.09$, $p=.152$, $\eta^2_p=.023$, and, as evidenced by the graphic from Figure 3, it suggests that participants may be taking significantly longer to indicate their agreement towards normative answers, but only in the no-conflict condition.

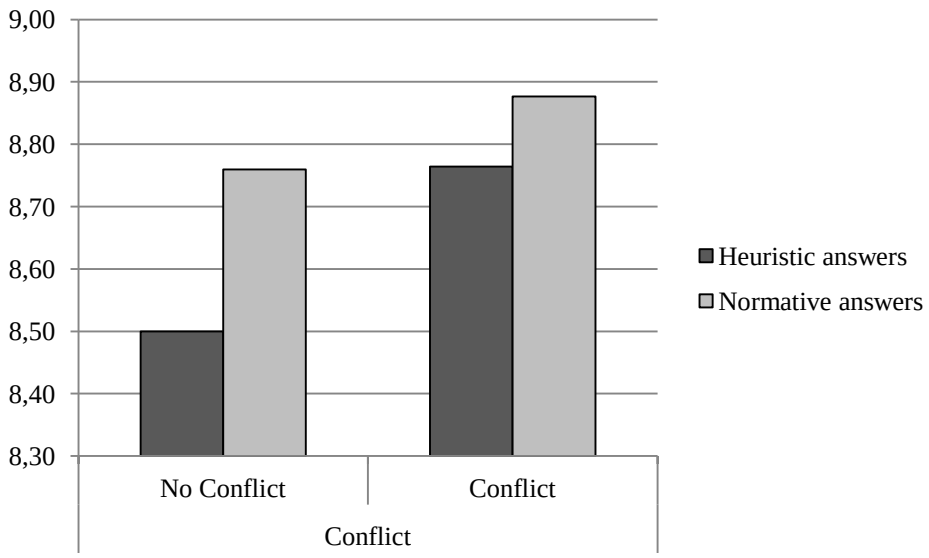


Figure 3 – Agreement Latency Times (log) (ANOVA Response x Conflict)

Analysis by problem (see Outputs 57-60). Results of composite latency times were replicated in the majority of the analysis made at the problem level. The main effect of the Response variable was significant in Conjunctions, $F(1,85)=24.57$, $p<.001$, $\eta^2_p=.224$, and Syllogisms, $F(1,85)=6.05$, $p=.016$, $\eta^2_p=.066$, but did not reach significance in Base-Rates, $F(1,85)=.50$, $p=.481$, $\eta^2_p=.006$, and Ratio-Bias, $F(1,85)=.09$, $p=.763$, $\eta^2_p=.001$. The main effect of conflict was clear in the Syllogism tasks, $F(1,85)=6.60$, $p=.012$, $\eta^2_p=.072$, only marginal in the Base-Rates and Ratio-Bias tasks ($F(1,85)=3.40$, $p=.069$, $\eta^2_p=.038$, and $F(1,85)=3.20$, $p=.077$, $\eta^2_p=.036$, respectively), and not significant in Conjunctions, $F(1,85)=.87$, $p=.353$, $\eta^2_p=.010$.

The type of problems that seem to induce the marginal interaction are the Syllogism tasks, $F(1,85)=7.88$, $p=.006$, $\eta^2_p=.085$. This interaction effect might be due to the exceptional size difference between the heuristic answers in the no-conflict condition, and the other three type of answers. No significant interaction effect was found regarding Base-Rates, $F(1,85)=.50$, $p=.482$, $\eta^2_p=.006$, Conjunctions, $F(1,85)=.22$, $p=.641$, $\eta^2_p=.003$, and Ratio-Bias tasks, $F(1,85)=.40$, $p=.527$, $\eta^2_p=.005$.

Perceived reliability of Heuristic vs. Normative responses

Perceived reliability of justifications variable will allow us to test if participants feel heuristic and normative justifications as having different value and if by adding a conflicting cue it increases equally their value.

Composite analysis (see Outputs 61-63). The analysis of the composite variable did not show evidence of any main effect either regarding the Response, $F(1,87)=1.56$, $p=.216$, $\eta^2_p=.018$, or Conflict factors, $F(1,87)=.41$, $p=.525$, $\eta^2_p=.005$. However, a significant interaction effect between these variables, $F(1,87)=6.85$, $p=.010$, $\eta^2_p=.073$, suggests that in no-conflict condition participants judge heuristic answers as more reliable, compared to normative ones and that in the conflict condition the reliability ratings of heuristic justifications decreased when added the normative cue and the reliability of normative answers increased when added the heuristic cue (see Figure 4). Contrasts analysis showed that the difference found in the no-conflict condition, between the heuristic and normative justifications, $t(1,87)=-2.78$, $p=.007$, disappear in the conflict condition, $t(1,87)=.95$, $p=.343$.

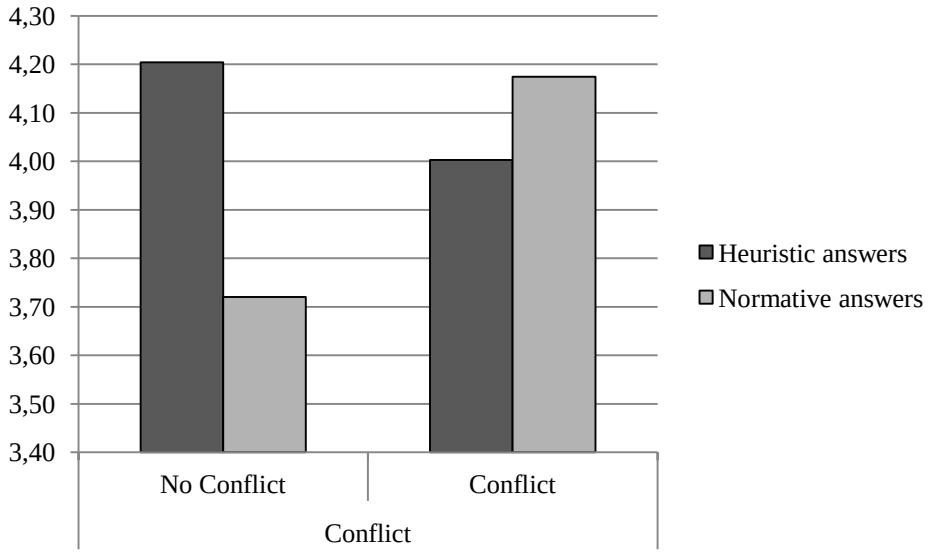


Figure 4 – Reliability Composite (ANOVA Response x Conflict)

Analysis by problem (see Outputs 64-69 and Table 4). Not all sets of heuristics promoted, in the same way, this general pattern of results. The absence of a main effect of the Response variable was only found regarding the Conjunctions, $F(1,85)=1.05$, $p=.308$, $\eta^2_p=.012$, and Syllogisms, $F(1,85)=2.67$, $p=.106$, $\eta^2_p=.030$. In Base-Rates, participants judged heuristic answers as more reliable, $F(1,85)=4.42$, $p=.038$, $\eta^2_p=.049$, whilst in Ratio-Bias tasks, participants judged normative answers as more reliable, $F(1,85)=7.02$, $p=.010$, $\eta^2_p=.076$, compared to heuristic ones.

The absence of the conflict main effect was verified to all sets of problems: Base-Rates, $F(1,85)=1.91$, $p=.171$, $\eta^2_p=.022$, Conjunctions, $F(1,85)=.00$, $p=.947$, $\eta^2_p=.000$,

Syllogisms, $F(1,85)=.18$, $p=.675$, $\eta^2_p=.002$, and Ratio-Bias tasks, $F(1,85)=.12$, $p=.731$, $\eta^2_p=.001$.

The interaction effect that emerged at the general level, only achieved significance in the Syllogism tasks, $F(1,85)=12.60$, $p=.001$, $\eta^2_p=.013$. The pattern of data replicates the previous described: the difference suggesting higher perceived reliability of heuristic cues compared to normative ones, $t(1,85)=-3.73$, $p<.001$, in the no-conflict condition, disappear in the conflict condition, $t(1,85)=1.33$, $p=.186$. This interaction effect did not reach significance in Base-Rates, $F(1,85)=.492$, $p=.485$, $\eta^2_p=.006$, Conjunctions, $F(1,85)=1.189$, $p=.279$, $\eta^2_p=.014$, and Ratio-Bias tasks, $F(1,85)=.01$, $p=.91$, $\eta^2_p=.000$.

Table 4

Descriptive statistics of the Reliability variable (Ranked) across Conflict and Response variables, for all tasks

Task	Conflict	Response	
		Heuristic	**Normative**
Base-Rate	**No conflict**	M = 48,73 SD = 22,65 N = 24	M = 33,70 SD = 26,86 N = 22
	Conflict	M = 52,36 SD = 23,42 N = 22	M = 44,86 SD = 27,99 N = 21
Conjunction	**No conflict**	M = 51,11 SD = 28,34 N = 22	M = 39,50 SD = 29,81 N = 24
	Conflict	M = 44,76 SD = 22,07 N = 21	M = 45,11 SD = 21,54 N = 22
Syllogism	**No conflict**	M = 59,52 SD = 22,78 N = 22	M = 33,04 SD = 27,77 N = 24
	Conflict	M = 39,24 SD = 21,15 N = 21	M = 49,02 SD = 23,56 N = 22
Ratio-Bias	**No conflict**	M = 37,60 SD = 28,53 N = 24	M = 51,09 SD = 25,78 N = 22
	Conflict	M = 38,82 SD = 20,93 N = 22	M = 53,55 SD = 24,09 N = 21

Regarding the analysis of the probabilities associated with each Ratio-Bias problem, as opposed to what we previously observed for agreement, this time, the different percentages

associated with the heuristic answers didn't promote any differences regarding the reliability ratings, as we can observe from the graphic from the Figure in Output 70.

Reliability latency times

Latencies of reliability responses are expected to inform us about the processing features of the conflict promoted by presenting the heuristic cue and the normative cue at the same time. Double justification increases conflict in the computation of reliability if participants are attending to their content and trying to solve it, and so to the hypothesis of solving counterarguments. Double justifications are quickly evaluated if the simultaneous presentation has generated higher agreement by furnishing a path that does not anchor in counterargument evaluation.

Composite analysis (see Output 71). The latency times across all problems did not show evidence of a main effect of the Response variable, $F(1,87)=.02$, $p=.890$, $\eta^2_p=.000$, but as expected, a main effect of conflict was observed, $F(1,87)=14.59$, $p<.001$, $\eta^2_p=.144$. Participants took significantly longer time to indicate how reliable they considered answers in the no-conflict condition. As suggested by the graphic from Figure 5, this effect was the same for both heuristic and normative answers, $F(1,87)=1.02$, $p=.316$, $\eta^2_p=.012$.

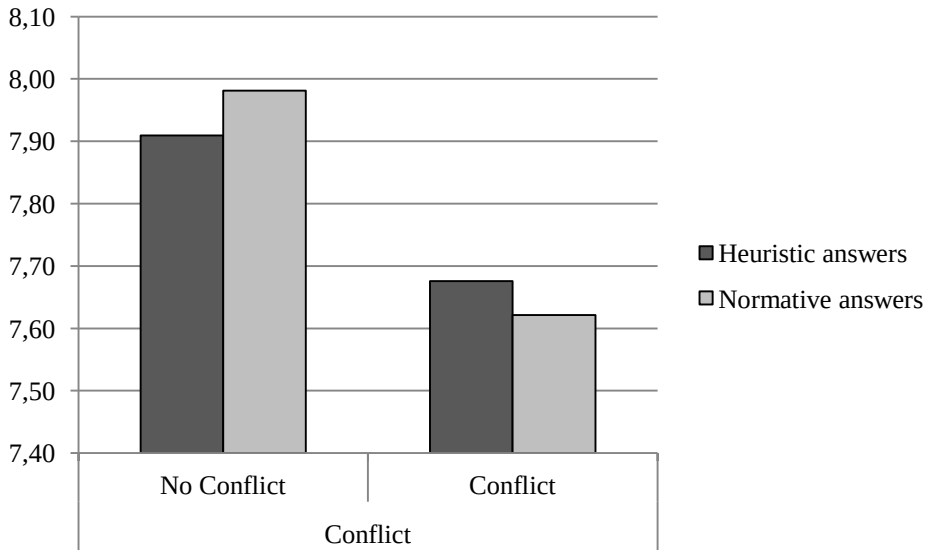


Figure 5 – Reliability Latency Times (log) (ANOVA Response x Conflict)

Analysis by problem (see Outputs 72-75). Separate analysis by problem showed that participants took significantly longer to indicate how reliable they considered the heuristic answers in Base-Rates, $F(1,85)=4.39$, $p=.039$, $\eta^2_p=.049$, Syllogisms, $F(1,85)=13.76$, $p<.001$, $\eta^2_p=.139$, and Ratio-Bias tasks, $F(1,85)=2.37$, $p=.128$, $\eta^2_p=.027$. Only in Conjunctions, participants took significantly longer to indicate how reliable they considered normative answers, $F(1,85)=21.95$, $p<.001$, $\eta^2_p=.205$.

The significant main effect of conflict was prevalent across all reasoning tasks: Base-Rates, $F(1,85)=8.20$, $p=.005$, $\eta^2_p=.088$, Conjunctions, $F(1,85)=5.12$, $p=.026$, $\eta^2_p=.057$, Syllogisms, $F(1,85)=3.10$, $p=.082$, $\eta^2_p=.035$, and Ratio-Bias tasks, $F(1,85)=3.49$, $p=.065$, $\eta^2_p=.039$.

Also, as previously observed, there was no significant interaction effect between these variables across all reasoning tasks: Base-Rates, $F(1,85)=1.24$, $p=.268$, $\eta^2_p=.014$, Conjunctions, $F(1,85)=.26$, $p=.614$, $\eta^2_p=.003$, Syllogisms, $F(1,85)=.01$, $p=.923$, $\eta^2_p=.000$, and Ratio-Bias tasks, $F(1,85)=.01$, $p=.936$, $\eta^2_p=.000$.

Control Variables

Next, we test if the individual characteristics we control for in our study moderate our hypothesis.

Need for Cognition: On appropriate items (Cacioppo et al., 1984), scores were reversed and the mean of 18 items was calculated to obtain an overall score for the need for cognition for each participant (M=3.46, SD=.49) (Output 76). The reliability (Cronbach's alpha) of the scale was .81 (Output 77). Overall, the mean value of the sample was higher than the mean value of the scale (M=3) so, in general, participants presented values which can be considered as relatively high of need for cognition.

Need for Cognition may be a moderator of the previous effects found because it is associated with the likelihood of participants to engage in a more intuitive or deliberative processing (Cacioppo & Petty, 1982). In order to analyze its role, two multiple regression analysis were performed, having as dependent variables either the heuristic or the normative agreement composites, and as predictors the main conflict variable and Need for Cognition.
The analysis performed (see Output 83) showed that higher levels of need for cognition significantly predicted a higher agreement towards normative answers, $\beta=.21$, $t=1.98$, $p=.051$,

and although it seems to indicate a relation with lower agreement towards heuristic answers, β=-.11, t=-1.03, p=.305, this effect was non-significant.

We then replicate the analysis adding the interaction of the two predictors as a new predictor factor. Relevant to our analysis, need for cognition did not interact significantly with the conflict variable regarding heuristic, β=-.36, t=-.45, p=.651, and normative agreement, β=-1.28, t=-1.67, p=.098. So, although we found evidence that need for cognition directly interferes with the agreement towards normative answers, this variable does not interfere with the relation between agreement and the conflict variable.

Faith in Intuition: The mean of 5 items was calculated in order to obtain an overall score for each participant (*M*=3.47, *SD*=.71) (Output 78). The reliability (Cronbach's alpha) of the scale was .79 (Output 79). Again, the mean value of the sample was higher than the mean value of the scale (*M*=3), hence, overall, participants presented values considered as relatively high of faith in intuition.

Because Faith in Intuition is associated with the likelihood of participants to trust more or less the inputs of their intuitive processing (Epstein *et al.*, 1996), this variable may also be a moderator of the previous effects found. Two multiple regression analysis having as dependent variables the heuristic or the normative agreement composites and as predictors the main conflict variable and Faith in Intuition was performed.

The analysis performed (Output 84) showed no evidence of a significant main effect of faith in intuition regarding heuristic, β=-.01, *t*=-.12, *p*=.902, and normative agreement, β=.06, *t*=.59, *p*=.560.

We then replicate the analysis adding the interaction of the two predictors as a new predictor factor. Relevant to our hypothesis, we found no significant interaction effect between faith in intuition and the conflict variable regarding heuristic, β=-.05, *t*=-.09, *p*=.928, and normative agreement, β=.38, *t*=.72, *p*=.471.

Bias Blind Spot: A composite measure of the bias blind spot was computed by summing the differences between the ratings for the average person and the self for each item (*M*=.16, *SD*=3.62) (Output 82). The mean value of the sample was close to 0, showing that, in general, participants didn't rate the average person as being more biased than the self, thus showing evidence of low bias blind spot.

Although no order effects were found regarding the order of self↔other ratings (other-self: *M*=.62, SD=4.07 vs. self-other: *M*=-.26, SD=3.16), (*t*(87)=-1.14, *p*=.258 (Output 4)), the

order by which participants rated the self or other in first place promoted different directions in the mean value of both groups of participants. As we can observe in the Table 5, only in the other-self rating order participants rated others as more likely to commit biases than themselves. However, in this condition, the bias blind spot effect was only significant for Outcome Bias and Framing Effect.

In order to analyze the possible moderator role of Bias Blind Spot, two multiple regression analysis, each one with the agreement variables and as predictors the conflict variable and Bias Blind Spot was performed.

The analysis performed (Output 85) showed that higher levels of bias blind spot significantly predicted lower agreement towards heuristic answers, β=-.25, *t*=-2.41, *p*=.018. This main effect was not significant regarding the agreement towards normative answers, β=-.04, *t*=-.37, *p*=.715.

We then replicate the analysis adding the interaction of the two predictors as a new predictor factor. We found no significant interaction effect between bias blind spot and conflict regarding the agreement towards heuristic, β=-.12, *t*=-1.17, *p*=.247, and normative answers, β=-.10, *t*=-.93, *p*=.356[7].

Relation between the control measures: Need for Cognition and Faith in Intuition did not correlate significantly in the present study, *r*=-.09, *p*=.397 (Output 80), corroborating their theoretical independency. Also, none of these measures correlated significantly with the BBS composite (Need for Cognition, *r*=.04, *p*=.728, Faith in Intuition *r*=-.04, *p*=.694 (Output 81).

[7] We found a significant main effect of the conflict variable regarding the agreement towards normative answers, β=-.24, t=-2.30, p=.024 (Output 85), indicating a greater agreement towards answers in which normative information is used against the heuristic justification. This effect was non-significant regarding the agreement towards heuristic answers, β=-.10, t=-.95, p=.347 (Output 85).

Table 5

Mean judgments about the extent to which Others and Self display cognitive biases and differences between Self-Self and Other-Other, by rating order

	Rating Order								
	Self-Other				Other-Self				Difference
	Mean	Std.Dv.	t	p	Mean	Std.Dv.	t	p	
Outcome Bias (Self)	3,979	1,242			3,488	0,883			0,490*
Outcome Bias (Other)	3,915	1,018	0,311	0,757	3,791	0,888	-2,675	0,011	0,124
Framing Effect (Self)	3,957	1,197			3,326	1,248			0,632*
Framing Effect (Other)	3,894	1,220	0,401	0,690	3,674	1,267	-1,886	0,066	0,219
Base-Rate Neglect (Self)	3,830	1,185			3,186	1,097			0,644*
Base-Rate Neglect (Other)	3,681	1,105	1,265	0,212	3,256	1,093	-0,518	0,607	0,425
Conjunction Error (Self)	3,447	1,138			3,163	0,814			0,284
Conjunction Error (Other)	3,404	1,014	0,467	0,642	3,349	0,870	-1,536	0,132	0,055
Anchoring & Adjustment (Self)	3,298	1,214			3,372	1,134			-0,074
Anchoring & Adjustment (Other)	3,447	1,080	-1,550	0,128	3,488	1,055	-0,741	0,463	-0,042
Myside Bias (Self)	3,766	1,220			3,488	1,334			0,278
Myside Bias (Other)	3,681	0,911	0,663	0,511	3,581	1,258	-0,381	0,705	0,099
Cell Phone Hazard (Self)	5,021	1,189			4,442	1,385			0,579*
Cell Phone Hazard (Other)	5,021	0,967	-0,000	1,000	4,349	1,478	0,613	0,543	0,672*

* $p \leq .05$.

Discussion

The present study aimed to test whether by making participants aware of the conflict between heuristic and normative cues, they would still rely on intuitive, heuristic answers. Our results clearly suggest that when the two modes of thinking, heuristic and normative, are put into conflict, people will still prefer a response that is in accordance with their intuitive judgments. As observed at the general level, regarding the agreement composites, the agreement towards heuristic answers was not impaired by the presentation of normative information. If anything, the presentation of normative information made people agree even more with heuristic answers and the presentation of heuristic information made them agree

more with the normative responses in general. This effect of conflict was not, however, clear when each problem was analyzed by individually. One could think conflict to promote a rebound effect, as suggested in our introduction, as a result of resistance to counterargument, but results regarding the perceived reliability don't support that interpretation. Conflict had an opposite effect regarding the perceived reliability of heuristic answers (diminishing it) and normative responses (augmenting it). So conflict does not seem to promote a rebound effect, rose from the overcome of the use of normative information as a counterargument. The overall tendency to accredit lower reliability to heuristic answers when conflict was promoted turned clear that participants might not actually be more confident about the use of heuristic responses as an argument against normative information.

What's interesting, however, is the dissociation found between agreement and perceived reliability in the conflicting condition. Regardless the fact that it promoted a decline of the reliability ratings towards heuristic justifications and an increase regarding normative ones (promoting no reliability differences between heuristic and normative justifications), participants agreed always more with heuristic answers, comparing to normative ones. This might suggest that two processes are being activated regarding each of these two measures. The conflict gives individuals access to information that the answer is not reliable (supposedly by System 2 activity), however it does not change individuals tendency to respond otherwise (supposedly by System 1 activity). The fact that latency times to agreement and reliability judgments have the opposite pattern may give support to this view. To make a reliability judgment, participants may have to think alternatively. This is facilitated in the conflict condition where all information is already available and is independent upon the type of answer given. However, to make an agreement judgment, individuals may feel somehow disturbed by the conflicting information (taking more time) and it is easy if they can simple rely on what comes to their mind (less time to heuristic vs. normative responses).

This dissociation is also evidence of the experience of conflict promoted. Just as De Neys, Cromheeke and Osman (2011) found that by giving a heuristic response in incongruent problems affected subsequent ratings of confidence, in our study, the lower ratings of response reliability constitute evidence of the experiencing conflict between intuitive and normative responses promoted by our conflict variable. The fact that participants took longer to indicate their dis/agreement towards normative answers can provide additional evidence of the presence of conflict that emerges even when people agree with heuristic answers (or in this case, reject a normative answer).While evidence already existed that people do detect, at least implicitly, this conflict despite the widespread bias and logical errors (e.g. De Neys,

2012), in our study, we provide evidence that, even through explicit conflict between intuitive and normative responses, people will still elect to respond in accordance with their intuitive judgments.

The fact that normative answers only promoted more perceived reliability and this only happened when conflict was activated is a point worth the attention. Why is this so? Agreement data clearly suggests that we prefer heuristic responses both when they are presented and when they are not (by disagreeing with normative responses). And that we think as more reliable heuristic responses than normative ones if nothing calls our attention to the conflict. Two points may be considered here. First, let us remember that according to the attribute substitution process (e.g., Kahneman & Frederick, 2002), heuristic judgments are more accessible. We corroborate this assumption in our study, based on the evidence that agreement latency times were shorter for heuristic answers. So the heuristic answers can come easily to our mind and mismatch the normative answers. However, they are taken into account in the conflicting situation. They match the answer but with a different status. The (heuristic) information that immediately comes to mind, are not, therefore, neglecting it in the answers given. Summing, the heuristic information might be so accessible that participants feel the need to see it concretized (counterargumented against) in the justifications given so that they feel like they can trust them. Congruently the obtained data showed that participants took significantly longer to indicate their agreement towards normative answers, especially in the no-conflict conditions. A second hypothesis is that the conflict engages individuals in a deeper processing, allowing them to present more rational responses. This is corroborated by greater latency times in conflict situations when presenting their level of agreement. In this case, we would have justified why individuals did not take longer times to deal with heuristic answers when conflict is established.

Important to all our claims, the level of agreement towards normative and heuristic answers seemed to indicate the tendency of individuals to engage in a deeper processing or to rely in more intuitive processing. Our data provided evidence that participants with higher levels of need for cognition agreed significantly more with normative answers and had a tendency to disagree with heuristic answers. Higher levels of need for cognition are known to be associated with the likelihood of engagement in a more deliberative processing (Cacioppo & Petty, 1982).

However, we found no direct effect of faith in intuition on the agreement towards heuristic or normative answers. According to the literature, we could expect to find that higher levels of faith in intuition would predict a higher susceptibility to the use of heuristics

in participants' judgments (Epstein, Pacini, Denes-Raj, & Heier, 1996), and hence, a greater agreement towards heuristic answers.

Specific problems

In general, all type of problems promoted conclusions similar to the composite measures. An exception was the Ratio-Bias task. Importantly, when we contrasted our results with those found by Denes-Raj and Epstein (1994), we found them highly comparable, therefore, replicating the results obtained in their study. In addition to those results, our data suggests that only the agreement towards heuristic answers seemed to differ according to the different percentages associated with each option, being this only clear when we promoted conflict between the heuristic and normative answers, making participants, therefore, consider more carefully all information available regarding the odds in game, choosing the trays with higher prospects.

So, what distinguishes the Ratio-Bias problems? Clearly, our results suggest that this task does not seem to have the same status as the other three here used, when it comes to the dissociation between heuristic and rational judgments. The research on the Ratio-Bias has been used to support one particular dual-process theory, the cognitive–experiential self theory (CEST) (e.g., Denes-Raj & Epstein, 1994; Epstein & Pacini, 2000–2001; Kirkpatrick & Epstein, 1992). However, there are some differences between this particular task and the others used in this study. First of all, there might be a difference in the source that promotes the heuristic response. While regarding Base-Rates, Conjuntions and Syllogisms, the heuristic response is cued by an internal source, group stereotypes based on prior beliefs, differing in salience depending on the person (Bonner & Newell, 2010), the same doesn't happen regarding the Ratio-Bias task. In this task, the heuristic response is cued by an external source, the numerator of the ratios, that can be made more or less salient through different formats of presentation (Rudski & Volksdorf, 2002). Also, in the ratio bias task, both heuristic and analytic processing depend on the same external source of information, hence, analytic processing in order to reach an optimal response is based on a single rule - calculate the percentage and choose the higher percentage (Bonner & Newell, 2010). Contrastingly, the analytic processing in the other three tasks used will require that participants integrate information from internal and external sources, thus difficulting the furnishing of an optimal response.

Bias Blind Spot

Given that our experimental paradigm is supported in the level of agreement with another person, it could be the case that the effects observed are dependent upon the level of bias blind spot of our participants. However, bias blind spot results showed that this measure did not moderate our effects, suggesting that the level of agreement towards heuristic answers, through explicit conflict, did not depend on the level with which people usually belief that thinking biases are more prevalent in others than in themselves. Nevertheless, our results showed that participants with lower levels of bias blind spot agreed significantly more with heuristic, biased answers, which may be contrary to what we should have expected. In their study, West, Meserve and Stanovich (2012) had proposed that people who are more aware of their own biases, with lower bias blind spots, are better able to overcome them. However, their data showed little evidence that people with lower levels of bias blind spot performed less biased in classic cognitive biases. Contrasting with these results, our data showed that lower levels of bias blind spot significantly predicted a greater agreement towards heuristic answers. Also, the bias blind spot measure did not predict the agreement towards normative answers, which also contrasts with the findings that a larger bias blind spot is associated with higher cognitive ability (West, Meserve & Stanovich, 2012). Finally, in their study, West, Meserve and Stanovich (2012) had found a positive significant correlation between the bias blind spot composite and the scores of NFC, which we didn't replicate here. Because results regarding this new measure of bias blind spot are still scarce in the literature, it is important to replicate both findings reported.

Also interesting was the order effect detected regarding some bias blind spot items. As mentioned, although we found no order effects regarding the composite of the seven bias blind spot items, only in the other-self classification order participants rated others as more likely to commit biases than themselves. Although such effect was not obtained by West, Meserve and Stanovich (2012), the results found in our study could suggest that for participants it might be easier to aggrandize themselves after rating how likely it is that another person will commit a bias, than it is to derogate a person after indicating how likely it is that themselves commit the bias. In other words, it might be harder to consider the others as worse than it is to consider the self as better. In fact, the self-ratings for the different bias blind spot items were the ones in which the rating orders promoted bigger differences. That is, we noticed that the ratings for the average person were similar across the different ratings orders, however, after indicating how likely is was that another person would commit a bias,

the ratings for the self were significantly lower in the majority of the items. Again, such effect should be studied and replicated in the future in order to better understand its process.

Some considerations for Dual Process theories

According to the lax monitoring view (Kahneman & Frederick, 2002; Kahneman, 2003), it is assumed that people will only rely on their intuitive, heuristic route, to make decisions when conflict is not detected, i.e., without analytic considerations into account. This way, people will make intuitive decisions only and because they fail to detect the conflict between their intuitive and normative considerations, not noticing that their intuition is biased or wrong. So, when people become aware of the normative rule, they will correct their judgments and respond accordingly, overriding their intuitive judgments (Kahneman, 2003).

By showing that when heuristic and normative judgments were put into conflict participants still preferred responses in accordance with their intuitive judgments, our data supports contrasting theories. Specifically, the parallel activation view (e.g., Epstein, 1994; Sloman, 1996), that states that both heuristic and analytic routes are simultaneously activated, promoting a conflict whenever both systems point to different responses. Through latency times and reliability ratings, the results found in our study also support additional empirical evidence that shows that people always take into account the analytic considerations, experiencing conflict with their intuitive beliefs (De Neys, 2012).

Although existing evidence seems to support the parallel model, its principles disregard the benefits of the intuitive route, by stating that people will always start the consuming and demanding analytic computations (De Neys, 2012). Accordingly, De Neys (2012) recently proposed a Logical Intuition Model in order to solve this conceptual problem. The idea of this model is that instead of a mere parallel activation of both systems, there would be a parallel activation of two different types of intuitive responses: a heuristic intuitive response, based on semantic and stereotypical associations, and a logical intuitive response, based on the activation of logical and probabilistic normative principles (De Neys, 2012). According to this model, a more deliberate processing is triggered by conflict between both intuitive responses. However, according to the model, this still does not imply that people will consider the logical response as fully warranted. On the other hand, if both responses are consistent, people select the cued consistent response and the reasoning process finishes without further deliberations (De Neys, 2012).

However, if these intuitive systems cue both a heuristic and a logical response, one might ask why the heuristic response still rules in case of conflict. One explanation advanced

by De Neys (2012) is that the heuristic response might be more strongly activated, salient or appealing than the logical one. In our study, we promoted a context of full awareness of the violation of normative principles, in scenarios where both heuristic and normative responses were equally made available, promoting an explicit conflict, and hence, a more deliberate processing. The fact that participants still preferred heuristic responses even through explicit conflict does not refute the idea of the model, however, the explanation of heuristic prevalence due to different levels of activation or saliency still needs to be explored.

The present study provides evidence that people's preference for heuristic judgments is not diminished by the presentation of normative arguments. Besides the theoretical implications already discussed, these results provide practical implications regarding the way people deal with all information available when making a decision. Our results support the idea that the reason why people are, predominantly, making decisions that fail to obey to rational rules might not be due to the lack of accessibility of normative information, although generalization of these results is, obviously, required. In our study, even after promoting an explicit conflict between intuitive and normative considerations, participants still relied on the use of the heuristic justifications as a conscious argument against normative rules. In fact, the experience of presenting people with an argument based on normative rules to which they counter argue with a heuristic argument is not that uncommon. Either in a meeting, when discussing a series of recent bad results and the regression to the mean, or in a casino with friends, when a sequence of 10 red numbers in the roulette can't avoid this "little homunculus in our heads" from jumping up and down, shouting – "black!".

Study Limitations and Future Research

Future research should focus several issues opened by the findings of our study, as well as some limitations to be considered. As observed, our results showed that people still choose to rely on heuristic, intuitive judgments even through explicit conflict by presentation of normative information. However, one can question how much, in fact, did participants represent adequately the problems presented, and how effective was the presentation of the conflicting information. If participants did not represent the problems adequately, then it is admissible to assume that the conflict promoted was not effective and that the presentation of "even-though"-conflicting-information did not promote the desired conflict. Although latency times and reliability ratings give some support to the assumption that participants did, in fact, experience conflict through the presentation of normative information, future studies should ensure that the conflict is, indeed, understood by participants. A way to do so, might be by

obligating participants to use the normative information at stake, and define the probabilities correctly in order to make sure that the problems are properly represented.

Another consideration to take into account regards the use of agreement as the dependent measure employed to register the participants' preference for heuristic responses. We can conjecture that by asking participants to indicate their agreement towards these already accessible responses, that will make them agree more easily with the heuristic answers provided. Hence, the opposite regarding normative answers, providing a possible explanation to why the low level of agreement towards normative answers. The process by which people agree or disagree with these answers might, therefore, be different than the one they would actually use to provide an answer to these tasks. This way, because participants might be comparing responses already accessible in their heads to ones provided, the process by which they are indicating their agreement might be similar to recognition. In order to control this aspect, future studies should focus not only on promoting a conflict that is correctly represented by participants but also on asking for participants to provide their own answers to the problems presented. The comparison between agreement and answering conditions regarding the agreement or provision of heuristic answers may provide valuable information regarding this aspect.

A final consideration regards the agreement latency times variable used in this study. The obtained data provides evidence of the conflict experienced by participants in conflict conditions, by taking significantly longer to indicate their agreement towards the answers presented. However, due prudence must be taken into consideration when interpreting agreement latency times because of the conflicting answers' bigger size when comparing to no-conflict answers. This difference is most evident among the Syllogism task items and might have contributed to the conflict significant main effect observed. In order to control for this confounding variable, future studies that might apply this paradigm should employ items with similar size. A way to do so might be by using filler content in no-conflict answers, in order to make all items similar in size. Another way to deal with this methodological concern might be by initially present the to-be-judged-answers in a first screen, and allow for participants to provide their answers only the following screen, therefore, providing a pure measure of response latency times.

Bibliographic References

Ball, L. J., Philips, P., Wade, C. N., & Quayle, J. D. (2006). Effects of belief and logic on syllogistic reasoning: Eye-movement evidence for selective processing models. *Experimental Psychology, 53,* 77–86.

Bargh, J. A. (1997). The automaticity of everyday life. In R. S. Wyer, Jr. (Ed.). *The automaticity of everyday life: Advances in social cognition* (Vol. 10, pp.1–61). Mahwah, NJ: Erlbaum

Baron, J. (1995). Myside bias in thinking about abortion. *Thinking and Reasoning, 1,* 221-235.

Bloomberg Businessweek, 2012 Tim Cook's Freshman Year: The Apple CEO Speaks Josh Tyrangiel December 06, 2012, http://www.businessweek.com/articles/2012-12-06/tim-cooks-freshman-year-the-apple-ceo-speaks

Bonnefon, J. F. (2011). *Le raisonneur et ses modèles.* [The reasoner and his models]. Grenoble, France: Presses Universitaires de Grenoble.

Bonner, C. & Newell, B.R. (2010). In conflict with ourselves? An investigation of heuristic and analytic processes in decision making. *Memory & Cognition, 38,* 186-196.

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology, 42,* 116–131.

Cacioppo, J. T., Petty, R. E., & Kao, C. F. (1984). The efficient assessment of need for cognition. *Journal of Personality Assessment, 48,* 306–307.

Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes. II: Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology, 65,* 5–17.

Castaneda, C. (1991). *Fire from Within.* Washington Square Press

Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology.* New York: Guilford Press.

Conover, W. J., & Iman, R. L. (1976), On Some Alternative Procedures Using Ranks for the Analysis of Experimental Designs. *Communications in Statistics, A5, 14,* 1348-1368.

Denes-Raj, V., & Epstein, S. (1994). Conflict between experiential and rational processing: When people behave against their better judgment. *Journal of Personality and Social Psychology, 66,* 819-829.

De Neys, W. (2012). Bias and conflict: A case for logical intuitions. *Perspectives on Psychological Science, 7,* 28-38.

De Neys W, Cromheeke S, Osman M (2011) Biased but in Doubt: Conflict and Decision Confidence. *PLoS ONE, 6(1)*

De Neys, W., & Franssens, S. (2009). Belief inhibition during thinking: Not always winning but at least taking part. *Cognition, 113,* 45–61.

De Neys, W., & Glumicic, T. (2008). Conflict monitoring in dual process theories of thinking. *Cognition, 106,* 1248–1299.

De Neys, W., Moyens, E., & Vansteenwegen, D. (2010). Feeling we're biased: Autonomic arousal and reasoning conflict. *Cognitive, Affective, and Behavioral Neuroscience, 10,* 208-216.

De Neys, W., Vartanian, O., & Goel, V. (2008). Smarter than we think: When our brains detect that we are biased. *Psychological Science, 19,* 483-489

Epstein, S. (1973). The self-concept revisited or a theory of a theory. *American Psychologist, 28(5),* 404-416.

Epstein, S. (1990). Cognitive-experiential Self-theory. In L. Pervin (Ed.), *Handbook of personality theory and research: Theory and research* (pp. 165-192). NY: Guilford Publications, Inc.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49(8),* 709–724.

Epstein, S., & Pacini, R. (2000-2001). The influence of visualization on intuitive and analytical information processing. *Imagination, Cognition & Personality, 20,* 195-216.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in Intuitive-Experiential and Analytical-Rational Thinking Styles. *Journal of Personality and Social Psychology, 71(2),* 390-405.

Evans, J. (2009). How many dual-process theories do we need? One, two, or many? In J. Evans & K. Frankish (Eds.), *In two minds: Dual processes and beyond* (p. 33-54). Oxford: Oxford University Press.

Evans, J. S. B. T, Barston, J., & Pollard, P. (1983). On the conflict between logic and belief in syllogistic reasoning. *Memory & Cognition, 11,* 295-306.

Evans, J. St B. T., & Over, D. E. (1996). *Rationality and reasoning.* Hove, UK: Psychology Press

Evans, J. St. B. T, Over, D. E., & Manktelow, K. (1993). Reasoning, decision making and rationality. *Cognition, 49,* 165-187.

Fazio, R. H. (1990b). A practical guide to the use of response latency in social psychological research. In C. Hendrick & M. S. Clark (Eds.), *Research methods in personality and social psychology. Review of personality and social psychology, Vol. 11* (pp. 74–97). Newbury Park, CA: Sage.

George, C. (1995). The endorsement of the premises: Assumption-based or belief-based reasoning. *British Journal of Psychology, 56,* 93-111..

Gould, S. J. (1991). *Bully for brontosaurus: Reflections in natural history.* W. W. Norton.

Hammond, K. (2000). *Human judgment and social policy: Irreducible uncertainty, inevitable error, unavoidable injustice.* New York, NY: Oxford University Press

Heider, F. (1944). Social perception and phenomenal casuality. *Psychological Review, 51,* 358–374

Iman, R. L. (1974). A power study of a rank transform for the two-way classification model when interactions may be present. *Canadian Journal of Statistics, 2(2),* 227–239

Iman, R. L., & Conover, W. J. (1976). A Comparison of Several Rank Tests for the Two-Way Layout. Technical Report SAND76-0631, Sandia Laboratories, Albuquerque, New Mexico.

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30,* 513–541.

Jacoby, L. L. (1996). Dissociating automatic and consciously controlled effects of study/test compatibility. *Journal of Memory and Language, 35,* 32–52

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110,* 306–340.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58,* 697-720.

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In: T. Gilovich, D. Griffin & D. Kahneman (eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 49-81). New York: Cambridge University Press.

Kahneman, D., & Frederick, S. (2005). A model of heuristic judgment. In Holyoak, K. J., & Morrison, R. G. [eds.]. *The Cambridge Handbook of Thinking and Reasoning*. Cambridge University Press, 267-293.

Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review, 93,* 136–153.

Kahneman, D., Ritov, I., & Schkade, D. (1999). Economic preferences or attitude expressions? An analysis of dollar responses to public issues. *Journal of Risk and Uncertainty, 19,* 220–242.

Kahneman, D., Slovic, P. & Tversky, A. (Eds.). (1982). *Judgment under uncertainty: Heuristics and biases.* New York: Cambridge University Press.

Kahneman, D. & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80,* 237-251.

Kahneman, D., & Varey, C. A. (1990). Propensities and counterfactuals: The loser that almost won. *Journal of Personality and Social Psychology, 59,* 1101–1110.

Kirkpatrick, L., & Epstein, S. (1992). Cognitive-experiential selftheory and subjective probability: Further evidence for two conceptual systems. *Journal of Personality & Social Psychology, 63,* 534-544.

Klaczynski, P. A., Gordon, D. H., & Fauth, J. (1997). Goal-oriented critical reasoning and individual differences in critical reasoning biases. *Journal of Educational Psychology, 89,* 470-485.

Klaczynski, P. A., & Narasimham, G. (1998). Development of scientific reasoning biases: Cognitive versus ego-protective explanations. *Developmental Psychology, 34,* 175-187.

Markovits, H., & Nantel, G. (1989). The belief-bias effect in the production and evaluation of logical conclusions. *Memory & Cognition, 17,* 11-17.

Michotte, A. (1963). *The perception of causality* (T. R. Miles & E. Miles, Trans.). New York: Basic Books

Moshman, D., & Franks, B. (1986). Development of the concept of inferential validity. *Child Development, 57,* 153-165.

Newell, A., & Rosenbloom, P. S. (1981). Mechanisms of skill acquisition and the law of practice. In J. R. Anderson (Ed.), *Cognitive skills and their acquisition* (pp. 1-55). Hillsdale, NJ: Erlbaum

Oakhill, J., Johnson-Laird, P., and Garnham, A. (1989). Believability and syllogistic reasoning. *Cognition, 31,* 117-140.

Peterson, C. R., & Beach, L. R. (1967). Man as an intuitive statistician. *Psychological Bulletin, 68,* 29-46.

Rudski, J. M., & Volksdorf, J. (2002). Pictorial versus textual information and the ratio-bias effect. *Perceptual & Motor Skills, 95,* 547-554.

Sá, W. C., West, R. F., & Stanovich, K. E. (1999). The domain specificity and generality of belief bias: Searching for a generalizable critical thinking skill. *Journal of Educational Psychology, 91,* 497-510.

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45*, 513–523.

Schwarz, N., & Vaughn, L. A. (2002). The availability heuristic revisited: Ease of recall and content of recall as distinct sources of information. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 103–119). Cambridge: Cambridge University Press

Silva, J., & Garcia-Marques, T. (2006). Medindo necessidade de cognição e fé na intuição: Tradução e adaptação das duas escalas à população portuguesa. *Laboratório de Psicologia, 4(1),* 29-43.

Simon, H. A. (1955). A Behavioral Model of Rational Choice. *Quarterly Journal of Economics, 69(1),* 99–118.

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin, 119,* 3–22.

Sloman, S. A. (2002). Two systems of reasoning. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp.379–396). Cambridge: Cambridge University Press.

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp.397–420). Cambridge: Cambridge University Press.

Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate. *Behavioral and Brain Sciences, 23*, 645–665.

Tormala, Z.L., & Petty, R.E. (2004). Resistance to persuasion and attitude certainty: The moderating role of elaboration. *Personality and Social Psychology Bulletin, 30*, 1446-1457.

Tversky, A., Kahneman, D. (1971). Belief in the law of small numbers. *Psychological Bulletin, 76(2),* 105–110.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5(2),* 207–232.

Tversky, A., & Kahneman, D. (1974). *Judgment under uncertainty: Heuristics and biases. Science, 185(4157),* 1124–1131.

Tversky, A., & Kahneman, D. (1983). Extensional vs. intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review, 90,* 293–3l5.

West, R. F., Meserve, R. J., & Stanovich, K. E. (2012). Cognitive sophistication does not attenuate the bias blind spot. *Journal of Personality and Social Psychology, 103(3),* 506-519.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35,* 151–175.

Zajonc, R. B. (1997). Emotions. In D.T. Gilbert, S.T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th Ed., Vol. 1, pp. 591–632). New York: Oxford University Press.

Annexes

Annex A – Literature Review

In the present section it will be presented a more detailed review of the concepts and views addressed in the present dissertation.

Heuristics and Biases Approach

Since psychological research on reasoning and decision-making bloomed in the late 1950s, the once economic perspective that human thinking follows from normative models, such as probability and statistics (Peterson & Beach, 1967), has faded. The economist theorization of decision-making was progressively replaced by the psychological perspective that accounts for the human decisions as limited and subjective (e.g., Kahneman, 2003; Simon, 1955; Tversky & Kahneman, 1974).

Herbert Simon's (1955) bounded rationality, that recognized the inherent limitations of the human mind's processing, was the most significant contribute the revolution in the research of human judgment. According to Simon (1955), people's ability to do rational choices relies under the constraints imposed by their cognitive limitations and restricted amount of time available to make a decision. According to Simon (1956), the decision-maker is, thus, a satisficer. Because he lacks the cognitive resources to make optimal choices, he seeks for a satisfactory solution over an optimal one. Satisficing explains, therefore, the tendency to choose the first option that addresses most needs instead of an optimal one (Simon, 1956).

Through the research program, now known as the heuristics and biases approach, Tversky and Kahneman (1974) contributed also to this shift in the research of human judgment. Inspired by the central idea that judgment under uncertainty often relies on a confined number of simplifying heuristics over the normative processing, their program began with the study of statistical intuitions in experts (Tversky & Kahneman, 1971). Through this study, Tversky and Kahneman (1971) found that these experts showed an excessively confidence in the replicability from small samples, evidencing a lack of sensitivity to the effects of sample size. Turns out, these experts were not employing the statistical principles with which they were fully familiar with. Through this program, Tversky and Kahneman described three general heuristics that underlie intuitive judgments under uncertainty – representativeness, availability, and adjustment and anchoring.

Representativeness Heuristic:

According to Tversky and Kahneman (1974), many of the probabilistic questions with which we deal daily belong to one of the following types: What is the probability that object A belongs to class B? What is the probability that event A originates from process B? What is the probability that process B will generate event A?

In order to answer these questions, people typically rely on the representativeness heuristic. According to this heuristic, probabilities are evaluated by the degree to which A is similar to B, that is, by the degree to which A is *representative* of B. Consequently, when A is highly representative of B, people judge the probability that A originates from B as high. On the other hand, if A does not resemble B, the probability that A originates from B is judged to be low (Tversky & Kahneman, 1974).

Making use of an example illustrated by Tversky and Kahneman in their pivotal article (1974, p.1124), let us consider a person who was described as follows: "Steve is very shy and withdrawn, invariably helpful, but with little interest in people, or in the world of reality. A meek and tidy soul, he has a need for order and structure, and a passion for detail." In order to assess the most probable occupation of Steve (for example, salesman, pilot, librarian, or physician) and to order these occupations form the most to least likely, people may rely on the representativeness heuristic. This way, the probability that Steve is a librarian, for example, will be assessed by the degree to which he represents the stereotype of a librarian. Research with this type of problems has shown that, in fact, people order the occupations by probability and by similarity in the exact same way, leading to serious errors, because representativeness is not influenced by factors that should affect the judgments of probability, like the prior probability of outcomes, sample sizes, misconceptions of chances and of regression (Tversky and Kahneman, 1974).

Availability Heuristic:

Additionally to the use of representativeness, there are also situations in which people assess the probability of an event by the “ease with which instances or occurrences can be brought to mind” (Tversky and Kahneman, 1974, p.1127), this is, by the use of an availability heuristic. Making use of another example used by Tversky and Kahneman (1974), people may assess the risk of heart attack among middle-aged people through the recollection of such events among known people. The availability heuristic is useful when it comes to the evaluation of frequencies or probabilities, because instances of large classes are typically recalled faster and better than those ones of less frequent classes. But, because this heuristic is

affected by factors other than frequency or probability (such as familiarity, salience, and imaginability) the reliance on availability leads to some predictable biases, like the retrievability of instances, effectiveness of a search set and illusory correlation (Tversky and Kahneman, 1974).

Adjustment and Anchoring:

In other probabilistic situations, people may generate estimates by starting from an initial value, after adjusted in order to produce a final answer (Tversky and Kahneman, 1974). This initial value may be suggested by the frame of the problem description, or as a result of a partial computation. What happens, in either case, is that the adjustments produced are typically insufficient, reason why Tversky and Kahneman (1974) called this phenomenon anchoring. In a demonstration of this effect (Tversky & Kahneman, 1974), people were asked to estimate various quantities, stated in percentages (for example, the percentage of African countries in the United Nations). A number between 0 and 100 was determined by a spinning wheel in the subjects' presence, and they were asked to indicate whether that number was higher or lower than the value of the quantity of countries, before they estimated the value of the quantity by moving upward or downward from the given number. Different groups of participants were given different numbers for each quantity, and these random numbers had a significant effect on the estimates performed. For instance, the median estimates of the percentage of African countries were 25 and 45 for groups that received 10 and 65, respectively, as starting points.

Accordingly, when asked to evaluate the frequency of doping use in sportsmen, people may instead assess how easy it is to recall examples of famous sportsmen doping-users (availability heuristic). When asked to evaluate the likelihood that a given actor is a cocaine user, people may assess the similarity between that actor and the stereotypical cocaine user (representativeness heuristic). And, either these questions, may also be answered by starting with an accessible initial value and adjusted in order to reach a final answer (anchoring and adjustment heuristic) (Gilovich & Griffin, 2002).

Attribute Substitution and Accessibility

The general hypothesis that guided the early research on judgment heuristics was that when confronted with a difficult question, people may answer an easier one instead, being often unaware of this substitution (Kahneman & Frederick, 2002, 2005). For example, a

"professor who has heard a candidate's job talk and now considers the question *«How likely is it that this candidate could be tenured in our department?»* may answer the easier question: *«How impressive was the talk?»"* (Kahneman & Frederick, 2005, p.269). This is an example of the representativeness heuristic, according to which some probability judgments (e.g., the probability that object A belongs to class B) are evaluated ("substituted") by the degree to which A is representative of B, that is, the degree to which A resembles B (Tversky & Kahneman, 1974). In order to explain the results obtained in the experts study, Tversky and Kahneman (1971) conjectured that people expect the statistics of a sample to resemble ("represent") the corresponding population parameters, even when the sample is small (Kahneman & Frederick, 2002).

This way, we can infer that a judgment is mediated by a heuristic when a person assesses a judgmental object (the target attribute) by substituting another property of that object (the heuristic attribute), which comes more readily to mind, this is, which is more accessible (Kahneman & Frederick, 2002).

Although, initially, the heuristics and biases approach (Tversky & Kahneman, 1974) did not include a definition of judgmental heuristics, since they were described as principles, processes or sources of cues for judgment (Kahneman, 2003), presently, the *attribute substitution* constitutes an explicit definition of a generic heuristic process. Towards this new definition, the word 'heuristic' is used in two senses, specifically, the noun refers to the cognitive process, and the adjective in 'heuristic attribute' defines the substitution process that takes place when making a judgment (Kahneman, 2003).

Many probability judgments are based on this process of attribute substitution. Natural attributes such as similarity (e.g., Tversky & Kahneman, 1983), cognitive fluency (e.g., Jacoby & Dallas, 1991; Schwarz & Vaughn, 2002; Tversky & Kahneman, 1973), causal propensity (Heider, 1944; Kahneman & Varey, 1990; Michotte, 1963), surprisingness (Kahneman & Miller, 1986), mood (Schwarz & Clore, 1983), and affective valence (e.g., Bargh, 1997; Cacioppo, Priester, & Berntson, 1993; Kahneman, Ritov, & Schkade, 1999; Slovic et al., 2002; Zajonc, 1980, 1997), are routinely evaluated as part of perception and comprehension, and are therefore permanent candidates for attribute substitution, due to their high accessibility (Tversky & Kahneman, 1983).

In fact, accessibility – the ease (or effort) with which particular contents come to mind (e.g., Higgins, 1996; Tulving & Pearlstone, 1996) - constitutes the main concept of this analysis of intuitive judgments and preferences (Kahneman, 2003). Here, the term *accessibility* groups the notions of salience, selective attention, and response activation

(Kahneman, 2003), being determined both by characteristics of the cognitive mechanisms that produce it and by the characteristics of the stimuli and events that evoke it (Kahneman & Frederick, 2005).

Attributes not naturally assessed can too become accessible if recently evoked or primed (e.g., Bargh *et al*., 1986; Higgins & Brendl, 1995). For example, a study by Strack, Martin and Schwarz (1988) employed a survey that included two questions: "How happy are you with your life in general?" and "How many dates did you have last month?". This study showed that the correlation between these two questions was trifling when occurred in the shown order, but significant if the dating frequency question was asked in first place. As proposed by Kahneman and Frederick (2005), the dating question may automatically evoke the evaluation of one's romantic satisfaction and this assessment lingers to become the heuristic attribute when the general-happiness question is subsequently evaluated. Whether the heuristic attribute is chronically or temporarily accessible by priming, the mechanism of attribute substitution is, however, the same (Kahneman & Frederick, 2005).

Sometimes, it might succeed that there is more than one candidate for the role of heuristic attribute. Therefore, consider the following question: "Are there more deaths caused by bike accidents or by running over?". In this sense, a person who recently read about someone who died from a bike accident or running over may use the availability of these instances as a heuristic. However, if no instances come to mind, this person may use the impressions of the gravity of the typical bike accident or running over as an application of representativeness (Kahneman & Frederick, 2005). In fact, it's possible that the question described triggers both an evaluation of gravity and a search for instances. This way, an accessibility's dispute will determine the role of the two heuristics in the final response given (Kahneman & Frederick, 2005).

The observed systematicity of the attribute substitution implies that intuitive judgments may be driven by processes other than the slower and more deliberate computations we learn to perform (Kahneman & Frederick, 2005). This way, the heuristics and biases program was, since early, guided by the view that these intuitive judgments occupy a position between the automatic, fast operations of perception, and the controlled, serial operations of reasoning (Kahneman, 2003; Kahneman & Frederick, 2002, 2005). Presently, the distinction between intuition and reasoning is widely accepted under the general label of dual-process theories (Kahneman & Frederick, 2005).

Dual-Process theories

The intuitive and reasoning processes' distinction has been subject of great attention in the last decades (Chaiken & Trope, 1999). In order to organize the apparently contradictory results in the judgment under uncertainty area of research (Kahneman & Frederick, 2002; Sloman, 1996, 2002; Stanovich, 1999; Stanovich & West, 2002), differences between these two modes of thinking have been invoked.

Regardless the "many flavors" (Kahneman & Frederick, 2005, p.267) of dual process theories (e.g., Chaiken & Trope, 1999; Epstein, 1994; Hammond, 2000; Jacoby, 1991, 1996; Sloman, 1996, 2002), there is a substantial agreement on the distinguishing features of the two types of cognitive processes, labeled by Stanovich and West (2000) as System 1 and System 2. Table 1 (from Evans, 2008, p.257) provides an overview of the names given to each type of system in different dual-process theories, and Table 2 (from Evans, 2008, p.257) provides an idea of the features usually attribute to each. Among other features, the operations of System 1 are automatic, fast, effortless and hard to control. Contrastingly, the operations of System 2 are controlled, slower, effortful and intentionally controlled. System 1 and System 2 have various characteristics attributed to them, but, as mentioned, the general idea remains essentially the same. Whereas the operations of System 1 quickly proposes intuitive and automatic answers to judgment problems, System 2, the effortful and rule-governed cognitive system, monitors the quality of these proposals (Stanovich & West, 2000), and may approve, correct, or override them (Kahneman & Frederick, 2002, 2005).

Table 1. Labels attached to dual-processes in the literature, aligned on the assumption of a generic dual-system theory (from Evans, 2008, p.257)

References	System 1	System 2
Fodor (1983, 2001)	Input modules	Higher cognition
Schneider & Schiffrin (1977)	Automatic	Controlled
Epstein (1994), Epstein & Pacini (1999)	Experiential	Rational
Chaiken (1980), Chen & Chaiken (1999)	Heuristic	Systematic
Reber (1993), Evans & Over (1996)	Implicit/tacit	Explicit
Evans (1989, 2006)	Heuristic	Analytic
Sloman (1996), Smith & DeCoster (2000)	Associative	Rule based
Hammond (1996)	Intuitive	Analytic
Stanovich (1999, 2004)	System 1 (TASS)	System 2 (Analytic)
Nisbett et al. (2001)	Holistic	Analytic
Wilson (2002)	Adaptive unconscious	Conscious
Lieberman (2003)	Reflexive	Reflective
Toates (2006)	Stimulus bound	Higher order
Strack & Deustch (2004)	Impulsive	Reflective

Table 2. Clusters of attributes associated with dual systems of thinking (from Evans, 2008, p.257)

System 1	System 2
Cluster 1 (Consciousness)	
Unconscious (preconscious)	Conscious
Implicit	Explicit
Automatic	Controlled
Low effort	High effort
Rapid	Slow
High capacity	Low capacity
Default process	Inhibitory
Holistic, perceptual	Analytic, reflective
Cluster 2 (Evolution)	
Evolutionarily old	Evolutionarily recent
Evolutionary rationality	Individual rationality
Shared with animals	Uniquely human
Nonverbal	Linked to language
Modular cognition	Fluid intelligence
Cluster 3 (Functional characteristics)	
Associative	Rule based
Domain specific	Domain general
Contextualized	Abstract
Pragmatic	Logical
Parallel	Sequential
Stereotypical	Egalitarian
Cluster 4 (Individual differences)	
Universal	Heritable
Independent of general intelligence	Linked to general intelligence
Independent of working memory	Limited by working memory capacity

In a latter version of his theory, Stanovich (2009) replaced System 1 and System 2 with Type 1 and Type 2 processes. These processes are divided among three minds identified as the autonomous mind (Type 1, previous System 1), the algorithmic mind and the reflective mind. This way, Stanovich (2009) divided the System 2 into two distinct systems. The algorithmic mind refers to the information processing part of System 2, such as perceptual registration mechanisms and short- and long-term-memory storage systems. This mind explains how some tasks are processed but not the reason why, which is explained by the reflective mind, that contains the goals and beliefs associated with them. Despite this distinction, Type 1 and Type 2 processes keep the characteristics Stanovich previously associated with System and System 2.

Despite the agreement about the nature of responses furnished by different systems, there are different views on how conflict between these two systems are processed and resolved, and how these systems operate sequentially (e.g., Kahneman & Frederick, 2002) or in parallel (e.g., Sloman, 1996).

According to Kahneman and Frederick (2002), the widespread heuristic bias can be attributed to a failure in the monitoring of intuition, this is, the lightness with which System 2 monitors the outputs of System 1. As they state, "people are not accustomed to thinking hard, and are often content to trust a plausible judgment that quickly comes to mind." (Kahneman and Frederick, 2002, p.58). According to this lax monitoring perspective, people fail to detect the conflict between their intuitive and normative considerations, therefore not noticing that their intuition is biased, or wrong. As so, when people make these intuitive judgments, they "normally know little about how their judgments come about and know even less about its logical entailments" (Kahneman & Frederic, 2006, p.274). As a consequence, when people become aware of this bias, they correct their judgments and may even overcorrect (Kahneman, 2003).

Contrastingly, the work of Epstein (1994) and Sloman (1996) provides a different view on conflict monitoring. For instance, they assume that a heuristic and analytic routes are simultaneously activated, through a parallel activation (e.g., Epstein, 1994; Sloman, 1996), and people do experience this conflict between their intuitive responses and normative considerations. This way, people "simultaneously believe two contradictory responses" (Sloman, 1996, p.11), but despite noticing this conflict they do not always manage to override their intuitive beliefs, and therefore "behave against their better judgment" (Denes-Raj & Epstein, 1994, p.1). This way, rather than resulting from a monitoring failure, this view assumes that biased judgments are attributed to an inhibition failure (De Neys, Vartanian, & Goel, 2008).

Implicit Conflict Detection

Available evidence suggests that people do detect, at least implicitly, the conflict between their intuitive and normative responses, despite the widespread bias and logical errors. A number of studies have shown that people need more time to solve problems where the cued heuristic response is inconsistent with the normative principles, than when both cue the same response (e.g., Bonner & Newell, 2010; De Neys & Glumicic, 2008; Stupple & Ball,

2008; Thompson, Striemer, Reikoff, Gunter, & Campbell, 2003; Villejoubert, 2009). Bellow, an example of these two types of problems (De Neys, 2012):

Base-rate neglect task:

Conflict version:

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of 995 females and 5 males. The description below was chosen at random from the 1000 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

No conflict version:

A psychologist wrote thumbnail descriptions of a sample of 1000 participants consisting of 995 males and 5 females. The description below was chosen at random from the 1000 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

The conflict, classic versions, cue a heuristic response ("Jo is a man") that conflicts with the normatively correct one, according to standard logic or probability theory principles ("Jo is a woman"). In the no-conflict, control versions, changes in the description content are made in order to guarantee that the cued heuristic response is consistent with the logical response ("Jo is a man"). This latency findings support the idea that people take normative considerations into account, supporting the idea that people are sensitive to traditional normative status of their judgment (De Neys, 2012).

Gaze and eye tracking studies showed also that these longer latencies are accompanied by a longer inspection of normative information in conflict versions (Ball *et al.*, 2006). Similarly, through the resolution of conflict base-rate problems, De Neys and Glumicic (2008) showed that participants tend to review the paragraph with the base-rate information,

after they have read the personality description, more often when compared to control versions.

This conflict findings have also been validated through neuroimaging studies (De Neys, Vartanian, & Goel, 2008). In their study, De Neys, Vartanian and Goel (2008) used fMRI to monitor the activation of the anterior cingulate cortex (ACC), believed to mediate the conflict detection during reasoning (e.g., Botvinick, Cohen, & Carter, 2004). Supporting the already described behavioral findings, the results of this study showed that the ACC was significantly more activated through the resolution of conflict versions than when people solved control versions. A subsequent study (De Neys, Moyens, & Vansteenwegen, 2010) recorded participants' skind conductance in order to monitor autonomic nervous system activation. The results showed that through the resolution of conflict problems participants' phisiological data evidenced a clear electrodermal activation spike.

A study conducted by De Neys, Cromheeke and Osman (2011) gave further support to the existence of conflict between intuitive and normative considerations, by showing that these neural conflict signals also affect participants' subjective response confidence. Typically, participants indicated that they felt less confident about their answers after the resolution of conflict problems, comparing to the resolution of control problems.

Based on this data, De Neys (2012) proposes that despite people's errors, there is an implicit knowledge of the logical and probabilistic principles evoked in classic reasoning tasks, and a consequent automatic activation of this knowledge, which contrasts with the biased tendency to respond.

Explicit Heuristic Use

The assumption of a simultaneous activation of an intuitive response and normative principles when faced with a reasoning problem, turns interesting on contexts where individuals still rely on their intuitive responses. This may happen because they lack motivation or resources to use normative principles (e.g., Kahneman & Frederick, 2002), or because they are considering their intuitive judgments to be the ones they can trust the most.

There is some empirical evidence that suggests that this implicit preference (heuristic use) may ultimately reach an explicit level being accepted as the "better response", although no empirical work have directly focused this issue.

Through introspective self-reports in a Ratio-Bias task, Denes-Raj and Epstein (1994) have shown that when offered a chance to win money by drawing a red jelly bean from one of two bowls, participants frequently chose to draw from a bowl that contained a greater absolute

number, but smaller proportion, of red beans (e.g., 7 in 100) than from a bowl with fewer red beans but better odds (e.g., 1 in 10). However, what's interesting about this study, regarding the assumption of explicit heuristic use, is the great number of participants who still chose the bowl with worse odds, despite showing an explicit knowledge of the probabilities corresponding to each bowl. Participants commonly commented that although they *knew* the probabilities were against them, they *felt* they had a better chance of winning when there were more red beans (Denes-Raj & Epstein, 1994).

Additional evidence of the explicit preference for judgments based on heuristics, despite normative knowledge, comes from a study conducted by De Neys and Glumicic (2008). In this study, participants solved classic base-rate neglect problems while thinking aloud. The verbal protocols used in this study indicated that, when the base-rates were explicitly and spontaneously verbalized, there were still 15% of times when participants preferred the heuristic, intuitive judgment, instead of an accurate answer. These results are, actually, similar to those obtained by Kahneman and Tversky (1973), which documented almost complete neglect of the base-rates even when these were explicitly stated in the response options. The difference, however, is that in De Neys and Glumicic (2008) study, some participants show explicit statistical inferences about the base-rates, and still prefer the heuristic response: "According to the statistics there is a greater chance he is a lawyer but because of the things he does (…) it makes more sense that he is an engineer so...I don't know I will go with that." (De Neys & Glumic, 2008, p. 1258).

Explicit conflict and lack of normative resolution has also been reported in the well known Stephen Jay Gould (1991) anecdote, in which he states that, "I know that the [conjunction] is least probable, yet a little homunculus in my head continues to jump up and down, shouting at me – 'but she can't just be a bank teller; read the description'" (Gould, 1991, p.469).

Synthesis and Study Systematization

After this review, and based on the evidence supporting the hypothesis that when two modes of thinking will be put into conflict, most people, although fully aware of the normative rule, will elect to respond in accordance with their intuitive judgment, we suggest that heuristics may be used explicitly and as a kind of "conscious arguments" used to convince, if not others, the self "against" the normative rules, if people feel them as the best response.

Approaches that frame System 1 and System 2 as being simultaneous activated (e.g., Epstein, 1994; Sloman, 1996), offer us the proper context to assume that people give intuitive responses on contexts of full awareness of violation of normative principles. Aiming to directly test this hypothesis, we should, however, not disregard the fact that these approaches concur with other with alternative views (e.g., Kahneman & Frederick, 2002; Kahneman, 2003). According to the pure lax monitoring hypothesis, when people become aware of the normative rule, they will correct their judgments and respond accordingly, overriding their intuitive judgments (Kahneman, 2003).

A study conducted by Tormala and Petty (2004) that found that when people resist persuasion they perceive this resistance and become more certain of their initial attitudes, raises another hypothesis. Specifically, it could be the case that when the two modes of thinking are put into conflict people will not simply continue to use their initial activated response but trust it even more. This could happen because normative information would act as counterarguments regarding the intuitive response. Because people have to take those normative principles into account, and overcome them in order to make an intuitive decision, they will be more confident in it. That is, this conflict could have a paradoxical effect by reinforce the "disconfirmation" of the normative considerations, based on the intuitive judgments.

To test these hypotheses, we will direct the approach of our study to scenarios where the conflict between both responses, heuristic and normative, is clear and consciously perceived by participants. This way, we will be able to test if one of the ways through which people solve this conflict is by sustaining their responses on the shortcut, showing evidence of explicit heuristic processing, despite normative knowledge.

Bibliographic References

Ball, L. J., Philips, P., Wade, C. N., & Quayle, J. D. (2006). Effects of belief and logic on syllogistic reasoning: Eye-movement evidence for selective processing models. *Experimental Psychology, 53,* 77–86.

Bargh, J. A. (1997). The automaticity of everyday life. In R. S. Wyer, Jr. (Ed.). *The automaticity of everyday life: Advances in social cognition* (Vol. 10, pp.1–61). Mahwah, NJ: Erlbaum

Bargh, J. A., Bond, R. N., Lombardi, W. J., & Tota, M. E. (1986). The additive nature of chronic and temporary sources of construct accessibility. *Journal of Personality and Social Psychology, 50,* 869 – 878

Bonner, C. & Newell, B.R. (2010). In conflict with ourselves? An investigation of heuristic and analytic processes in decision making. *Memory & Cognition, 38,* 186-196.

Botvinick, M. M., Cohen, J. D., & Carter, C. S. (2004). Conflict monitoring and anterior cingulate cortex: An update. *Trends in Cognitive Sciences, 12,* 539-546

Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes. II: Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology, 65,* 5–17.

Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology.* New York: Guilford Press.

Denes-Raj, V., & Epstein, S. (1994). Conflict between experiential and rational processing: When people behave against their better judgment. *Journal of Personality and Social Psychology, 66,* 819-829.

De Neys, W. (2012). Bias and conflict: A case for logical intuitions. *Perspectives on Psychological Science, 7,* 28-38.

De Neys W, Cromheeke S, Osman M (2011) Biased but in Doubt: Conflict and Decision Confidence. *PLoS ONE, 6(1)*

De Neys, W., & Glumicic, T. (2008). Conflict monitoring in dual process theories of thinking. *Cognition, 106,* 1248–1299.

De Neys, W., Moyens, E., & Vansteenwegen, D. (2010). Feeling we're biased: Autonomic arousal and reasoning conflict. *Cognitive, Affective, and Behavioral Neuroscience, 10,* 208-216.

De Neys, W., Vartanian, O., & Goel, V. (2008). Smarter than we think: When our brains detect that we are biased. *Psychological Science, 19,* 483-489

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49(8),* 709–724.

Evans, J. St. B. T. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology, 59,* 255–278.

Gilovich, T., & Griffin, D. (2002). Introduction – Heuristics and Biases: Then and Now. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp.1–18). Cambridge: Cambridge University Press.

Gould, S. J. (1991). *Bully for brontosaurus: Reflections in natural history.* W. W. Norton.

Hammond, K. (2000). *Human judgment and social policy: Irreducible uncertainty, inevitable error, unavoidable injustice.* New York, NY: Oxford University Press

Heider, F. (1944). Social perception and phenomenal casuality. *Psychological Review, 51,* 358–374

Higgins, E. T. (1996). Knowledge activation: Accessibility, applicability, and salience. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 133–168). New York: Guilford PressTulving & Pearlstone.

Higgins, E.T., & Brendl, M. (1995). Accessibility and applicability: Some "activation rules" influencing judgment. *Journal of Experimental Social Psychology, 31,* 218-243

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30,* 513–541.

Jacoby, L. L. (1996). Dissociating automatic and consciously controlled effects of study/test compatibility. *Journal of Memory and Language, 35,* 32–52

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110,* 306–340.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58,* 697-720.

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In: T. Gilovich, D. Griffin & D. Kahneman (eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 49-81). New York: Cambridge University Press.

Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review, 93,* 136–153.

Kahneman, D., Ritov, I., & Schkade, D. (1999). Economic preferences or attitude expressions? An analysis of dollar responses to public issues. *Journal of Risk and Uncertainty, 19,* 220–242.

Kahneman, D., & Varey, C. A. (1990). Propensities and counterfactuals: The loser that almost won. *Journal of Personality and Social Psychology, 59,* 1101–1110.

Michotte, A. (1963). *The perception of causality* (T. R. Miles & E. Miles, Trans.). New York: Basic Books

Peterson, C. R., & Beach, L. R. (1967). Man as an intuitive statistician. *Psychological Bulletin, 68,* 29-46.

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45,* 513–523.

Schwarz, N., & Vaughn, L. A. (2002). The availability heuristic revisited: Ease of recall and content of recall as distinct sources of information. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp. 103–119). Cambridge: Cambridge University Press

Simon, H. A. (1955). A Behavioral Model of Rational Choice. *Quarterly Journal of Economics, 69(1),* 99–118.

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review, 63(2),* 129-138.

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin, 119,* 3–22.

Sloman, S. A. (2002). Two systems of reasoning. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp.379–396). Cambridge: Cambridge University Press.

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment* (pp.397–420). Cambridge: Cambridge University Press.

Stanovich, K. E. (2009). *What intelligence tests miss: The psychology of rational thought.* New Haven, CT: Yale University Press

Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate. *Behavioral and Brain Sciences, 23,* 645–665.

Strack, F., Martin, L. L., & Schwarz, N. (1988). Priming and communication: Social determinants of information use in judgments of life satisfaction. *European Journal of Social Psychology, 18,* 429-442.

Stupple, E. J. N., & Ball, L. J. (2008). Belief-logic conflict resolution in syllogistic reasoning: Inspection-time evidence for a parallel-process model. *Thinking & Reasoning, 14,* 168-181.

Thompson, V. A., Striemer, C. L., Reikoff, R., Gunter, R. W. & Campbell, J. I. D. (2003). Syllogistic reasoning time: Disconfirmation disconfirmed. *Psychonomic Bulletin & Review 10,* 184–189.

Tormala, Z.L., & Petty, R.E. (2004). Resistance to persuasion and attitude certainty: The moderating role of elaboration. *Personality and Social Psychology Bulletin, 30,* 1446-1457.

Tversky, A., Kahneman, D. (1971). Belief in the law of small numbers. *Psychological Bulletin, 76(2),* 105–110.

Tversky, A., & Kahneman, D. (1974). *Judgment under uncertainty: Heuristics and biases. Science, 185(4157),* 1124–1131.

Tversky, A., & Kahneman, D. (1983). Extensional vs. intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review, 90,* 293–3l5.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5(2),* 207–232.

Villejoubert, G. (2009). Are representativeness judgments automatic and rapid? The effect of time pressure on the conjunction fallacy. *Proceedings of the Annual Meeting of the Cognitive Science society, 30,* 2980-2985.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35,* 151–175.

Zajonc, R. B. (1997). Emotions. In D.T. Gilbert, S.T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th Ed., Vol. 1, pp. 591–632). New York: Oxford University Press.

Annex B – Reasoning tasks used and respective answers

Base-Rate Tasks

1. Num estudo foram testadas 1000 pessoas. Entre os participantes existem 5 pessoas com dezasseis anos de idade e 995 com cinquenta anos de idade. A Ana é uma participante deste estudo que foi escolhida aleatoriamente.
A Ana gosta de ouvir hip hop e rap. Ela usa habitualmente camisolas justas e calças de ganga. Ela adora dançar e tem um pequeno *piercing* no nariz.
O que é mais provável?

- A Ana tem 16 anos
- A Ana tem 50 anos

- **Heuristic:** A Ana tem 16 anos, uma vez que gosta de ouvir hip hop e rap e tem um *piercing* no nariz.
- **Heuristic (conflict):** A Ana tem 16 anos, uma vez que gosta de ouvir hip hop e rap e tem um *piercing* no nariz, mesmo apesar de existirem mais pessoas com 50 anos.
- **Normative:** A Ana tem 50 anos, porque existem mais pessoas com 50 anos.
- **Normative (conflict):** A Ana tem 50 anos, porque existem mais pessoas com 50 anos, mesmo apesar dela gostar de ouvir hip hop e rap e ter um *piercing* no nariz.

2. Num estudo foram testadas 1000 pessoas. Entre os participantes existem 6 engenheiros e 994 advogados. O João é um participante deste estudo que foi escolhido aleatoriamente.
O João tem 36 anos. É solteiro e algo introvertido. Ele gosta de passar o seu tempo livre a ler ficção científica e a escrever programas para computadores.
O que é mais provável?

- O João é um advogado
- O João é um engenheiro

- **Heuristic:** O João é um engenheiro, uma vez que gosta de ler ficção científica e de escrever programas para computadores.
- **Heuristic (conflict):** O João é um engenheiro, uma vez que gosta de ler ficção científica e de escrever programas para computadores, mesmo apesar de existirem mais advogados.
- **Normative:** O João é um advogado, porque existem mais advogados.
- **Normative (conflict):** O João é um advogado, porque existem mais advogados, mesmo apesar dele gostar de ler ficção científica e de escrever programas para computadores.

3. Num estudo foram testadas 1000 pessoas. Entre os participantes existem 3 pessoas que vivem num condomínio privado e 997 que vivem numa fazenda. O Carlos é um participante deste estudo que foi escolhido aleatoriamente.
O Carlos trabalha num banco e é solteiro. Ele trabalha durante várias horas e veste fatos Armani para o trabalho. Ele gosta de usar óculos escuros.
O que é mais provável?

- O Carlos vive num condomínio privado
- O Carlos vive numa fazenda

- **Heuristic:** O Carlos vive num condomínio privado, uma vez que trabalha num banco e veste fatos Armani para o trabalho.
- **Heuristic (conflict):** O Carlos vive num condomínio privado, uma vez que trabalha num banco e veste fatos Armani para o trabalho, mesmo apesar de existirem mais pessoas que vivem em fazendas.
- **Normative:** O Carlos vive numa fazenda, porque existem mais pessoas que vivem em fazendas.
- **Normative (conflict):** O Carlos vive numa fazenda, porque existem mais pessoas que vivem em fazendas, mesmo apesar dele trabalhar num banco e vestir fatos Armani para o trabalho.

4. Num estudo foram testadas 1000 pessoas. Entre os participantes existem 4 pessoas cuja série televisiva favorita é o Star Trek (ficção científica) e 996 cuja série de televisão favorita é a telenovela diária (drama). O Pedro é um participante deste estudo que foi escolhido aleatoriamente.
O Pedro tem 26 anos e está a tirar o curso de Engenharia Física. Ele passa a maior parte do tempo em casa e gosta de jogar vídeo-jogos.
O que é mais provável.

- A série favorita do Pedro é a telenovela diária (drama)
- A série favorita do Pedro é o Star Trek (ficção científica)

- **Heuristic:** A série favorita do Pedro é o Star Trek, uma vez que ele está a estudar Física e gosta de jogar vídeo-jogos.
- **Heuristic (conflict):** A série favorita do Pedro é o Star Trek, uma vez que ele está a estudar Física e gosta de jogar vídeo-jogos, mesmo apesar de existirem mais pessoas cuja série favorita é a telenovela diária.
- **Normative:** A série favorita do Pedro é a telenovela diária, porque existem mais pessoas cuja série favorita é a telenovela diária.
- **Normative (conflict):** A série favorita do Pedro é a telenovela diária, porque existem mais pessoas cuja série favorita é a telenovela diária, mesmo apesar dele estar a estudar Física e gostar de jogar vídeo-jogos.

Conjunction Tasks (adapted from De Neys et al., 2011)

1. O Ricardo tem 16 anos. Ele veste roupas antiquadas. Ele estuda muito e é o aluno preferido da professora. Ele não tem muitos amigos e não tem sucesso com as raparigas.
O que é mais provável?

- O Ricardo vai muitas vezes a festas
- O Ricardo vai muitas vezes a festas e é vítima de bullying.

- **Heuristic:** O Ricardo vai muitas vezes a festas e é vítima de bullying, uma vez que é o aluno preferido da professora e não tem muitos amigos.
- **Heuristic (conflict):** O Ricardo vai muitas vezes a festas e é vítima de bullying, uma vez que é o aluno preferido da professora e não tem muitos amigos, mesmo apesar de apenas um número de alunos que vão muitas vezes a festas serem vítimas de bullying.
- **Normative:** O Ricardo apenas vai muitas vezes a festas, porque somente um pequeno número de alunos que vão muitas vezes a festas são vítimas de bullying.
- **Normative (conflict):** O Ricardo apenas vai muitas vezes a festas, porque somente um pequeno número de alunos que vão muitas vezes a festas são vítimas de bullying, mesmo apesar dele ser o aluno preferido da professora e de não ter muitos amigos.

2. O Jaime tem 26 anos. Ele vive em Cascais. Ele gosta de usar roupas de grandes estilistas e age de forma um tanto arrogante. Aos Domingos, ele joga golfe com o seu pai.
O que é mais provável?

- O Jaime é voluntário num Centro de Dia no seu tempo livre e é corrector de acções na bolsa
- O Jaime é voluntário num Centro de Dia no seu tempo livre

- **Heuristic:** O Jaime é voluntário num Centro de Dia no seu tempo livre e é corrector de acções na bolsa, uma vez que usa roupas de grandes estilistas e aos Domingos joga golfe com o pai.
- **Heuristic (conflict):** O Jaime é voluntário num Centro de Dia no seu tempo livre e é corrector de acções na bolsa, uma vez que usa roupas de grandes estilistas e aos Domingos joga golfe com o pai, mesmo apesar de apenas uma porção de voluntários nos Centros de Dia serem correctores de acções.
- **Normative:** O Jaime apenas é voluntário num Centro de Dia no seu tempo livre, porque somente uma porção de voluntários nos Centros de Dia são correctores de acções na bolsa.
- **Normative (conflict):** O Jaime apenas é voluntário num Centro de Dia no seu tempo livre, porque somente uma porção de voluntários nos Centros de Dia são correctores de acções, mesmo apesar de usar roupas de grandes estilistas e aos Domingos jogar golfe com o pai.

3. O Joaquim tem 20 anos. Ele cresceu numa família pobre num bairro negligenciado. Ele é muito violento e já cumpriu uma pequena pena na prisão.
O que é mais provável?

- O Joaquim toca violino
- O Joaquim toca violino e está no desemprego

- **Heuristic:** O Joaquim toca violino e está no desemprego, uma vez que é muito violento e já cumpriu pena na prisão.
- **Heuristic (conflict):** O Joaquim toca violino e está no desemprego, uma vez que é muito violento e já cumpriu pena na prisão, mesmo apesar de apenas um número de pessoas que toca violino estar no desemprego.
- **Normative:** O Joaquim apenas toca violino, porque somente um número de pessoas que toca violino está no desemprego.
- **Normative (conflict):** O Joaquim apenas toca violino, porque somente um número de pessoas que toca violino está no desemprego, mesmo apesar de ser muito violento e já ter cumprido pena na prisão.

4. O Júlio tem 32 anos. É inteligente, pontual mas sem imaginação e algo sem vida. Na escola, era bom a matemática mas fraco em línguas e arte.
O que é mais provável?

- O Júlio toca numa banda de rock e é contabilista
- O Júlio toca numa banda de rock

- **Heuristic:** O Júlio toca numa banda rock e é contabilista, uma vez que tem pouca imaginação e na escola era bom a matemática e fraco em línguas e arte.
- **Heuristic (conflict):** O Júlio toca numa banda rock e é contabilista, uma vez que tem pouca imaginação e na escola era bom a matemática e fraco em línguas e arte, mesmo apesar de apenas uma porção de pessoas que tocam em bandas de rock serem contabilistas.
- **Normative:** O Júlio apenas toca numa banda de rock, porque somente uma porção de pessoas que tocam em bandas de rock são contabilistas.
- **Normative (conflict):** O Júlio apenas toca numa banda de rock, porque somente uma porção de pessoas que tocam em bandas de rock são contabilistas, mesmo apesar dele ter pouca imaginação e de na escola ter sido bom a matemática e fraco em línguas e arte.

Syllogism Tasks (adapted from De Neys et al., 2010)

1. Todas as flores precisam de luz
As rosas precisam de luz
Logo, as rosas são flores
A conclusão decorre logicamente das premissas? Sim; Não
(Invalid/Believable)

- **Heuristic:** Sim, uma vez que as rosas são flores.
- **Heuristic (conflict):** Sim, uma vez que as rosas são flores, mesmo apesar do facto de todas as flores e as rosas precisarem de luz não implicar que as rosas sejam flores.
- **Normative:** Não, uma vez que o facto de todas as flores e as rosas precisarem de luz não implica que as rosas sejam flores.
- **Normative (conflict):** Não, uma vez que o facto de todas as flores e as rosas precisarem de luz não implica que as rosas sejam flores, mesmo apesar das rosas serem flores.

2. Todos os mamíferos conseguem andar
As baleias são mamíferos
Logo, as baleias conseguem andar
A conclusão decorre logicamente das premissas? Sim; Não
(Valid/Unbelievable)

- **Heuristic:** Não, uma vez que as baleias não conseguem andar.
- **Heuristic (conflict):** Não, uma vez que as baleias não conseguem andar, mesmo apesar da primeira afirmação excluir a hipótese de nenhum mamífero não conseguir andar.
- **Normative:** Sim, uma vez que a primeira afirmação exclui a hipótese de nenhum mamífero não conseguir andar.
- **Normative (conflict):** Sim, uma vez que a primeira afirmação exclui a hipótese de nenhum mamífero não conseguir andar, mesmo apesar do facto de as baleias não conseguem andar.

3. Todos os cães têm focinhos
Os labradores têm focinhos
Logo, os labradores são cães
A conclusão decorre logicamente das premissas? Sim; Não
(Invalid/Believable)

- **Heuristic:** Sim, uma vez que os labradores são cães.
- **Heuristic (conflict):** Sim, uma vez que os labradores são cães, mesmo apesar do facto de todos os cães e os labradores terem focinhos não implicar que os labradores sejam cães.
- **Normative:** Não, uma vez que o facto de todos os cães e os labradores terem focinhos não implica que os labradores sejam cães.
- **Normative (conflict):** Não, uma vez que o facto de todos os cães e os labradores terem focinhos não implica que os labradores sejam cães, mesmo apesar dos labradores serem cães.

4. Todos os veículos têm rodas
Um barco é um veículo
Logo, um barco tem rodas
A conclusão decorre logicamente das premissas? Sim; Não
(Valid/ Unbelievable)

- **Heuristic:** Não, uma vez que os barcos não têm rodas.
- **Heuristic (conflict):** Não, uma vez que os barcos não têm rodas, mesmo apesar da primeira afirmação excluir a hipótese de nenhum veículo não ter rodas.
- **Normative:** Sim, uma vez que a primeira afirmação exclui a hipótese de nenhum veículo não ter rodas.
- **Normative (conflict):** Sim, uma vez que a primeira afirmação exclui a hipótese de nenhum veículo não ter rodas, mesmo apesar do facto dos barcos não terem rodas.

Ratio-Bias Tasks (adapted from Denes-Raj and Epstein, 1994)

1. A Maria foi a um concurso televisivo, no qual terá de escolher entre dois conjuntos de envelopes. No conjunto A, existem 100 envelopes, 9 dos quais premiados. No conjunto B, existem 10 envelopes, havendo 1 premiado. A Maria poderá ganhar 1,000€ se retirar um envelope premiado de um dos dois conjuntos.
O que deverá a Maria fazer?

- Retirar um envelope do conjunto A.
- Retirar um envelope do conjunto B.

- **Heuristic:** A Maria deverá retirar um envelope do conjunto A, uma vez que neste conjunto existem mais envelopes premiados do que no conjunto B.
- **Heuristic (conflict):** A Maria deverá retirar um envelope do conjunto A, uma vez que neste conjunto existem mais envelopes premiados do que no conjunto B, mesmo apesar da proporção de envelopes premiados ser menor no conjunto A
- **Normative:** A Maria deverá retirar um envelope do conjunto B, uma vez que a proporção de envelopes premiados é maior neste conjunto.
- **Normative (conflict):** A Maria deverá retirar um envelope do conjunto B, porque a proporção de envelopes premiados é maior neste conjunto, mesmo apesar de existirem mais envelopes premiados no conjunto A do que no conjunto B.

2. A Maria foi a um concurso televisivo, no qual terá de escolher entre dois sacos contendo várias fichas. No saco A existem 10 fichas de poker, havendo 1 ficha vermelha. No saco B existem 100 fichas de poker, 7 das quais vermelhas. A Maria poderá ganhar 1,000€ se extrair uma ficha vermelha de um dos dois sacos.
O que deverá a Maria fazer?

- Retirar uma ficha ao acaso do saco A
- Retirar uma ficha ao acaso do saco B

- **Heuristic:** A Maria deverá retirar uma ficha do saco B, uma vez que neste saco existem mais fichas vermelhas do que no saco A.
- **Heuristic (conflict):** A Maria deverá retirar uma ficha do saco B, uma vez que neste saco existem mais fichas vermelhas do que no saco A, mesmo apesar da proporção de fichas vermelhas ser menor no conjunto B.
- **Normative:** A Maria deverá retirar uma ficha do saco A, uma vez que a proporção de fichas vermelhas é maior neste saco.
- **Normative (conflict):** A Maria deverá retirar uma ficha do saco A, uma vez que a proporção de fichas vermelhas é menor no conjunto B, mesmo apesar de existirem mais fichas vermelhas no saco B do que no saco A.

3. A Maria foi a um concurso televisivo, no qual terá de escolher entre duas urnas contendo várias bolas. Na urna A existem 100 bolas, 8 das quais vermelhas. Na urna B existem 10 bolas, havendo 1 bola vermelha. A Maria poderá ganhar 1,000€ se retirar uma bola vermelha de um dos dois sacos.
O que deverá a Maria fazer?

- Retirar uma bola ao acaso da urna A.
- Retirar uma bola ao acaso da urna B.

- **Heuristic:** A Maria deverá retirar uma bola da urna A, uma vez que nesta urna existem mais bolas vermelhas do que na urna B.
- **Heuristic (conflict):** A Maria deverá retirar uma bola da urna A, uma vez que nesta urna existem mais bolas vermelhas do que na urna B, mesmo apesar da proporção de bolas vermelhas ser menor na urna A.
- **Normative:** A Maria deverá retirar uma bola da urna B, uma vez que a proporção de bolas vermelhas é maior neste conjunto.
- **Normative (conflict):** A Maria deverá retirar uma bola da urna B, uma vez que a proporção de bolas vermelhas é menor na urna A, mesmo apesar de existirem mais bolas vermelhas na urna A do que na urna B.

4. A Maria foi a um concurso televisivo, no qual terá de escolher entre duas máquinas contendo vários berlindes. Na máquina A existem 10 berlindes, havendo 1 berlinde vermelho. Na urna B existem 100 berlindes, 5 dos quais vermelhos. A Maria poderá ganhar 1,000€ se for seleccionado um berlinde vermelho de uma das duas máquinas
O que deverá a Maria fazer?

- Retirar um berlinde da máquina A.
- Retirar um berlinde da máquina B.

- **Heuristic:** A Maria deverá retirar um berlinde da máquina B, uma vez que nesta existem mais berlindes vermelhos do que na máquina A.
- **Heuristic (conflict):** A Maria deverá retirar um berlinde da máquina B, uma vez que nesta existem mais berlindes vermelhos do que na máquina A, mesmo apesar da proporção de berlindes vermelhos ser menor na máquina B.
- **Normative:** A Maria deverá retirar um berlinde da máquina A, uma vez que a proporção de berlindes vermelhos é maior neste conjunto.
- **Normative (conflict):** A Maria deverá retirar um berlinde da máquina A, uma vez que a proporção de berlindes vermelhos é maior nesta máquina, mesmo apesar de existirem mais berlindes vermelhos na máquina B do que na máquina A.

Annex C – Need for Cognition Scale (Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984), adapted to the Portuguese population by Silva and Garcia-Marques (2006)

Need for Cognition Scale – Portuguese Version

1. Prefiro problemas complexos aos simples.
2. Gosto de ter a responsabilidade de lidar com situações em que é preciso pensar muito.
3. Pensar não me diverte.
4. Prefiro fazer algo que não me obrigue a pensar, em vez de algo que desafie a minha capacidade de pensar.
5. Tento antecipar e evitar situações onde é provável que eu tenha que pensar profundamente sobre alguma coisa.
6. Reflectir muito e por muito tempo, é algo que me satisfaz.
7. Penso apenas tão profundamente quanto necessário.
8. Prefiro pensar em pequenos projectos e imediatos, a pensar em projectos a longo prazo.
9. Gosto de tarefas que, uma vez aprendidas, não requerem muito pensamento.
10. A noção de depender do pensamento para ter sucesso atrai-me.
11. Gosto muito de uma tarefa que envolva a descoberta de soluções novas para problemas.
12. Aprender novas maneiras de pensar não me entusiasma muito.
13. Prefiro que a minha vida esteja cheia de quebra-cabeças para resolver.
14. Considero apelativo pensar de modo abstracto.
15. Prefiro uma tarefa que seja intelectual, difícil e importante a uma que seja algo importante mas que não requeira muito pensamento.
16. Sinto alívio em vez de satisfação quando completo uma tarefa que requer muito esforço mental.
17. Para mim é suficiente que a tarefa seja feita, não me interessa como e porque é que é feita.
18. Dou por mim frequentemente a reflectir sobre assuntos, mesmo quando estes não me dizem respeito.

Annex D – Faith in Intuition Scale (Epstein, Pacini, Denes-Raj, & Heier, 1996), adapted to the Portuguese population by Silva and Garcia-Marques (2006)

Faith in Intuition Scale – Portuguese Version

1. Confio nas minhas primeiras impressões sobre as pessoas.
2. Creio poder confiar nos meus palpites.
3. As minhas primeiras impressões acerca dos outros estão sempre quase certas.
4. No que se refere a confiar nas pessoas, geralmente confio nos meus instintos.
5. Geralmente consigo sentir se uma pessoa está certa ou errada, mesmo sem conseguir explicar como.

Annex E – Bias Blind-Spot Questionnaire (West, Meserve & Stanovich, 2012)

1. Outcome Bias/Enviesamento pelo resultado

Os psicólogos descobriram que as pessoas tendem a julgar a qualidade de uma decisão baseando-se em como a decisão resultou. Isto é, as pessoas esquecem-se por vezes que a qualidade de uma decisão deve ser julgada pelo que se sabia no momento em que a decisão foi tomada, e não pelo seu resultado, uma vez que por resultado não é conhecido no momento da decisão. É um erro julgar a capacidade de um decisor, após o facto, baseando-se essencialmente no resultado dessa decisão. Quando as pessoas fazem isto, tal é designado de enviesamento pelo resultado.

a. Até que ponto acredita que é provável que cometa o enviesamento pelo resultado?
b. Até que ponto acredita que um aluno médio do ISPA é provável de cometer o enviesamento pelo resultado?

2. Framing Effect/Efeito de enquadramento

Os psicólogos têm demonstrado que as pessoas tendem a avaliar frases, argumentos, ou políticas de forma diference consoante a escolha de palavras. Isto significa que as opiniões das pessoas relativamente à mesma política ou decisão ou produto podem ser manipuladas através de ligeiras alterações no texto que não mudam o significado. Por exemplo, um artigo alimentar designado como "98% livre de gordura" é julgado como mais atractivo do que um designado como "contém 2% de gordura". Quando as opiniões das pessoas são manipuladas baseando-se numa reformulação que não altera o significado, tal é denominado de efeito de enquadramento.

a. Até que ponto acredita que é provável que seja susceptível aos efeitos de enquadramento?
b. Até que ponto acredita que um aluno médio do ISPA é provável de ser susceptível aos efeitos de enquadramento?

3. Base-Rate Neglect/Insensibilidade à probabilidade prévia

Os psicólogos têm demonstrado que as pessoas tendem a ignorar probabilidades gerais quando estão a julgar o quão provável uma coisa é, e em vez disso, focam-se demasiado na situação específica. Por exemplo, quando as pessoas julgam a probabilidade de um ataque de tubarão, estas tendem a focar-se numa notícia de um único ataque, em vez de se focarem no facto de que apesar de vários milhões de pessoas nadarem no oceano, apenas algumas são mortas por tubarões todos os anos. Quando as pessoas se focam no exemplo específico e ignoram a probabilidade geral, tal é designado de insensibilidade à probabilidade prévia.

a. Até que ponto acredita que é provável que cometa a insensibilidade à probabilidade prévia?
b. Até que ponto acredita que um aluno médio do ISPA é provável de cometer a insensibilidade à probabilidade prévia?

4. Conjunction Error/Erro de conjunção

Os psicólogos descobriram que as pessoas tendem a classificar conjunções de eventos (situações em que dois ou mais eventos ocorrem juntos) como muito prováveis. As conjunções de eventos tornam-se menos prováveis à medida que o número de eventos aumenta. Por exemplo, (A) as pessoas estimam que no próximo ano existe 1% de probabilidade de que um incêndio na Califórnia irá matar 200 pessoas. Ao mesmo tempo, (B) as pessoas estimam que no próximo ano existe 3% de probabilidade de que um terramoto na Califórnia irá provocar um incêndio que matará 200 pessoas. No entanto, se o Evento B (terramoto e incêndio) ocorrer, então o Evento A (incêndio) também ocorre, logo o Evento A não pode ser menos provável. Quando as pessoas não conseguem diminuir as probabilidades à medida que o número de eventos conjuntos aumenta, tal é designado denominado de erro de conjunção.

a. Até que ponto acredita que é provável que seja susceptível ao erro de conjunção?
b. Até que ponto acredita que um aluno médio do ISPA é provável de ser susceptível ao erro de conjunção?

5. Anchoring and Adjustment/Efeitos de ancoragem

Os psicólogos descobriram que quando as pessoas fazem estimativas numéricas estas tendem a focar-se em qualquer número que esteja disponível para os ajudar. Isto é uma boa estratégia, excepto em situações em que os números disponíveis não estão relacionados com a quantidade que estamos a tentar estimar. Por exemplo, as pessoas reportam menos dores de cabeça quando lhes é perguntado: "Quantas dores de cabeça tem por mês -0, 1, 2- quantas?" do que quando lhes é perguntado: "Quantas dores de cabeça tem por mês -5, 10, 15- quantas?" Quando as nossas estimativas são afectadas por quantidades que são irrelevantes para o que estamos a estimar, tal é designado de efeito de ancoragem.

a. Até que ponto acredita que é provável que seja susceptível aos efeitos de ancoragem?
b. Até que ponto acredita que um aluno médio do ISPA é provável de ser susceptível aos efeitos de ancoragem?

6. Myside Bias/Enviesamento pelo meu ponto de vista

Os psicólogos descobriram que as pessoas não avaliam as evidências de forma razoável quando têm já uma opinião sobre o assunto. Isto é, tendem a avaliar as evidências como sendo mais favoráveis à sua própria opinião do que realmente são. Quando isto acontece, tal é designado de enviesamento pelo meu ponto de vista.

a. Até que ponto acredita que é provável que seja susceptível a este enviesamento?
b. Até que ponto acredita que um aluno médio do ISPA é provável de ser susceptível a este enviesamento?

7. Cell Phone Hazard

Os investigadores têm demonstrado que os condutores têm uma probabilidade quatro vezes maior de se envolverem num acidente de viação sério durante os momentos em que estão a falar ao telemóvel enquanto conduzem. Este efeito foi designado de "cell phone hazard".

a. Até que ponto acredita que é (ou seria mais provável de ser) mais perigoso quando conduz enquanto usa o telemóvel?
b. Até que ponto acredita que um aluno médio do ISPA é (ou seria mais provável de ser) mais perigoso quando conduz enquanto usa o telemóvel?

Annex F – Outputs from Statistical Analyses Performed

Output 1 – Descriptive Statistics of the Sample

Descriptive Statistics

	Valid N	Mean	Minimum	Maximum	Std.Dev.
Age	91	22,85556	18,00000	56,00000	7,081486

Frequency table: Gender

	Count	Cumulative - Count	Percent	Cumulative - Percent
Female	70	70	76,92308	76,9231
Male	21	91	23,07692	100,0000

Output 2 – T-Student for checking measure regarding the two different keyboard keys used for agreement

T-test for Dependent Samples Marked differences are significant at p < ,05000

	Mean	Std.Dv.	N	Diff.	Std.Dv. - Diff.	t	df	p
Control_RT_L	861,6241	350,1307						
Control_RT_S	803,0163	266,4305	49	58,6078	314,2088	1,30567	48	0,197887

Output 3 – T-Student for Need for Cognition and Faith in Intuition Order effects

T-tests; Grouping: NFC_FI_order
Group 1: NFC-FI Group 2: FI-NFC

	Mean - NFC-FI	Mean - FI-NFC	t-value	df	p	Valid N - NFC-FI	Valid N - FI-NFC	Std.Dev. - NFC-FI	Std.Dev. - FI-NFC	F-ratio - Variances	p - Variances
NFC	3,526005	3,387626	1,365607	89	0,175504	47	44	0,442910	0,522600	1,392221	0,271413
FaithInt	3,489362	3,454545	0,233274	89	0,816084	47	44	0,789946	0,616613	1,641231	0,103896

Output 4 – T-Student for Bias Blind Spot composite order effects

T-tests; Grouping: BBS_order: Self/Other
Group 1: Self-Other Group 2: Other-Self

	Mean – Self-Other	Mean - Other-Self	t-value	df	p	Valid N Self-Other	Valid N - Other-Self	Std.Dev. - Self-Other	Std.Dev. - Other-Self	F-ratio - Variances	p - Variances
BBS composite	-0,255319	0,619048	-1,13815	87	0,258182	47	42	3,158619	4,072228	1,662148	0,095257

Output 5 – Multiple regression analyses controlling for all predictors, having as dependent variables agreement and reliability

Base-Rates

	Parameter Estimates Sigma-restricted parameterization					
	BR_Agreem - t	**BR_Agreem - p**	**BR_Agreem - Beta (ß)**	**BR_Rel - t**	**BR_Rel - p**	**BR_Rel - Beta (ß)**
Intercept	10,66525	0,000000		7,64632	0,000000	
Order	0,73455	0,464590	0,118346	0,98443	0,327632	0,226206
Conflict	0,80455	0,423275	0,058228	1,20877	0,230027	0,124771
BR	-5,21344	0,000001	-0,839916	-1,82982	0,070702	-0,420441

Conjunctions

	Parameter Estimates Sigma-restricted parameterization					
	Conj_Agreem - t	**Conj_Agreem - p**	**Conj_Agreem - Beta (ß)**	**Conj_Rel - t**	**Conj_Rel - p**	**Conj_Rel - Beta (ß)**
Intercept	3,07990	0,002771		2,392589	0,018882	
Order	-0,76593	0,445793	-0,164912	0,497606	0,620017	0,117293
Conflict	0,39458	0,694118	0,038164	-0,724934	0,470438	-0,076760
Conj	-2,64997	0,009561	-0,570538	-0,099056	0,921322	-0,023348

Syllogisms

	Parameter Estimates Sigma-restricted parameterization					
	Sil_Agreem - t	**Sil_Agreem - p**	**Sil_Agreem - Beta (ß)**	**Sil_Rel - t**	**Sil_Rel - p**	**Sil_Rel - Beta (ß)**
Intercept	0,232892	0,816393		3,082750	0,002747	
Order	1,370261	0,174131	0,302207	-0,015370	0,987772	-0,003585
Conflict	2,633895	0,009990	0,260946	0,101886	0,919081	0,010675
Syll	0,135586	0,892461	0,029902	-0,923537	0,358282	-0,215393

Ratio-Bias

	Parameter Estimates Sigma-restricted parameterization					
	RB_Agreem - t	**RB_Agreem - p**	**RB_Agreem - Beta (ß)**	**RB_Rel - t**	**RB_Rel - p**	**RB_Rel - Beta (ß)**
Intercept	-0,999965	0,320101		3,545624	0,000633	
Order	0,431284	0,667329	0,088760	-0,504217	0,615383	-0,114661
Conflict	1,399401	0,165248	0,129374	0,648095	0,518631	0,066205
RB	1,979280	0,050946	0,407326	1,732416	0,086743	0,393941

Output 6 – Test of Normality for the Agreement variable regarding Base-Rate tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Base-Rate: Agreement	1 1	,334	24	,000	,695	24	,000
	1 2	,351	23	,000	,704	23	,000
	2 1	,339	22	,000	,693	22	,000
	2 2	,280	22	,000	,796	22	,000

a. Lilliefors Significance Correction

Output 7 – Test of Normality for the Agreement variable regarding Conjunction tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Conjunction: Agreement	1 1	,298	23	,000	,854	23	,003
	1 2	,260	24	,000	,853	24	,003
	2 1	,240	22	,002	,882	22	,013
	2 2	,215	22	,010	,887	22	,017

a. Lilliefors Significance Correction

Output 8 – Test of Normality for the Agreement variable regarding Syllogism tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Syllogism: Agreement	1 1	,177	23	,061	,908	23	,038
	1 2	,197	24	,017	,896	24	,018
	2 1	,258	22	,001	,877	22	,011
	2 2	,181	22	,060	,906	22	,040

a. Lilliefors Significance Correction

Output 9 – Test of Normality for the Agreement variable regarding Ratio-Bias tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Ratio-Bias: Agreement	1 1	,312	24	,000	,720	24	,000
	1 2	,267	23	,000	,800	23	,000
	2 1	,196	22	,028	,870	22	,008
	2 2	,340	22	,000	,709	22	,000

a. Lilliefors Significance Correction

Output 10 – Test of Homogeneity of Variance for the Agreement variable regarding Base-Rate tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Base-Rate: Agreement	Based on Mean	1,472	3	87	,228
	Based on Median	,672	3	87	,572
	Based on Median and with adjusted df	,672	3	81,976	,572
	Based on trimmed mean	1,124	3	87	,344

Output 11 – Test of Homogeneity of Variance for the Agreement variable regarding Conjunction tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Conjunction: Agreement	Based on Mean	,577	3	87	,632
	Based on Median	,061	3	87	,980
	Based on Median and with adjusted df	,061	3	74,919	,980
	Based on trimmed mean	,495	3	87	,687

Output 12 – Test of Homogeneity of Variance for the Agreement variable regarding Syllogism tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Syllogism: Agreement	Based on Mean	1,444	3	87	,236
	Based on Median	1,292	3	87	,282
	Based on Median and with adjusted df	1,292	3	81,747	,283
	Based on trimmed mean	1,483	3	87	,225

Output 13 – Test of Homogeneity of Variance for the Agreement variable regarding Ratio-Bias tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Ratio-Bias: Agreement	Based on Mean	1,680	3	87	,177
	Based on Median	,828	3	87	,482
	Based on Median and with adjusted df	,828	3	65,695	,483
	Based on trimmed mean	1,626	3	87	,189

Output 14 – Test of Normality for the Reliability variable regarding Base-Rate tasks

Tests of Normality

	Reliabity	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Base-Rate: Reliability	1 1	,132	24	,200*	,953	24	,317
	1 2	,100	23	,200*	,946	23	,246
	2 1	,117	22	,200*	,957	22	,436
	2 2	,175	22	,076	,930	22	,123

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 15 – Test of Normality for the Reliability variable regarding Conjunction tasks

Tests of Normality

	Reliabity	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Conjunction Reliability	1 1	,133	23	,200*	,928	23	,101
	1 2	,143	24	,200*	,953	24	,317
	2 1	,121	22	,200*	,977	22	,865
	2 2	,200	22	,023	,891	22	,020

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 16 – Test of Normality for the Reliability variable regarding Syllogism tasks

Tests of Normality

	Reliabity	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Syllogism: Reliability	1 1	,178	23	,058	,859	23	,004
	1 2	,117	24	,200*	,949	24	,258
	2 1	,175	22	,077	,918	22	,068
	2 2	,129	22	,200*	,943	22	,231

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 17 – Test of Normality for the Reliability variable regarding Ratio-Bias tasks

Tests of Normality

	Reliabity	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Ratio-Bias: Reliability	1 1	,208	24	,009	,868	24	,005
	1 2	,203	23	,015	,847	23	,002
	2 1	,144	22	,200*	,943	22	,225
	2 2	,184	22	,052	,828	22	,001

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 18 – Test of Homogeneity of Variance for the Reliability variable regarding Base-Rate tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Base-Rate: Reliability	Based on Mean	2,379	3	87	,075
	Based on Median	2,002	3	87	,120
	Based on Median and with adjusted df	2,002	3	71,325	,121
	Based on trimmed mean	2,355	3	87	,078

Output 19 – Test of Homogeneity of Variance for the Reliability variable regarding Conjunction tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Conjunction: Reliability	Based on Mean	3,028	3	87	,034
	Based on Median	2,341	3	87	,079
	Based on Median and with adjusted df	2,341	3	80,009	,079
	Based on trimmed mean	3,226	3	87	,026

Output 20 – Test of Homogeneity of Variance for the Reliability variable regarding Syllogism tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Syllogism: Reliability	Based on Mean	1,860	3	87	,142
	Based on Median	1,933	3	87	,130
	Based on Median and with adjusted df	1,933	3	84,162	,130
	Based on trimmed mean	1,837	3	87	,146

Output 21 – Test of Homogeneity of Variance for the Reliability variable regarding Ratio-Bias tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Ratio-Bias: Reliability	Based on Mean	3,889	3	87	,012
	Based on Median	1,856	3	87	,143
	Based on Median and with adjusted df	1,856	3	77,378	,144
	Based on trimmed mean	3,766	3	87	,014

Output 22 – Test of Normality for the Agreement Latency Times variable regarding Base-Rate tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Base-Rate LT: Agreement	1 1	,103	24	,200*	,964	24	,532
	1 2	,219	23	,006	,701	23	,000
	2 1	,120	22	,200*	,915	22	,060
	2 2	,096	22	,200*	,963	22	,557

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 23 – Test of Normality for the Agreement Latency Times variable regarding Conjunction tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Conjunction LT: Agreement	1 1	,119	23	,200*	,955	23	,363
	1 2	,175	24	,055	,886	24	,011
	2 1	,210	22	,013	,920	22	,076
	2 2	,176	22	,075	,951	22	,327

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 24 – Test of Normality for the Agreement Latency Times variable regarding Syllogism tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Syllogism LT: Agreement	1 1	,233	23	,002	,896	23	,021
	1 2	,139	24	,200*	,935	24	,124
	2 1	,140	22	,200*	,946	22	,260
	2 2	,219	22	,008	,884	22	,014

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 25 – Test of Normality for the Agreement Latency Times variable regarding Ratio-Bias tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Ratio-Bias LT: Agreement	1 1	,168	24	,077	,909	24	,034
	1 2	,291	23	,000	,798	23	,000
	2 1	,221	22	,007	,904	22	,036
	2 2	,141	22	,200*	,944	22	,237

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 26 – Test of Homogeneity of Variance for the Agreement Latency Times variable regarding Base-Rate tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Base-Rate: Agreement LT	Based on Mean	,725	3	87	,540
	Based on Median	,767	3	87	,516
	Based on Median and with adjusted df	,767	3	72,711	,516
	Based on trimmed mean	,801	3	87	,497

Output 27 – Test of Homogeneity of Variance for the Agreement Latency Times variable regarding Conjunction tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Conjunction: Agreement LT	Based on Mean	3,000	3	87	,035
	Based on Median	2,089	3	87	,108
	Based on Median and with adjusted df	2,089	3	65,665	,110
	Based on trimmed mean	2,806	3	87	,044

Output 28 – Test of Homogeneity of Variance for the Agreement Latency Times variable regarding Syllogism tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Syllogism: Agreement LT	Based on Mean	9,736	3	87	,000
	Based on Median	7,954	3	87	,000
	Based on Median and with adjusted df	7,954	3	70,123	,000
	Based on trimmed mean	9,873	3	87	,000

Output 29 – Test of Homogeneity of Variance for the Agreement Latency Times variable regarding Ratio-Bias tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Ratio-Bias: Agreement LT	Based on Mean	2,305	3	87	,082
	Based on Median	1,261	3	87	,293
	Based on Median and with adjusted df	1,261	3	71,639	,294
	Based on trimmed mean	2,050	3	87	,113

Output 30 – Test of Normality for the Reliability Latency Times variable regarding Base-Rate tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Base-Rate LT: Reliability	1 1	,147	24	,192	,908	24	,031
	1 2	,170	23	,084	,848	23	,002
	2 1	,187	22	,044	,825	22	,001
	2 2	,177	22	,072	,907	22	,040

a. Lilliefors Significance Correction

Output 31 – Test of Normality for the Reliability Latency Times variable regarding Conjunction tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Conjunction LT: Reliability	1 1	,139	23	,200*	,942	23	,200
	1 2	,229	24	,002	,814	24	,001
	2 1	,192	22	,034	,832	22	,002
	2 2	,197	22	,026	,889	22	,018

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 32 – Test of Normality for the Reliability Latency Times variable regarding Syllogism tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Syllogism LT: Reliability	1 1	,252	23	,001	,709	23	,000
	1 2	,268	24	,000	,641	24	,000
	2 1	,269	22	,000	,686	22	,000
	2 2	,251	22	,001	,822	22	,001

a. Lilliefors Significance Correction

Output 33 – Test of Normality for the Reliability Latency Times variable regarding Ratio-Bias tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Ratio-Bias LT: Reliability	1 1	,216	24	,005	,828	24	,001
	1 2	,106	23	,200*	,931	23	,115
	2 1	,218	22	,008	,915	22	,059
	2 2	,168	22	,105	,919	22	,074

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 34 – Test of Homogeneity of Variance for the Reliability Latency Times variable regarding Base-Rate tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Base-Rate: Reliability LT	Based on Mean	3,130	3	87	,030
	Based on Median	2,208	3	87	,093
	Based on Median and with adjusted df	2,208	3	64,116	,096
	Based on trimmed mean	2,898	3	87	,040

Output 35 – Test of Homogeneity of Variance for the Reliability Latency Times variable regarding Conjunction tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Conjunction: Reliability LT	Based on Mean	4,985	3	87	,003
	Based on Median	3,403	3	87	,021
	Based on Median and with adjusted df	3,403	3	45,287	,025
	Based on trimmed mean	4,027	3	87	,010

Output 36 – Test of Homogeneity of Variance for the Reliability Latency Times variable regarding Syllogism tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Syllogism: Reliability LT	Based on Mean	3,070	3	87	,032
	Based on Median	1,721	3	87	,169
	Based on Median and with adjusted df	1,721	3	60,723	,172
	Based on trimmed mean	2,043	3	87	,114

Output 37 – Test of Homogeneity of Variance for the Reliability Latency Times variable regarding Ratio-Bias tasks

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Ratio-Bias: Reliability LT	Based on Mean	8,267	3	87	,000
	Based on Median	6,170	3	87	,001
	Based on Median and with adjusted df	6,170	3	50,865	,001
	Based on trimmed mean	7,511	3	87	,000

Output 38 – Test of Normality for the Agreement Latency Times (log) variable regarding Base-Rate tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Base-Rate LT(log): Agreement	1 1	,156	24	,137	,925	24	,074
	1 2	,122	23	,200*	,927	23	,093
	2 1	,124	22	,200*	,942	22	,221
	2 2	,170	22	,098	,916	22	,063

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 39 – Test of Normality for the Agreement Latency Times (log) variable regarding Conjunction tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Conjunction LT(log): Agreement	1 1	,129	23	,200*	,929	23	,104
	1 2	,100	24	,200*	,972	24	,726
	2 1	,146	22	,200*	,941	22	,205
	2 2	,131	22	,200*	,937	22	,169

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 40 – Test of Normality for the Agreement Latency Times (log) variable regarding Syllogism tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Syllogism LT(log): Agreement	1 1	,159	23	,139	,969	23	,670
	1 2	,239	24	,001	,919	24	,057
	2 1	,141	22	,200*	,927	22	,107
	2 2	,146	22	,200*	,945	22	,255

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 41 – Test of Normality for the Agreement Latency Times (log) variable regarding Ratio-Bias tasks

Tests of Normality

	Agreement	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Ratio-Bias LT(log): Agreement	1 1	,167	24	,082	,927	24	,082
	1 2	,208	23	,011	,923	23	,079
	2 1	,135	22	,200*	,958	22	,445
	2 2	,111	22	,200*	,954	22	,385

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 42 – Test of Normality for the Reliability Latency Times (log) variable regarding Base-Rate tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Base-Rate LT(log): Reliability	1 1	,089	24	,200*	,979	24	,881
	1 2	,074	23	,200*	,987	23	,985
	2 1	,114	22	,200*	,973	22	,777
	2 2	,099	22	,200*	,962	22	,532

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 43 – Test of Normality for the Reliability Latency Times (log) variable regarding Conjunction tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Conjunction LT(log): Reliability	1 1	,155	23	,160	,940	23	,184
	1 2	,125	24	,200*	,977	24	,845
	2 1	,090	22	,200*	,972	22	,765
	2 2	,094	22	,200*	,972	22	,758

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 44 – Test of Normality for the Reliability Latency Times (log) variable regarding Syllogism tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Syllogism LT(log): Reliability	1 1	,141	23	,200*	,933	23	,125
	1 2	,138	24	,200*	,939	24	,153
	2 1	,135	22	,200*	,932	22	,138
	2 2	,151	22	,200*	,940	22	,193

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 45 – Test of Normality for the Reliability Latency Times (log) variable regarding Ratio-Bias tasks

Tests of Normality

	Reliability	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Ratio-Bias LT(log): Reliability	1 1	,097	24	,200*	,981	24	,909
	1 2	,117	23	,200*	,928	23	,098
	2 1	,157	22	,167	,974	22	,810
	2 2	,156	22	,177	,926	22	,103

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 45 – Test of Normality for all composite variables

Tests of Normality

	Conflict	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Heuristic Agreement	No Conflict	,131	46	,048	,959	46	,108
	Conflict	,125	43	,089	,956	43	,097
Normative Agreement	No Conflict	,156	46	,027	,942	46	,053
	Conflict	,199	43	,043	,926	43	,090
Heurist Agreement LT(log)	No Conflict	,092	46	,200*	,960	46	,114
	Conflict	,075	43	,200*	,985	43	,838
Normative Agreement LT(log)	No Conflict	,122	46	,083	,963	46	,144
	Conflict	,065	43	,200*	,967	43	,247
Heuristic Reliability	No Conflict	,085	46	,200*	,952	46	,054
	Conflict	,113	43	,195	,957	43	,108
Normative Reliability	No Conflict	,100	46	,200*	,977	46	,477
	Conflict	,094	43	,200*	,963	43	,186
Heurist Reliability LT(log)	No Conflict	,122	46	,084	,963	46	,155
	Conflict	,101	43	,200*	,972	43	,379
Normative Reliability LT(log)	No Conflict	,087	46	,200*	,968	46	,229
	Conflict	,108	43	,200*	,969	43	,288

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Output 46 – Test of Homogeneity of Variance for all composite variables

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Heuristic Agreement	Based on Mean	,022	1	87	,882
	Based on Median	,008	1	87	,930
	Based on Median and with adjusted df	,008	1	86,034	,930
	Based on trimmed mean	,011	1	87	,916
Normative Agreement	Based on Mean	,003	1	87	,954
	Based on Median	,000	1	87	,997
	Based on Median and with adjusted df	,000	1	86,577	,997
	Based on trimmed mean	,002	1	87	,963
Heurist Agreement LT(log)	Based on Mean	6,909	1	87	,010
	Based on Median	6,702	1	87	,011
	Based on Median and with adjusted df	6,702	1	79,273	,011
	Based on trimmed mean	6,868	1	87	,010
Normative Agreement LT(log)	Based on Mean	7,817	1	87	,006
	Based on Median	7,586	1	87	,007
	Based on Median and with adjusted df	7,586	1	86,950	,007
	Based on trimmed mean	7,758	1	87	,007
Heuristic Reliability	Based on Mean	4,495	1	87	,037
	Based on Median	4,483	1	87	,037
	Based on Median and with adjusted df	4,483	1	86,370	,037
	Based on trimmed mean	4,506	1	87	,037
Normative Reliability	Based on Mean	3,153	1	87	,079
	Based on Median	3,093	1	87	,082
	Based on Median	3,093	1	83,566	,082

	and with adjusted df				
	Based on trimmed mean	3,106	1	87	,081
Heurist Reliability LT(log)	Based on Mean	,284	1	87	,596
	Based on Median	,323	1	87	,571
	Based on Median and with adjusted df	,323	1	84,973	,571
	Based on trimmed mean	,342	1	87	,560
Normative Reliability LT(log)	Based on Mean	,140	1	87	,709
	Based on Median	,134	1	87	,715
	Based on Median and with adjusted df	,134	1	82,287	,715
	Based on trimmed mean	,133	1	87	,716

Output 47 – Repeated measures ANOVA 2x2 (Response x Conflict) for Agreement Composite

Repeated Measures Analysis of Variance with Effect Sizes and Powers

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	3291,617	1	3291,617	1059,352	0,000000	0,924107	1059,352	1,000000
Conflict	17,483	1	17,483	5,626	0,019896	0,060744	5,626	0,650190
Error	270,326	87	3,107					
Response	85,262	1	85,262	28,537	0,000001	0,246992	28,537	0,999554
Response* Conflict	2,678	1	2,678	0,896	0,346406	0,010197	0,896	0,154883
Error	259,940	87	2,988					

Descriptive analysis

Breakdown Table of Descriptive Statistics N=89

Conflict	Heuristic Agreement Means	Heuristic Agreement N	Heuristic Agreement Std.Dev.	Normative Agreement Means	Normative Agreement N	Normative Agreement Std.Dev.
No Conflict	4,804348	46	1,796535	3,173913	46	1,755048
Conflict	5,186047	43	1,707906	4,046512	43	1,717605
All Grps	4,988764	89	1,754827	3,595506	89	1,781975

Output 48 – ANOVA 2x2 (Response x Conflict) for Base-Rate Agreement (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Agreement (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	175025,7	1	175025,7	643,0808	0,000000	0,883255	643,0808	1,000000
Conflict	175,9	1	175,9	0,6462	0,423734	0,007544	0,6462	0,124910
Response	31373,6	1	31373,6	115,2732	0,000000	0,575580	115,2732	1,000000
Conflict* Response	179,2	1	179,2	0,6584	0,419398	0,007686	0,6584	0,126365
Error	23134,2	85	272,2					

Output 49 – ANOVA 2x2 (Response x Conflict) for Conjunction Agreement (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Conjunction Agreement (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	183320,3	1	183320,3	358,2480	0,000000	0,808234	358,2480	1,000000
Conflict	51,6	1	51,6	0,1009	0,751544	0,001186	0,1009	0,061374
Response	11884,9	1	11884,9	23,2256	0,000006	0,214604	23,2256	0,997478
Conflict* Response	341,1	1	341,1	0,6666	0,416517	0,007781	0,6666	0,127344
Error	43495,6	85	511,7					

Output 50 – ANOVA 2x2 (Response x Conflict) for Syllogism Agreement (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Syllogism Agreement (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	183380,8	1	183380,8	325,8758	0,000000	0,793125	325,8758	1,000000
Conflict	3180,6	1	3180,6	5,6520	0,019680	0,062348	5,6520	0,651925
Response	3376,7	1	3376,7	6,0006	0,016353	0,065940	6,0006	0,677929
Conflict* Response	891,4	1	891,4	1,5840	0,211627	0,018295	1,5840	0,237803
Error	47832,2	85	562,7					

Output 51 – ANOVA 2x2 (Response x Conflict) for Ratio-Bias Agreement (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Ratio-Bias Agreement (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	183938,1	1	183938,1	372,8131	0,000000	0,814335	372,8131	1,000000
Conflict	940,6	1	940,6	1,9065	0,170976	0,021937	1,9065	0,276431
Response	12032,8	1	12032,8	24,3885	0,000004	0,222953	24,3885	0,998261
Conflict* Response	102,9	1	102,9	0,2086	0,649003	0,002449	0,2086	0,073676
Error	41937,2	85	493,4					

Output 52 – Contrast Analysis for Ratio-Bias Agreement: 9%/7% vs. 8%/5% (Heuristic answers)

Univariate Test of Significance for Planned Comparison

	Sum of - Squares	Degr. of - Freedom	Mean - Square	t	F	p
M1	2,029150	1	2,029150	4,375063	19,14118	0,000034
Error	9,010823	85	0,106010			

Output 53 – Contrast Analysis for Ratio-Bias Agreement: 9%/7% vs. 8%/5% (Heuristic answers – Conflict condition)

Univariate Test of Significance for Planned Comparison

	Sum of - Squares	Degr. of - Freedom	Mean - Square	t	F	p
M1	1,920455	1	1,920455	4,256271	18,11584	0,000053
Error	9,010823	85	0,106010			

Output 54 – Percentages associated with agreement with Ratio-Bias heuristic answers in the conflict condition (9%)

Conflict=Conflict, Ratio_Bias=H Frequency table: RB1_Agreem(9%): Agreement_S/L
K-S d=,35923, p<,01

	Count	Cumulative - Count	Percent - of Valid	Cumul % - of Valid	% of all - Cases	Cumulative % - of All
Disagree	10	10	45,45455	45,4545	45,45455	45,4545
Agree	12	22	54,54545	100,0000	54,54545	100,0000
Missing	0	22	0,00000		0,00000	100,0000

Output 55 – Percentages associated with agreement with Ratio-Bias heuristic answers in the conflict condition (5%)

Conflict=Conflict, Ratio_Bias=H Frequency table: RB4_Agreem(5%): Agreement_S/L
K-S d=,42957, p<,01

	Count	Cumulative - Count	Percent - of Valid	Cumul % - of Valid	% of all - Cases	Cumulative % - of All
Disagree	15	15	68,18182	68,1818	68,18182	68,1818
Agree	7	22	31,81818	100,0000	31,81818	100,0000
Missing	0	22	0,00000		0,00000	100,0000

Output 56 – Repeated measures ANOVA 2x2 (Response x Conflict) for Agreement LT (log) Composite

Repeated Measures Analysis of Variance with Effect Sizes and Powers
Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	13534,91	1	13534,91	44948,01	0,000000	0,998068	44948,01	1,000000
Conflict	1,62	1	1,62	5,38	0,022746	0,058209	5,38	0,630540
Error	26,20	87	0,30					
Response	1,54	1	1,54	13,22	0,000468	0,131908	13,22	0,949030
Response* Conflict	0,24	1	0,24	2,09	0,152342	0,023405	2,09	0,297740
Error	10,12	87	0,12					

Descriptive analysis

Breakdown Table of Descriptive Statistics N=89

Conflict	Heuristic Agreement LT (log) Means	Heuristic Agreement LT (log) N	Heuristic Agreement LT(log) Std.Dev.	Normative Agreement LT (log) Means	Normative Agreement LT (log) N	Normative Agreement LT (log) Std.Dev.
No Conflict	8,499626	46	0,342316	8,759478	46	0,535490
Conflict	8,764350	43	0,515815	8,876476	43	0,407231
All Grps	8,627526	89	0,452334	8,816005	89	0,478790

Output 57 – ANOVA 2x2 (Response x Conflict) for Conjunction Agreement LT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Conjunc Agreement LT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	7197,240	1	7197,240	35071,03	0,000000	0,997582	35071,03	1,000000
Conflict	0,179	1	0,179	0,87	0,353307	0,010144	0,87	0,151798
Response	5,043	1	5,043	24,57	0,000004	0,224262	24,57	0,998361
Conflict* Response	0,045	1	0,045	0,22	0,641122	0,002568	0,22	0,074848
Error	17,444	85	0,205					

Output 58 – ANOVA 2x2 (Response x Conflict) for Syllogism Agreement LT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Syllogism Agreement LT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	6574,710	1	6574,710	15988,02	0,000000	0,994712	15988,02	1,000000
Conflict	2,713	1	2,713	6,60	0,011967	0,072015	6,60	0,718792
Response	2,486	1	2,486	6,05	0,015973	0,066398	6,05	0,681144
Conflict* Response	3,241	1	3,241	7,88	0,006191	0,084860	7,88	0,792657
Error	34,954	85	0,411					

Output 59 – ANOVA 2x2 (Response x Conflict) for Base-Rate Agreement LT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Agreement RT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	6348,896	1	6348,896	29313,17	0,000000	0,997109	29313,17	1,000000
Conflict	0,736	1	0,736	3,40	0,068799	0,038429	3,40	0,445320
Response	0,108	1	0,108	0,50	0,481262	0,005853	0,50	0,107651
Conflict* Response	0,108	1	0,108	0,50	0,482442	0,005821	0,50	0,107333
Error	18,410	85	0,217					

Output 60 – ANOVA 2x2 (Response x Conflict) for Ratio-Bias Agreement LT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Agreement LT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	6567,711	1	6567,711	26264,84	0,000000	0,996774	26264,84	1,000000
Conflict	0,800	1	0,800	3,20	0,077324	0,036251	3,20	0,423937
Response	0,023	1	0,023	0,09	0,762935	0,001076	0,09	0,060317
Conflict* Response	0,101	1	0,101	0,40	0,526717	0,004731	0,40	0,096337
Error	21,255	85	0,250					

Output 61 – Repeated measures ANOVA 2x2 (Response x Conflict) for Reliability Composite

Repeated Measures Analysis of Variance with Effect Sizes and Powers
Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	2880,878	1	2880,878	1646,096	0,000000	0,949801	1646,096	1,000000
Conflict	0,714	1	0,714	0,408	0,524792	0,004665	0,408	0,096795
Error	152,261	87	1,750					
Response	1,083	1	1,083	1,556	0,215612	0,017570	1,556	0,234515
Response* Conflict	4,770	1	4,770	6,854	0,010433	0,073025	6,854	0,735323
Error	60,557	87	0,696					

Descriptive analysis

Breakdown Table of Descriptive Statistics N=89

Conflict	Heuristic Reliability Means	Heuristic Reliability N	Heuristic Reliability Std.Dev.	Normative Reliability Means	Normative Reliability N	Normative Reliability Std.Dev.
No Conflict	4,203804	46	1,204263	3,720109	46	1,258633
Conflict	4,002907	43	0,927221	4,174419	43	0,977857
All Grps	4,106742	89	1,078020	3,939607	89	1,148293

Output 62 – Contrast Analysis for Reliability composites: Heuristic vs. Normative answers (no-conflict condition)

Univariate Test of Significance for Planned Comparison
Tests for transformed variables

	Sum of - Squares	Degr. of - Freedom	Mean - Square	t	F	p
M1	5,38111	1	5,381114	-2,78045	7,730879	0,006653
Error	60,55675	87	0,696055			

Output 63 – Contrast Analysis for Reliability composites: Heuristic vs. Normative answers (Conflict condition)

Univariate Test of Significance for Planned Comparison
Tests for transformed variables

	Sum of - Squares	Degr. of - Freedom	Mean - Square	t	F	p
M1	0,63245	1	0,632449	0,953216	0,908620	0,343122
Error	60,55675	87	0,696055			

Output 64 – ANOVA 2x2 (Response x Conflict) for Conjunction Reliability (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Conjunction Reliability (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	180784,0	1	180784,0	270,5812	0,000000	0,760955	270,5812	1,000000
Conflict	3,0	1	3,0	0,0045	0,946526	0,000053	0,0045	0,050507
Response	703,9	1	703,9	1,0535	0,307623	0,012242	1,0535	0,173757
Conflict* Response	794,5	1	794,5	1,1892	0,278577	0,013797	1,1892	0,190143
Error	56791,2	85	668,1					

Output 65 – ANOVA 2x2 (Response x Conflict) for Syllogism Reliability (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Syllogism Reliability (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	181457,8	1	181457,8	313,2412	0,000000	0,786561	313,2412	1,000000
Conflict	102,8	1	102,8	0,1774	0,674657	0,002083	0,1774	0,070097
Response	1547,1	1	1547,1	2,6706	0,105916	0,030462	2,6706	0,365512
Conflict* Response	7298,8	1	7298,8	12,5995	0,000632	0,129094	12,5995	0,939337
Error	49239,7	85	579,3					

Output 66 – ANOVA 2x2 (Response x Conflict) for Base-Rate Reliability (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Reliability (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	179115,8	1	179115,8	281,1892	0,000000	0,767880	281,1892	1,000000
Conflict	1213,4	1	1213,4	1,9050	0,171143	0,021920	1,9050	0,276253
Response	2817,2	1	2817,2	4,4227	0,038421	0,049458	4,4227	0,547493
Conflict* Response	313,7	1	313,7	0,4924	0,484764	0,005760	0,4924	0,106712
Error	54144,5	85	637,0					

Output 67 – ANOVA 2x2 (Response x Conflict) for Ratio-Bias Reliability (Ranked)

Univariate Tests of Significance, Effect Sizes, and Powers for Ratio-Bias Reliability (Ranked)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	181931,1	1	181931,1	289,1006	0,000000	0,772788	289,1006	1,000000
Conflict	74,8	1	74,8	0,1188	0,731165	0,001396	0,1188	0,063411
Response	4418,3	1	4418,3	7,0210	0,009605	0,076297	7,0210	0,745279
Conflict* Response	8,6	1	8,6	0,0136	0,907374	0,000160	0,0136	0,051527
Error	53490,5	85	629,3					

Output 68 – Contrast Analysis for Syllogism Reliability: Heuristic vs. Normative answers (No-Conflict condition)

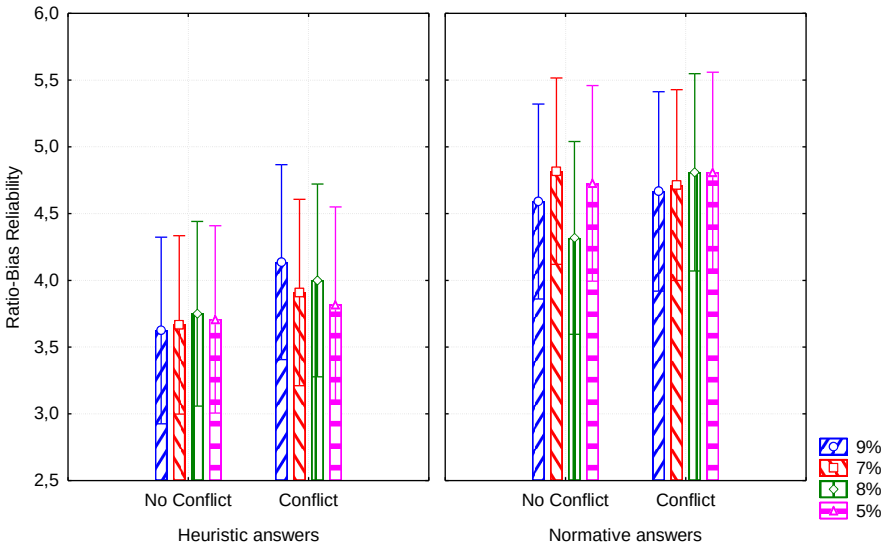
Univariate Test of Significance for Planned Comparison						
	Sum of - Squares	**Degr. of - Freedom**	**Mean - Square**	**t**	**F**	**p**
Effect	8049,09	1	8049,091	-3,72756	13,89473	0,000348
Error	49239,75	85	579,291			

Output 69 – Contrast Analysis for Syllogism Reliability: Heuristic vs. Normative answers (Conflict condition)

Univariate Test of Significance for Planned Comparison						
	Sum of - Squares	**Degr. of - Freedom**	**Mean - Square**	**t**	**F**	**p**
Effect	1028,64	1	1028,638	1,332548	1,775684	0,186242
Error	49239,75	85	579,291			

Output 70 – Ratio-Bias reliability for all probabilities (ANOVA Response x Conflict)

Repeated Measures Analysis of Variance with Effect Sizes and Powers								
	SS	**Degr. of - Freedom**	**MS**	**F**	**p**	**Partial eta-squared**	**Non-centrality**	**Observed power (alpha=0,05)**
Intercept	6428,151	1	6428,151	679,4778	0,000000	0,888813	679,4778	1,000000
Conflict	3,819	1	3,819	0,4037	0,526906	0,004727	0,4037	0,096293
Response	64,927	1	64,927	6,8630	0,010421	0,074709	6,8630	0,735678
Conflict* Response	0,448	1	0,448	0,0473	0,828273	0,000557	0,0473	0,055319
Error	804,136	85	9,460					
Percent	0,166	3	0,055	0,0787	0,971515	0,000925	0,2360	0,064001
Percent* Conflict	1,455	3	0,485	0,6906	0,558504	0,008060	2,0719	0,195492
Percent* Response	1,705	3	0,568	0,8089	0,489925	0,009427	2,4267	0,223934
Percent* Conflict* Response	1,598	3	0,533	0,7584	0,518364	0,008844	2,2753	0,211725
Error	179,118	255	0,702					



Descriptive analysis

Percent*Conflict*Response; Unweighted Means
Current effect: F(3, 255)=,75843, p=,51836 Effective hypothesis decomposition

	Conflict	Response	Percent	Mean	Std.Dev	N
1	No Conflict	H	(9%)	3,625000	0,351607	24
2	No Conflict	H	(8%)	3,750000	0,347619	24
3	No Conflict	H	(7%)	3,666667	0,336293	24
4	No Conflict	H	(5%)	3,708333	0,352743	24
5	No Conflict	N	(9%)	4,590909	0,367242	22
6	No Conflict	N	(8%)	4,318182	0,363076	22
7	No Conflict	N	(7%)	4,818182	0,351247	22
8	No Conflict	N	(5%)	4,727273	0,368428	22
9	Conflict	H	(9%)	4,136364	0,367242	22
10	Conflict	H	(8%)	4,000000	0,363076	22
11	Conflict	H	(7%)	3,909091	0,351247	22
12	Conflict	H	(5%)	3,818182	0,368428	22
13	Conflict	N	(9%)	4,666667	0,375884	21
14	Conflict	N	(8%)	4,809524	0,371620	21
15	Conflict	N	(7%)	4,714286	0,359513	21
16	Conflict	N	(5%)	4,809524	0,377098	21

Output 71 – Repeated measures ANOVA 2x2 (Response x Conflict) for Reliability LT (log) Composite

Repeated Measures Analysis of Variance with Effect Sizes and Powers
Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	10808,60	1	10808,60	40263,54	0,000000	0,997844	40263,54	1,000000
Conflict	3,92	1	3,92	14,59	0,000250	0,143653	14,59	0,965452
Error	23,35	87	0,27					
Response	0,00	1	0,00	0,02	0,890465	0,000219	0,02	0,052140
Response* Conflict	0,18	1	0,18	1,02	0,315826	0,011564	1,02	0,169528
Error	15,13	87	0,17					

Descriptive analysis

Breakdown Table of Descriptive Statistics N=89

Conflict	Heuristic Reliability LT (log) Means	Heuristic Reliability LT (log) N	Heuristic Reliability LT(log) Std.Dev.	Normative Reliability LT (log) Means	Normative Reliability LT (log) N	Normative Reliability LT (log) Std.Dev.
No Conflict	7,909469	46	0,458362	7,981204	46	0,511177
Conflict	7,675682	43	0,460674	7,621223	43	0,445997
All Grps	7,796516	89	0,471727	7,807281	89	0,511159

Output 72 – ANOVA 2x2 (Response x Conflict) for Base-Rate Reliability RT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Reliability RT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	5366,926	1	5366,926	16535,03	0,000000	0,994886	16535,03	1,000000
Conflict	2,663	1	2,663	8,20	0,005263	0,088028	8,20	0,808370
Response	1,426	1	1,426	4,39	0,039035	0,049155	4,39	0,544831
Conflict* Response	0,403	1	0,403	1,24	0,268422	0,014390	1,24	0,196402
Error	27,589	85	0,325					

Output 73 – ANOVA 2x2 (Response x Conflict) for Syllogism Reliability RT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Syllogism Reliability RT(log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	5306,531	1	5306,531	15824,08	0,000000	0,994657	15824,08	1,000000
Conflict	1,038	1	1,038	3,10	0,082053	0,035150	3,10	0,412992
Response	4,615	1	4,615	13,76	0,000369	0,139338	13,76	0,956127
Conflict* Response	0,003	1	0,003	0,01	0,923381	0,000109	0,01	0,051043
Error	28,504	85	0,335					

Output 74 – ANOVA 2x2 (Response x Conflict) for Ratio-Bias Reliability RT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Agreement RT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	5091,269	1	5091,269	11819,37	0,000000	0,992860	11819,37	1,000000
Conflict	1,502	1	1,502	3,49	0,065331	0,039398	3,49	0,454713
Response	1,020	1	1,020	2,37	0,127541	0,027106	2,37	0,330786
Conflict* Response	0,003	1	0,003	0,01	0,935887	0,000077	0,01	0,050729
Error	36,614	85	0,431					

Output 75 – ANOVA 2x2 (Response x Conflict) for Conjunction Reliability RT (log)

Univariate Tests of Significance, Effect Sizes, and Powers for Base-Rate Agreement RT (log)

	SS	Degr. of - Freedom	MS	F	p	Partial eta-squared	Non-centrality	Observed power (alpha=0,05)
Intercept	5352,759	1	5352,759	16682,26	0,000000	0,994931	16682,26	1,000000
Conflict	1,644	1	1,644	5,12	0,026159	0,056844	5,12	0,609432
Response	7,043	1	7,043	21,95	0,000011	0,205240	21,95	0,996226
Conflict* Response	0,082	1	0,082	0,26	0,614232	0,003002	0,26	0,079123
Error	27,274	85	0,321					

Output 76 – Descriptive statistics of the Need for Cognition scale

Descriptive Statistics (Thesis - DB)					
	Valid N	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**
Need for Cognition	89	3,459096	2,333333	4,722222	0,485371

Output 77 – Alpha de Cronbach (Need for Cognition)

Mean=62,2637 S.D.=8,73669 Valid N:89 Cronbach alpha: ,813797 Standardized alpha: ,821466

	Alpha if - deleted
NFC_1	0,800685
NFC_2	0,791249
NFC_3i	0,796772
NFC_4i	0,799049
NFC_5i	0,812374
NFC_6	0,790537
NFC_7i	0,820862
NFC_8i	0,826064
NFC_9i	0,801658
NFC_10	0,799729
NFC_11	0,797860
NFC_12i	0,803007
NFC_13	0,798511
NFC_14	0,810330
NFC_15	0,800954
NFC_16i	0,803716
NFC_17i	0,805253
NFC_18	0,824344

Output 78 - Descriptive statistics of the Faith in Intuition scale

Descriptive Statistics (Thesis - DB)					
	Valid N	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**
FaithInt	89	3,472527	2,000000	5,000000	0,707745

Output 79 – Alpha de Cronbach (Faith in Intuition)

Mean=17,3626 S.D.=3,53873 Valid N:89 Cronbach alpha: ,785443 Standardized alpha: ,788267	
	Alpha if - deleted
FI_1	0,764104
FI_2	0,707763
FI_3	0,743489
FI_4	0,739991
FI_5	0,769835

Output 80 – Correlation between Need for Cognition and Faith in Intuition

Correlations Marked correlations are significant at p < ,05000 N=89 (Casewise deletion of missing data)	
	Faith in Intuition
Need for Cognition	-,0754
	p=,478

Output 81 – Correlation between Bias Blind Spot and Need for Cognition and Faith in Intuition

Correlations Marked correlations are significant at p < ,05000 N=89 (Casewise deletion of missing data)		
	Need for Cognition	**Faith in Intuition**
Bias Blind Spot Composite	,0374	-,0423
	p=,728	p=,694

Output 82 – Descriptive statistics of the Bias Blind Spot questionnaire

Descriptive Statistics (Thesis - DB)					
	Valid N	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**
Bias Blind Spot composite	89	0,157303	-12,0000	9,000000	3,624095

Output 83 – Multiple regression analysis – Need for Cognition, Conflict - Agreement Composites

Parameter Estimates Sigma-restricted parameterization							
	Level of Effect	**Heuristic Agreem - t**	**Heuristic Agreem - p**	**Heuristic Agreem - Beta (ß)**	**Normative Agreem - t**	**Normative Agreem - p**	**Normative Agreem - Beta (ß)**
Intercept		4,61011	0,000014		0,74691	0,457181	
Conflict	No Conflict	0,34188	0,733285	0,273798	1,28718	0,201524	0,98052
NFC		-1,03127	0,305341	-0,113614	1,98054	0,050877	0,20754
Conflict*NFC	1	-0,45379	0,651136	-0,364804	-1,67099	0,098402	-1,27772

Output 84 – Multiple regression analysis – Faith in Intuition, Conflict - Agreement Composites

Parameter Estimates Sigma-restricted parameterization							
	Level of Effect	**Heuristic Agreem - t**	**Heuristic Agreem - p**	**Heuristic Agreem - Beta (ß)**	**Normative Agreem - t**	**Normative Agreem - p**	**Normative Agreem - Beta (ß)**
Intercept		5,404139	0,000001		3,31131	0,001365	
Conflict	No Conflict	-0,114318	0,909255	-0,061899	-1,16975	0,245373	-0,614709
FI		-0,123965	0,901636	-0,013419	0,58553	0,559744	0,061515
Conflict*FI	1	-0,091142	0,927594	-0,049386	0,72405	0,471026	0,380765

Output 85 – Multiple regression analysis – Bias Blind Spot, Conflict -Agreement Composites

Parameter Estimates Sigma-restricted parameterization							
	Level of Effect	**Heuristic Agreem - t**	**Heuristic Agreem - p**	**Heuristic Agreem - Beta (ß)**	**Normative Agreem - t**	**Normative Agreem - p**	**Normative Agreem - Beta (ß)**
Intercept		27,67329	0,000000		19,49049	0,000000	
Conflict	No Conflict	-0,94574	0,346962	-0,098241	-2,30250	0,023751	-0,241019
BBS		-2,40650	0,018273	-0,250309	-0,36623	0,715100	-0,038387
Conflict*BBS	1	-1,16527	0,247170	-0,121282	-0,92809	0,355987	-0,097341

Annex G – Content analysis of the verbal protocols resulting from the De Neys and Glumicic (2008) study

1. In a study 1000 people were tested. Among the participants there were 5 sixteen-year olds and 995 fifty-year olds. Ellen is a randomly chosen participant of this study. Ellen likes to listen to hip hop and rap music. She enjoys wearing tight shirts and jeans. She's fond of dancing and has a small nose piercing.
What is most likely?
a. Ellen is sixteen
b. Ellen is fifty

Verbal protocols	Keywords			
Incorrect response, base rates not mentioned	Hip Hop and rap	Tight shirt and jean	Dancing	Piercing
2. ... I guess she is younger so I am gonna answer 16.				
3. I **hope** she is a 16-year-old because it would be horrible if she was a fifty year old who liked to wear **tight cloths** and had a **nose piercing**. So I think she is a sixteen year old.		X		X
4. I would say she is 16 because I don't thing a fifty year old would have a **nose ring** or would wear **tight shirts and jeans**.		X		X
5. I think Ellen is 16 because that is the time girls that age are mostly **fond of things on TV**.				
6. Sixteen because it sounds like a 16-year-old. I mean **tight shirts** and a **nose piercing**...yeah she must be 16.		X		X
7. She likes to listen to **hip-hop and rap** and has a **nose piercing** so she is sixteen.	X			X
8. Ellen is 16 because old people do not listen to **hip-hop and rap**.	X			
9. Ellen is 16...because she listens to **hip-hop and rap**, and...wears **tight cloths** so it sounds like someone younger.	X	X		
10. **I don't really have to think about this** I can just say she is sixteen. Do I have to say why? Ok then I didn't really think anything I just know she is 16.				
11. I say that Ellen is 16, because I don't see a 50-year-old wearing **tight clothes** and listening to **rap**... Yeah and having a **nose ring**.	X	X		X
Incorrect response, base rates mentioned				
Correct response, base rates not mentioned				
Correct response, base rates mentioned				
1. Even though what is described to me says that she is a sixteen year old it doesn't really make a difference, she could still be fifty and according to the statistics she is more likely to be fifty.				
12. ...Even though I don't want to see a 50-year-old in tight jeans and small shirt rapping to hip- hop...there were more 50 year olds...so maybe she is a fifty year old...yuk...haha.	X	X		
	5	6		5
	Hip Hop and rap	Tight shirt and jean	Dancing	Piercing

2. In a study 1000 people were tested. Among the participants there were 5 engineers and 995 lawyers. Jack is a randomly chosen participant of this study. Jack is 36 years old. He is not married and is somewhat introverted. He likes to spend his free time reading science fiction and writing computer programs. What is most likely?
a. Jack is an engineer
b. Jack is a lawyer

Verbal protocols	**Keywords**			
Incorrect response, base rates not mentioned	Not married	Introverted	Read SciFi	Write computer games
2. So I am gonna guess he is an engineer because he likes **writing computer programs**.				X
3. Jack is most likely an engineer is the answer, because he **writes science programs** and **reads science fiction novels**.			X	X
4. Jack is an engineer because he likes **science fiction** and **writing computer programs**.			X	X
5. He is an engineer because he likes **writing computer programs**.				X
7. He **reads science fiction** and **writes computer programs** so he would be an engineer.			X	X
8. Jack is a...engineer because they are **good with computers**, and he is **introverted**, for a lawyer you have to be active.		X		X
9. Jack is an engineer because he likes **reading science fiction** and **writing computer programs**.			X	X
10. Jack would most likely be...an engineer.				
11. I would say Jack is an engineer...because he likes to **write computer programs**...and **science fiction**...and engineering is a science thing I guess.			X	X
12. This guy is an engineer, because he likes **computers** and **science fiction**, and he seems like a loner...no wife.	X		X	X
Incorrect response, base rates mentioned				
1. ...It depends how you want to go if you want to go **according to the statistics** there is a greater chance he is a lawyer but because of the things he does...he is **introverted**, spends his time reading fiction and writing computer games, it **makes more sense that he is an engineer** so...I don't know I will go with that.		X	X	X
Correct response, base rates not mentioned				
Correct response, base rates mentioned				
6. ...ok 5 engineers... you would think he is an engineer but cause **there were more** lawyers he is a lawyer.				
	1	2	7	9
	Not married	Introverted	Read SciFi	Write computer games

3. In a study 1000 people were tested. Among the participants there were three who live in a condo and 997 who live in a farmhouse. Kurt is a randomly chosen participant of this study.
Kurt works on Wall Street and is single. He works long hours and wears Armani suits to work. He likes wearing shades.
What is most likely?
a. Kurt lives in a condo
b. Kurt lives in a farmhouse

Verbal protocols	**Keywords**				
Incorrect response, base rates not mentioned	Wall Street	Single	Works long hours	Armani suits	Wearing Shades
2. ...I am gonna guess he lives in a condo because he works on **Wall Street**.	X				
3. Kurt lives in a condo, he is **single** so he can't run a farm on his own, he wears **Armani suits** to work so it is not work at a farm.		X		X	
4. I would say he lives in a condo because he works on **Wall Street** and there is probably no farms in that area.	X				
5. Condo because if he **works a lot** his job should be near to where he lives, and he **likes Versace and other expensive stuff**. So he probably lives in a condo because he can afford it, and condo is more expansive than a farm house.			X	X	X
7. **Armani suits** to work and **shades** that would be...or he lives in a condo, he can't wear those at a farm.				X	X
8. Kurt lives in a condo there is no farmhouses close to the **Wall Street.**	X				
9. Kurt lives in a condo because he works on **Wall Street** and...he **dresses well**.	X			X	X
10. Kurt lives in a condo he is **rich**.					
11. Kurt lives in a condo, because he works on **Wall Street**, and... I don't think that he would be too close to farmhouses...and he wears **Armani suits**.	X			X	
12. Seems like a cool guy...**shades**, **Armani**...he lives in a Condo.				X	X
Incorrect response, base rates mentioned					
6. In a condo...or no...997 lived in a farmhouse so it could be a farmhouse...I am undecided.					
Correct response, base rates not mentioned					
Correct response, base rates mentioned					
1. So... **this can go either way** if you want to go according to...Even though there is more...there is 997 people who live in a farmhouse **so it is more likely because of the things that describe to me**...that he **works long hours** which seems more like a **city type a job**, **Armani suits for work**, in a farmhouse area I just think of more you know ripped jeans and a T-shirt...So it seems that he lives in a condo, **but again there were only three who live in a condo so according to statistics it is more likely that he actually lives in a farmhouse**.	X		X	X	
	6	1	2	7	4
	Wall Street	Single	Works long hours	Armani suits	Wearing Shades

4. In a study 1000 people were tested. Among the participants there were four whose favorite series is Star Trek and 996 whose favorite series is Days of Our Lives.
Jeremy is a randomly chosen participant of this study.
Jeremy is 26 and is doing graduate studies in physics. He stays at home most of the time and likes to play video-games.
What is most likely?
a. Jeremy's favorite series is Star Trek
b. Jeremy's favorite series is Days of Our Lives

Verbal protocols	Keywords		
Incorrect response, base rates not mentioned	Physics	Home	Video-games
2. ...He likes to play **video games** so most likely his favorite show is Star Trek.			X
3. What a nerd he watches Star Trek for sure, because number one he is a **guy** and they don't like watching soup operas, and he likes **physics** which kind of goes hand in hand with Star Trek.	X		
4. I would say his favourite series is Star Trek because he likes **physics**.	X		
5. Star Trek because Star Treks uses a lot of **physics** to create whatever things they want.	X		
7. He is studying **physics**, plays **video games**...just sounds more like someone who watches Star Trek.	X		X
8. Star Trek because he plays **video games** and watches Star Trek so he stays at **home**, so he must be a nerd, so... he watches Star Trek.		X	
9. Jeremy's favourite series is Star Trek because he is doing graduate studies in **physics** and likes to play **video games**...so it sounds like he would watch something like Star Trek.	X		X
10. So my answer is... Jeremy's favourite series is Star Trek.			
11. Jeremy's favourite series is Star Trek, because he likes to stay at **home** and play **video games**.		X	X
12. He stays at **home** and plays **video games**...so obviously he likes Star Trek...he seems like a nerd haha.		X	X
Incorrect response, base rates mentioned			
Correct response, base rates not mentioned			
Correct response, base rates mentioned			
1. So **even though he likes physics and video games**, so without the statistics I would say Star Trek, but because of the statistics I will say he is most likely to watch Days of Our Lives.	X		X
6. 4...Star Trek...996 Days of Our Lives...so (b) Jeremy's favourite series is Days of Our Lives.			
	6	3	6
	Physics	Home	Video-games