UiT The Arctic University of Norway

Department of Psychology, Faculty of Health Sciences

Exploring the Relationship Between Feeling of Rightness and Recall: A Study Challenging Dual Process Theory

Validating Feeling of Rightness and recall proxies for detecting system 1 and system 2 usage.

Nora Tveit

Master's thesis in psychology (PSY-3900), May 2023

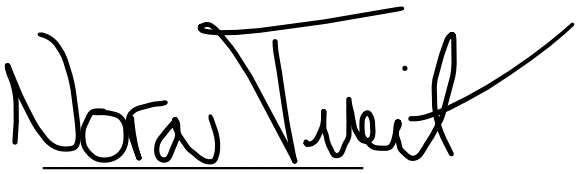
Preface

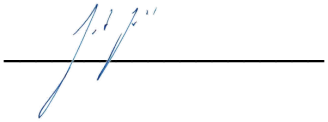
It has been a journey writing this master's thesis. I remember moving to Tromsø two years ago, never having been here before and not knowing what to expect. Not long after I arrived, I got in contact with Dr. Gerit Pfuhl. We quickly agreed that we had the same interest in cognitive psychology, and since then, I have had a supervisor who supports and pushes me through the dark winter times and writing blocks. You have encouraged me to take weekend breaks (which is difficult when deadlines creep up) and make the most out of the sunny days when we have them. I am very grateful for all the guidance, time and work you have put in to help me get my master's degree. It has been an honor working with you.

I would also like to express gratitude to the amazing research team that I have been so lucky to be a part of. To Martin Jensen Mækelæ, Rikke Eriksen and Kristoffer Klevjer, I thank you for giving me advice and help throughout my time here, and I wish you all the best of luck with your projects.

Lastly, I want to thank my family and friends for being there for me and sending me things in this process. You have sent forgotten computer chargers and house keys in the mail. You have sent money, best wishes and most of all love when I needed it, and for that I am forever grateful. You have reminded me that doing my best is good enough. To all my classmates: Thank you for an amazing journey. It has been amazing to see us having each others backs and get through this as a team.

Thank you all! - Nora, 27.04.2023





Nora Tveit

Gerit Pfuhl

Exploring the Relationship Between Feeling of Rightness and Recall:

A Study Challenging Dual Process Theory

Nora Tveit

PSY-3900

Department of Psychology – Faculty of Health Sciences

UiT, The Arctic University of Norway

Supervisor: Gerit Pfuhl

May 2. 2023

Sammendrag

Tidlig forskning på bedømming- og beslutningstaking antyder at vi har to systemer som tas i bruk når vi tenker: et raskt, intuitivt system (system 1) og et langsommere, mer overveiende system (system 2), referert til som toprosessteorien. Gjennom resonneringsoppgaver har denne forskningen vist at system 2 produserer normativt korrekte svar, og system 1 produserer feilaktige intuitive svar, og at system 2 tar lengre tid enn system 1. Nyere forskning utfordrer dette, da raske svar kan være normative, og tregere svar feilaktige. Følelsen av korrekthet (FoR) anses som en måling av konfliktdeteksjon, og lav FoR skal utløse bruk av system 2. Hvis system 2 brukes kan vi forvente mer bevisst overveielse, og dermed bedre tilbakekalling av informasjonen. Vi testet denne teorien ved å rekruttere 107 deltakere, hovedsakelig studenter fra UiT – Norges Arktiske Universitet. Vi brukte tre oppgaver for å teste hypotesen om tilbakekalling for Dual Process Theory: base-rate oppgaver, syllogismeoppgaver og teleologiske uttalelsesoppgaver. Oppgavene ble utført i et mellom-deltaker-design. Korrekthet, FoR og tilbakekalling ble målt. Konsistent gjennom alle oppgavene fant vi ingen signifikant sammenheng mellom FoR og tilbakekalling. Det vil si at lav FoR ikke forutsa bedre tilbakekalling. Dette antyder at lav FoR ikke utløser bruk av system 2, eller at FoR ikke er et mål på konfliktdeteksjon. Fremtidig forskning bør vurdere alternative teorier for toprosessteorien, eller endre egenskapene til hvert av systemene for å gi et mer korrekt bilde av hvordan vi bedømmer og tar beslutninger.

Nøkkelord: toprosessteorien, følelsen av riktighet, tilbakekalling, konfliktdeteksjon, overveielse

Abstract

Early research on judgement and decision making suggests that we have two processing systems, one fast, intuitive system (system 1), and a slower, deliberate system (system 2), referred to as Dual Process Theory. Given reasoning items, this research shows that system 2 produces correct normative answers and system 1 produces erroneous intuitive answers, the former taking more time than the latter. Newer research question this as fast responses can be normative, and slow responses incorrect. Still, Feeling of Rightness (FoR) is seen as a measurement of conflict detection, and low FoR is supposed to trigger system 2 usage. Subsequently, if system 2 is used, more deliberate processing and better recall of the item could be expected. We tested this hypothesis. We recruited 107 participants, most of them undergraduate students from UiT – the Arctic University of Norway. We used three tasks to test the recall hypothesis for Dual Process Theory: base-rate tasks, syllogism tasks and teleological statement tasks. The tasks were implemented in a between-participant design. Accuracy, FoR and recall were measured. Consistent among all three tasks, we found no significant relationship between FoR and recall, i.e., low FoR did not predict better recall. This suggests that low FoR does not trigger system 2 usage, or that FoR is not a proxy for conflict detection. Future research should consider alternative theories for the Dual Process Theory or alter the characteristics of each of the systems to paint a more correct picture of how we come to judge and make decisions.

Keywords: dual process theory, feeling of rightness, recall, conflict detection, deliberation

Exploring the Relationship Between Feeling of Rightness and Recall: A Study Challenging Dual Process Theory

"(...) research has rarely identified with precision the strategies actually used on judgement tasks" (Eysenck & Keane, 2020, p. 633).

In the field of psychology, dual process theories have been one of the leading theories of how people think and make decisions. It states that we have two systems that are involved in all aspects of thinking; system 1 and system 2 (Kahneman, 2011). System 1 is a fast and intuitive way of thinking, for instance how we recognize the face of a loved one, or how we can solve 1 + 1 with ease. System 2 is slower and more analytical, like solving a more difficult math problem or trace your steps back to remember where you put your keys. Since system 1 is so fast, it is often seen as the more flawed system of the two, as it uses shortcuts like heuristics and biases to come to conclusions quickly. Since system 2 is more analytical and takes more time, it is seen as producing smarter and more correct outcomes. Feeling of Rightness (FoR) is a metacognitive feeling that accompanies every decision we make, indicating the amount of correctness we feel when the decision is made (Thompson et al., 2011). FoR has shown to be an indicator of system 1 and system 2 usage, low FoR indicating system 2 and high FoR indicating system 1.

Several dual process theories, and how the two systems interact with one another, have been proposed (Pennycook et al., 2015). However, newer research shows that the very existence of the two separate systems is diffuse (Melnikoff & Bargh, 2018; Raoelison et al., 2020). For instance, aspects that are typical for system 1 have been seen under conditions where it is natural to assume system 2 usage.

The present study will explore whether the use of recall tests and FoR can provide support for a core value of dual process theories. Some research suggests that recall tests can be used as a measurement of system 2 usage, as it indicates that information has been

deliberately processed more deeply. We argue that these tests and FoR measures, when accompanying standard Dual Process Theory tests, are suitable for detecting system 2 usage, by indicating that system 2 usage should have better recall, and show signs of low FoR.

Theoretical Background

Judgement and Decision Making

Throughout the course of a day, we make countless decisions and judgements. Anything from deciding when to get up, which jobs to apply for, and calculating the time it takes to get from your front door to the bus stop, taking into consideration the distance, weather conditions and putting on shoes. The difference between a judgement and a decision is that a judgement has to do with the assessment of the probability of an event happening, given incomplete information (Eysenck & Keane, 2020), and decision making has to do with the selection of one of several options. Judgement is often, but not exclusively, needed when making decisions, as we seldom have all the information we need. Decision making must not be confused with problem solving, which is a scenario where there are no options to choose from, forcing the decision maker to produce their own explication. Hastie and Dawes (2010) described that a rational decision is made when outcome potentials, probability and personal value have been considered. But with either incomplete or complete information, people have a tendency to make irrational judgements and decisions (Barbey & Sloman, 2007; Clark, 2010; Evans, 2003; Eysenck & Keane, 2020; Gigerenzer et al., 1999; Hastie & Dawes, 2010; Kahneman, 2003, 2011; Melnikoff & Bargh, 2018). Decision making based on logic and probability are called “normative decision making” (Thompson & Johnson, 2014). An example of normative decision making is when we are able to take base-rate information into consideration. Base-rate is information about “the relative frequency of an event within a given population” (Eysenck & Keane, 2020, s. 624). For instance, if you know that the base-rate within a population is 50 women and 50 men, you should take that into consideration

when figuring out the probability of the person you are pointing at random at is a woman. The normative answer would be that there is a 50 % chance of pointing to a woman. However, if you were told that the person you are pointing at is a person who loves to watch football, drink beer and listen to hard rock music, you might be biased to assume a higher than 50% probability of the person being a man. This is called the base-rate fallacy (Bar-Hillel, 1980). We are ignoring the fact that there is a 50/50 chance of pointing at a woman (the base-rate) and focusing on stereotypical tendencies. This is often done unconsciously or intuitively and is a shortcut our brain uses to reach conclusions faster and more efficiently. In other words, it is a heuristic. Heuristics are strategies people use to reach a conclusion with less effort, often ignoring parts of the information to get there (Eysenck & Keane, 2020). There are several different heuristics, each a different mental shortcut. Two examples are the representativeness heuristic and the availability heuristic. The representativeness heuristic helps us quickly categorize by evaluating whether the object or person is representative (stereotypical) or not for said category. The availability heuristic evaluates the frequency of an event by favoring the information that comes quickly to mind. Answers that are produced through these shortcuts are usually not normative, as they rely more on past experiences and convenience, more than logic and probability. In a sense, one could argue that to conclude with a rational answer, you must process the information more in depth and be deliberate about weighing the information, because intuition and heuristics can produce biased answers. Note, however, that deliberation based on incomplete or erroneous information can also produce biased answers (Melnikoff & Bargh, 2018).

Dual Process Theories

Intuition, or a gut feeling based on experience, serve us well in situations where we need to make quick decisions and generally in our day to day lives. Deliberation, or analytical reasoning, is required when experience alone is unable to guide us. Accordingly, intuition and

deliberation have been proposed to be two different processes. Already in 1890, William James described two kinds of reasoning (James, 1890). This has since developed into what will be referred to here, namely intuitive reasoning as system 1 and deliberate reasoning as system 2, adopting the terminology from Kahneman (2003). System 1 is believed to be the reasoning that humans share with other animals (Evans, 2003). System 1 is a set of both innate behaviors and naturally acquired knowledge. It is reasoning that happens without much effort. Examples of system 1 thinking are to turn your head towards a sudden sound, calculating simple mathematical problems and detecting that one thing is more distant than another thing (Kahneman, 2011). System 2 is believed to be newer in evolutionary terms, and also unique to humans (Evans, 2003). It is a slower way of thinking, which includes abstract and hypothetical thinking. Examples of system 2 thinking are calculating more complicated mathematical problems, focusing on one specific voice in a crowded room and parking a car in a narrow space (Kahneman, 2011).

The dual process theories differ in nuance, particularly on how these two systems interact with one another. The "Default-Interventionist" theory argues that system 1 comes before system 2 and that system 1 is used as a default way of thinking, i.e. there is serial processing (De Neys, 2012). In this theory the system 2 thinking will occur after system 1, if at all. In the Parallel Processing theory, both system 1 and system 2 are engaged from the start, with system 1 being more overriding due to its speed and autonomy (Handley & Trippas, 2015). Another study suggest a three-stage dual process theory, with conflict detection being the third process that determines whether one should engage in deliberation, or stick with intuition (Pennycook et al., 2015). Several studies find that when we are faced with conflicting information or information that causes a cognitive conflict, we tend to prioritize our heuristic responses, rather than normative considerations (De Neys, 2012; De Neys & Glumicic, 2008; Thompson & Johnson, 2014). In some dual process theories,

conflict is the factor that induces the change from system 1 usage to system 2 usage (De Neys, 2012).

In the Default-Interventionalist theory, the ability to engage in system 2 thinking is an act of, and therefore also limited to, our working memory (WM), and is also what we refer to as deliberation. Because it is an active, although possibly unconscious, choice we make to engage in more analytic and deep processing of information, system 2 thinking has been associated with normatively correct answers (De Neys, 2012), making it so that system 1 generates wrong answers, while system 2 corrects them (Morewedge & Kahneman, 2010). Slower response times (RTs) and solving items correctly were seen as evidence for system 2. That is, deliberation requires time for reasoning, and these items can only be solved by deliberation. In other words, according to this theory, RT should be longer and accuracy higher when solving conflict problems. However, recent takes on dual process theories are questioning these assumptions (Melnikoff & Bargh, 2018; Raoelison et al., 2020).

Recent Dual Process Theory

A theory contrasting the Default-Interventionalist and Parallel Processing view is “the smart intuitor” view (Raoelison et al., 2020; Thompson et al., 2018). This view suggests that people can make correct decisions fast. The model distinguishes between two types of intuition: intuitive heuristic and intuitive logical. The heuristic intuition is often associated with producing incorrect responses, as it is based on biases and heuristics, making us ignore the facts in favor of our perceived reality. This is somewhat similar to the standard system 1 description (Kahneman, 2003). The logical intuition is more associated with producing correct answers. Both intuitions are accompanied by a feeling of being right, which decides whether further deliberation is needed.

Feeling of Rightness

Having a feeling of being correct, when we in fact are wrong, is something most people have felt. Perhaps you had a test in school that you were confident that you nailed. However, when discussing the answers with your classmates, you realize you were completely wrong. The Feeling of Rightness (FoR) is an operationalization of this specific feeling, a metacognitive assessment which accompanies every decision we make (Thompson et al., 2011, 2013, 2018). In other words, FoR is a confidence measurement where we evaluate the correctness of our answer. According to the smart intuitor view, high FoR is associated with the fast heuristic intuition (Raoelison et al., 2020). This intuition ignores conflict and makes use of biases and heuristics to reach conclusions, not leaving much room for uncertainty. The logical intuition is also fast, but often produces correct answers. This intuition can for instance come as a result of expertise or special interest. Even though it is said to produce correct answers, it is often accompanied by a low FoR, indicating that some sort of deliberation that causes uncertainty might have taken place.

FoR has proven to be a good indicator of whether system 2 has been engaged. Several studies have found that when tested, FoR would predict the probability of participants wanting to revise their answer or not, given the chance, as well as predicting longer rethinking times (Thompson et al., 2011; Wang & Thompson, 2019). This is, according to the Default-Interventionist approach, a sign that deliberation has taken place. High FoR, which indicates that the participants were confident that their answer was correct, predicted a low tendency of answer revision. FoR can therefore also be seen as a cue to whether people have detected conflict or not. Low FoR is a sign that the participants have a wish for answer revision and longer rethinking times when they encounter problems that do not have an immediately obvious answer. Hence, they detect conflict. Using this logic, and what we know about dual process theories, we can assume that FoR indicates the presence of system 2

usage. Thompson and Johnson (2014) did a study where they had participants solve conflict and non-conflict versions of several different reasoning tasks. They measured RTs and had the participants answer the first thing that came to mind. They were then given more time to think through the items again with as much time as needed. They found that participants' FoR was low during conflict items and higher in non-conflict items. This study supports the idea that low FoR indicate conflict detection.

Working Memory and Recall Testing

System 2 requires deeper processing, or deliberation, and is therefore highly dependent on WM, which is mainly involved in the processing, maintenance and control of information over a shorter period of time (Loaiza et al., 2011), and is what allows us to engage in deep processing and deliberation (De Neys & Glumicic, 2008). This is, to some extent, the main characteristics distinguishing system 1 and 2. Research on WM show that deeper processing is dependent on the different operations carried out by the WM, like structural, semantic and episodic analyses (Craik & Tulving, 1975; Loaiza et al., 2011).. To see if deliberation, or system 2, has been engaged, one can investigate recall tests. De Neys and Glumicic (2008) conducted a study where they had participants think out loud in order to make sure they processed the information consciously. However, they recognized that this method never took into consideration the information that might never have reached the conscious mind. This implicit monitoring was then accounted for by giving the participants a surprise recall test. They hypothesized that "successful conflict detection should be accompanied by a deeper processing of the base-rate information which should benefit recall" (De Neys & Glumicic, 2008, p. 1253). In this sense, conflict items should have better recall proxies than non-conflict items when answered normatively correct. Their data supported this hypothesis. Additionally, the study by Craik and Tulving (1975) and Loaiza et al. (2011)

show that words that has been processed deeply (where the word's meaning, rather than its physical characteristics, has been processed), resulted in better recall of said word.

Testing Dual Process Theories

We understand that recall tests are good measures of system 2 engagement, but traditionally, there are several tests that can and have been used to measure Dual Process Theory. These tests have items that elicit an intuitive response that is normatively wrong, and that when taking all of the information into consideration, you will find the correct answer. One such test, which has been used in several studies on Dual Process Theory, is "The Cognitive Reflection Test" (CRT) (Barr et al., 2015; Frederick, 2005; Purcell et al., 2022; Raoelison et al., 2020; Thompson et al., 2013, 2018). This test consists of three "easy" math problems that trigger an intuitive answer, but that requires some level of system 2 usage to get to the correct answer (Frederick, 2005). One of the problems is famously called "the bat and ball problem", and looks like this:

> *"A bat and a ball cost $1.10 in total. The bat cost $1.00 more than the ball How much does the ball cost? ____ cents."* (Frederick, 2005).

Intuitively, people tend to say the ball cost 10 cents, as $1.10 minus $1.00 is 10 cents. However, the correct answer is 5 cents, as $1.05 plus 5 cents is $1.10. If the ball had cost 10 cents, the bat would have to cost $1.10 in order to cost $1.00 more, making it a total of $1.20. The correct answer seems obvious when explained, but requires that you suppress an intuitive answer to get it correct. The CRT test looks in other words primarily on RTs as an indicator of dual process theories, in accordance with the Default-Interventionalist view. We now know that RTs are not informative, as some reasoners have accurate intuitions (Raoelison et al., 2020) or respond normatively correct intuitively (Thompson et al., 2018).

Other tasks that have been used to assess dual process theories are base-rate tests, teleological statement tests and syllogistic reasoning tests.

Base-rate questions are a common method to research Dual Process Theory (e.g. (Barbey & Sloman, 2007; Bar-Hillel, 1980; Evans & Elqayam, 2007; Thompson et al., 2018)). They have been used to measure the base-rate fallacy, which is the tendency we have to ignore base-rate information in favor of other, often more personalized, information (Bar-Hillel, 1980). The participants can for example be presented with the following information:

> *"In a study 1000 people were tested. Among the participants there were 5 engineers and 995 lawyers. Jack is 36 years old. Jack 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? Jack is an engineer. Jack is a lawyer."* (De Neys & Glumicic, 2008).

The base-rate informs us about the distribution of lawyers and engineers in the population, which strongly favors the lawyers. The description, however, is of one that is stereotypically associable with an engineer. The participants are asked what profession is more likely for the described person. These descriptions elicit not only an intuitive, here stereotypical, answer, but also cue a conflict between the base-rate information and the stereotypical information. Under time pressure, the base-rate questions, as well as the teleological statements, are more difficult to answer normatively (Kelemen et al., 2013; Thompson & Johnson, 2014). The normatively correct answer in this case would be that Jack is a lawyer. Note, however, that it is debatable whether there is such a thing as correct and incorrect when it comes to stereotypical information. If you have never in your life met a single lawyer with the same interests as Jack, it would not be incorrect to assume that he is an engineer.

The use of teleological statements are similar in objective. They are based on the tendency we have to explain that phenomena exist by referring to its function (Kelemen, 1999), instead of the actual, objective reason for its existence. An example of such a statement is:

"*Trees produce oxygen so that animals can breathe*." (Kelemen et al., 2013).

This statement elicits an intuitive, here teleological, answer, which is that the statement is "true". And it is true that animals can breathe because the air contains oxygen, but the oxygen from trees is a by-product of photosynthesis and not intentional, so the correct answer is "false". Teleological statements take one of two forms, either teleological or physical, and each of those can be either false or true (Kelemen, 1999; Kelemen et al., 2013). The teleological ones give objects specific reasons for existing (like the example above), and often a purpose that we, to some extent, can relate to. These statements cause conflict between our wish to give worldly phenomena meaning, and the facts we know to be true. The physical statements, however, simply state a fact. An example of a physical statement can be:

"Viruses replicate because they are microscopic." (Kelemen et al., 2013).

Here, the statement does not give viruses a purpose, it simply implies a fact, even though it is false in this case. These physical statements will often not elicit as much of a conflict, as it is not as difficult for us to determine whether a fact is true or false, as to determine the deeper meaning behind phenomena. Physical statements are often answered more correctly than the teleological (Kelemen et al., 2013) and are used as control items.

Syllogistic reasoning tests are a third way of testing dual process theories, as it tests our ability to use logic as a way of reasoning. The tasks are presented as a set of two premises and a conclusion, with each presented in one of four ways: (1) All A are B, (2) Some A are B, (3) No A are B, (4) Some A are not B (Khemlani & Johnson-Laird, 2012). The syllogisms can be one of two natures: valid or invalid. The following examples differentiate between a valid and an invalid syllogism, respectively:

"Premise 1: All animals with four legs are dangerous.

Premise 2: Poodles are not dangerous.

Conclusion: Poodles do not have four legs."

"Premise 1: All flowers have petals.

Premise 2: Roses have petals.

Conclusion: Roses are flowers." (Markovits & Nantel, 1989)

The first syllogism is valid, but is presented as unbelievable and causes in that sense a conflict: The conclusion is correct, considering the premises, but it does not represent the facts we know to be true in the real world. The latter is an example of an invalid syllogism that is presented as believable. This also elicits a conflict because given the premises provided, the conclusion cannot be considered a finite truth, however, the conclusion is one that we know to be true in the real world. For syllogisms it is important to ignore the facts that you already know to be true. This is often where the confusion starts, and the conflict is elicited. It is important to only take into consideration the two premises provided. Valid syllogisms can also be presented as believable, and invalid presented as unbelievable. Syllogisms require a type of reasoning that does not hold roots in most people's everyday lives, and can therefore not be solved through past experiences or intuition (Thompson et al., 2018). Therefore, people are forced to use deliberation (allegedly) in order to solve the problems.

Although Dual Process Theory has gained popularity in cognitive research, there is still uncertainty about whether system 1 and system 2 are valid operationalizations of how we think. Newer theories, like the smart intuitor view, are already challenging the construction of the Dual Process Theory. There are indications of the presence of system 1 and system 2 usage through response accuracy, FoR and recall, but not much research combines these factors to find cohesive and continuous support.

The Present Study

Can we find support for a core feature of Dual Process Theory, namely shallow and deep processing for system 1 and system 2, respectively? If there in fact are two systems, we

should be able to find support for them through answer accuracy (normatively), FoR and recall proxies when there is a conflict between intuition and logic/probability. Since accuracy and RTs are ambiguous to identify system 1 and system 2 usage, we focus on FoR and recall. From this overarching question, we derive our main research question:

Does low FoR indicate conflict detection and use of deliberation?

To address this, we operationalize it by assuming that low FoR indicates conflict detection and that this may lead to deeper processing seen in better recall, i.e., is there a relationship between FoR and recall?

Null hypothesis (H0): FoR is not related to recall accuracy.

Main hypothesis (H1): Low FoR is related to better recall.

We assume that FoR is an indicator of conflict detection and recall an indicator of processing depth. Low FoR should indicate conflict detection and good recall should indicate deliberation. If system 2 is engaged after conflict detection, deeper processing should have taken place. To find support for dual process theories, we should be able to see low FoR and better recall of the items that have been solved normatively correct in conflict items. If we do not find these tendencies, we might conclude that alternative theories to dual process theories should be considered.

Adjunct second, third and fourth hypotheses (H2, H3 and H4) are:

H2: Response accuracy is lower for conflict items than non-conflict items.

H3: Non-conflict items have higher FoR than conflict items.

H4: Normatively answered conflict items are better recalled than incorrectly answered conflict items.

These latter hypotheses are based on previous research on dual process theories (De Neys & Glumicic, 2008; Thompson & Johnson, 2014), and will not be the focal point in this study. However, it will be interesting to see if we can replicate results from previous research.

Given that previous research has found low FoR and good recall to be indications of system 2 usage, finding the same results for normatively correctly solved items will contribute to support dual process theories.

Method

Ethical Considerations

The project has been approved by the internal review board at the Department of Psychology at UiT - The Arctic University of Norway, and data collection was anonymous. See Appendix A for ethical approval. The study was pre-registered, and all material can be found on the Open Science Framework (OSF). Pre-registration and materials can be found here: https://osf.io/k9sjb.

Participants

Participants were recruited through snowballing from UiT - The Arctic University of Norway, e.g., through Studentsamfunnet Driv, which is a student organization, consisting of students from all faculties. The majority were recruited through a mandatory work requirement in the courses PSY-1012 and PSY-2553. 139 participants were randomly assigned to one of three groups, in which they were asked to answer a survey. People without sufficient English reading and understanding skills were excluded from the data. The Wordsum test was used for measuring English proficiency (Mækelæ et al., 2018).

Experimental design

The experiment was a randomized between-subject design, where the task paradigms are teleological reasoning, base-rate and syllogisms. In all three paradigms participants received items with and without conflict, they provided their response and answered FoR and recall questions. Each of the three questionnaires consist of six components: (1) A consent form, (2) the Wordsum test, (3) teleological statements, base-rate questions or syllogisms, as well as (4) a recall task, (5) the Need for Cognition questionnaire, and (6) demographic

questions about age and gender. We measure response accuracy and RTs, FoR, validity and reliability after each item, and after all items, a recall test is given. All three questionnaires have components that have been widely used in research on dual process theories. Their specific qualities will be presented in the following sections. The recall test allows us to detect whether or not deep processing, or deliberation, has been taken place. We assume that if the participants have processed the information, or the items (base-rate, teleological or syllogism) deeply, they should be able to remember a missing word from one of said items. Note that we chose to exclude the cognitive reflection test (CRT), as it is well known in the field, and many students at UiT, specifically at the Faculty of Health Science, are familiar with the tests.

Materials and Procedure

Before data collection began, a pilot study was conducted. We tested all three paradigms to make sure they measured what we expected. All participants were tested once. The questionnaires were administered in Qualtrics (Qualtrics, Provo, UT) and completed on the participants' personal computer or mobile phone. The participants recruited from the PSY-1012 class, as well as those recruited through Studentsamfunnet Driv, were given the base-rate form. Participants recruited from the PSY-2553 were randomly assigned to either the syllogism or teleological form. For each form, the questions were randomized. See appendix for an overview of all the three complete forms.

Need for Cognition

Participants were tested for Need for Cognition (NfC), but will not be further discussed in this paper, except for an overview of the results.

Wordsum Test

The Wordsum test is included to track the participants' English skills and also serves as a verbal intelligence proxy (Barr et al., 2015). The test consists of ten English words with

increasing difficulty. That is, how common the word is. The participants are asked to identify the meaning of the target word by selecting among a handful of words the closest match. For example, one target word could be “beast”. Participants choose between “afraid”, “words”, “large”, “animal” and “separate”. The word that closest resembles the target word would be “animal” in this case.

Base-rate Form

Base-rate problems produce a conflict within reasoners, who has to make a decision based on either statistics or beliefs (Thompson et al., 2018). In the base-rate problems, participants are presented with two pieces of information, one about the statistics regarding the problem, and one description of a randomly selected person, usually in a stereotypical manner in regard to the occupations presented as alternatives. The items were either congruent, incongruent or neutral. In congruent items, the statistical information and the stereotypical information are not supposed to induce conflict. In incongruent items, there is a conflict between the statistical and stereotypical information. The neutral items were created with statistical information, but no stereotypical information. Rather, the items would have a neutral description of a person. These items should not cause conflict. Examples of congruent, incongruent and neutral base-rate questions, respectively:

> *“In a study, 1000 people were tested. Among the participants there were 5 Americans and 995 French people. Martine is a randomly chosen participant. Martine is 26 years old. She is bilingual and reads a lot in her spare time. She is a very fashionable dresser and a great cook. What is most probable? Martine is American. Martine is French.”*
>
> *“In a study, 1000 people were tested. Among the participants there were 4 whose favorite series is Star Trek and 996 whose favorite series is Friends. Jeremy is a randomly chosen participant. Jeremy is 26 and is doing graduate studies in physics.*

He stays at home most of the time and likes to play videogames. What is most probable? Jeremy's favorite series is Star Trek. Jeremy's favorite series is Friends."

"In a study 1000 people were tested. Among the participants there were 995 prison guards and 5 judges. Alex is a randomly chosen participant. Alex has brown eyes, brown hair and drives a gray car. What is most probable? Alex is a prison guard. Alex is a judge."

Items are taken from the work of De Neys and Glumicic (2008) and Thompson et al. (2018). However, some modification has been done to adapt it for a Norwegian context.

Syllogism Form

Syllogisms are reasoning tasks which consist of two premises and one conclusion. The participants' task is to verify whether the conclusion is true or false. There are four ways to formulate the syllogisms – two congruent and two incongruent, yielding four categories: invalid/believable (IB), invalid/unbelievable (IU), valid/believable (VB), and valid/unbelievable (VU). Examples of each category, respectively:

"Premise 1: All things that have a motor need oil, Premise 2: Automobiles need oil, Conclusion: Automobiles have motors."

"Premise 1: All ants have wings, Premise 2: Everything winged sings, Conclusion: Everything that sings is an ant."

"Premise 1: All grasses are green, Premise 2: Everything green is alive, Conclusion: All grasses are alive."

"Premise 1: All things that are smoked are good for health, Premise 2: Cigarettes are smoked, Conclusion: Cigarettes are good for health."

Each participant was given eight items per category, 32 syllogisms in total, in a randomized order. Here, we consider IB and VU as conflict items, and IU and VB as non-conflict items.

The items are taken from the work of Markovits and Nantel (1989) and Čavojová et al. (2018).

Teleological Form

Teleological statements communicate an object or event by referring to a consequence or purpose (Kelemen et al., 2013). Participants are asked to verify whether 32 such statements are true or false, and the statements can take one of four forms: Physical/false, physical/true, teleological/false and teleological/true. Examples of these statements are, respectively:

"Viruses replicate because they are microscopic."

"People wear contact lenses in order to see more clearly."

"The sun radiates heat because warmth nurtures life."

"Schools exist in order to help people learn new things."

For most of the statements, the intuitive response is that the statement is "true", but the correct answer is actually "false". However, some of the items, the teleological control items, will seem to be true, and actually be true. It is important to include these control items to make sure that the participants do not detect a pattern in the teleological test items. There were 6 physical true statements, 10 physical false statements, 4 teleological true statements and 12 teleological false statements. In total 32 statements. Order was randomized per participant. The statements were taken from Kelemen et al. (2013).

Feeling of Rightness

Inspired by Thompson et al. (2011, 2013; 2014; 2019), we measured Feeling of FoR through a self-reported scale where participants indicate their FoR on a sliding-scale from 1 to 10. They are asked to indicate "at the time I provided my answer, I felt: "guessing" (coded as 1), "fairly certain" (coded as 5) and "certain, I am right" (coded as 10).

Believability and Fluency

In all three paradigms we also measure believability or fluency, or both. Fluency, which is the ease with which information comes to mind mediate the relationship between FoR and answer revision (Wang & Thompson, 2019). The syllogism questionnaire tested for believability. The items would be followed up by the question: "is the conclusion in line with your view of the world". If the syllogism was valid/believable, the believability rating should reflect that. In the teleological questionnaire, we tested for fluency by asking "was the answer immediately obvious to you?" In the base-rate questionnaire, we asked for both fluency and believability. "Was the answer immediately obvious to you?" measuring fluency, and "Did the answer you picked match the description of the person?" measuring believability. This will not be further discussed in this paper.

Recall test

After all items had been answered, participants were asked to remember one essential key word from some of the items. We would take one sentence from an item and have the participants fill in a blank word by typing in that word themselves. Examples of a recall task from base-rate, syllogism and teleological items are as follows, respectively:

Fill in the missing word from a previously presented sentence:

"Among the participants there were 4 whose favorite series is Star Trek and 996 whose favorite series is _____."

Fill in the missing word from a previous premise:

"Automobiles need _____."

Please fill in the missing word from a previously presented statement:

"_____ replicate because they are microscopic."

Analysis

Statistical tests were performed with a statistics program (JASP, 2022, version 0.16.4). To compare the means between all paradigms and conditions, a repeated measures analysis of variance (rmANOVA) was done for the base-rate and syllogism, and paired samples t-test for the teleological / control items. rmANOVA was used for accuracy, FoR and recall. Since we used Qualtrics, RTs might not be reliable, as participants can get distracted or interrupted when they take the survey at home and not in a lab. RTs are also not sufficient to identify system 1 or system 2 usage. Participants with a Wordsum score less than 4 were excluded as this indicates poor English (Mækelæ & Pfuhl, 2018). For H1, a correlation analysis between FoR and recall accuracy for conflict items (base-rate incongruent, syllogism IB, VU, and teleological statements) was performed. Items without a conflict served as fillers and to assess whether the conflict items do induce non-normative responses. Recall had to be scored manually, (since participants typed in the word) as incorrect = 0 or correct = 1.

Results

Table 1 presents an overview of mean scores and standard deviation for each variable in each paradigm. 111 responses were collected; 30 participants completed the base-rate task (F=21, M=9, age range from 19 to 52, M_{age} = 24.1 years, SD = 8.1 years), 41 participants completed the syllogism task (F=34, M=6, Non-binary=1, age range from 20 to 50, M_{age} = 24.6 years, SD = 6.6 years) and 45 participants completed the teleological task (F=30, M=15, age range from 20 to 37, M_{age} = 23.5 years, SD = 3.8 years). 9 participants were excluded due to lack of adequate English skills (Word sum test score <4), resulting in 107 valid responses. An overall tendency of low accuracy and FoR on the conflict items on the base-rate tasks (incongruent items) and the teleological tasks (teleological items) reveal that those tasks indeed work as they were intended. This was not as prominent for the syllogism task.

Table 1

Mean Score and Standard Deviation of Each Paradigm in Each Condition

Paradigm	Accuracy	RT	FoR	Recall
BR congruent	96.6 (0.052)	2.880 (0.440)	5.497 (1.842)	54.8 (0.202)
BR incongruent*	74.7 (0.324)	2.900 (0.498)	4.486 (2.083)	41.1 (0.124)
BR neutral	92.8 (0.091)	2.880 (0.467)	3.391 (1.675)	28.0 (0.236)
Teleo physical	91.4 (0.078)	7.422 (3.021)	7.594 (1.283)	86.8 (0.119)
Teleo teleological*	74.8 (0.168)	8.572 (3.641)	7.207 (1.566)	72.1 (9.138)
Syllogism IB*	34.4 (0.252)	19.170 (11.455)	6.521 (1.909)	35.8 (0.224)
Syllogism IU	66.3 (0.176)	27.422 (28.506)	5.125 (1.892)	60.4 (0.195)
Syllogism VB	81.3 (0.160)	19.807 (11.312)	6.486 (2.122)	33.7 (0.241)
Syllogism VU*	79.5 (0.257)	19.556 (12.313)	6.635 (2.067)	45.8 (0.222)

*Note: *= conflict. BR = Base-rate, Teleo physical = teleological task/physical items, Teleo teleological = teleological task/teleological items, Syllogism = Syllogism task, IB = invalid/believable, IU = invalid/unbelievable, VB = valid/believable, VU = valid/unbelievable. Accuracy means normative responding and is presented as percent (%), RTs are presented in seconds, recall is recall accuracy in percent (%). Standard Deviation in brackets.*

Wordsum test

9 participants had a score of 3 or less, one in base-rate task (n=29), five in syllogism task (n=36) and three in the teleological task (n= 42). These 9 participants are excluded from further analysis, resulting in N=107.

Need for Cognition Score

In the base-rate task the average NfC score was 58.79, SD = 9.9 (range 37 to 77). In the syllogism task the average NfC score was 57.94, SD = 10.99 (range 31 to 83). In the teleological task the average NfC score was 62.73, SD = 11.56 (range 34 to 83).

Results Base-rate task

For base-rate we measured RTs, response accuracy, FoR and recall accuracy in each of the three conditions: congruent, incongruent and neutral. Means and SDs are reported in Table 1.

Base-rate and Response Accuracy

With correct answers coded as 1 and wrong answers coded as 0, we found that participant on average had 96.6% correct in the congruent condition, 74.7% in the incongruent condition and 92.8% in the neutral condition. We found a significant difference for response accuracy by condition, $F(1.090, 30.512) = 12.365$, $p = .001$, $\eta^2 = 0.306$. A post-hoc test yielded a significant difference between the congruent and incongruent condition, t = 4.649, $P_{holm} = <.001$, *Cohen's d*(28) = 1.111, and between incongruent and neutral condition, t = -3.854, $P_{holm} = <.001$, *Cohen's d*(28) = -0.921. This supports H2.

Base-rate and RTs

Mean RTs are higher for the incongruent condition ($M = 2.900$, SD = .498), than in the congruent ($M = 2.880$, SD = .440) and neutral ($M = 2.880$, SD = .467). There was no significant difference in RTs between the three conditions, $F(2, 56) = 0.110$, $p = .896$, $\eta^2 = .004$.

Base-rate and FoR

FoR is highest in the congruent condition ($M = 5.497$), intermediate in the incongruent condition ($M = 4.486$) and lowest in the neutral condition ($M = 3.391$). We found a significant difference in FoR by condition, $F(2, 56) = 61.581$, $p = <.001$, $\eta^2 = 0.687$. A post-hoc test reveals a significant difference between congruent and neutral, t = 11.095, $P_{holm} = <.001$, *Cohen's d*(28) = 1.124; and a significant difference between congruent and incongruent, t = 5.328, $P_{holm} = <.001$, *Cohen's d*(28) = 0.540, and also a significant

difference between incongruent and neutral, t = 5.767, P_{holm} = <.001, *Cohen's d*(28) = 0.584. This supports H3.

Base-rate and Recall Accuracy

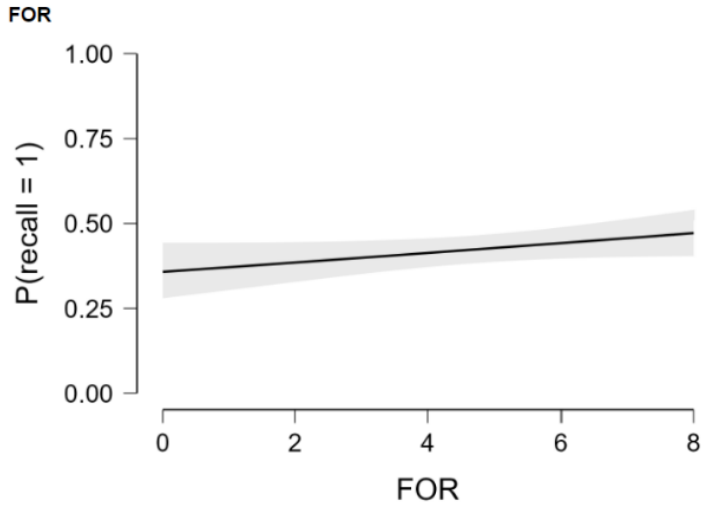
Recall is significantly better for the congruent items, *M* = .548, followed by incongruent items, *M* = .411, and neutral items *M* = .280. The differences were significant, *F*(1.601, 43.218) = 19.085, *p* = <.001, η^2 = 0.414. A post-hoc test found significant differences between congruent and neutral, t = 6.178, P_{holm} = <.001, *Cohen's d*(28) = 1.387; between congruent and incongruent, t = 3.157, P_{holm} = .005, *Cohen's d*(28) = 0.709, and between incongruent and neutral, t = 3.020, P_{holm} = .005, *Cohen's d*(28) = 0.678. For conflict items (incongruent condition) recall accuracy was 42.2% for correctly solved items and 37.6% for incorrectly solved items. Recall accuracy was not significantly different for correctly or incorrectly solved conflict items, *t* = -0.763, *p* = .446, *Cohen's d* = -.092. This does not support H4.

FoR and Recall

Figure 1 shows logistic regression results for the incongruent (conflict) condition.

Figure 1

Recall accuracy as a function of FoR for normatively correctly answered incongruent Base-rate items.



We found that both FoR (M = 5.497) and recall (M = 54.8) are better in the congruent condition, that is, the non-conflict inducing problems, in the base-rate tasks. In other words, the higher the FoR, the better the recall. To assess H1, we look at recall accuracy as a function of FoR for normatively correctly answered conflict items only. There was no significant effect of FoR on recall B = .059, p = .082. This contradicts H1.

Results Syllogism task

For syllogism, we measured RTs, response accuracy, FoR and recall accuracy in each of the four conditions: invalid/believable (IB), invalid/unbelievable (IU), valid/believable (VB) and valid/unbelievable (VU). IU and VB are congruent, while IB and VU are incongruent. The descriptives are shown in Table 1.

Syllogism and Response Accuracy

With correct items coded as 1 and wrong answers coded as 0, IB, IU, VB and VU have the following means, respectively: M_{IB} = 0.344, M_{IU} = 0.663, M_{VB} = 0.813, and M_{VU} = 0.795. There was a significant difference in response accuracy, F(3, 105) = 36.193, p = <.001, η^2 = 0.508. A post-hoc test found significant differences between IB and IU, t = -6.260, P_{holm} = <.001, *Cohen's d*(35) = -1.480, between IB and VB, t = -9.185, P_{holm} = <.001, *Cohen's d*(35) = -2.171, and between IB and VU, t = -8.845, P_{holm} = <.001, *Cohen's d*(35) = -2.091. The results partially support H2, i.e., the non-conflict condition VB had highest accuracy, followed by the conflict condition VU, then the non-conflict condition IU and finally IB.

Syllogism and RT

The mean RTs solving the syllogisms are: M_{IB}=19.170, M_{IU}=27.422. M_{VB}=19.807, M_{VU}=19.556. There were no significant differences for RT by condition, F(1.386, 48.507) = 2.696, p = .035, η^2 = 0.078.

Syllogism and FoR

Descriptives reveal mean scores as M_{IB} = 6.521, M_{IU} = 5.125, M_{VB} = 6.486, and M_{VU} = 6.635. We found a significant main effect of FoR by condition, $F(3, 105) = 26.880$, p = <.001, $\eta^2 = 0.434$. Post-hoc test yielded a significant difference between IB and IU, t = 7.166, P_{holm} = <.001, *Cohen's d*(35) = 0.698, between IU and VB, t = -6.988, P_{holm} = <.001, *Cohen's d*(35) = -0.681, and between IU and VU, t = -7.754, P_{holm} = <.001, *Cohen's d*(35) = -0.755. The results do not support H3, i.e., conflict items had higher FoR (IB and VU) than non-conflict items (IU and VB).

Syllogism and Recall Accuracy

Mean recall scores were M_{IB}=0.358, M_{IU}=0.604, M_{VB}=0.337, and M_{VU}=0.458. We found a highly significant main effect of recall accuracy by condition, $F(3, 105) = 22.194$, p = <.001, $\eta^2 = 0.388$. Post-hoc test yielded a significant difference between IB and IU, t = -6.727, P_{holm} = <.001, *Cohen's d*(35) = -1.116, between IU and VB, t = 7.295, P_{holm} = <.001, *Cohen's d*(35) = 1.211, between IU and VU, t = 3.979, P_{holm} = <.001, *Cohen's d*(35) = 0.660, and also between VB and VU, t = -3.316, P_{holm} = .004, *Cohen's d*(35) = -0.550. Recall proxies are lower for both believable conditions and higher for both unbelievable conditions. For conflict items recall accuracy was 47.5% for correctly solved items and 53.3% for incorrectly solved items, i.e., correctly solved conflict items were not recalled better, disconfirming H4.

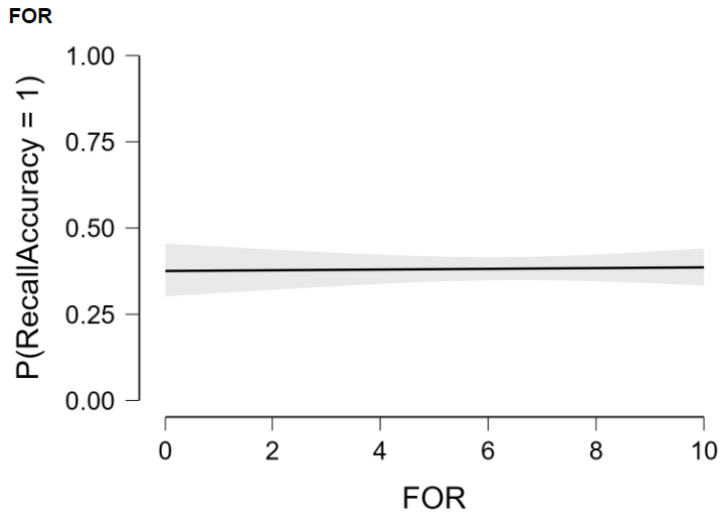
FoR and Recall

Figure 2 shows logistic regression results for the conflict conditions. We found that the IU (conflict) condition has low FoR (5.125) and high recall accuracy (66.3%), giving some support to H1. However, for the IB (6.521, 35.8%), VB (6.486, 33.7%) and VU (6.635, 45.8%), FoR is high and recall is low. In other words, the higher the FoR, the lower the recall accuracy for conflict conditions. When This contradicts H1. To assess H1, we look at recall

accuracy as a function of FoR for normatively correctly answered conflict items only. There was no significant effect of FoR on recall B = -0.509, p = .854.

Figure 2

Recall accuracy as function of FoR in correctly solved conflict items; syllogism task, invalid believable and valid unbelievable items.



Results Teleological Task

To analyze the results from the teleological task, we performed a paired samples t-test. In this paradigm, there are only two conditions, physical and teleological. Physical statements are control questions, while the teleological statements are conflict inducing.

Teleological and Response Accuracy

Participants answer on average 91.4% of the physical control items and 74.8% of the teleological items correct. This difference was statistically significant, $t(40) = 6.795$, p = <.001, *Cohen's d* = 1.049. This confirms H2.

Teleological and RT

For RTs we found that the teleological items take longer than the physical items to answer, M_P=7.422, M_T=8.572. There was a statistical significant difference in the RTs between the two conditions, $t(40) = -2.789$, p =.008, *Cohen's d* = -0.430.

Teleological and FoR

We found that participants have higher FoR on the physical statements, $M_P = 7.594$ than in the teleological statements, $M_T = 7.207$; $t(40) = 2.927$, $p = .006$, $d = 0.452$. This confirmed H3.

Teleological and Recall Accuracy

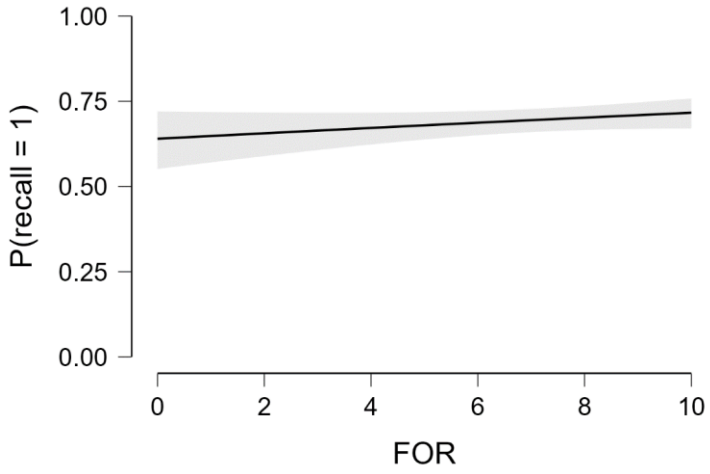
Overall recall is better for the physical statements, $M_P = 0.868$, than the teleological statements, $M_T = 0.721$. The paired samples t-test was significant, $t(40) = 6.942$, $p = <.001$, $d = 1.071$. For teleological items, recall accuracy was 71.2% for correctly solved items and 65% for incorrectly solved items. The difference was not significant, t = -1.622, p = .105, Cohen's d = -.134. This does not support H4.

FoR and Recall

Figure 3 shows logistic regression results for the conflict conditions. To assess H1, we look at recall accuracy as a function of FoR for normatively correctly answered conflict items only. There was a significant effect of FoR on recall $B = .077$, $p = .002$. We found no support for H1. The higher the FoR (7.594), the better the recall (86.8%).

Figure 3

Recall accuracy as a function of FoR; teleological test items



Low FoR Does Not Lead to Better Recall

To assess H1, we focus on normatively correctly solved conflict items in the three task paradigms (16 syllogism items, 12 incongruent base-rate items, 12 teleological items), and assess the relationship between the FoR rating (ordinal from 1 to 10) of the items with its recall accuracy (either 0 or 1). As can be seen in Figure 1 to 3, the probability of a correct recall is more or less independent of the FoR for the (conflict) item when answered normatively correct. These results also hold up when looking at table 1, i.e., conditions with larger FoR also have better recall. Table 1 provides an overview of the descriptives (accuracy, RT, FoR and recall accuracy) per condition and paradigm. As can be seen, the conflict items (incongruent base-rate, teleological statements, syllogisms IB and syllogism VU) had lower response accuracy, generally lower FoR and somewhat mixed recall results.

Discussion

We wanted to see if we could find support for a core feature of dual process theories and find support for the presence of two different systems governing the way we think. To address this, we implemented tasks that are well-known in Dual Process Theory testing, namely base-rate tasks, syllogistic reasoning tasks and teleological statement tasks. We wanted to see if conflict detection, in the sense of low FoR would lead to deliberation, in the sense of good recall. Confirming this would contribute to the evidence that supports dual process theories. To recap our hypothesis, the main ones are as follows: H0: FoR is not related to recall. H1: Low FoR is related to better recall. Adjunct hypotheses are: H2: Response accuracy is lower for conflict items than non-conflict items. H3: Non-conflict items have higher FoR than conflict items. H4: Normatively answered conflict items are better recalled than incorrectly answered conflict items.

H1: Low FoR is not predicting better recall.

To see if we could find support for H1, we measured FoR and recall in three task paradigms. From the base-rate paradigm we found that the tasks with the lowest FoR score, namely the neutral, non-conflict, items also have the lowest recall scores. The conflict items, the incongruent condition, does not have the lowest FoR or best recall. In fact, the non-conflict congruent items have the highest recall accuracy. This rejects H1, but does not support H0 either. From the syllogism tasks, we found that the condition with lowest FoR is the IU condition, also non-conflict. The IU condition has the highest recall scores, giving support for H1 and seemingly rejecting H0. However, the two conflict conditions, IB and VU should have low FoR and high recall if the conflict is detected and overridden. However, there is no indication for that. Hence, also in the syllogism task we found no support for H1. In the teleological paradigm we found the lowest FoR score in the teleological items, that is, the conflict items. We also found, similarly to the base-rate paradigm, that the lower the FoR, the lower the recall. This does not support H1.

In sum, across the three task paradigms we found no support for FoR triggering deeper processing as seen in better recall. This questions the presence of system 2 usage in the tasks or the necessity to implicate two processing systems, or both.

H2: Response Accuracy is Lower for Conflict Items than Non-Conflict Items.

From results on response accuracy from the base-rate paradigm, we found that the congruent and neutral items, both non-conflict conditions, had higher accuracy (96.6% and 92.8%) than conflict items (74.7%). From the syllogism we found partly support for H2. For this paradigm we had two conflict conditions (IB and VU) and two non-conflict conditions (IU and VB). Here, we found the lowest response accuracy in the IB condition (34.4%), supporting H2. However, the other conflict condition (VU) has almost as high response accuracy (79.5%) as the VB condition (81.3%). Since IB is so significantly lower when

compared to all the other three conditions, it is natural to assume there either is a mistake with the VU condition and that it does not elicit much conflict after all, or that it is simply easier with the valid (V) conditions than the invalid (I) conditions. From the teleological paradigm, we found lower accuracy for the teleological, here conflict, items. All in all, we found lower response accuracy for conflict items, supporting H2, and replicating previous studies (e.g. (Barbey & Sloman, 2007; Kelemen et al., 2013; Oakhill et al., 1989; Thompson & Johnson, 2014)).

H3: Conflict items often have Low FoR

In the base-rate paradigm the incongruent condition has the lowest response accuracy. But this condition does not have the lowest FoR score, the neutral condition has. This suggests that difficulty is not linearly related to FoR. For the syllogism task, we found VB to have the highest response accuracy and second lowest FoR score. The two conflict conditions, VU and IB, do not have the lowest FoR, rather the non-conflict condition IU has the lowest FoR. This contradicts the findings by Thompson and Johnson (2014) and H3. For the teleological paradigm, we found that the physical items have high FoR scores whereas the teleological (conflict) items have low FoR, supporting H3. In sum, in two of the three task paradigms conflict items do yield low FoR, replicating Thompson and Johnson (2014).

H4: Normatively Answered Conflict Items Are Not Better Recalled Than Incorrectly Answered Conflict Items

From the base-rate paradigm, we found that correctly answered conflict items are similarly well recalled than conflict items incorrectly solved. The same is true for teleological items solved correctly or incorrectly and for conflict syllogism items. This does not replicate the finding by de Neys and Glumicic (2008).

General Discussion

There are many interesting finds from all three paradigms. Looking at the results, we conclude that we found no support for H1. In other words, low FoR is not related to better recall. When it comes to H2, H3 and H4, we get some mixed results. This study found support for H2 and H4, and not for H1 and H3. The fact that conflict items show lower accuracy and correctly solved items leads to better recall, it means that non-conflict and "easier" items are remembered better. This may indicate that difficulty does not predict FoR and recall accuracy, and hence challenge the idea that we have two separate systems. Since the easier items are remembered better, it seems that the system we see as fast and intuitive to a great extent makes use of WM and could also be a sort of deep processing. And what we believed to be the deliberate system 2, does not necessarily result in deep processing or deliberation.

Looking at the previous work on recall in dual process testing, they found that conflict items and deeply processed words result in better recall (Craik & Tulving, 1975; De Neys & Glumicic, 2008; Loaiza et al., 2011). Being that we tested for the same, and in similar nature, we should be able to find somewhat similar results. However, our results show no such effect. This might have to do with the nature of the recall tests. De Neys and Glumicic (2008) used the base-rate and recall task to measure deep processing, but focused the recall task on the base-rate information, not a word, like we did. Participants had to remember the specific base-rate information. Craik and Tulving (1975) and Loaiza et al. (2011) had tasks that focused on words and their meaning, either the characteristics or the meaning of words. Even though we also had participants focusing on specific words for our recall task, they had never been asked to remember the characteristics or deeper meaning of that specific word. In some cases, one might argue that this is not giving the participants a fair chance of remembering the words, but if they actually processed all the information deeply, they should be able to

remember key words from said information. How the difference in recall accuracy comes to be, is therefore not very clear. It might have to do with the nuanced difference in the presentation of the recall tasks, or it simply goes to show that with all the tasks, deep processing never really occurred the way we assume it should.

The FoR-scale was highly influenced by Thompson et al.'s work (2011, 2013; 2014; 2019). Thompson et al. found consistent results where low FoR indicates conflict detection and high FoR indicated no conflict detection. In alignment, we also found low FoR in the conflict condition for both the base-rate task and teleological task, however, not for the syllogism task. This might be because we used other syllogisms, using words that would be easier to remember in recall tasks. That change could potentially influence recall results and RTs, but should in theory not change the FoR score between ours and Thompson et al.'s results, as the logic behind the premises are the same. But other than the syllogism, the pattern is the same. This indicate that FoR in fact enables us to differentiate between conflict and non-conflict items. One could also argue that these factors say something about the difficulty level of the tasks. FoR is not necessarily a measurement of a person's actual conflict detection, but is rather an indication of how confident the person is to have given the correct answer. One may guess correctly as there was a 50% chance in the three task paradigms.

According to the default interventionalist theory, RT and answer accuracy proxies should be enough to determine that either system 1 or system 2 has been used. Both RT and accuracy should be high when system 2 has been used. Our RT and accuracy results show no clear pattern where RT and accuracy is high in the same task. With our results showing no significant difference in RT for conflict versus non-conflict items, and previous research finding similar results (Melnikoff & Bargh, 2018; Raoelison et al., 2020), RT is not a defining feature of system 1 or 2 usage. The smart intuitor view, which recognizes that

people tend to make normatively correct answers fast, differentiates between two heuristic responses: heuristic and logical intuition. To recap, the heuristic intuition is associated with normatively wrong answers, as it is based on biases and heuristics. Logical intuition is associated with normatively correct answers and could for instance be based on expertise. For this view, RTs would not distinguish between right and wrong answers, but could potentially distinguish between intuition and deliberation, and cognitive capacity was an indication of answering intuitively correct. Our study has not aimed to find support for the two intuitions, but our evidence points in a direction where deliberation and intuition cannot be identified by RTs or recall accuracies. Hence, a broader and more intricate parting of the systems should be evaluated.

Implications and Future Direction

In developing the present study, we challenged a leading theory within the field of judgement and decision making, namely the Dual Process Theory (Kahneman, 2003). Even though this study alone does not reject dual process theories as a concept, it opens up for discussion of whether alternative theories should be considered. Perhaps a single-process theory of reasoning is more explanatory, where reasoning is a more intricate process of intuition and deliberation, without a standardized pattern (Dewey, 2022). Or perhaps something entirely different, like “a many-processes theory” with several sub-processes within both intuition and deliberation, explaining the relationship between our FoR, what we recall, what we answer correctly, what we answer fast, and how these factors communicate with each other. Future research could benefit from finding a better measurement of system 2 usage, as we see that FoR and recall does not hold its stance. Alternatively, if system 2 is legitimate, it might need to be redefined, as the current characteristics of it are not supported in this study. System 2 might represent a combination of the current characteristics of both system 1 and system 2, only it operates differently depending on factors like difficulty of the

task, previous experiences and WM, as well as IQ and individual differences. On a broader sense, this research contributes to the ever-expanding field of judgement and decision making. Expanded knowledge in this field will help us better understand human behavior and potentially improve decision making by enabling us to identify and correct for biases and heuristics that commonly make us judge and conclude with error. These corrections can for example help us make better financial decisions and help group decision making within an organization.

Limitations

This study had limitations, mainly related to our task paradigms, the sample and the administration of the experiment. For the base-rate task we measured correctness by referring to whether they were able to ignore stereotypical information in favor of base-rate information. This, however, is not necessarily the conclusion of correctness, and is the reason we emphasized “normative correctness”. The task might have been more informative if it was able to capture a subjective idea of correctness. For the other tasks, this was not so much a problem as neither syllogism or teleological statements have the element of individual experience coloring the idea of correctness. Participants must consider whether or not a statement is true or false, rather than consider possibility.

A potential limitation with the syllogism task is that we used the version of this task that has words we are familiar with. There also exists a version with words that are nonsense (Thompson et al., 2018). We chose to not use these as they were too difficult for a recall test. That might have altered some of the difficulty aspects of solving the items, making it easier to solve than they could have been.

The second and third limitation regards our sample size and quantity. First of all, we gathered 107 valid responses. Our study would benefit from having a larger sample size. Additionally, the sample size could benefit from consisting of people from other

backgrounds, with different lifestyles, or both. Common for most of our participants is that they are students living in Tromsø, many of which study psychology. It is natural to assume some of the participants were familiar with concepts or contents of the tasks presented. This could result in them already knowing the answers or understanding that we measure more than we want them to believe. To try and minimize this effect, we excluded the well-known CRT test and gave the also well-known base-rate task to mainly students outside of The Department of Psychology at UiT. The lesser-known syllogism and teleological statement tasks we were more confident could go to psychology students. However, we cannot exclude the possibility that some were familiar with those as well.

The fifth and last limitation is that participants did the test online on their own terms. They performed the test on either their personal computer or phone, meaning that RTs are not as reliable as for lab experiments, i.e. participants could take it in their own time and spend as much time as they wanted. We controlled for this by asking whether they were distracted during the questionnaire, however it would be even better to have participants answer the questionnaire in a controlled setting.

Conclusion

To answer the research question "Does low FoR indicate conflict detection and use of deliberation?" the answer is: No, it does not appear to do so. This does not necessarily debunk the entire idea of dual process theories, but it opens for the idea that alternative theories should be explored. As presented introductory, Eysenck and Keane (2020) wrote: "(…) research has rarely identified with precision the strategies actually used on judgement tasks". This study does not identify the strategies used on judgement tasks, but it gives new insight into the field by comparing well known Dual Process Theory tests with FoR and recall tests. This combination has not yet been researched to a great extent. Results from it also show signs of altering typical FoR and recall results, contradicting typical FoR and recall

tests when measured separately. Post-hoc tests reveal large effect sizes, and we see statistically significant results across the paradigms, so there is little indication that our results are due to chance. It is obvious that our study should be tested on a larger scale with a bigger sample size and preferably on a variety of people across ages and cultures. Hopefully, this contributes to broadening the knowledge of how we tend to make judgements and decisions, and also how we measure dual process theories (or alternative theories) in the future.

References

Barbey, A. K., & Sloman, S. A. (2007). Base-rate respect: From ecological rationality to dual processes. *Behavioral and Brain Sciences*, *30*(3), 241–254. https://doi.org/10.1017/S0140525X07001653

Bar-Hillel, M. (1980). The base-rate fallacy in probability judgments. *Acta Psychologica*, *44*(3), 211–233. https://doi.org/10.1016/0001-6918(80)90046-3

Barr, N., Pennycook, G., Stolz, J. A., & Fugelsang, J. A. (2015). Reasoned connections: A dual-process perspective on creative thought. *Thinking & Reasoning*, *21*(1), 61–75. https://doi.org/10.1080/13546783.2014.895915

Čavojová, V., Šrol, J., & Adamus, M. (2018). My point is valid, yours is not: Myside bias in reasoning about abortion. *Journal of Cognitive Psychology*, *30*(7), 656–669. https://doi.org/10.1080/20445911.2018.1518961

Clark, L. (2010). Decision-making during gambling: An integration of cognitive and psychobiological approaches. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1538), 319–330. https://doi.org/10.1098/rstb.2009.0147

Craik, F. I. M., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General*, *104*(3), 268–294. https://doi.org/10.1037/0096-3445.104.3.268

De Neys, W. (2012). Bias and Conflict: A Case for Logical Intuitions. *Perspectives on Psychological Science*, *7*(1), 28–38. https://doi.org/10.1177/1745691611429354

De Neys, W., & Glumicic, T. (2008). Conflict monitoring in dual process theories of thinking. *Cognition*, *106*(3), 1248–1299. https://doi.org/10.1016/j.cognition.2007.06.002

Dewey, C. (2022). Metacognitive control in single- vs. Dual-process theory. *Thinking & Reasoning*, 1–36. https://doi.org/10.1080/13546783.2022.2047106

Evans, J. St. B. T. (2003). In two minds: Dual-process accounts of reasoning. *Trends in Cognitive Sciences*, *7*(10), 454–459. https://doi.org/10.1016/j.tics.2003.08.012

Evans, J. St. B. T., & Elqayam, S. (2007). Dual-processing explains base-rate neglect, but which dual-process theory and how? *Behavioral and Brain Sciences*, *30*(3), 261–262. https://doi.org/10.1017/S0140525X07001720

Eysenck, M. W., & Keane, M. T. (2020). *Cognitive psychology: A student's handbook* (Eighth edition). Routledge.

Frederick, S. (2005). Cognitive Reflection and Decision Making. *Journal of Economic Perspectives*, *19*(4), 25–42. https://doi.org/10.1257/089533005775196732

Gigerenzer, G., Todd, P. M., & The ABC Research Group. (1999). *Simple Heuristics that Make Us Smart*. Oxford University Press.

Handley, S. J., & Trippas, D. (2015). Dual Processes and the interplay between knowledge and structure: A new parallel processing model. I *Psychology of Learning and Motivation* (Bd. 62, ss. 33–58). Elsevier. https://doi.org/10.1016/bs.plm.2014.09.002

Hastie, R., & Dawes, R. M. (2010). *Rational choice in an uncertain world: The psychology of judgment and decision making* (2nd ed). SAGE.

James, W. (1890). *The principles of psychology, Vol I.* Henry Holt and Co. https://doi.org/10.1037/10538-000

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, *58*(9), 697–720. https://doi.org/10.1037/0003-066X.58.9.697

Kahneman, D. (2011). *Thinking, fast and slow* (1st ed). Farrar, Straus and Giroux.

Kelemen, D. (1999). Function, goals and intention: Children's teleological reasoning about objects. *Trends in Cognitive Sciences*, *3*(12), 461–468. https://doi.org/10.1016/S1364-6613(99)01402-3

Kelemen, D., Rottman, J., & Seston, R. (2013). Professional physical scientists display tenacious teleological tendencies: Purpose-based reasoning as a cognitive default. *Journal of Experimental Psychology: General*, *142*(4), 1074–1083. https://doi.org/10.1037/a0030399

Khemlani, S., & Johnson-Laird, P. N. (2012). Theories of the syllogism: A meta-analysis. *Psychological Bulletin*, *138*(3), 427–457. https://doi.org/10.1037/a0026841

Loaiza, V. M., McCabe, D. P., Youngblood, J. L., Rose, N. S., & Myerson, J. (2011). The influence of levels of processing on recall from working memory and delayed recall tasks. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *37*(5), 1258–1263. https://doi.org/10.1037/a0023923

Markovits, H., & Nantel, G. (1989). The belief-bias effect in the production and evaluation of logical conclusions. *Memory & Cognition*, *17*(1), 11–17. https://doi.org/10.3758/BF03199552

Melnikoff, D. E., & Bargh, J. A. (2018). The mythical number two. *Trends in Cognitive Sciences*, *22*(4), 280–293. https://doi.org/10.1016/j.tics.2018.02.001

Morewedge, C. K., & Kahneman, D. (2010). Associative processes in intuitive judgment. *Trends in Cognitive Sciences*, *14*(10), 435–440. https://doi.org/10.1016/j.tics.2010.07.004

Mækelæ, M. J., Moritz, S., & Pfuhl, G. (2018). Are psychotic experiences related to poorer reflective reasoning? *Frontiers in Psychology*, *9*, 122. https://doi.org/10.3389/fpsyg.2018.00122

Oakhill, J., Johnson-Laird, P. N., & Garnham, A. (1989). Believability and syllogistic reasoning. *Cognition*, *31*(2), 117–140. https://doi.org/10.1016/0010-0277(89)90020-6

Pennycook, G., Fugelsang, J. A., & Koehler, D. J. (2015). What makes us think? A three-stage dual-process model of analytic engagement. *Cognitive Psychology*, *80*, 34–72. https://doi.org/10.1016/j.cogpsych.2015.05.001

Purcell, Z. A., Howarth, S., Wastell, C. A., Roberts, A. J., & Sweller, N. (2022). Eye tracking and the cognitive reflection test: Evidence for intuitive correct responding and uncertain heuristic responding. *Memory & Cognition*, *50*(2), 348–365. https://doi.org/10.3758/s13421-021-01224-8

Raoelison, M., Thompson, V. A., & De Neys, W. (2020). The smart intuitor: Cognitive capacity predicts intuitive rather than deliberate thinking. *Cognition*, *204*, 104381. https://doi.org/10.1016/j.cognition.2020.104381

Thompson, V. A., & Johnson, S. C. (2014). Conflict, metacognition, and analytic thinking. *Thinking & Reasoning*, *20*(2), 215–244. https://doi.org/10.1080/13546783.2013.869763

Thompson, V. A., Pennycook, G., Trippas, D., & Evans, J. St. B. T. (2018). Do smart people have better intuitions? *Journal of Experimental Psychology: General*, *147*(7), 945–961. https://doi.org/10.1037/xge0000457

Thompson, V. A., Prowse Turner, J. A., & Pennycook, G. (2011). Intuition, reason, and metacognition. *Cognitive Psychology*, *63*(3), 107–140. https://doi.org/10.1016/j.cogpsych.2011.06.001

Thompson, V. A., Turner, J. A. P., Pennycook, G., Ball, L. J., Brack, H., Ophir, Y., & Ackerman, R. (2013). The role of answer fluency and perceptual fluency as metacognitive cues for initiating analytic thinking. *Cognition*, *128*(2), 237–251. https://doi.org/10.1016/j.cognition.2012.09.012

Wang, S., & Thompson, V. (2019). Fluency and feeling of rightness: The effect of anchoring and models. *Psihologijske teme*, *28*(1), 37–72. https://doi.org/10.31820/pt.28.1.3

Appendix A

Ethical Approval

UiT
NORGES
ARKTISKE
UNIVERSITET

Institutt for Psykologi
Arkiv ref.: 11/22/R2
Dato: 10. mai 2022
offl. § **26,4**

Gerit Pfuhl
Department of Psychology
UiT - The Arctic University of Norway

Ethical evaluation of research project

Dear Gerit,

Your application concerning your research project *"When do we reason intuitively and when do we deliberate? Validating feeling of rightness, response times and recall as proxies for detecting system 1 and system 2 usage, respectively"* has been evaluated and approved by the Department of Psychology's internal research ethics committee (IPS-REC) based on the received information.

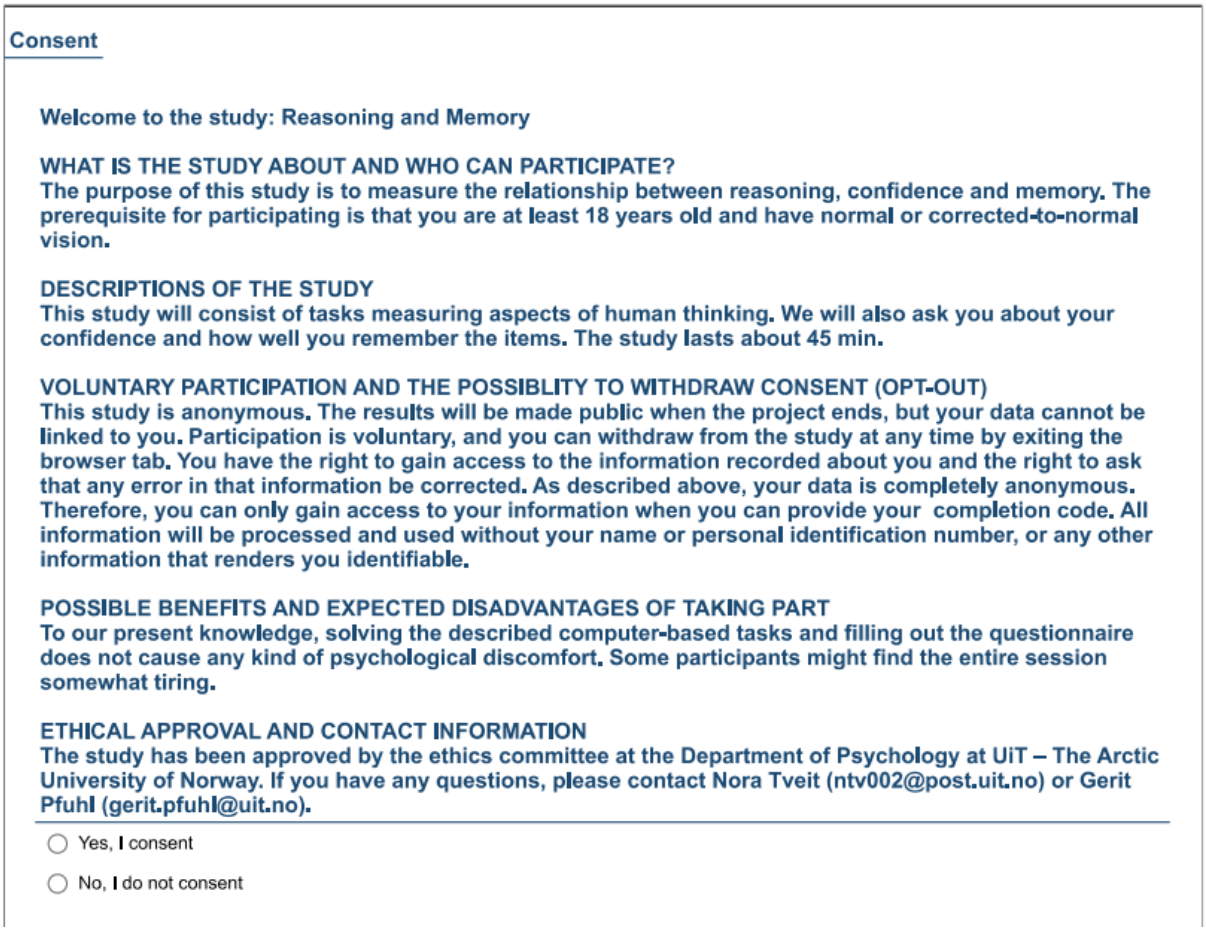
on behalf of the Committee

Matthias Mittner
Chair of IPS-REC
–
research-ethics.ips@uit.no

Kopi sendt: John Vegard Bjørklund

Appendix B

Informed Consent



Consent

Welcome to the study: Reasoning and Memory

WHAT IS THE STUDY ABOUT AND WHO CAN PARTICIPATE?
The purpose of this study is to measure the relationship between reasoning, confidence and memory. The prerequisite for participating is that you are at least 18 years old and have normal or corrected-to-normal vision.

DESCRIPTIONS OF THE STUDY
This study will consist of tasks measuring aspects of human thinking. We will also ask you about your confidence and how well you remember the items. The study lasts about 45 min.

VOLUNTARY PARTICIPATION AND THE POSSIBLITY TO WITHDRAW CONSENT (OPT-OUT)
This study is anonymous. The results will be made public when the project ends, but your data cannot be linked to you. Participation is voluntary, and you can withdraw from the study at any time by exiting the browser tab. You have the right to gain access to the information recorded about you and the right to ask that any error in that information be corrected. As described above, your data is completely anonymous. Therefore, you can only gain access to your information when you can provide your completion code. All information will be processed and used without your name or personal identification number, or any other information that renders you identifiable.

POSSIBLE BENEFITS AND EXPECTED DISADVANTAGES OF TAKING PART
To our present knowledge, solving the described computer-based tasks and filling out the questionnaire does not cause any kind of psychological discomfort. Some participants might find the entire session somewhat tiring.

ETHICAL APPROVAL AND CONTACT INFORMATION
The study has been approved by the ethics committee at the Department of Psychology at UiT – The Arctic University of Norway. If you have any questions, please contact Nora Tveit (ntv002@post.uit.no) or Gerit Pfuhl (gerit.pfuhl@uit.no).

◯ Yes, I consent

◯ No, I do not consent

Appendix C

Base-Rate Form

Consent

Welcome to the study: Reasoning and Memory

WHAT IS THE STUDY ABOUT AND WHO CAN PARTICIPATE?
The purpose of this study is to measure the relationship between reasoning, confidence and memory. The prerequisite for participating is that you are at least 18 years old and have normal or corrected-to-normal vision.

DESCRIPTIONS OF THE STUDY
This study will consist of tasks measuring aspects of human thinking. We will also ask you about your confidence and how well you remember the items. The study lasts about 45 min.

VOLUNTARY PARTICIPATION AND THE POSSIBLITY TO WITHDRAW CONSENT (OPT-OUT)
This study is anonymous. The results will be made public when the project ends, but your data cannot be linked to you. Participation is voluntary, and you can withdraw from the study at any time by exiting the browser tab. You have the right to gain access to the information recorded about you and the right to ask that any error in that information be corrected. As described above, your data is completely anonymous. Therefore, you can only gain access to your information when you can provide your completion code. All information will be processed and used without your name or personal identification number, or any other information that renders you identifiable.

POSSIBLE BENEFITS AND EXPECTED DISADVANTAGES OF TAKING PART
To our present knowledge, solving the described computer-based tasks and filling out the questionnaire does not cause any kind of psychological discomfort. Some participants might find the entire session somewhat tiring.

ETHICAL APPROVAL AND CONTACT INFORMATION
The study has been approved by the ethics committee at the Department of Psychology at UiT – The Arctic University of Norway. If you have any questions, please contact Nora Tveit (ntv002@post.uit.no) or Gerit Pfuhl (gerit.pfuhl@uit.no).

- ◯ Yes, I consent
- ◯ No, I do not consent

Wordsum

We want to know how people guess the meaning of words that they rarely or never use. You will be presented with some words in capital letters that you may or may not know the meaning of, along with five other random words. Your task is to find the word that best describes or goes well with the capital letter word.
Here is an example:

BEAST
afraid, words, large, animal, separate

The correct answer in this instance is "animal" as that is the word that resembles beast the most.

Space

- ◯ school
- ◯ noon
- ◯ captain
- ◯ room
- ◯ board
- ◯ don't know

BROADEN

- ◯ efface
- ◯ make level
- ◯ elapse
- ◯ embroider
- ◯ widen
- ◯ don't know

EMANATE

- ◯ populate
- ◯ free
- ◯ prominent
- ◯ rival
- ◯ come
- ◯ don't know

EDIBLE

- ◯ auspicious
- ◯ eligible
- ◯ fit to eat
- ◯ sagacious
- ◯ able to speak
- ◯ don't know

ANIMOSITY

- ◯ hatred
- ◯ animation
- ◯ disobedience
- ◯ diversity
- ◯ friendship
- ◯ don't know

PACT

- ◯ puissance
- ◯ remonstrance
- ◯ agreement
- ◯ skillet
- ◯ pressure
- ◯ don't know

CLOISTERED

- ◯ miniature
- ◯ bunched
- ◯ arched
- ◯ malady
- ◯ secluded
- ◯ don't know

CAPRICE

- ◯ value
- ◯ a star
- ◯ grimace
- ◯ whim
- ◯ inducement
- ◯ don't know

ACCUSTOM

- ◯ disappoint
- ◯ customary
- ◯ encounter
- ◯ get used to
- ◯ business
- ◯ don't know

ALLUSION

- ◯ reference
- ◯ dream
- ◯ eulogy
- ◯ illusion
- ◯ aria
- ◯ don't know

Info

On the next pages your task is to make a decision based on the information provided. There are no right or wrong answers. After the task, you will be asked to state your level of confidence, how obvious the answer felt and the basis of your choice. You will also be asked to remember some parts the test.

BRi_01

In a study 1000 people were tested. Jack is a randomly chosen participant of this study. Among the participants there were 5 engineers and 995 lawyers.

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 more probable?

- ◯ Jack is an engineer
- ◯ Jack is a lawyer

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRi_02

In a study 1000 people were tested. Kurt is a randomly chosen participant of this study. Among the participants there were 3 who live in a penthouse apartment and 997 who live in a student house.

Kurt works on Wall Street and is single. He works long hours and wears Armani suits to work. He collects designer sunglasses.

What is more probable?

- ◯ Kurt lives in a penthouse apartment
- ◯ Kurt lives in a student house

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_03

In a study 1000 people were tested. Paul is a randomly chosen participant of this study. Among the participants there were 997 nurses and 3 doctors.

Paul is 34 years old. He lives in a beautiful home in a posh suburb. He is well spoken and very interested in politics. He invests a lot of time in his career.

What is more probable?

- ○ Paul is a doctor
- ○ Paul is a nurse

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_04

In a study 1000 people were tested. Jessie is a randomly chosen participant of this study. Among the participants there were 996 women and 4 men.

Jessie is 23 years old and is finishing a degree in engineering. On Friday nights, Jessie likes to go out with friends and listen to loud music and drink beer.

What is more probable?

- ○ Jessie is a woman
- ○ Jessie is a man

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_05

In a study 1000 people were tested. Jeremy is a randomly chosen participant of this study. Among the participants there were 4 whose favorite series is Star Wars and 996 whose favorite series is Friends.

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 more probable?

- ○ Jeremy's favorite series is Star Wars
- ○ Jeremy's favorite series is Friends

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_06

In a study 1000 people were tested. Ellen is a randomly chosen participant of this study. Among the participants there were 995 fifty-year olds and 5 sixteen-year olds

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 probable?

- ◯ Ellen is a fifty-year old
- ◯ Ellen is a sixteen-year old

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRc_07

In a study 1000 people were tested. Karen is a randomly chosen participant of this study. Among the participants there were 5 who buy their clothes at thrift shops and 995 who buy their clothes at high-end retailers.

Karen is a 33-year-old female. She works in a business office and drives a Porsche. She lives in a fancy penthouse with her boyfriend.

What is most probable?

- ◯ Karen buys clothes at thrift shops
- ◯ Karen buys clothes at high-end retailers

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_08

In a study 1000 people were tested. Kelly is a randomly chosen participant of this study. Among the participants there were 3 boys and 997 girls.

Kelly is 13 years old. Kelly's favourite subject is art. Kelly's favourite things to do are shopping and having sleepovers with friends to gossip about other kids at school.

What is most probable?

- ○ Kelly is a boy
- ○ Kelly is a girl

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_09

In a study 1000 people were tested. Jay is a randomly chosen participant of this study. Among the participants there were 997 who have a tattoo and 3 without a tattoo.

Jay is a 29-year-old male. He has served a short time in prison. He has been living on his own for 2 years now. He has an older car and listens to punk music.

What is most probable?

- ○ Jay has a tattoo
- ○ Jay does not have a tattoo

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_10

In a study 1000 people were tested. Lilly is a randomly chosen participant of this study. Among the participants there were 996 kindergarten teachers and 4 executive managers.

Lilly is 37 years old. She is married and has 3 kids. Her husband is a veterinarian. She is committed to her family and always watches the daily cartoon shows with her kids.

What is most probable?

- ○ Lilly is a kindergarten teacher
- ○ Lilly is an executive manager

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_11

In a study 1000 people were tested. Tara is a randomly chosen participant of this study. Among the participants there were 4 Bruce Springsteen fans and 996 Britney Spears fans.

Tara is 15. She loves to go shopping at the mall and to talk with her friends about their crushes at school.

What is most probable?

- ◯ Tara is a Bruce Springsteen fan
- ◯ Tara is a Britney Spears fan

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRc_12

In a study 1000 people were tested. Lucy is a randomly chosen participant of this study. Among the participants there were 995 French people and 5 Americans.

Lucy is 26 years old. She is bilingual and reads a lot in her spare time. She is a very fashionable dresser and a great cook.

What is most probable?

- ◯ Lucy is French
- ◯ Lucy is American

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_13

Brannon is 29 years old. He is very good with numbers but is shy around people. He spends much of his time working.

In the study 1000 people were tested. Brannon is a randomly chosen participant of this study. Among the participants there were 5 accountants and 995 street artists.

What is most probable?

- ○ Brannon is an accountant
- ○ Brannon is a street artist

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_14

Floyd is 40 years old. He is an imaginative person and enjoys street theatre. He loves experimenting with different types of food.

In the study 1000 people were tested. Floyd is a randomly chosen participant of this study. Among the participants there were 3 musicians and 997 consultants.

What is most probable?

- ○ Floyd is a musician
- ○ Floyd is a consultant

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_15

Geraldine is 41 years old. She loves books and spends a lot of her free time reading. She enjoys helping her two children with their homework.

In the study 1000 people were tested. Gerladine is a randomly chosen participant of this study. Among the participants there were 997 drummers and 3 librarians.

What is most probable?

- ○ Geraldine is a drummer
- ○ Geraldine is a librarian

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_16

Tyrone is 27 years old. All his friends consider him very brave and he is in relatively good physical shape. He goes to the gym regularly.

In the study 1000 people were tested. Tyrone is a randomly chosen participant of this study. Among the participants there were 996 managers and 4 firemen.

What is most probable?

- ◯ Tyrone is a manager
- ◯ Tyrone is a fireman

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRi_17

Hank is 42 years old. He is a creative and introverted person. He considers his home computer his most prized possession.

In a study 1000 people were tested. Hank is a randomly chosen participant of this study. Among the participants there were 4 writers and 996 construction workers.

What is most probable?

- ◯ Hank is a writer
- ◯ Hank is a construction worker

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRi_18

Molly is 25 years old. She is very healthy and she works out at least five times a week. She enjoys pop music and dancing.

In a study 1000 people were tested. Molly is a randomly chosen participant of this study. Among the participants there were 995 researchers and 5 aerobics instructors.

What is most probable?

- ○ Molly is a researcher
- ○ Molly is an aerobics instructor

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_19

Richard is 56 years old. He is a good public speaker and is good at meeting people. He is a top notch debater and can argue both sides of an issue with ease.

In a study 1000 people were tested. Richard is a randomly chosen participant of this study. Among the participants there were 5 I.T. Technicians and 995 politicians.

What is most probable?

- ○ Richard is an I.T technician
- ○ Richard is a politician

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_20

Lucius is 34 years old. He is pretty aggressive and tends to get involved in bar fights more than the average person. He recently got divorced.

In a study 1000 people were tested. Lucius is a randomly chosen participant of this study. Among the participants there were 3 hippies and 997 boxers.

What is most probable?

- ○ Lucius is a hippie
- ○ Lucius is a boxer

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_21

Dianna is 59 years old. She loves children and has been employed at her current job for 7 years. She enjoys drinking tea and visiting with family and friends.

In a study 1000 people were tested. Dianna is a randomly chosen participant of this study. Among the participants there were 997 nannies and 3 telemarketers.

What is most probable?

- ◯ Dianna is a nanny
- ◯ Dianna is a telemarketer

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRc_22

George is 36 years old. He is very intelligent and has nerves of steel. He has great hand-eye coordination.

In a study 1000 people were tested. George is a randomly chosen participant of this study. Among the participants there were 996 aeroplane pilots and 4 shop assistants.

What is most probable?

- ◯ George is an aeroplane pilot
- ◯ George is a shop assistant

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_23

Corinne is 32 years old. She is a great organizer and always dresses neatly. She loves talking to her friends and family on the phone.

In a study 1000 people were tested. Corinne is a randomly chosen participant of this study. Among the participants there were 4 gardeners and 996 secretaries.

What is most probable?

- ○ Corinne is a gardener
- ○ Corinne is a secretary

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRc_24

Dan is 30 years old. He is a good driver and a takes his job very seriously. He is married, but has no children.

In a study 1000 people were tested. Dan is a randomly chosen participant of this study. Among the participants there were 995 paramedics and 5 clowns.

What is most probable?

- ○ Dan is a clown
- ○ Dan is a paramedic

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_25

In a study 1000 people were tested. Alex is a randomly chosen participant of this study. Among the participants there were 995 prison guards and 5 judges.

Alex has brown eyes, brown hair and drives a gray car.

What is most probable?

- ○ Alex is a prison guard
- ○ Alex is a judge

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_26

Bobby is 40 years old. He likes wearing t-shirts and shorts. He is bald and he has two daughters.

In a study 1000 people were tested. Bobby is a randomly chosen participant of this study. Among the participants there were 995 shoe shop workers and 5 butchers.

What is most probable?

- ◯ Bobby is a shoe shop worker
- ◯ Bobby is a butcher

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRn_27

In a study 1000 people were tested. Nina is a randomly chosen participant of this study. Among the participants there were 995 introverts and 5 extroverts.

Nina is 20 years old. She has blond hair, green eyes and has parents in Michigan.

What is most probable?

- ◯ Nina is an introvert
- ◯ Nina is an extrovert

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes

BRn_28

In a study 1000 people were tested. Emma is a randomly chosen participant of this study. Among the participants there were 995 car enthusiast and 5 bike enthusiasts.

Emma is 40 years old. She has red hair, freckles and five fingers on each hand. She likes music and sleeping.

What is most probable?

- Emma is a car enthusiast
- Emma is a bike enthusiast

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes

BRn_29

In a study 1000 people were tested. Frida is a randomly chosen participant of this study. Among the participants there were 995 professors and 5 biologists.

Frida is 27 years old and originally from Germany. She likes to wear her hair in a pony tail and drives her red car to work.

What is most probable?

- Frida is a professor
- Frida is a biologist

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_30

Thomas is 31 years old and likes to talk to his parents when he is not working on his hobby. Thomas has two sisters and one older brother.

In a study 1000 people were tested. Thomas is a randomly chosen participant of this study. Among the participants there were 995 body builders and 5 gamers.

What is most probable?

- ○ Thomas is a body builder
- ○ Thomas is a gamer

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_31

In a study 1000 people were tested. Tina is a randomly chosen participant of this study. Among the participants there were 500 piano players and 500 guitar players.

Tina is 43 years old. As a child she had a pet hamster and she loves to listen to music. She has long hair and likes to put it all in a bun when she works. She loves the color blue.

What is most probable?

- ◯ Tina is a piano player
- ◯ Tina is a guitar player

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

BRn_32

Emily is 31 years old. She likes to play sports with her friends and talk to them on the phone. She has a pet cat that lives with her. She likes to cook and paint in her free time.

In a study 1000 people were tested. Emily is a randomly chosen participant of this study. Among the participants there were 500 tennis players and 500 golf players.

What is most probable?

- ◯ Emily plays tennis
- ◯ Emily plays golf

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_33

In a study 1000 people were tested. Katarina is a randomly chosen participant of this study. Among the participants there were 500 ballet dancers and 500 construction workers.

Katarina is 26 years old. She enjoys going to the theater and eat lean food. She is very organized at home and likes to dress elegantly when going out.

What is most probable?

- ○ Katarina is a ballet dancer
- ○ Katarina is a construction worker

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_34

In a study 1000 people were tested. James is a randomly chosen participant of this study. Among the participants there were 500 film reviewers and 500 football players.

James is 34 years old. He enjoys a night in with good food and drink. He goes to the movies with his mates every thursday, and has three cats with his fiancé.

What is most probable?

- ○ James is a film reviewer
- ○ James is a football player

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_35

In a study 1000 people were tested. Gladys is a randomly chosen participant of this study. Among the participants there were 500 twenty-year olds and 500 seventy-year olds.

Gladys likes having friends over to gossip over cake and coffee. She drinks tea every morning and enjoy sewing curtains and pillows when she is not watering her plants.

What is most probable?

- ○ Gladys is a twenty-year old
- ○ Gladys is a seventy-year old

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

BRn_36

In a study 1000 people were tested. Tom is a randomly chosen participant of this study. Among the participants there were 500 people who walk to school and 500 people who drive a car to school.

Tom is sixteen years old and just got his drivers licence. He is not particularly motivated for school and would rather play video games with his friends. His favorite meal is pizza and diet coke.

What is most probable?

- ◯ Tom walks to school
- ◯ Tom drives a car to school

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Did the answer you picked match the description of the person?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

Recall_simple

Write down as many capital letter words you can remember from the word comparison task in the beginning of this survey. If you don't remember any of them you may write "don't know" or choose from the lower case letter words from the same task.

Fill in the missing word from a previously presented sentence:

"Kelly's favourite things to do are _____ and having sleepovers with friends to gossip about other kids at school."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 5 _____ and 995 lawyers".

Fill in the missing word from a previously presented sentence:

"Among the participants there were 3 who live in a condo and 997 who live in a _____".

Fill in the missing word from a previously presented sentence:

"Among the participants there were 997 nurses and 3 _____".

Fill in the missing word from a previously presented sentence:

"Jay has been living on his own for 2 years. He has an older car and listens to _____ music"

Fill in the missing word from a previously presented sentence:

"On Friday nights, Jessie likes to go out with friends and listen to loud music and drink _____".

Fill in the missing word from a previously presented sentence:

"Among the participants there were 4 whose favorite series is Star Wars and 996 whose favorite series is _____.

Fill in the missing word from a previously presented sentence:

"Among the participants there were 995 _____ olds and 5 sixteen-year olds."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 5 who buy their clothes at _____ and 995 who buy their clothes at high-end retailers."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 996 _____ and 4 executive managers."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 4 Bruce Springsteen fans and 996 _____ fans."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 995 French people and 5 _____."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 5 _____ and 995 street artists."

Fill in the missing word from a previously presented sentence:

"Molly is 25 years old. She is very healthy and she works out at least _____ times a week. "

Fill in the missing word from a previously presented sentence:

"Nina has blond hair, green eyes and has parents in _____."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 3 _____ and 997 consultants."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 997 _____ and 3 librarians."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 996 _____ and 4 firemen."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 4 _____ and 996 construction workers."

Fill in the missing word from a previously presented sentence:

"Alex has brown eyes, brown hair and drives a _____ car."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 995 shoe shop workers and 5 _____."

Fill in the missing word from a previously presented sentence:

"Emma has red hair, _____ and five fingers on each hand."

Fill in the missing word from a previously presented sentence:

"Frida is 27 years old and originally from _____."

Fill in the missing word from a previously presented sentence:

"Among the participants there were 995 body builders and 5 _____."

NfC-18i

For each of the statements below, please indicate whether or not the statement is characteristic of you or of what you believe. For example, if the statement is extremely uncharacteristic of you or of what you believe about yourself (not at all like you) please click on the first dot to the right of the statement. If the statement is extremely characteristic of you or of what you believe about yourself (very much like you) please click on the dot furthest to the right next to the statement.

	Extremely uncharacteristic of me	Somewhat uncharacteristic of me	Uncertain	Somewhat characteristic of me	Extremely characteristic of me
I would prefer complex over simple problems.	○	○	○	○	○
I like to have the responsibility of handling a situation that requires a lot of thinking.	○	○	○	○	○
Thinking is not my idea of fun.	○	○	○	○	○
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.	○	○	○	○	○
I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.	○	○	○	○	○
I find satisfaction in deliberating hard and for long hours.	○	○	○	○	○
I only think as hard as I have to.	○	○	○	○	○
I prefer to think about small daily projects over long term projects.	○	○	○	○	○
I like tasks that require little thought once I've learned them.	○	○	○	○	○

	Extremely uncharacteristic of me	Somewhat uncharacteristic of me	Uncertain	Somewhat characteristic of me	Extremely characteristic of me
The idea of relying on thought to make my way to the top appeals to me.	○	○	○	○	○
I really enjoy a task that involves coming up with new solutions to problems.	○	○	○	○	○
Learning new ways to think doesn't excite me very much.	○	○	○	○	○
I prefer my life to be filled with puzzles that I must solve.	○	○	○	○	○
The notion of thinking abstractly is appealing to me.	○	○	○	○	○
I would prefer a task that is intellectual, difficult, and important over one that is somewhat important but does not require much thought.	○	○	○	○	○
I feel relief rather than satisfaction after completing a task that requires a lot of mental effort.	○	○	○	○	○
It's enough for me that something gets the job done; I don't care how or why it works.	○	○	○	○	○
I usually end up deliberating about issues even when they do not affect me personally.	○	○	○	○	○

Pers

What is your gender?

- ○ Female
- ○ Male
- ○ Non-binary

How old are you?

Which subject are you studying? (e.g. Medicine)

Were you at any point distracted by for instance your phone, TV, people or something else while taking this survey?

- ○ Yes
- ○ No

Code

Thanks for taking part / Takk for at du deltok
For å få arbeidskrav godkjent sender du en post til ntv002@post.uit.no og angi koden: TverskyKahneman1979

Appendix D

Teleological Form

Consent

Please test your judgement and decision-making skills. There are 32 slightly different tasks assessing judgement and decision-making, followed by a confidence rating and at the end a memory test. It should take 25-35 min

- ◯ Yes, I consent and my data can be used for research
- ◯ Yes, I consent but my data shall not be used for research

Wordsum

We want to know how people guess the meaning of words that they rarely or never use. You will be presented with some words in capital letters that you may or may not know the meaning of, along with five other random words. Your task is to find the word that best describes or goes well with the capital letter word.
Here is an example:

BEAST
afraid, words, large, animal, separate

The correct answer in this instance is "animal" as that is the word that resembles beast the most.

Space

- ◯ school
- ◯ noon
- ◯ captain
- ◯ room
- ◯ board
- ◯ don't know

BROADEN

- ◯ efface
- ◯ make level
- ◯ elapse
- ◯ embroider
- ◯ widen
- ◯ don't know

EMANATE

- ◯ populate
- ◯ free
- ◯ prominent
- ◯ rival
- ◯ come
- ◯ don't know

EDIBLE

- ◯ auspicious
- ◯ eligible
- ◯ fit to eat
- ◯ sagacious
- ◯ able to speak
- ◯ don't know

ANIMOSITY

- ◯ hatred
- ◯ animation
- ◯ disobedience
- ◯ diversity
- ◯ friendship
- ◯ don't know

PACT

- ◯ puissance
- ◯ remonstrance
- ◯ agreement
- ◯ skillet
- ◯ pressure
- ◯ don't know

CLOISTERED

- ◯ miniature
- ◯ bunched
- ◯ arched
- ◯ malady
- ◯ secluded
- ◯ don't know

CAPRICE

- ◯ value
- ◯ a star
- ◯ grimace
- ◯ whim
- ◯ inducement
- ◯ don't know

ACCUSTOM

- ◯ disappoint
- ◯ customary
- ◯ encounter
- ◯ get used to
- ◯ business
- ◯ don't know

ALLUSION

- ◯ reference
- ◯ dream
- ◯ eulogy
- ◯ illusion
- ◯ aria
- ◯ don't know

Information

In the following you will be shown statements. Please indicate whether you think the statement is true or false. You will thereafter be asked to indicate how confident and easy this felt.

Teleo01

Viruses replicate because they are microscopic

False	True
◯	◯

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
◯	◯	◯	◯	◯

Teleo02

Potatoes contain starch because they grow in the ground

False	True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo03

Snowflakes are white because they are symmetrical

False ○ True ○

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo04

Keys open locked doors because they are made of metal

False ○ True ○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo05

Paper towels are absorbent because they are thin

False True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo06

Skyscrapers are built so that cities have landmarks

False True

At the time I provided my answer, I felt:

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo07

Houses have doorbells in order to make dogs bark

False | True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo08

Lamps shine brightly so that they can produce heat

False | True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo09

Kittens have soft fur so that people will want to pet them

False | True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo10

The sun radiates heat because warmth nurtures life

False	True
○	○

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo11

The sun makes light so that plants can photosynthesize

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo12

The sun sets because darkness discourages predators

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo13

The earth rotates around the sun so that it can receive light

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo14

Grass grows so that herbivores can graze on it

False	True
○	○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo15

Molecules fuse in order to create matter

False	True
○	○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo16

Germs mutate in order to become drug resistant

False	True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo17

Oceans dissolve rocks in order to retain ocean minerals

False	True
○	○

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo18

The earth has an ozone layer in order to protect it from UV light

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo19

Birds transfer seeds in order to help plants reproduce

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo20

Glaciers compact snow in order to conserve volume

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo21

Bees frequent flowers in order to aid pollination

False	True
○	○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo22

Bats hunt mosquitoes in order to control over-population

False	True
○	○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo23

People wear contact lenses in order to see more clearly

False	True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo24

Lollipops are sweet because sugar is a main ingredient

False | True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree

Teleo25

Leaves change color because chlorophyll deteriorates

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo26

Cigarettes produce smoke because tobacco burns

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo27

Objects fall downwards because they are affected by gravity

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo28

Magnets stick together because their poles attract

False	True
○	○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo29

Icicles melt because the temperature increases

False	True
○	○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo30

Parties happen in order to help celebrate special occasions

False	True

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo31

Schools exist in order to help people learn new things

False	True
○	○

At the time I provided my answer, I felt:

Guessing | Fairly certain | Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Teleo32

Alarm clocks beep in order to wake people up

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain, I'm right

Was the answer immediately obvious to you?

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
○	○	○	○	○

Recall

Write down as many capital letter words you can remember from the word comparison task in the beginning of this survey. If you don't remember any of them you may write "don't know" or choose from the lower case letter words from the same task.

Please fill in the missing word form a previously presented statement:

"_____ replicate because they are microscopic"

Please fill in the missing word form a previously presented statement:

"Potatoes contain _____ because they grow in the ground"

Please fill in the missing word form a previously presented statement:

"Snowflakes are white because they are _____"

Please fill in the missing word form a previously presented statement:

"Kyes open _____ because they are made of metal"

Please fill in the missing word form a previously presented statement:

"_____ are absorbent because they are thin"

Please fill in the missing word form a previously presented statement:

"_____ are built so that cities have landmarks"

Please fill in the missing word form a previously presented statement:

"Houses have _____ in order to make dogs bark"

Please fill in the missing word form a previously presented statement:

"Lamps shine brightly so that they can produce _____"

Please fill in the missing word form a previously presented statement:

"Kittens have soft fur so that people will want to _____ them"

Please fill in the missing word form a previously presented statement:

"The sun radiates heat because _____ nurtures life"

Please fill in the missing word form a previously presented statement:

"The sun makes light so that plants can _____"

Please fill in the missing word form a previously presented statement:

"The sun sets because _____ discourages predators"

Please fill in the missing word form a previously presented statement:

"The earth rotates around the sun so that it can receive _____"

Please fill in the missing word form a previously presented statement:

"Grass grows so that herbivores can _____ on it"

Please fill in the missing word form a previously presented statement:

"Molecules fuse in order to create _____"

Please fill in the missing word form a previously presented statement:

"_____ mutate in order to become drug resistant"

Please fill in the missing word form a previously presented statement:

"Oceans dissolve _____ in order to retain ocean minerals"

Please fill in the missing word form a previously presented statement:

"The earth has an ozone layer in order to protect it from _____"

Please fill in the missing word form a previously presented statement:

"Birds transfer _____ in order to help plants reproduce"

Please fill in the missing word form a previously presented statement:

"Glaciers compact _____ in order to conserve volume"

Please fill in the missing word form a previously presented statement:

"_____ frequent flowers in order to aid pollination"

Please fill in the missing word form a previously presented statement:

"Bats hunt _____ in order to control over-population "

Please fill in the missing word form a previously presented statement:

"People wear _____ in order to see more clearly"

Please fill in the missing word form a previously presented statement:

"_____ are sweet because sugar is a main ingredient"

Please fill in the missing word form a previously presented statement:

"Leaves change color because _____ deteriorates"

Please fill in the missing word form a previously presented statement:

"Cigarettes produce smoke because _____ burns"

Please fill in the missing word form a previously presented statement:

"Objects fall downwards because they are affected by _____"

Please fill in the missing word form a previously presented statement:

"Magnets stick together because their _____ attract"

Please fill in the missing word form a previously presented statement:

"Icicles melt because the _____ increases"

Please fill in the missing word form a previously presented statement:

"_____ happen in order to help celebrate special occasions"

Please fill in the missing word form a previously presented statement:

"_____ exist in order to help people learn new things"

Please fill in the missing word form a previously presented statement:

"Alarm clocks _____ in order to wake people up"

NfC-18i

For each of the statements below, please indicate whether or not the statement is characteristic of you or of what you believe. For example, if the statement is extremely uncharacteristic of you or of what you believe about yourself (not at all like you) please click on the first dot to the right of the statement. If the statement is extremely characteristic of you or of what you believe about yourself (very much like you) please click on the dot furthest to the right next to the statement.

	Extremely uncharacteristic of me	Somewhat uncharacteristic of me	Uncertain	Somewhat characteristic of me	Extremely characteristic of me
I would prefer complex over simple problems.	○	○	○	○	○
I like to have the responsibility of handling a situation that requires a lot of thinking.	○	○	○	○	○
Thinking is not my idea of fun.	○	○	○	○	○
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.	○	○	○	○	○
I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.	○	○	○	○	○
I find satisfaction in deliberating hard and for long hours.	○	○	○	○	○
I only think as hard as I have to.	○	○	○	○	○
I prefer to think about small daily projects over long term ones.	○	○	○	○	○
I like tasks that require little thought once I've learned them.	○	○	○	○	○
The idea of relying on thought to make my way to the top appeals to me.	○	○	○	○	○
I really enjoy a task that involves coming up with new solutions to problems.	○	○	○	○	○
Learning new ways to think doesn't excite me very much.	○	○	○	○	○
I prefer my life to be filled with puzzles that I must solve.	○	○	○	○	○
The notion of thinking abstractly is appealing to me.	○	○	○	○	○
I would prefer a task that is intellectual, difficult, and important over one that is somewhat important but does not require much thought.	○	○	○	○	○
I feel relief rather than satisfaction after completing a task that requires a lot of mental effort.	○	○	○	○	○
It's enough for me that something gets the job done; I don't care how or why it works.	○	○	○	○	○
I usually end up deliberating about issues even when they do not affect me personally.	○	○	○	○	○

Pers

What is your gender?

- ○ Female
- ○ Male

- ◯ Non-binary

How old are you?

Appendix E

Syllogism Form

Consent

Please test your judgement and decision-making skills. There are 32 slightly different tasks assessing judgement and decision-making, followed by a confidence rating and at the end a memory test. It should take 35-45 min

- ◯ Yes, I consent and my data can be used for research
- ◯ Yes, I consent but my data shall not be used for research

Wordsum

We want to know how people guess the meaning of words that they rarely or never use. You will be presented with some words in capital letters that you may or may not know the meaning of, along with five other random words. Your task is to find the word that best describes or goes well with the capital letter word.
Here is an example:

BEAST
afraid, words, large, animal, separate

The correct answer in this instance is "animal" as that is the word that resembles beast the most.

Space

- ◯ school
- ◯ noon
- ◯ captain
- ◯ room
- ◯ board
- ◯ don't know

BROADEN

- ◯ efface
- ◯ make level
- ◯ elapse
- ◯ embroider
- ◯ widen
- ◯ don't know

EMANATE

- ◯ populate
- ◯ free
- ◯ prominent
- ◯ rival
- ◯ come
- ◯ don't know

EDIBLE

- ◯ auspicious
- ◯ eligible
- ◯ fit to eat
- ◯ sagacious
- ◯ able to speak
- ◯ don't know

ANIMOSITY

- ◯ hatred
- ◯ animation
- ◯ disobedience
- ◯ diversity
- ◯ friendship
- ◯ don't know

PACT

- ◯ puissance
- ◯ remonstrance
- ◯ agreement
- ◯ skillet
- ◯ pressure
- ◯ don't know

CLOISTERED

- ◯ miniature
- ◯ bunched
- ◯ arched
- ◯ malady
- ◯ secluded
- ◯ don't know

CAPRICE

- ◯ value
- ◯ a star
- ◯ grimace
- ◯ whim
- ◯ inducement
- ◯ don't know

ACCUSTOM

- ◯ disappoint
- ◯ customary
- ◯ encounter
- ◯ get used to
- ◯ business
- ◯ don't know

ALLUSION

- ◯ reference
- ◯ dream
- ◯ eulogy
- ◯ illusion
- ◯ aria
- ◯ don't know

Information

In the following task you will be presented with two premises and one conclusion. Your task is to evaluate whether the conclusion is true or false, based on the premises. It is important to set aside the facts you already know to be true in the real world and only focus on the premises you have been given.

You will also be asked to rate your level of confidence and whether the conclusion is in line with your view of the world.

SylloVU01

Premise 1: All things that are smoked are good for health
Premise 2: Cigarettes are smoked

Conclusion: Cigarettes are good for health

False	True
◯	◯

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
◯	◯	◯	◯	◯

SyllogismVU02

Premise 1: All animals with four legs are dangerous
Premise 2: Poodles are not dangerous

Conclusion: Poodles do not have four legs

False ○ True ○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not ○ Probably not ○ Might or might not ○ Probably yes ○ Definitely yes ○

SyllogismVU03

Premise 1: All mammals walk
Premise 2: Whales are mammals
Conclusion: Whales walk

False ○ True ○

At the time I provided my answer, I felt:

Guessing — Fairly certain — Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not ○ Probably not ○ Might or might not ○ Probably yes ○ Definitely yes ○

SyllogismVU04

Premise 1: All animals love water
Premise 2: Cats do not like water

Conclusion: Cats are not animals

False True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismVU05

Premise 1: All grapes are ripe
Premise 2: Everything ripe glows in the dark

Conclusion: All grapes glow in the dark

False True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismVU06

Premise 1: All trees are batteries
Premise 2: All apples are trees

Conclusion: All apples are batteries

False True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismVU07

Premise 1: No edible product is a toadstool
Premise 2: Some jumping mushrooms are toadstools

Conclusion: Some jumping mushrooms are not edible

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismVU08

Premise 1: All raspberries speak Polish
Premise 2: No blueberries are raspberries

Conclusion: Some vegetables that speak Polish are not blueberries

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismVB09

Premise 1: All grasses are green
Premise 2: Everything green is alive

Conclusion: All grasses are alive

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismVB10

Premise 1: All plums have seeds
Premise 2: All Mirabelle prunes are plums

Conclusion: All Mirabelle prunes have seeds

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismVB11

Premise 1: No rabbits have colorful feathers
Premise 2: Some ducks have colorful feathers

Conclusion: Some ducks are not rabbits

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismVB12

Premise 1: All moths fly at night
Premise 2: No bats are moths

Conclusion: Some animals that fly at night are not bats

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismVB13

Premise 1: All women's rights should be supported
Premise 2: Some of women's rights are abortions

Conclusion: Some abortions should be supported

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismVB14

Premise 1: Some fetuses should be protected
Premise 2: All fetuses are human beings

Conclusion: Some human beings should be protected

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismVB15

Premise 1: Some dogs are not mastiffs
Premise 2: All dogs are mammals

Conclusion: Some mammals are not mastiffs

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismVB16

Premise 1: All pigs are mammals
Premise 2: Some carnivores are pigs

Conclusion: Some carnivores are mammals

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIB17

Premise 1: All unemployed people are poor
Premise 2: Rockefeller is not unemployed

Conclusion: Rockefeller is not poor

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIB18

Premise 1: All flowers have petals
Premise 2: Roses have petals

Conclusion: Roses are flowers

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIB19

Premise 1: All eastern countries are communist
Premise 2: Canada is not an eastern country

Conclusion: Canada is not communist

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIB20

Premise 1: All things that have a motor need oil
Premise 2: Automobiles need oil

Conclusion: Automobiles have motors

- ○ False
- ○ True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismIB21

Premise 1: All the wormy fruits fall from the tree
Premise 2: All the fruits that fall from the tree are overripe

Conclusion: All overripe fruits are wormy

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not | Probably not | Might or might not | Probably yes | Definitely yes

SyllogismIB22

Premise 1: Everything healthy is sour
Premise 2: Everything yellow is healthy

Conclusion: Everything sour is yellow

False | True

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIB23

Premise 1: No hare is a fox
Premise 2: Some devious animals are foxes

Conclusion: Some hares are not devious

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIB24

Premise 1: Some human beings should be protected
Premise 2: All fetuses are human beings

Conclusion: Some fetuses should be protected

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU25

Premise 1: Everything that runs breathes
Premise 2: No living frog is running

Conclusion: Some living frogs do not breathe

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU26

Premise 1: All kids have toys
Premise 2: All toys are made from wood

Conclusion: All things made from wood are kids

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU27

Premise 1: All ants have wings
Premise 2: Everything winged sings

Conclusion: Everything that sings is an ant

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU28

Premise 1: All parrots have horns
Premise 2: All red birds are parrots

Conclusion: Everything with horns is a red bird

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU29

Premise 1: No smiling apples grow on bushes
Premise 2: Some pretty berries grow on bushes

Conclusion: Some smiling apples are not pretty berries

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU30

Premise 1: No cockroach lives in houses
Premise 2: Some nasty bugs live in houses

Conclusion: Some cockroaches are not nasty bugs

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU31

Premise 1: All tigers have two tails
Premise 2: No horse is a tiger

Conclusion: Some horses do not have two tails

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

SyllogismIU32

Premise 1: All munchins wear hats
Premise 2: No penny is a munchin

Conclusion: Some pennies do not wear hats

False	True
○	○

At the time I provided my answer, I felt:

Guessing Fairly certain Certain I'm right

Is the conclusion in line with your view of the world?

Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
○	○	○	○	○

Recall

Write down as many capital letter words you can remember from the word comparison task in the beginning of this survey. If you don't remember any of them you may write "don't know" or choose from the lower case letter words from the same task.

Fill in the missing word from a previous fact:

"All things that are _____ are good for health"

Fill in the missing word from a previous fact:

"All animals with four legs are _____"

Fill in the missing word from a previous fact:

"Whales are _____"

Fill in the missing word from a previous premise:

"_____ do not like water"

Fill in the missing word from a previous premise:

"Everything _____ glows in the dark"

Fill in the missing word from a previous premise:

"All trees are _____"

Fill in the missing word from a previous premise:

"Some jumping _____ are toadstools"

Fill in the missing word from a previous premise:

"All raspberries speak _____"

Fill in the missing word from a previous premise:

"Everything green is _____"

Fill in the missing word from a previous premise:

"All Mirabelle prunes are _____"

Fill in the missing word from a previous premise:

"No _____ have colorful feathers"

Fill in the missing word from a previous premise:

"No _____ are moths"

Fill in the missing word from a previous premise:

"Some of women's rights are _____"

Fill in the missing word from a previous premise:

"All _____ are human beings"

Fill in the missing word from a previous premise:

"Some dogs are not _____"

Fill in the missing word from a previous premise:

"Some carnivores are _____"

Fill in the missing word from a previous premise:

"All unemployed people are _____"

Fill in the missing word from a previous premise:

"Roses have _____"

Fill in the missing word from a previous premise:

"_____ is not an eastern country"

Fill in the missing word from a previous premise:

"Automobiles need _____"

Fill in the missing word from a previous premise:

"All the fruits that fall from the tree are _____"

Fill in the missing word from a previous premise:

"Everything sour is _____"

Fill in the missing word from a previous premise:

"No _____ is a fox"

Fill in the missing word from a previous premise:

"Some fetuses should be _____"

Fill in the missing word from a previous premise:

"No living frog is _____"

Fill in the missing word from a previous premise:

"All kids have _____"

Fill in the missing word from a previous premise:

"All ants have _____"

Fill in the missing word from a previous premise:

"All parrots have _____"

Fill in the missing word from a previous premise:

"No _____ apples grow on bushes"

Fill in the missing word from a previous premise:

"Some nasty _____ live in houses"

Fill in the missing word from a previous premise:

"All tigers have two _____"

Fill in the missing word from a previous premise:

"No _____ is a munchin"

NfC-18i

For each of the statements below, please indicate whether or not the statement is characteristic of you or of what you believe. For example, if the statement is extremely uncharacteristic of you or of what you believe about yourself (not at all like you) please click on the first dot to the right of the statement. If the statement is extremely characteristic of you or of what you believe about yourself (very much like you) please click on the dot furthest to the right next to the statement.

	Extremely uncharacteristic of me	Somewhat uncharacteristic of me	Uncertain	Somewhat characteristic of me	Extremely characteristic of me
I would prefer complex over simple problems.	○	○	○	○	○
I like to have the responsibility of handling a situation that requires a lot of thinking.	○	○	○	○	○
Thinking is not my idea of fun.	○	○	○	○	○
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.	○	○	○	○	○
I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.	○	○	○	○	○
I find satisfaction in deliberating hard and for long hours.	○	○	○	○	○
I only think as hard as I have to.	○	○	○	○	○
I prefer to think about small daily projects over long term ones.	○	○	○	○	○
I like tasks that require little thought once I've learned them.	○	○	○	○	○
The idea of relying on thought to make my way to the top appeals to me.	○	○	○	○	○
I really enjoy a task that involves coming up with new solutions to problems.	○	○	○	○	○
Learning new ways to think doesn't excite me very much.	○	○	○	○	○
I prefer my life to be filled with puzzles that I must solve.	○	○	○	○	○
The notion of thinking abstractly is appealing to me.	○	○	○	○	○
I would prefer a task that is intellectual, difficult, and important over one that is somewhat important but does not require much thought.	○	○	○	○	○
I feel relief rather than satisfaction after completing a task that requires a lot of mental effort.	○	○	○	○	○
It's enough for me that something gets the job done; I don't care how or why it works.	○	○	○	○	○
I usually end up deliberating about issues even when they do not affect me personally.	○	○	○	○	○

Pers

What is your gender?

- ○ Female
- ○ Male

- ◯ Non-binary

How old are you?

Did you write down notes during this test to help you remember?

- ◯ No
- ◯ Yes