Rationally Biased Cognition

A Study of Ideologically Motivated Information Processing

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ABSTRACT

This thesis attempts to add to the literature on systematic biases that occur in politically motivated reasoning. Both liberals and conservatives display ideologically motivated cognition on a variety of issues; in other words, they use reason to fit evidence to previously held convictions. Intelligence and education has been shown to increase polarization and increase bias in political information processing, as higher levels of intelligence allow for greater dexterity in fitting facts to a narrative. This effect was further studied by using the Wason selection task, a logical test commonly used to investigate reasoning capacity. The test proved difficult for the sample population, and very few were able to correctly solve the prompt. The thesis also attempts to determine whether bias extends beyond the context of logical reasoning and policy. The conjunction fallacy, a test of narrative richness, was used to see whether subjects viewed members of the opposing ideology as immoral. While there were modest effects in the ideological conditions, the reference displayed the most significant results, as conservatives were more likely to make the conjunction fallacy than liberals when the immoral behavior was ascribed to an ex-convict. Polarization increased at higher levels of the Cognitive Reflection Test, a test of propensity to use logic, suggesting rationality may promote a more narratively rich worldview.

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INTRODUCTION

BACKGROUND INFORMATION

The popularity of the American political system has plummeted, with historically low approval ratings of congress and with the most recent election featuring the most unpopular presidential candidates ever (Gallup, Enten, 2016). The buzzword polarization has been thrown around the blogosphere and among the talking heads as the root of these issues. The reported problem is that the country is divided: Democrats and Republicans cannot agree on anything, refuse to work together, and are more concerned with winning elections than helping the American people. Prophetically, George Washington warned of the inherent problematic nature of a two party system in his farewell address, imploring the country to stay away from the today's model to avoid polarizing deadlock (Washington, 1776). But problems of polarization and bias lie deeper. While there are certainly issues with the two party system, they do not account for the entirety of observed political bias. Take climate change, an illustrative example often used in studies of political bias. Despite the fact that 99% of climate scientists agree that climate change is caused by man (Powell, 2015), only 48% percent of the general population hold this viewpoint (Pew Research Center). The problem is not solely within the confines of the system, but lies in the very way people think. Research concerning information processing in political context can lead to smarter policies, allowing for debates that are not hampered by the systematic biases. This thesis seeks to continue to add to the understanding of the complexities of political bias. Using data from a study in the Cultural Cognition Project about attempts to improve the Cognitive Reflection Test (See Appendix A and B for details of this study), this thesis aims to add to the current literature on polarization and motivated beliefs.

SCIENCE COMPREHENSION THESIS

Often the blame for political polarization is lack of education. Many people believe that with a more educated populace a variety of positions on polarized issues, such as gun control or climate change, would converge in the face of facts. In this model, conservatives who lack proper education simply do not realize the preponderance of evidence in favor of the cause of global warming being humans. This classic theory for why certain political disagreements arise, despite a preponderance of evidence pointing towards one solution, is the "Science Comprehension Thesis". The same theory is often applied to a variety of issues, and is often used by liberals to claim that if only the public were better educated about the issues, polarization would decrease. Yet while this theory is intuitively satisfying, there is little evidential support for its validity (and directly contradictory evidence that will be discussed later). In fact, the satisfying nature of the theory is quite detrimental, as much of the focus on combatting polarization centers on educational reform (see New York Times Editorial Board, 2015). Polarization needs to be scientifically studied, not intuitively understood in order to create more productive policies, scientific communication tactics, and debates. The problem may not be the underlying information used to engage with the issues but a more inherent issue due to the very way people think.

CONSERVATIVISM AS SOCIAL COGNITION

There is a trend in social psychology to consider differences in cognitive style based on ideology, largely placing the blame of polarization on conservatives. The theory is that conservatives are more fearful, biased, prejudiced, and less reliant on rationality. There definitely may be some truth to the claim there is a difference between conservatives and liberals. Liberals are seen as more educated because they are, and the difference is growing

(Pew Research Center). There is also a robust body of literature that points to a difference in cognition between those on the left and the right. As early as the 50's negative results were being reported about conservatives, as Adorno showed conservatives to be more authoritarian (Adorno, 1950). In a 2008 metanalysis this result was reiterated, and furthermore that conservatives were less open minded and less agreeable (Sibley & Duckitt, 2008). Conservatives are often seen as more individualistic, and having a more structured picture of the world, being less open to change, greater fear death, deal in absolutes, and are more reliant and trusting of institutions (Jost et al., 2003, Sibley & Duckitt, 2008, Deppe et al.m 2015). Low intelligence has also been linked to conservatism, as conservatives senators were shown to make less complex comments on policy even after controlling for other variables such as education (Tetlock, 1983). Conservatives were also found to have lower cognitive ability (Hodson & Busseri, 2012) and to have increased prejudice (Hodson & Busseri, 2012, Jost et al., 2003). They have also been shown to be more impacted by emotional states, especially in cases of fear and disgust. When disgust was activated, participants were shown to be more fearful of immigration and disdainful of homosexuals, and this result was found more prominently in conservatives (Terrizzi, Shook & Ventis, 2010, Eskine, Kacinik & Prinz 2011). More generally conservatives were linked to higher levels of disgust as well as greater disgust sensitivity (Inbar, Pizarro, Iyer & Haidt 2011). Findings such as these led Jost to suggest in his metanalysis that conservatism should be thought of as a social cognition. If this theory were true, it would make polarization an inevitable product of the conservative mind.

Recent results have challenged the theory of conservatism as a social cognition, as similar biases have been found in liberals and conservatives. These biases typically arise in

situations when an outcome does not fit a desired worldview. Take harm reduction as a policy to mitigate the negative effects of drug addiction. The opposition to harm reduction strategies like needle exchange is often seen as blight on the conservative psyche. Conservatives are so disgusted by drug usage they are unable to put in a policy that has been shown to help people, as they feel somehow complicit. Yet a recent study shows similar patterns in liberals, who are reticent to support harm reduction strategies in similarly moralized issues such as female circumcision (MacCoun, 2013). In fact, in many studies of political reasoning it seems similar patterns emerge in liberals and conservatives. Both groups distrusted science more if given scientific evidence that clashed with their worldview (Nisbet et al., 2015, Lewandowsky & Oberauer, 2016). Liberals are similarly biased against ideologically dissimilar groups as conservatives (Brandt et al., 2014). The belief in the irrationality of conservatives may been a product of a lack of diversity in social psychology. Liberal scientist and theorists, whose political views may have colored their perception, reported most of these results. They also were looking at issues in which conservatives are biased, leading to unfavorable results for the right (Duarte et al., 2015). Ultimately, while there may be differences between liberals and conservatives, a more nuanced view of the issue is necessary, and political bias is clearly present on both sides.

FUNDAMENTAL IRRATIONALITY

Another angle may be necessary to fully understand the phenomenon of polarization. Essentially, there is a fundamental dichotomy of human thought: intuitive, automatic System 1 Processes, and deliberate, rational System 2 processes (Kahneman, 2011) (For a more in depth analysis of the difference between System 1 and 2 Processes

see Appendix A). Political decisions would hopefully be made with System 2 processes, yet people do not always seem to approach politics rationally. Take voting, for example, which seems to be a System 2 process, as one needs to evaluate the policies of each candidate and come to a decision. Yet it seems intuitive judgments on meaningless characteristics such as looks factor heavily into decision-making (See Druckman, 2003 for an analysis of the Nixon Kennedy debate, Todorov et al., 2005). Other emotional affects can impact political decision making as well (Huang, Sedlovskaya, Ackerman & Bargh, 2011, Eskine, Kacinik & Prinz 2011). There seems to be an element of irrationality and a disconnect between the correct use of System 1 and 2 processes, but this does not fully explain issues such as polarization. If this were the reason, polarization would be mitigated by reliance on logic. The Cognitive Reflection Test, or CRT (See Appendix B for more detail), has been shown to be a reliable test of the propensity to use logical System 2 processes, (Toprak, West & Stanovich, 2014), yet this has not been shown to decrease polarization (Kahan, 2012). Neither have more traditional tests of intelligence such as numeracy (Kahan, 2013). The opposite has shown to be the case; as in a these studies the measures of logical ability were shown to increase polarization, and the implications of these results will be discussed shortly. So while there may be elements of irrationality in political thought, it cannot explain the phenomenon of polarization. In fact rationality seems directly linked to political polarization.

MOTIVATED REASONING

There may be a need for improved science education, and people may inherently be biased, but none of these theories can explain the phenomenon this paper is interested in: how people, in the face of overwhelming evidence, remain polarized on climate change, believe in birtherism, and bend information to fit their own narrative. In recent years,

political bias has been thought of as a form of motivated reasoning. Motivated reasoning occurs when humans process evidence presented to them in a way that confirms previously held conclusions. Perhaps the most famous example is that of the Seekers, a group who predicted the apocalypse in the 1950's, yet when that date came, and no apocalypse occurred, the group doubled down on their belief stating the apocalypse had been avoided due to their faith (Festinger, Riecken & Schachter 1959). The new piece of evidence, the fact that the apocalypse had not occurred, paradoxically led them to believe even more strongly that the prophecy was real.

There are many ways in which this type of self-deception can occur. Myside bias, or confirmation bias, is the process by which people bolster their own opinion by interpreting information, seeking evidence, or testing hypothesis in ways that will confirm their previously held beliefs (Stanovich & West, 2007, Nickerson, 1998, Chen, 1999, Green et al., 2002, Westfall et al., 2015, Kunda, 1990). This bias is a part of cognitive dissonance theory, which posits that people want all their beliefs to be held in harmony, and will work to get them to align (Festinger, 1962). This also results in people compensating when information goes against their world-view, by trying to find ways to reconcile this dissonant information (Proulx et al., 2012). So not only do people avoid information that challenges their worldview, when they come across it they attempt to dismiss it.

Haidt proposed a theory of moral judgments where decisions are made intuitively, and then intelligence and consciousness are used to defend them. As he puts it, human intelligence is used more often in the role of a lawyer than of scientist (Haidt, 2000). An illustrative example of these fallacies is of the generally over-optimistic nature of the human population. When predicting the future, an important use of reasoning, people are

likely to overrate their children's likely attributes, their own likelihood of success, and underrate the probability of negative events such as cancer or accidents (Sharot, 2011). They also are likely to rate themselves as better than they are (Hoorens, 1993), as well as create self-serving definitions of ambiguous traits to boost their ratings (Dunning, Meyerowitz & Holzberg, 1989).

Myside bias is mitigated by certain cognitive tendencies. While studies have shown that elementary education does not help informal reasoning (Perkins, 1985), other studies have shown that years in college can decrease bias (Toplak & Stanovich, 2003). Motivated reasoning has been shown to be unrelated to intelligence (Stanovich & West, 2007, Klaczynski & Gordon, 1996, Klaczynski & Robinson, 2000). Intelligence was shown to increase bias blind spots, or the tendency to view others as more biased than oneself (West, Meserve & Stanovich, 2012). Yet while intelligence is unrelated to bias, a reflective cognitive style, as measured by the CRT, has been shown to decrease myside bias (Toplak, West & Stanovich, 2001). In fact, it seems as though most people have a greater ability to decrease myside bias then they normally display. For example experimenters were able to decrease myside bias through instruction (Evans et al., 1994). And participants recommended less biased conclusions to a fictional experimenter than when asked about their own conclusions (Greenhoot, Semb, Colombo & Schreiber, 2004). Basically, people often have the ability to come to the correct conclusion upon reflection, but will often be satisfied with a more self-serving logical process.

IDENTIY-PROTECTIE COGNITION THESIS

An alternate to the Science Cognition Thesis (SCT), which accounts for Politically Motivated Reasoning, was proposed: the Identity-protective Cognition Thesis (ICT). Not

only do people avoid cognitive dissonance in general, but also there is extra motivation in this instance to remain with a viewpoint consistent with ones identity. This is a rational response, as in the grand scheme of things one has little impact on a debate such as climate change, but the consequences of changing opinions can be disastrous. A liberal scientist who came to the conclusion that climate change was a hoax would be ostracized, as would an NRA member who decided gun control would save lives. So in general, people avoid having political opinions that wedge them between their group (Kahan, 2010). It is not the case that people are over-reliant on heuristics, it is the fact that they systematically filter information to fit their world view (Stanovich, 2013 , Kahan, 2015). For example, subjects will rate studies and arguments more favorably if they conform to pre-conceived criteria (Lord, Ross & Lepper, 1979, Fagerlin, Gready & Peterson, 2002).

As in traditional examples of myside bias, politically motivated cognition does not follow a Bayesian framework. A perfectly logical thinker would have a prior, then, upon receiving new information, would attempt to update their beliefs. A likelihood ratio of the new information should be multiplied by the prior to get a posterior understanding of the subject. In this model, access to more information should always bring posterior likelihoods closer together. Yet in studies this has not been shown to be the case, as beliefs will not converge in a way that would be consistent with a Bayesian updating model (Kahan, 2015). The opposite is even true corrections of misinformation actually make ideologically motivated individuals more certain in their beliefs (Nyhan & Reifler, 2006). The way in which political thinkers intake information is clearly influenced by factors other than the evidence itself.

There seems to be a distinction between the ICT and myside bias, as intelligence plays a role in the former but not the latter. People use cognitive resources to create a worldview that fits their identity, and smarter people are better at filtering information that keeps them in congruence with their peers (Kahan & Corbin, 2016). They are better at interpreting it in favorable ways, and better at latching onto it when it confirms their identity. This is why beliefs can actually diverge in the face of more education or access to information (Kahan, 2013). For example, participants in one condition were asked to determine from experimental results whether a skin cream had worked, or in another condition whether a gun control experiment had worked. When asked about the skin cream, intelligence correlated with better performance across the board. In the gun control condition, increased intelligence actually increased polarization (Kahan et al., 2013). Similar results have been found in politically motivated reasoning (Kahan et al., 2012), but not outside of this context. In fact, most measures of cognitive capacity have been shown to increase polarization, demonstrating the ability of people to use logic to protect their worldview. The CRT has been shown to increase polarization (Kahan & Stanovich, 2016), as has the Actively Open-minded Test (Kahan & Corbin, 2016). The propensity to use logic allows for better protection of identity as the mind attempts to keep the socially expedient beliefs in place.

THE ROLE OF CULTURE AND IDENTITY

Rather than come to political opinions independently by weighing the pros and cons, group membership plays a large part in how people think. Culture has been shown to form mass opinions (Wildavsky, 1987). These findings are consistent with the ICT; as group identity is the most important factor in determine political thought. And contrary to

popular belief, everything does not break down upon party lines. For example, in a study asking about Outpatient Commitment Laws (OCLs), the breakdown in opinion was along cultural affiliation, especially between egalitarian communitarian types and hierarchical individualists (Kahan, Braman, Monahan, Callahan & Peters, 2010). In fact, identity is often more important in determining world-view than ideology (Kahan, 2012, Kahan, Braman, Slovic, Gastil, & Cohen, 2007). People usually form opinions and evaluations that line up with their cultural identity and defining values (Kahan and Braman, 2006). For example, a strong believer in capitalism and the power of innovation will be less likely to rate the risks of climate change highly as doing so would require a critical evaluation of the role of business in society (Kahan, Braman, Slovic, Gastil, & Cohen, 2007). Identity is dynamic though, and when group membership is less salient individual opinions will not adhere as closely to group (Conover, 1984). Framing climate change solutions as innovative and as related to the free market can decrease polarization as accepting climate change no longer presents a fundamental challenge to identity (Kahan, 2010).

IMPLEMENTS

COGNITIVE REFLECTION TEST

The goal of the current study is to look at the interactions between logical propensity and ideology and how this informs political information processing. Three measures of cognition were taken all measuring different things. Every participant took the CRT, and from there they were placed on one of two tracks. They either took a numeracy test, which is a measure of numerical intelligence (Weller et al. 2012, Kahan et al., 2013), or took a longer version of the CRT (See Appendix A). Both numeracy and CRT have been shown to increase polarization (Kahan & Stanovich, 2016) so the original CRT was taken as

a measure of cognitive capacity as the greatest number of subjects had taken this test. It is unclear exactly what distinctions can be made between these measures of cognition in a political context, but all seem to capture a similar effect. All results were checked with both numeracy and the inclusive CRT and the same patterns emerged, there was just a larger error involved, as the sample population was smaller.

WASON SELCTION TASK

For further understanding of motivated reasoning, the current study used the Wason Selection Task. The task was created by Wason in 1966 and is a difficult logical test about conditional rules. The task is perhaps the "most investigated experimental paradigm in the psychology of reasoning" (Maktelow, 2012). The general structure is as follows, participants are asked to determine if the following rule is true: "If P then Q". They are then presented with 4 cards to turn over, "P", "Not-P", "Q", "not-Q". They should turn over the "P" card and the "not-Q" card, but participants will often follow their heuristic answer and match the "Q" card with the prompt, turning it over, or often times they will not turn over the "not-Q" card (Wason, 1966, Cox & Grigss, 1982). It is a difficult task, with low baseline rates of correct reasoning. One of the reasons it has been such a useful tool to study reasoning capacity is that it is very context dependent. For example, people are better when content evokes relevant knowledge from memory, for example transportation use (Manktelow and Over, 1990). Performance on the task was also improved when it was policing social interactions (Tooby & Cosmides, 1992). This result has had important impact on the realm of evolutionary psychology.

Motivation has also been shown to increase performance on the test. Subjects were more likely to come to the correct conclusion that the prompt was incorrect when the

prompt's message was undesirable. If the rule stated they were more likely to have an early death they would be more likely to turn over the correct cards to disprove this claim, but if the rule did not imply an early death they were less likely to try to disprove it (Daweson, Gilovich, Regan, 2002). This result was important in demonstrating the ways in which confirmation bias comes about. For this reason, the Wason Selection Task stands as a promising tool to use in the study of political bias.

CONJUNCTION FALLACY

The other tool used in this thesis is the conjunction fallacy, which was used to look at new areas in which biased cognition may occur: whether they view similarly ideologically minded people as morally superior. There is reason to believe this would be the case, as there is a robust literature that shows humans view people more similarly to them more favorably. In-group out-group bias is a commonly held phenomenon that has been applied to politics in the past. People favor those who they view as in their group, and are more likely to give money to them in experimental settings. This has been observed in even minimal group pairs such as whether they like a certain painting (Tajfel et al., 1971). Groups give people a sense of self-esteem and provide a place in the world, and the enhancement of one's own group over others provides self-satisfaction but also leads to the in-group out-group dynamic. Group favoritism has been shown to apply to belief (Skitka et al., 2005). Yet the conjunction fallacy provides an opportunity for a more interesting test than simply one of whether democrats like republicans, as the answer to that would most likely be that they prefer themselves. The conjunction fallacy provides a window into the narrative richness of person's representations.

The conjunction fallacy is an example of a bias that occurs when people are over reliant on intuitive processes to make judgments, or heuristics. A heuristic commonly used for making evaluative judgments is the representativeness heuristic (Tversky & Kahneman, 1983). The heuristic is used to make a judgment by evaluating the degree of correspondence between and outcome and a previously held model (Tversky & Kahneman, 1983). For example robins and penguins are both birds, but a robin is more representative (Tversky & Kahneman, 1983). This heuristic allows for easy judgments without needing to bring in cognitively expensive System 2 processes in play. (Kahneman, 2011).

Tversky and Kahneman, in their foundational 1983 study, found that rather than use basic laws of probability, people will rely on these heuristics to determine how likely events are. One of the most basic tenants of probability is that the probability of a single event cannot be less than the probability of that and another event. Subjects were given the following description: “Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations”. The description was meant to elicit the representation of a feminist. Participants were asked whether it was more probable that she was a bank teller or a bank teller and a feminist. Of course it is more probable that she is a bank teller, as that set includes the second option. Yet 85% rated Linda as more probably a bank teller and a feminist (Tversky & Kahneman, 1983). This is because the event, Linda, fits the representation of feminist better than bank teller, and the strength of the causal link is overwhelming probability judgments (Thüring & Jungermann, 1990).

The conjunction fallacy can be used as a test of narrative richness, because for the fallacy to occur the subject must view the link between the condition and description as strong and causal. For this reason it has often been used as a tool to determine to robustness of prejudice. To test anti-atheist bias a study was done using a conjunction fallacy prompt that described untrustworthy and immoral behavior. Participants were much more likely to fall for the conjunction fallacy when the immoral individual was described as an atheist as opposed to other major religions (Gervais, 2014). Religious people were also more likely to make the error than atheists were, although the effect still existed (Giddings & Dunn, 2016). Information presented to subjects could also mitigate these effects, such as letting people know that most of the population is atheist (Giddings & Dunn, 2016). The conjunction fallacy was also used to show that the public holds specific negative representations of scientists, despite their high status in society. They were shown to be thought of as immoral, and would break norms, but they were not thought of as deliberately evil or unfair (Rutiens & Heine, 2016). The current study seeks to use this implement and see what negative representations abound in a political setting. The study will look at the effect of ideology and intelligence on these representations. The immediate goal is to begin investigating the role of intelligence in moral political judgments, as well as narrative judgments, looking at political cognition beyond information processing. The more general purpose of this paper is to add to the literature on motivated reasoning and begin to explore political bias in a similar context.

METHODS

The study tested motivated reasoning by asking a variety of questions used in previous studies that can elicit both heuristic and rational responses. A variety of

independent variables were assessed to try to parse out what factors can predict motivated reasoning. Tasks used were the Wason selection task to measure motivated reasoning and the conjunction fallacy to assess bias against political others. Independent variables were conditions, political ideology, and cognitive capacity.

POPULATION

The subjects of the study were a diverse sample of the United States Population. 2800 adults were recruited to participate by YouGov, and the survey was administered via the firm's on-line testing facilities. The sample was 55% female, 76% white, 9.4% black, and 8% Hispanic. The median age was 47 years old (SD = 17). Participants were asked their family income on a 16 point scale: 407 declined to respond, and of those who did the median on the scale was a 5 (SD = 3.2), corresponding to $40,000-$49,00. Similarly participants were asked education level on a scale from 1 (No High School) to 6 (Post Grad): the median score was a 3 (SD = 1.4) corresponding to some college.

STIMULUS 1

Participants were placed into one of three conditions to answer a Wason Selection Task question. In each condition they were asked to evaluate a logical rule "If P, then Q." The participant was then provided with four cards as follows: "P", "Not-P", "Q", "not-Q". The correct response would have been to turn over the "P" card and the "not-Q" card, and they would then find that the prompt to be false.

The three conditions asked about tax breaks for different technology companies. In the first condition participants were asked to test the allegation that: "If a company produced Nano-Widgets, then the IRS <u>denied</u> it a 'novel-technology manufacturer' tax exemption." The participants were then asked to turn over as few cards as possible in order

to determine whether or not the allegation was true. They cards they turned over were recorded.

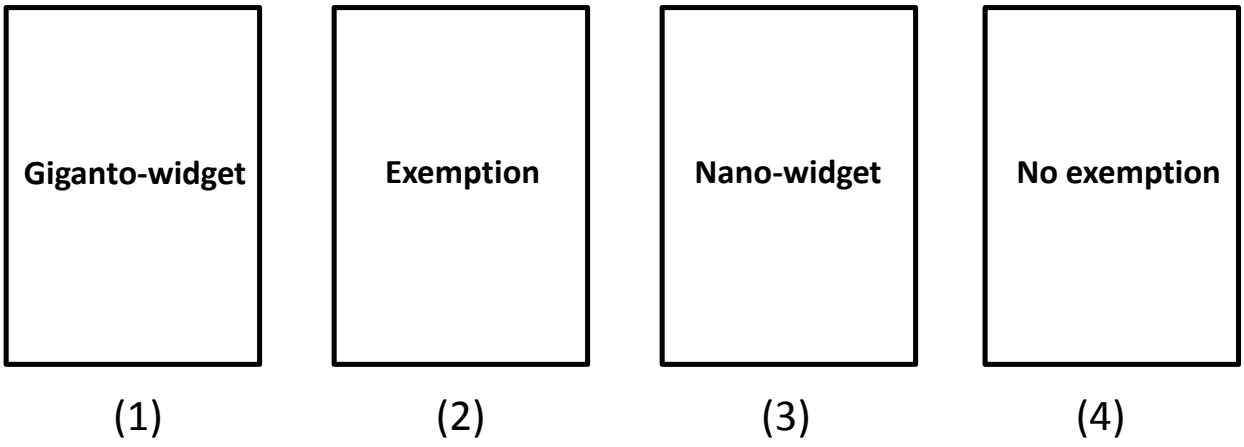

Figure 1: The cards facing the participant in the Nano-widget Wason Selection Task condition.

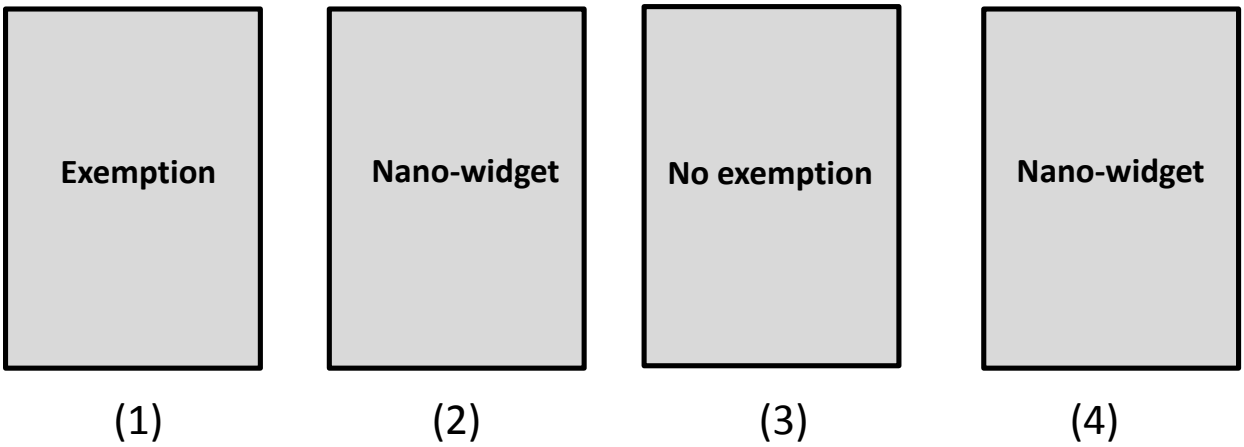

Figure 2: The underside of the cards in the Nano-widget Wason Selection Task condition, which the subjects could see if they chose to turn over the cards.

The allegation is false according to the cards, which becomes clear after turning over card 2. Following all logical rules a participant could either turn card 3 over first, then turn card 2 over and come to the conclusion that the claim is false, or they could just turn card 2 over and reach the conclusion. This condition concerned a non-politicized technology to have a reference condition.

The last two conditions asked for participants to use the same logical processes, except the allegations were slightly modified. Participants were placed either in a skeptical

or alarmed discrimination condition. In the skeptical condition the allegation they were asked to investigate was: "If a science-education foundation was 'skeptical about climate change,' then the Department of Education denied it a 'science-education-foundation' grant." The cards were as follows:

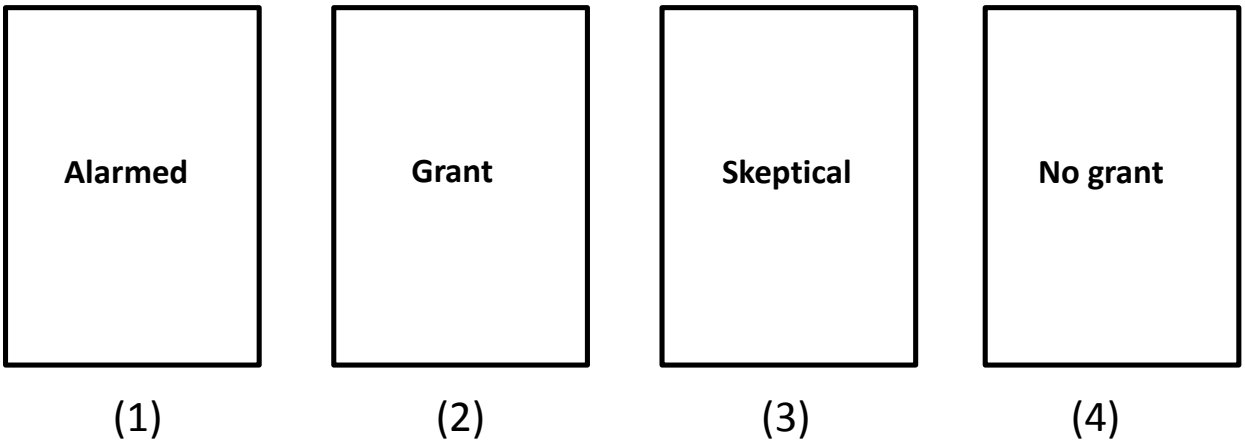

Figure 3: The cards used in the skeptical-discrimination condition of the Wason selection task.

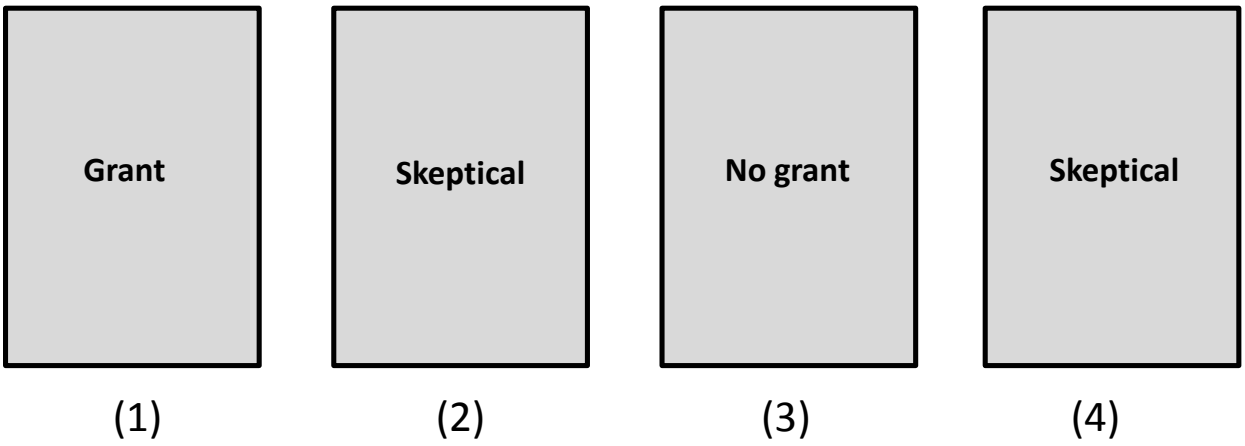

Figure 4: The underside of the cards in the skeptical-discrimination condition.

In the alarmed condition they were asked to investigate the claim that: "If science-education foundation was 'alarmed about climate change,' the Department of Education arbitrarily denied it a 'science-education-foundation' grant." The cards were the same except that alarmed and skeptical were switched at every spot (including on the backs).

The same logical processes apply in the alarmed and skeptic conditions as in the Nano-widget condition.

The breakdown was as follows: 929 subjects were asked a separate question not discussed in this paper, 943 subjects were in the Nano-widget condition, 463 subjects were in the skeptic-discrimination condition, and 465 subjects were in the alarmed-discrimination condition. The design was a between subjects one, as participants were assigned to only one condition.

STIMULUS 2

Participants were placed into one of three conditions and in each condition answered one conjunction fallacy question. All were given the same prompt, which was as follows:

> Richard is 31 years old. On his way to work one day, he accidentally backed his car into a parked van. Because pedestrians were watching, he got out of his car. He pretended to write down his insurance information. He then tucked the blank note into the van's window before getting back into his car and driving away.
>
> Later the same day, Richard found a wallet on the sidewalk. Nobody was looking, so he took all of the money out of the wallet. He then threw the wallet in a trash can.

They were then given two descriptions of Richard and asked which was more likely. The first option remained constant through the three conditions: that "Richard is self-employed". In the reference condition they were given the option of Richard as self-employed and a convicted felon (an answer which, according to the laws of probability, must be false).

Conditions were created to indirectly test whether political orientation was associated with distrust in a similar manner to a convicted felon. In the other two conditions the descriptions were: "self-employed and a very strong supporter of strict gun control laws" and "self-employed and a very strong opponent of strict gun control laws".

The breakdown was as follows: 923 were in the ex-convict condition, 918 were in the support condition, and 959 were in the oppose condition. The design was a between subjects one, as participants were assigned to only one condition.

*The test was administered from the 8th of November to the 16th of December, 2016.

INDEPENDENT VARIABLES

Experimental Condition was an independent variable between subjects. Besides condition, a few variables were used to predict performance on the stimuli.

IDEOLOGY

The first variable was subjects' political affiliation. Two questions about political affiliation at the end of the survey in the demographics section were used to create a measure of political ideology. For the first measure subjects were asked to rank their ideology on a five-point scale, ranging from very liberal (1) to very conservative (5). Of those who answered, the median was 3 (moderate), the mean was 3.1 (SD = 1.1), between moderate and conservative. The second measure was a seven-point scale asking participants to rank their party identification, from Strong Democrat to Strong Republican. Of those who answered the question the median was a 4 (independent) and the mean was 3.8 (SD = 2.1), between lean democratic and independent. 69 subjects skipped both of these questions and were removed from the analysis. 46 subjects answered the first question but not the second question so they were assigned the median score on the second question. 211 subjects answered the second question, but not the first question so they were assigned the median score on the first question. The answers to the two measures were standardized (median = 0, SD = 1), and then added together and standardized again. The

resulting score was used as a measure for ideology henceforth called ideology score (for short: ideo) (Cronbach's Alpha = .76).

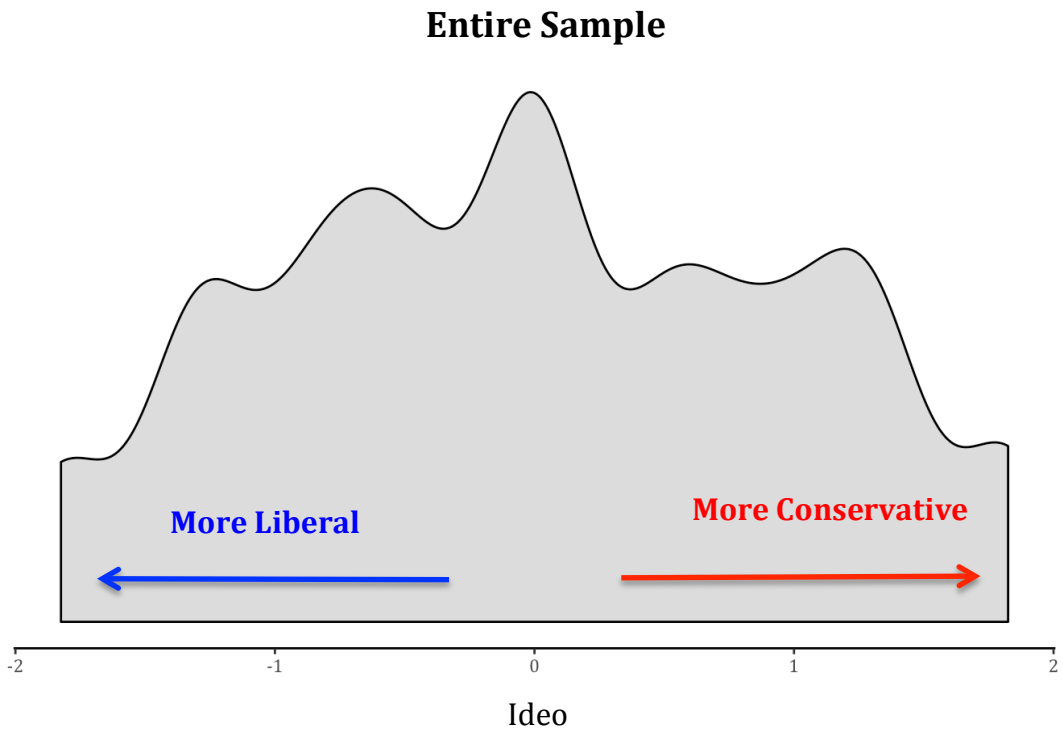

Figure 5: A breakdown of the sample population's ideological scores (called ideo).

CLASSIC CRT

Shane Frederick's original CRT (Frederick, 2005) test was administered to all participants. The test is a 3 question numeric instrument, which aims to test cognitive style and reliance on logic (for the test questions and a more detailed discussion of the CRT see Appendix B). Item response theory (IRT) analysis was used to weight the questions and derive a score from the three-question implement. IRT analysis provides improved accuracy of an implement, and can differentiate more finely than simply aggregating the score (Primi et al., 2015). This allows for more possible scores than the original 3. Nonetheless, the CRT is not a perfect instrument even after IRT analysis. 59% of subjects answered zero of the questions correctly. This is slightly higher than foundational studies

(Frederick, 2005), but a slightly higher percentage of zeroes makes sense, as the subject population was not taken from a university. The score after IRT analysis will be known as CRT in the results sections, and was the chosen measure of cognitive functioning (Cronbach's alpha = .69). Liberals (all participants with ideo < 0) had a mean of .117 (SD = .80) on the CRT scale, while conservatives (ideo > 0) had a mean of .085 (SD = .76).

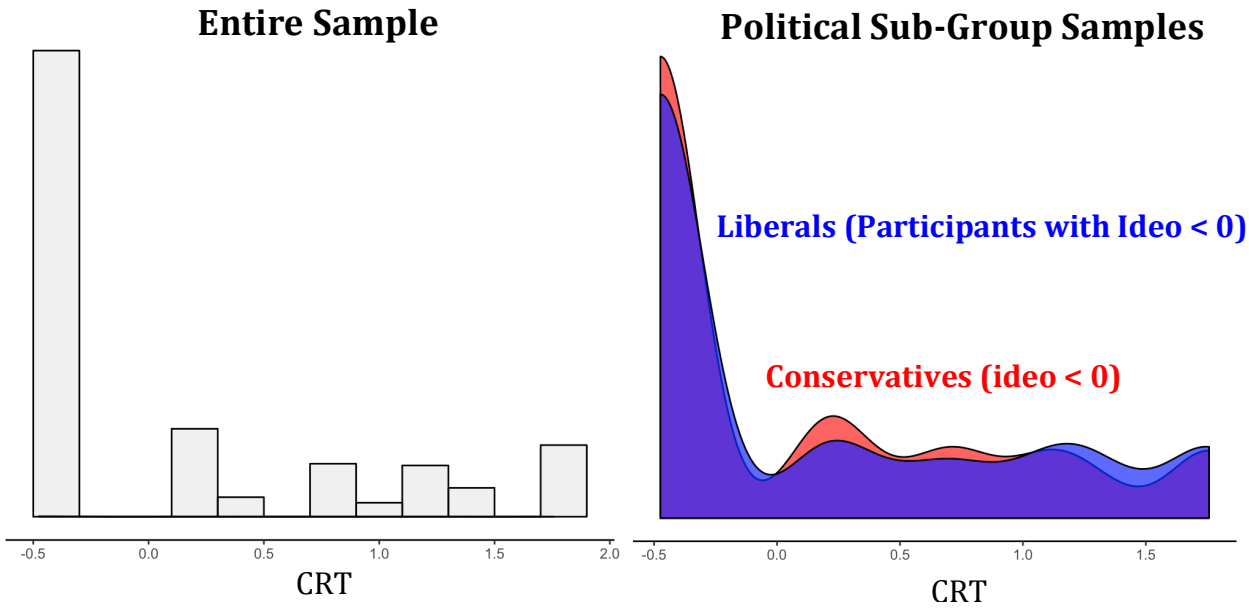

Figure 6: On the left is a histogram of the entire sample population's CRT scores after IRT analysis. On the right is a histogram of liberal score density overlaid on a histogram of conservative score density.

DATA ANALYSIS

A variety of models were created from the data using RStudio and Gary King's Zelig software. Logistic regressions were done with all of variables in the same model, in order to keep the power of the model (Judd, 2000). For each of the stimuli, condition was used as a dummy variable, with each condition being coded as one when in that condition, and the reference condition being activated when all conditions were zero. Ideological score was also used in the model, as well as its interaction with CRT. Correlation matrices are in

Appendix C and graphs were made with predictions from the models. Markov Chain Monte Carlo simulations were used to determine confidence intervals (King, 2000).

In the Wason Selection task there were three conditions coded as dummy variables, nano-widget, climate-alarmist, and climate-skeptic discrimination. The first outcome recorded was correct answer, or whether participant rated the statement as false. Other logical processes were tracked as well. Models were created to track whether correct logic was used to get the right answer, or whether any card was more likely to be chosen. Skipped answers were coded as wrong, as it showed an inability to deal with the subject matter. Few people skipped in either condition so it did not impact the results significantly. Independent variables in the model were condition, ideology and CRT.

For the conjunction stimulus there were three conditions coded as dummy variables, convict, supporter, and opponent. The outcome was recorded and a model was created to predict what percentage of people would get the prompt right in the actual population. The only dependent variable looked at was whether the outcome was correct. Skipped answers were coded as wrong. Independent variables in the model were condition, ideology and CRT.

HYPOTHESIS

THE WASON SELECTION TASK

The Wason Selection Task is strictly a logical test, so results consistent with the Idenity-protective Cognition Thesis would demonstrate some type of ideological motivation. The expectation is that if an organization from a person's identity group were being discriminated against, they would be motivated to prove that wrong as they do not want that to be the case. Yet there are some tangentially related results that suggest the

opposite might occur. People often claim that they are being discriminated against (see IRS targeting controversy) but are very unlikely to admit that they are discriminating. People will also view their in-group as being treated more unfairly (Hastorf & Cantril, 1954) and might be complacent and not motivated to correct the assertion that they are being treated unfairly. As a result, it is not entirely clear how people will be motivated, but the hypothesis is that in some way they will be, which would become clear when results were modeled. A null result would mean either that the prompt did not instigate motivated cognition or political bias did not occur for this topic. In this task, participants are not necessarily motivated to protect their identity in the same way they are when evaluating evidence of climate change. For this reason their performance may not depend heavily on ideology.

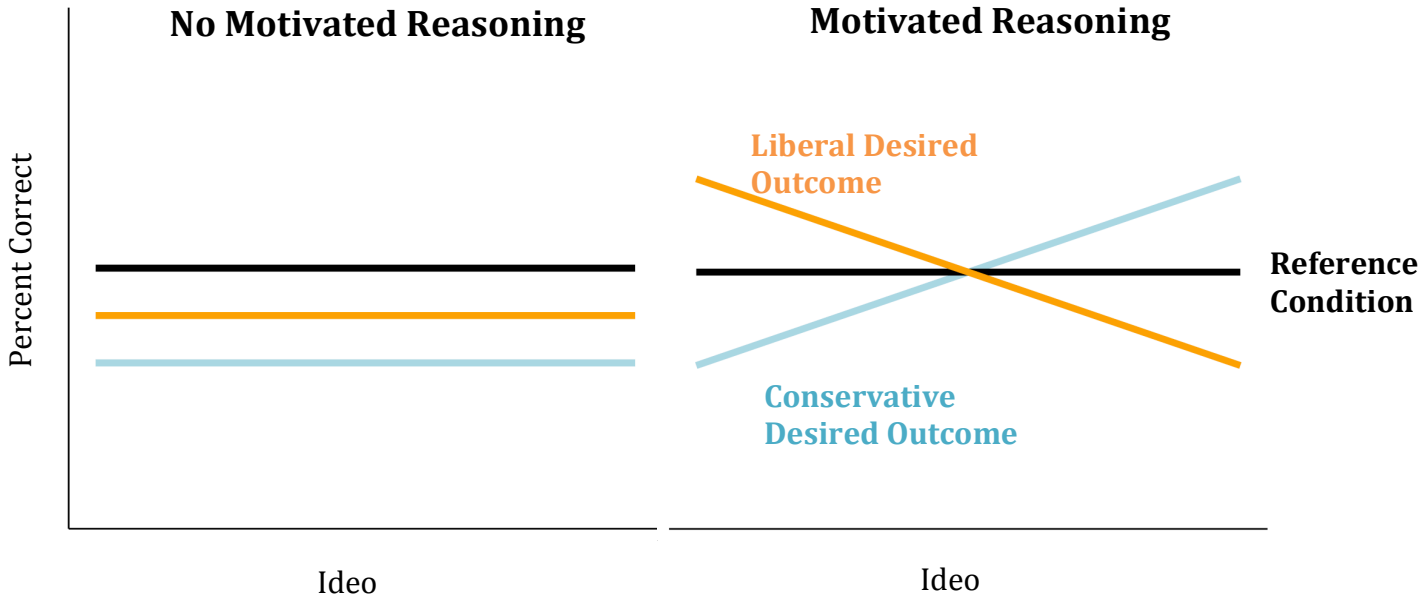

Figure 7: Two potential predicted results are displayed for the Wason selection task prompt. On the left is a prediction if subjects do not undergo motivated reasoning, as performance does not increase depending on ideology in polarized conditions. On the right is a prediction for a broadly applicable motivated reasoning thesis. Subjects are much better and worse depending on ideology and condition.

CONJUNCTION FALLACY

For the conjunction fallacy questions, condition should affect the correct response percentage. The ex-convict condition should provide a good baseline for how a

representative story behaves among the population. The gun control conditions may or may not be as representative as the ex-convict conditions. Ideology should influence the outcome of these questions, as most likely people will view Richard as more negatively if he holds the opposite political beliefs as them. If so this means people are more likely to portray ideological dissimilar people as immoral. It is very unlikely that people would be more likely to fall for the conjunction fallacy if Richard is described as having similar beliefs as them. If there is no effect of ideology on the population's view of Richard it could either be the instrument is imprecise, or people do not hold generally negative views of those in the opposite party. While in this day and age national politics have become quite polarized, it is not clear that this fervor and animosity is held on individual level. If the nation has become full of zealots, there may be a very strong bias against those of the opposite ideology. If not, less dramatic results would be expected.

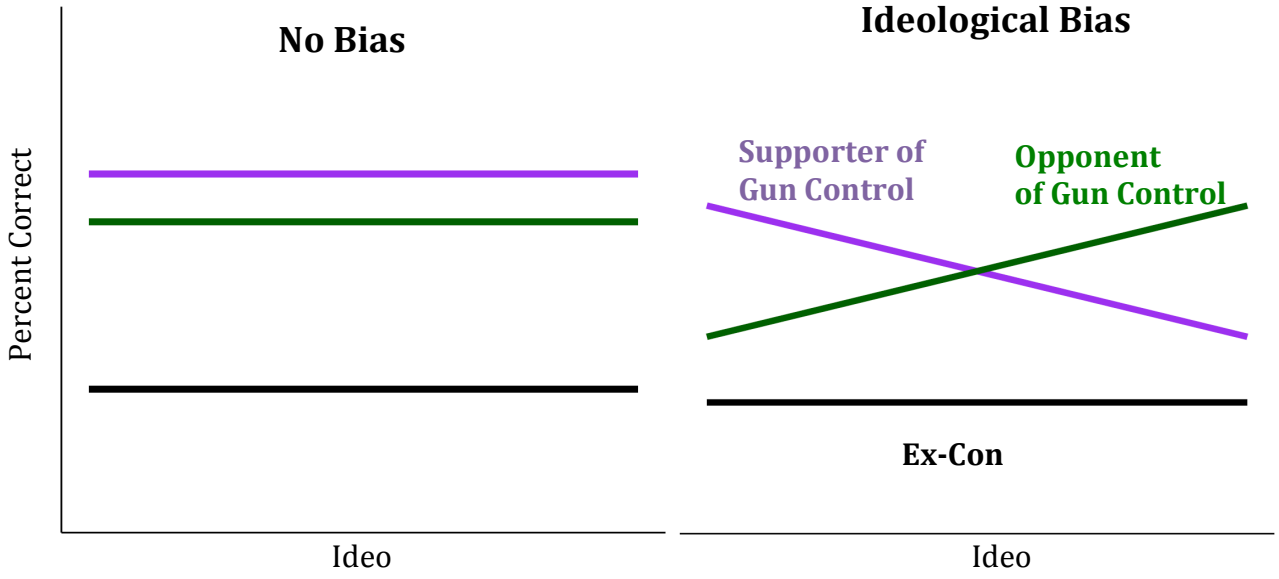

Figure 8: On the left is a prediction for a population where there was not a strongly negative representation of those with differing ideology. On the left is a prediction of a sample in which partisans held strongly negative views of those with differing ideology.

ROLE OF COGNITIVE CAPACITY

Results showing ideological polarization would not be very surprising, as they would fit in most political bias frameworks, including the SCT. Results consistent with the ICT would show an increased polarization with intelligence. The Wason Selection Task is very hard and requires the use of logic, so it seems likely CRT would improve performance. In an Identity Protection Thesis that individuals are motivated to will use logic to affirm their worldview. If results improved across all conditions regardless of motivation the way in which information was processed would most likely not be in order to protect identity.

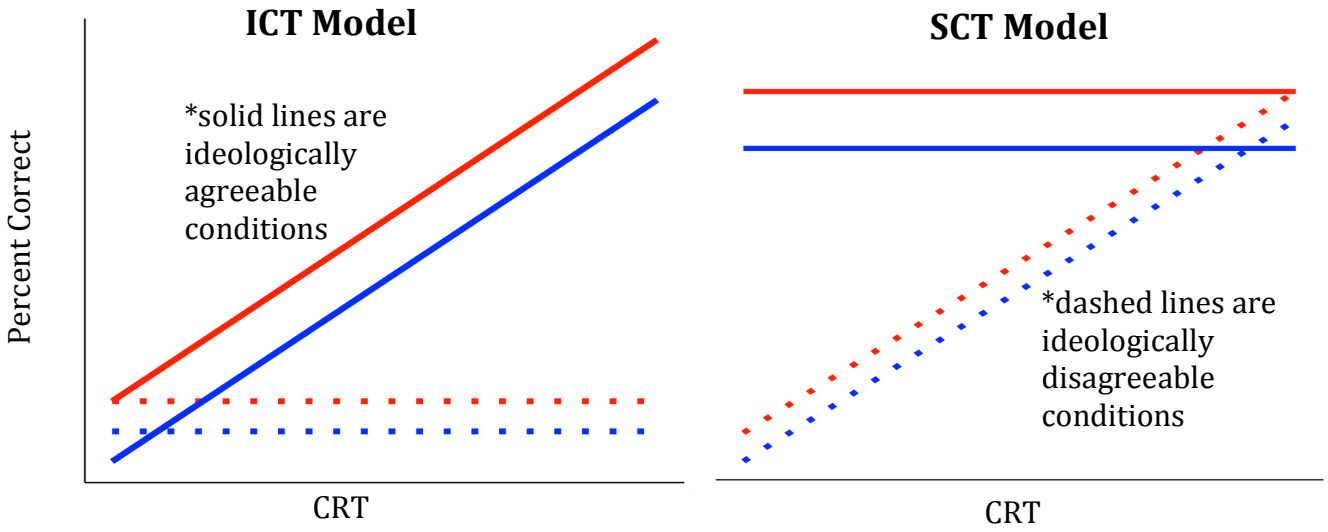

Figure 9: On the left measures of logical tendency correlate with increased polarization. This result fits with the Identity-protective Cognition Thesis. On the right the use of logic improves performance across all conditions and polarization decreases. This result fits with the Science Cognition Thesis.

For the conjunction fallacy, results could also follow similar patterns as in figure 9. If polarization increases along with CRT there could be a few explanations. More logical people seem better at fitting information to their worldview, and so perhaps they make harsher moral judgments. They also could simply be more polarized in general. Whatever the case, it would be clear that the narrative richness would increase for those with higher levels of cognition. In fact, even a null result of CRT would be significant. In previous

studies, CRT was shown to decrease the conjunction fallacy in the Linda problem (Oechssler & Roider, 2009). Or, if motivated reasoning is not a factor, performance may simply increase across the board.

RESULTS

WASON SELECTION TASK

In the three conditions, nano-widget, alarmed, and skeptic discrimination, no real effect was seen in regards to correct answer of the prompt, condition, and ideology (see Figure 10). As, subjects were asked a true false question and results hovered around 50% regardless of condition it seemed as though answers were random. This was backed up by the fact that 609 participants had picked an answer without turning over any cards, and they answered at similar rates as those who had actually turned over cards.

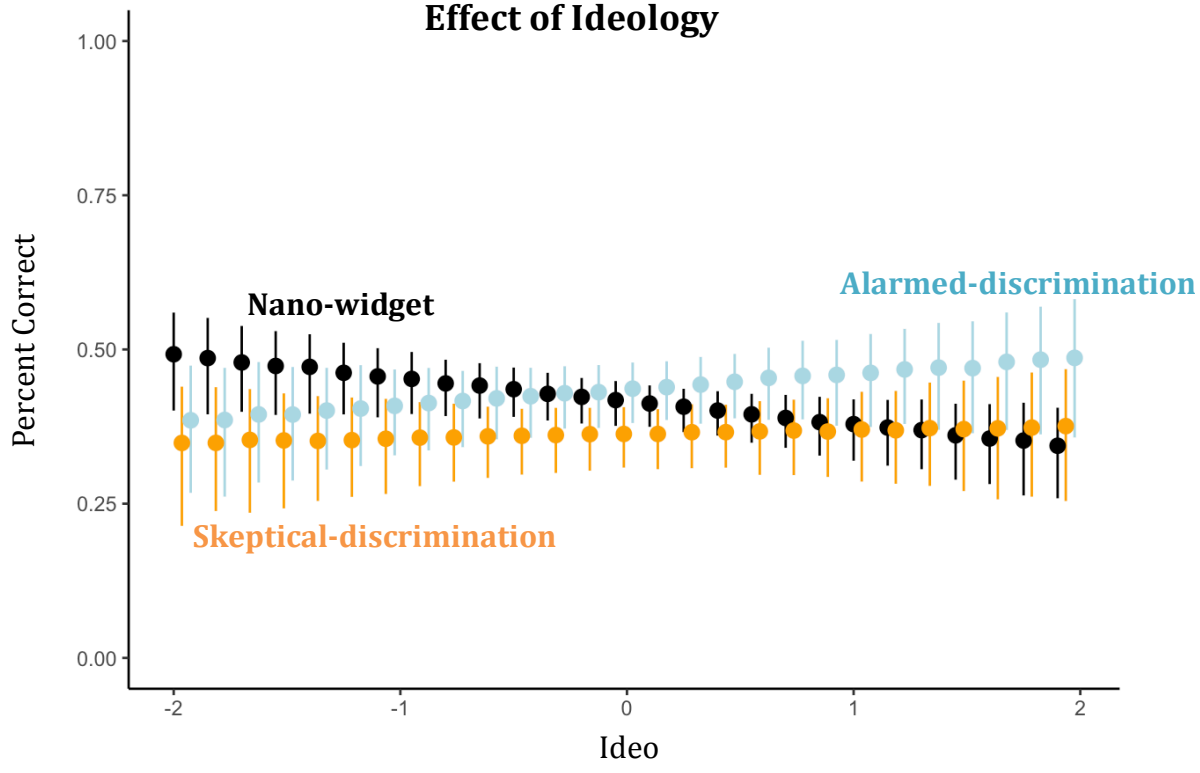

Figure 10: Logistic regression of all three conditions for the Wason selection task. The dots represent the mean expected value and the error bars represent 95% confidence intervals derived from an MCMC simulation. About 50% get the answer correct regardless of ideology or performance.

The effect of CRT was examined as well, and there did seem to be a positive correlation between CRT and performance. In all three conditions (see figure 10), CRT improved the chance of getting the answer correct, although the improvement is slight and the rate never rises significantly above 50%. There is no significant interaction between ideology and performance, as liberals and conservatives improve similarly over every condition (a quick note: in the simulations in figure 11 and in all subsequent simulations "liberals" are the predicted values of the models when ideo is set to -1, which is 1 SD left of center in the survey population. Blue lines correspond to this. Red lines, and "conservatives", correspond to 1 on the ideo scale, or one SD right of center).

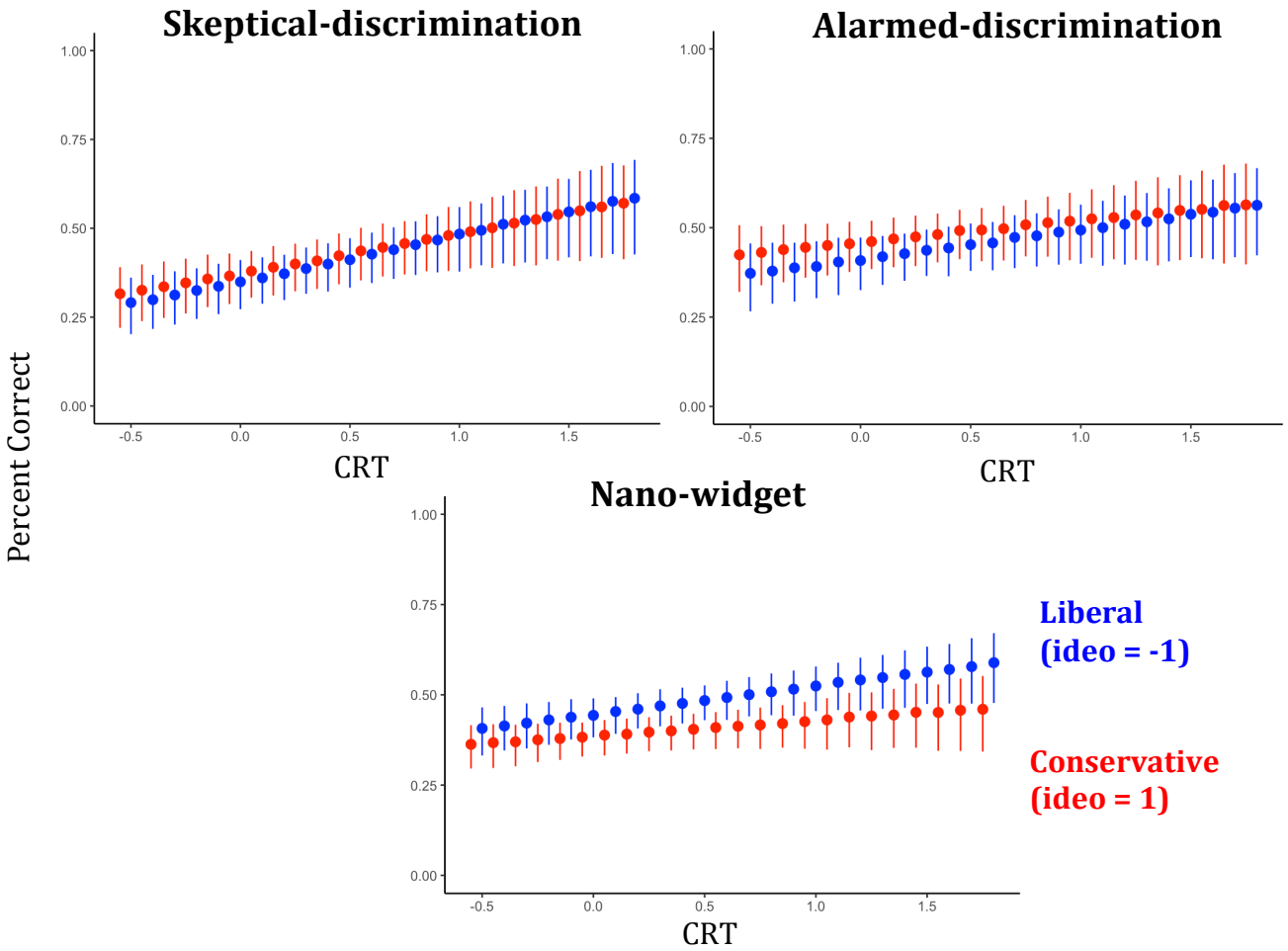

Figure 11: The three figures demonstrate the effect of CRT on each condition. In each condition both liberals (liberal (ideo=1) in blue in this graph and all future graphs) and conservatives (graphed in red) improve slightly over CRT, but no interaction effects are observed.

Next participant's logical ability was tested: whether they turned over the right cards and got the answer right. Very few participants used the correct logic to get to the answer. Of the 1210 participants that answered the discrimination questions, only 4% were able to identify the correct cards to turn over, as well as subsequently answer the question correctly. A model was created with the correct answer along with correct logical processes as the output. Neither ideology nor condition seemed to have an effect, as baseline rates of answering the question correctly were so low (see figure 12).

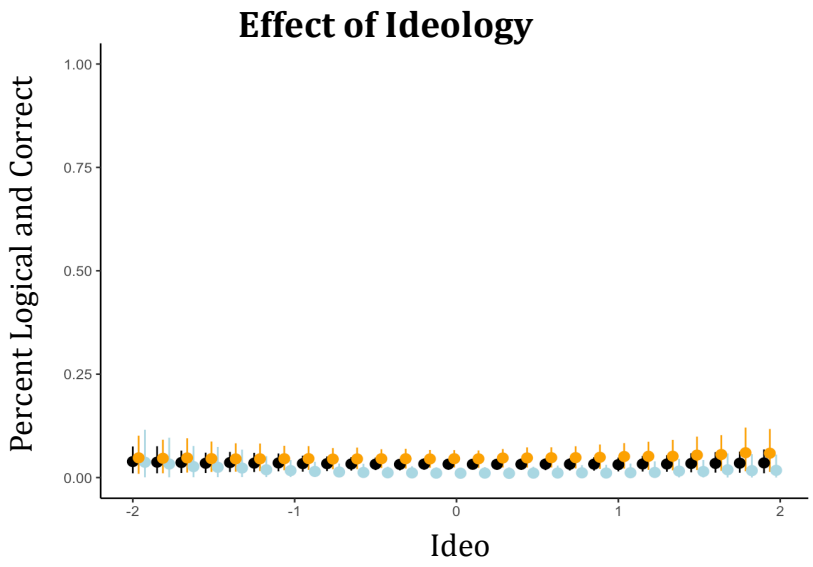

Figure 12: No effects are observed of ideology were observed in predicted values of getting the answer correctly through the proper logical processes. In each condition mean predicted rates are below 10%.

CRT was correlated with improved performance in this case, but there was again little difference between the conditions (see figure 13). Rates of solving the question correctly were pretty low up until very high levels of CRT. The max score someone received in the study population was a 1.8, and at that score no condition was significantly above 10%. No significant interaction occurred between ideology and intelligence, as in each condition conservatives and liberals improved similarly.

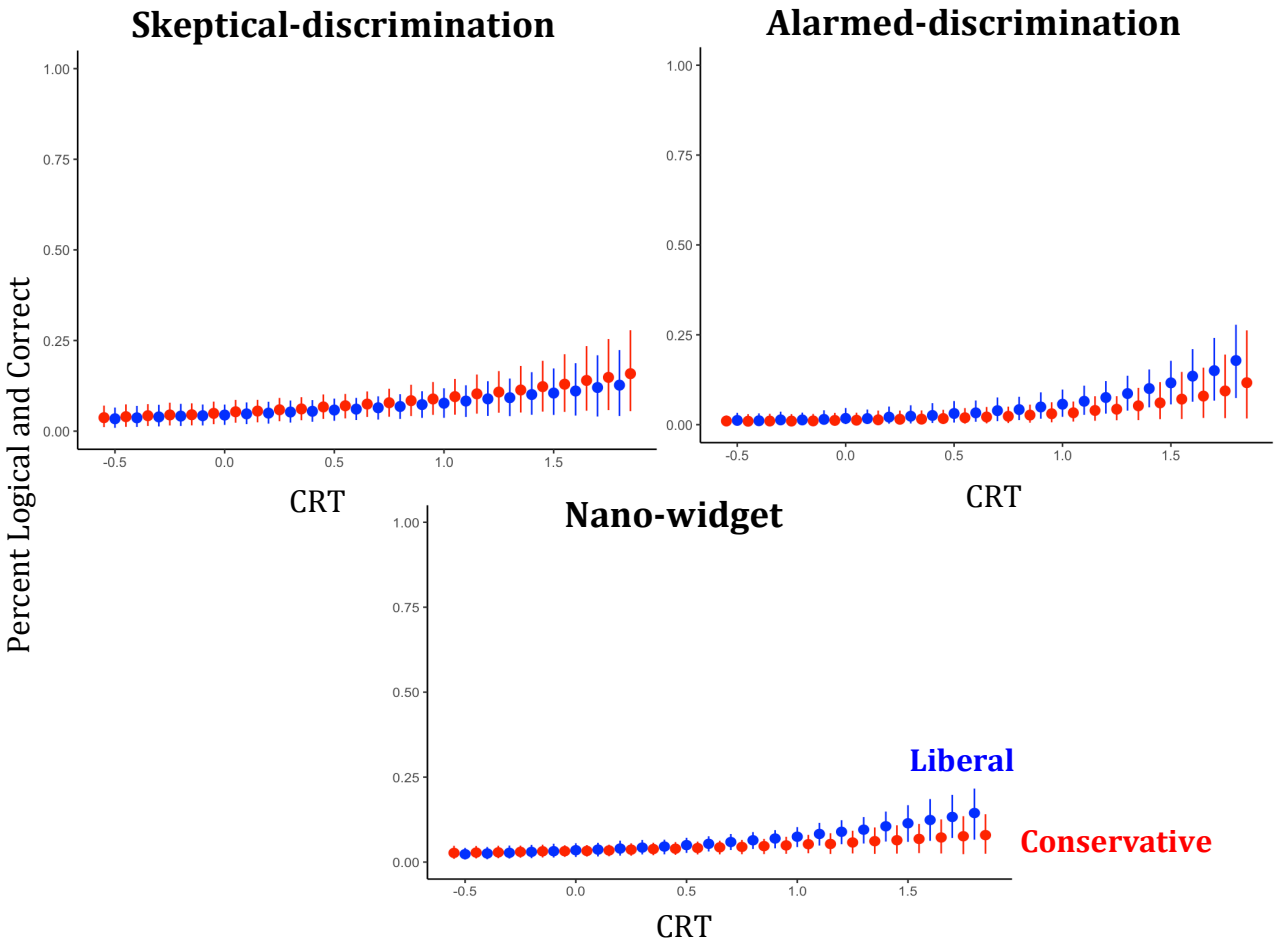

Figure 13: These graphs model correct answers arrived at logically over each condition among conservatives and liberals. Baseline rates are very low, and while CRT improves performance, there is little difference between conditions.

The next step was to try to expand the criteria for what was considered logical, allowing for some extraneous cards, but lowering the bar did not produce any new patterns. Finally, models were created for each card, to see if any systematic logical processes emerged. There was some random variation but no significant trends emerged surrounding any of the cards. All the cards were turned over about 2/3 of the time, further reinforcing the idea that performance on the selection task was largely random.

CONJUNCTION FALLACY

The conjunction fallacy prompt had higher rates of subjects arriving at the right answer, as it was considerably simpler. 36% of people got the right answer in the ex-con

condition (and therefore 64% fell for the fallacy), while 74% got the right answer in the gun control supporter condition and 70% got the right answer in the gun control opponent condition. There were slight ideological effects in the three conditions (see figure 14). For all ideologies, rates of conjunction fallacy were highest in the ex-convict condition. Liberals showed more biased than conservatives, as they were 8% (SE = 3%) more likely to fall for the conjunction fallacy when Richard opposed gun control than when he supported it (see figure 15). Conservatives were not more likely (0%, SE = 2%) to view a supporter of gun control as immoral but the result was not significant. The most dramatic result was actually found in the reference condition. Rather than act as a baseline rate to compare against the ex-convict condition varied between liberals and conservatives, as conservatives were 12% (SE = 3%) more likely than liberals to rate Richard as more likely to be an ex-convict and self-employed (see figure 16).

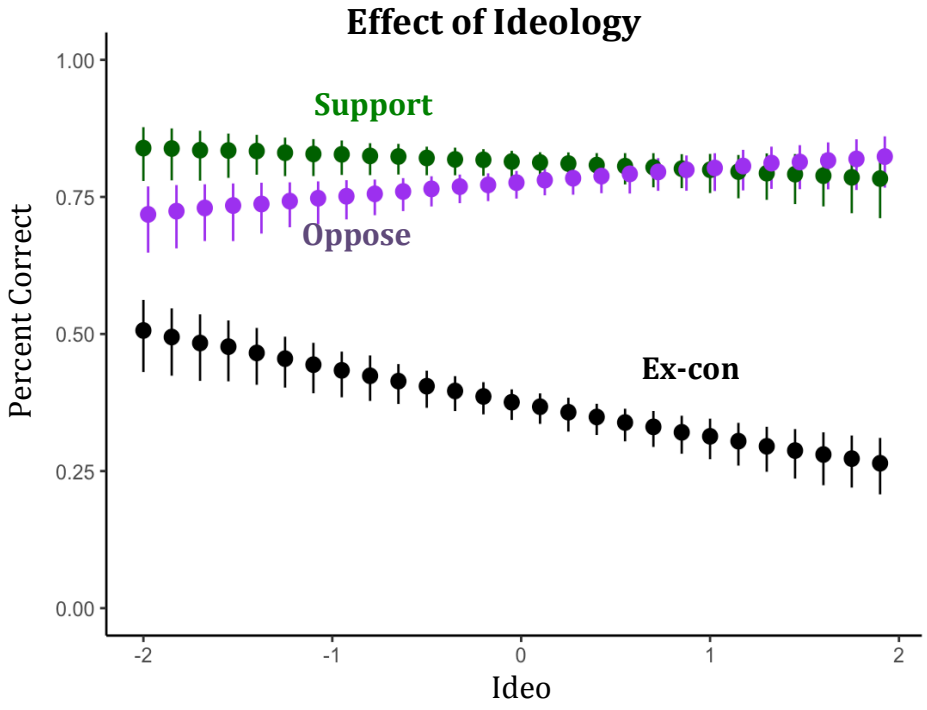

Figure 14: Logistic regression of all three conditions for the conjunction fallacy. The dots represent the mean expected value and the error bars represent 95% confidence intervals from an MCMC simulation. A higher percent right meant that the immoral behavior described was less representative of the condition.

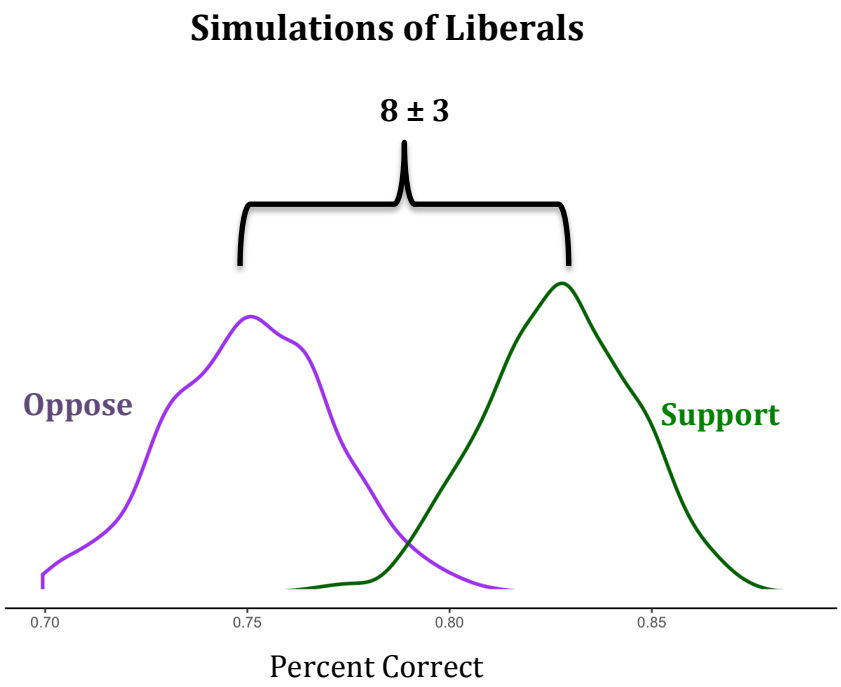

Figure 15: Density of simulations of liberals over the two gun control conditions. Basically a cross section of the graph in figure 14 at is = -1. 1000 MCMC simulations were recorded and then graphed. The mean of the support condition was 82% (95% CI = 79% to 86%). The mean of the oppose condition was 75% (95% CI = 70% to 78%).

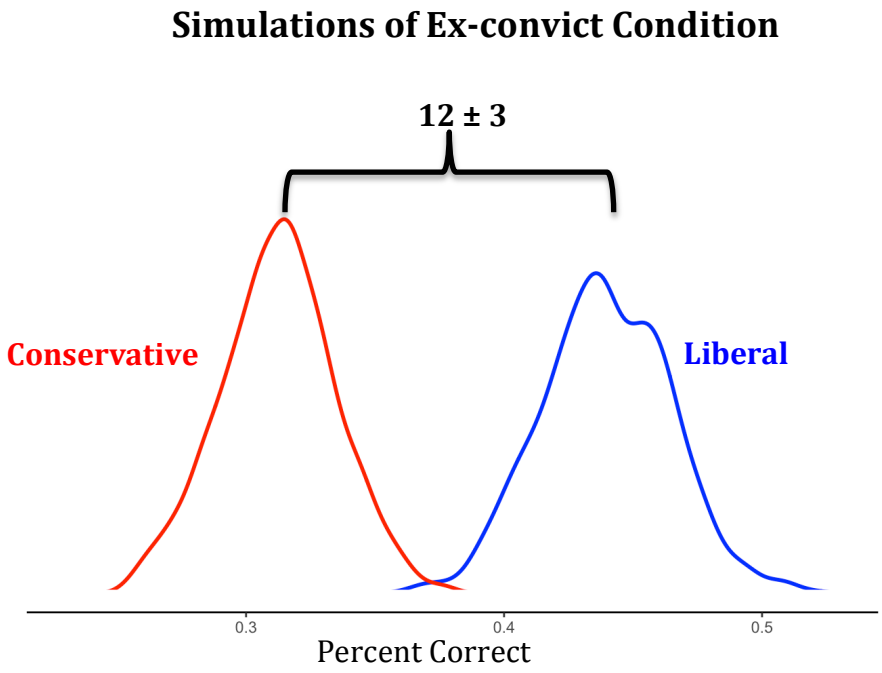

Figure 16: Density of simulations of the ex-convict condition for both liberals and conservatives. The reference condition actually displays interesting results, as conservatives are more likely to commit the conjunction error in the ex-convict condition. The mean of liberals was 43% (95% CI = 39% to 49%). The mean of conservatives was 31% (CI 95% = 27% to 35%). In this histogram and in future histograms liberals are in blue and conservatives are in red.

CRT increased polarization in two of the three conditions (See figure 17). In the oppose condition. In the oppose gun control condition, CRT slightly increased performance, but there was no significant polarization in either low or high CRT individuals. In the other two conditions polarization increased as CRT performance only impacted liberals. In fact, conservatives did not significantly increase performance with CRT in any condition.

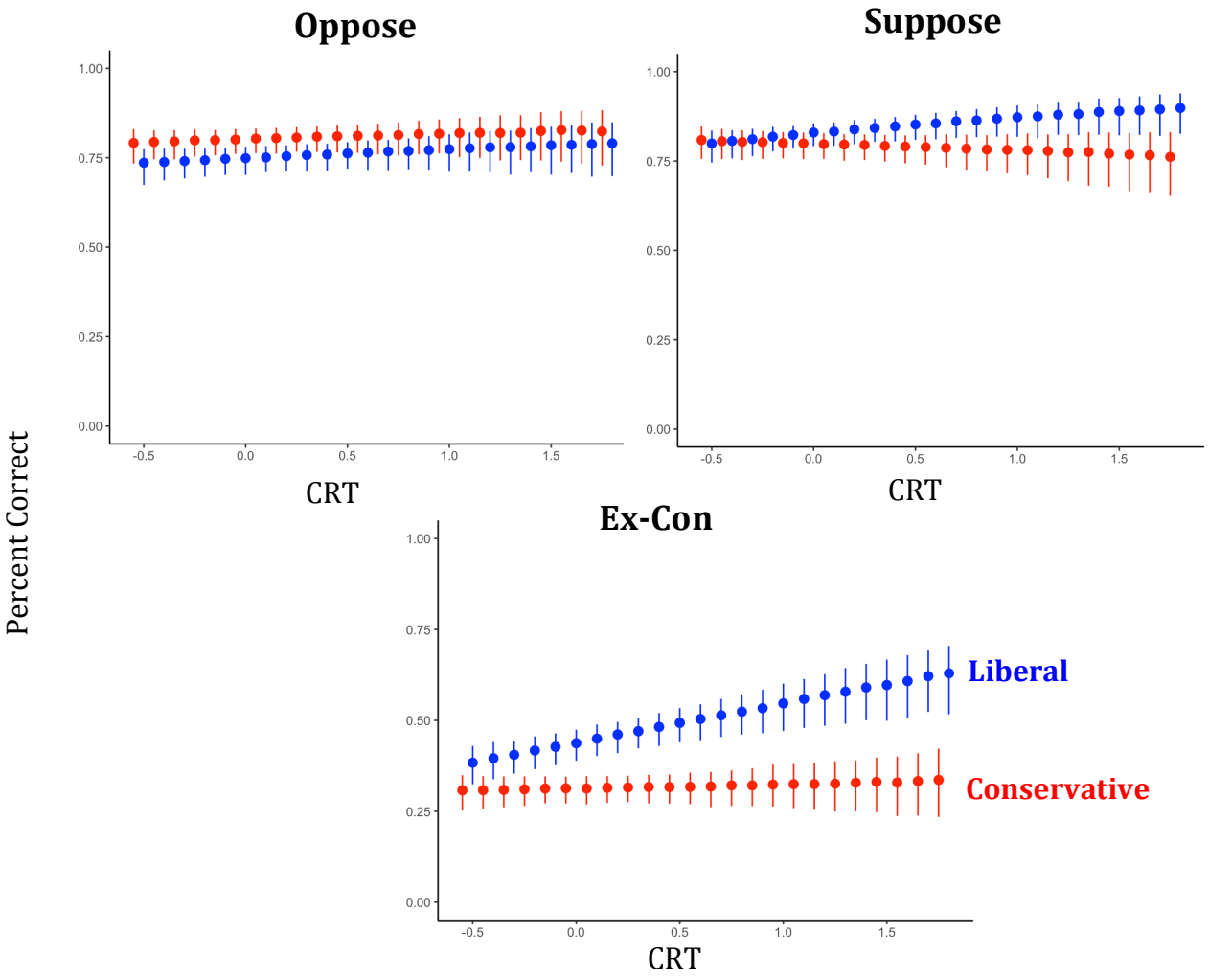

Figure 17: A look at the effects of CRT performance in each condition on both liberals and conservatives. The most dramatic result is found in the ex-convict condition.

Each condition was observed in more detail, to see if there were interaction effects between CRT performance and ideology. The question asked was as follows: do liberals improve more from low CRT (CRT = -.5) to high CRT (CRT = 1) than conservatives do. Four

simulations were done 1000 times in each condition. One simulation was done for low CRT liberals, one for high CRT liberals, one for low CRT conservatives, and one for high CRT conservatives. The improvement among the ideological group was tracked and compared.

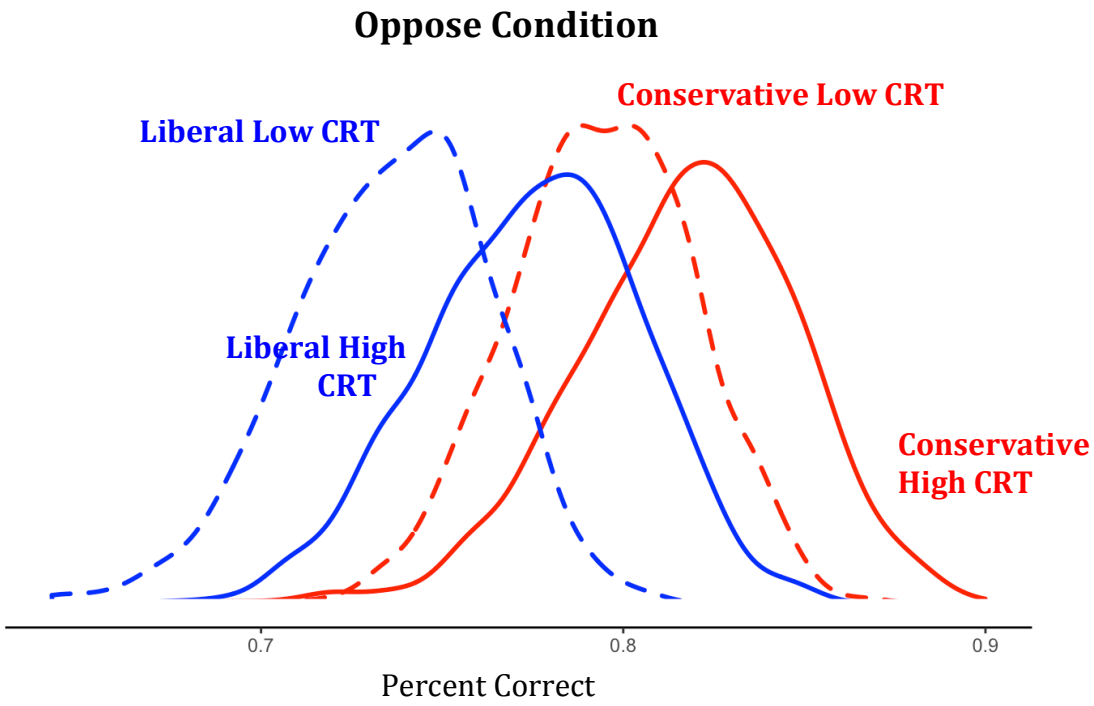

Figure 18: Simulations of four types of individuals in the oppose condition: high and low CRT liberals and conservatives. CRT slightly improves performance in both ideologies, and polarization does not increase. Low CRT individuals are represented by dotted lines, high CRT individuals by solid lines.

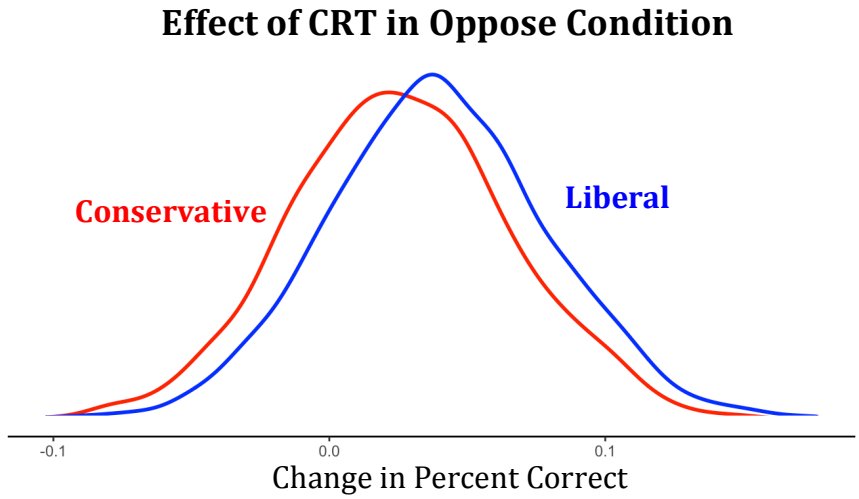

Figure 19: The histogram displays the improvement of percent correct as CRT goes from low to high in the simulations. In this condition, both improve slightly on average, but there is no interaction between ideology and CRT. Liberals improve by 4% (95% CI = -4 %to 11%) and conservatives improve by 2% (95% CI = -6% to 8%).

Polarization did increase at higher CRT scores in the support condition (see figure 20). Liberals increased performance in this condition at high CRT scores, while conservatives remained constant (see figure 20). Also, polarization only occurs at high levels of CRT. At low levels of CRT liberals performed equally to conservatives. At high levels, liberals were 9% (SE = 4%) more likely to get the question correct.

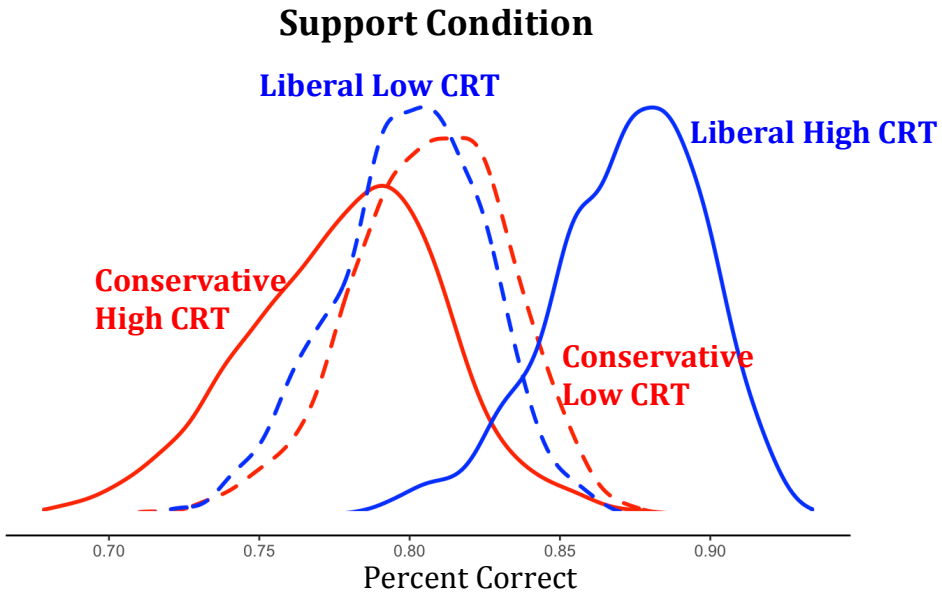

Figure 20: Simulations of four types of individuals in the support condition: high and low CRT liberals and conservatives. CRT improves performance in liberals, and polarization does increase.

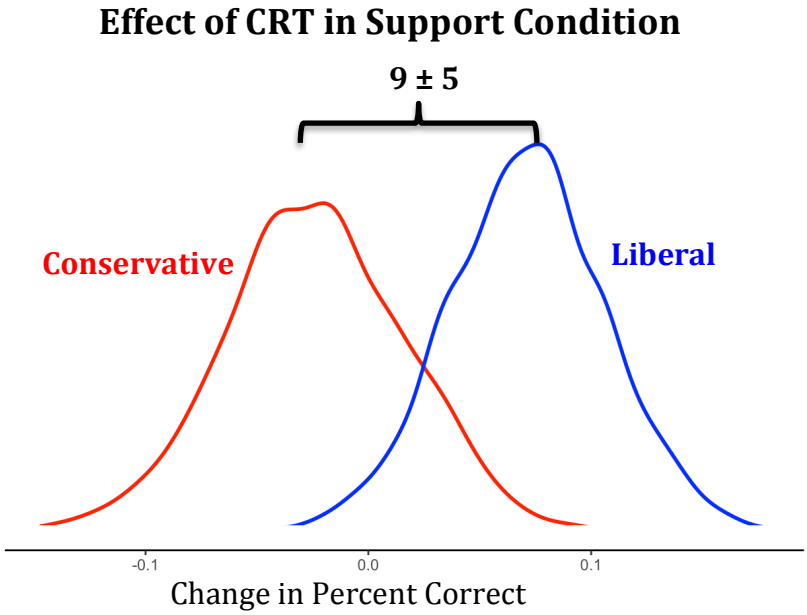

Figure 21: The histograms display the improvement as of low to high CRT simulations. In this condition, only liberals improve with higher levels of CRT. Liberals improve by 7% (95% CI = 0 %to 13%) and conservatives get worse by 2% (95% CI = -10% to 5%).

The most dramatic results were in the ex-convict condition. Polarization increased at higher levels of CRT (see figure 22), as high scoring liberals were 22% (SE = 5%) less likely to make the conjunction fallacy error than conservatives. The difference between low scoring CRT individuals was only 7% (SE = 4%). Increased polarization occurred as only liberals saw an increase in performance with high CRT levels (see figure 23).

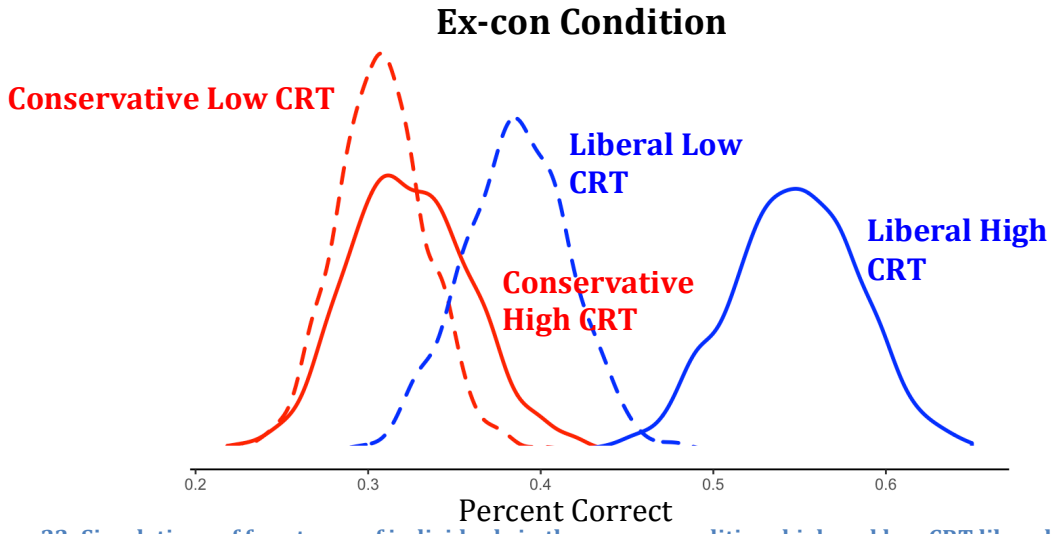

Figure 22: Simulations of four types of individuals in the ex-con condition: high and low CRT liberals and conservatives. CRT improves performance in liberals, and polarization does increase.

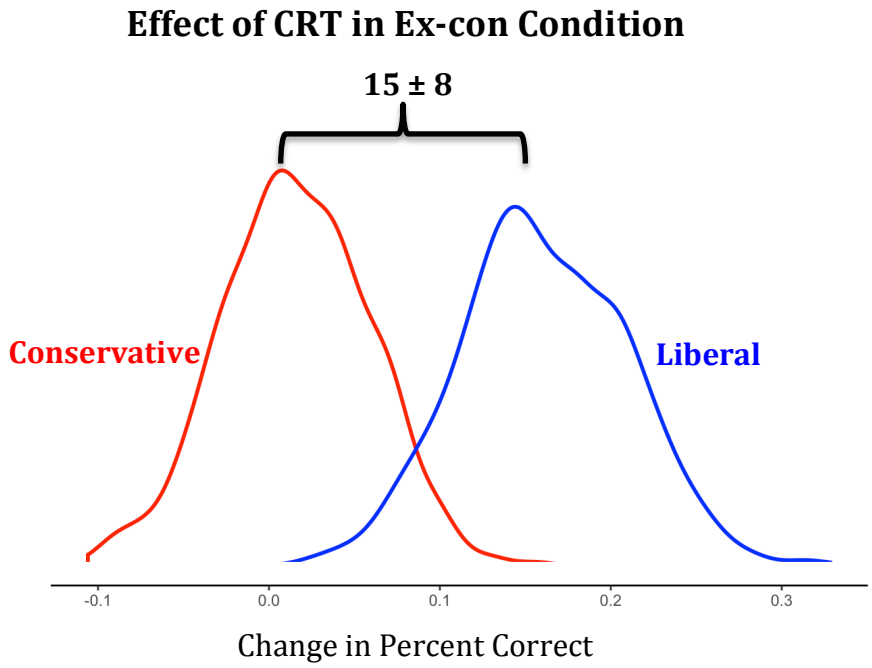

Figure 23: The histograms display the improvement as of low to high CRT simulations. In this condition, only liberals improve with higher levels of CRT. Liberals improve by 16% (95% CI = 6 %to 22%) and conservatives improve by 1% (95% CI = -7% to 8%).

DISCUSSION

WASON SELECTION TASK

Performance across the board in the Wason Selection Task was very low. The task appeared too hard, and even under conditions that normally produce better performance, few were able to do the task. There was no discernable effect of ideology, and it seems like people were guessing more than solving the problem. There was correlation with CRT performance, but even at high levels of CRT so few people are getting the answer right it is difficult to draw any conclusions from the results. At almost all levels of CRT, the expected percent correct in the regression was less than 10%. Only at the highest levels of CRT did it rise above that level. And in terms of simply getting the answer right, the result never reached significantly above chance.

The results may have been driven down by the fact that the question was towards the end of a very difficult test, and people may not have given that much effort on the problem. Many did not even turn over any of the cards and just answered at chance. Even lowering the bar and looking at logical processes, to determine whether people were able to get close to the right answer was not correlated discernably to ideology. Ultimately, it was difficult to tell whether or not the prompt activated motivated reasoning.

CONJUNCTION FALLACY

There was a slight result between the two politicized conditions, but there is clearly not a strong representation between immoral behavioral and policy position on gun control. Not only was there not much difference between the two conditions, but also the rate of falling for the conjunction fallacy was so low there does not seem to be a relevant representation. No animosity seems to be captured by this result, although the slight

difference does point to some effect of ideology. This may be because liberals and conservatives do not have strong negative representations of each other, and are only slightly biased. While there may be some in-group out-group bias, there is not a strong negative portrayal of the other side. The viciousness may be left to the politicians.

The other possible explanation is that the conditions were too unrelated to the prompt. In this scenario there is still as strong link between immoral behavior and opposite ideology. In this case, ideology would be viewed as a moral characteristic. The study implement was unable to unearth this representation though. Perhaps the link between one policy position and immoral behavior was too tenuous. A more salient and relevant representation may be needed. Ideology is an all-encompassing moral undertaking and the one element itself is not closely related to immoral behavior. Or perhaps gun control was not the best focus, as it may be considered a character flaw but not linked to petty crime.

It is unclear as to why the bias was only found in liberals, as conservatives answered at similar rates in the two gun control conditions. Most results have either found equal or greater bias in conservatives, so it is a bit surprising to find the effect only in liberals. This may be because liberals have a stronger association between immoral behavior and gun control, as they see those opposed to it as complicit in mass shootings. In cases such as climate change this may not be the case. Liberals also might be more likely to view conservatives as immoral in general. There also may simply have been ceiling effects as the rate of conjunction fallacy was so low to begin with. This topic should be explored more, and potential ways to do so are mentioned in the future directions.

The most interesting results are in the interaction effects between ideology and intelligence. Unlike previous studies, polarization in results does not occur due to biased

information processing. Instead, the conjunction fallacy is a test of narrative richness. CRT normally increases performance on the test (Oechssler & Roider, 2009), as subjects are less reliant on intuitive judgments and are more likely to use logic. If rates of conjunction fallacy increase or stay constant, then most likely the link between the condition and immorality is getting stronger to overcome the propensity to use logic.

In the supports gun control condition, CRT improved performance in liberals. Very few liberals saw a supporter of gun control as an immoral person, and even fewer intelligent liberals saw the connection as representative. Republicans though did not increase with CRT, suggesting that the narrative richness of the account may have increased which offset natural improvements that would be expected in more logical people.

In the opposes gun control condition, CRT improved performance modestly in both liberals and conservatives. If that condition had followed the patterns of the support and reference condition, one would expect conservatives to improve with CRT, but not liberals, increasing polarization. This would also follow previous results of ideologically motivated cognition, as liberals and conservatives have shown similar biases in most studies. Yet there are distinct differences between ideologically motivated cognition and the bias associated with the conjunction fallacy. It is unclear whether there is a fundamental difference in the narrative accounts of conservatives and liberals, or whether this implement was too subtle. Ceiling effects may also have played a role in capping conservative improvement in the condition.

The most dramatic interaction between ideology and intelligence was found in the reference condition. Polarization increased dramatically with increase in CRT scores,

suggesting that the narrative richness of conservatives increased. This could have implications in bias and prejudice. Smarter people are better at applying logic to fit a worldview, and this could allow them to create more narratively rich accounts of people. In this example conservatives may be biased against ex-cons, and view them as immoral, slightly more than liberals do. This would fit previous findings as conservatives are more reliant on social institutions and societal order (Jost et al., 2003). As CRT increases, liberals are more likely to look past their less narratively rich account, and come to the correct conclusion that Richard is more likely to not be an ex-convict. Smart conservatives though, have created a more robust story in which ex-convicts are immoral, and therefore their performance does not increase despite their natural inclination to use logic. In the future this topic and theory should be investigated.

FUTURE STUDY

Here is a proposed test to be given to a demographically similar group of participants:
Original CRT:

1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? [correct answer = 5 cents; heuristic answer = 10 cents]
2. If it takes 5 minutes for five machines to make five widgets, how long would it take for 100 machines to make 100 widgets? [correct answer = 5 minutes; heuristic answer = 100 minutes]
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? [correct answer = 47 days; heuristic answer = 24 days]

New CRT Questions:

1. There a three full decks of cards on a table and a dealer is drawing cards. From Deck 1 he draws three black cards. From Deck 2 he draws 2 blacks and 1 red card. From Deck 3 he draws three red cards. You want to pick a black card. Which deck should you draw from? [correct answer = 3; heuristic answer = 1]
2. When I was 6 my sister was half my age. I am now 50, how old is she? [correct answer = 47; heuristic answer = 25]
3. You are told to design new armor for the military, and you need to decide where to put bulletproof material. People mostly get shot in the arms or the head. Doctors notice that most injured people coming back from the war have wounds in their

arms. Where should armor be reinforced? [correct answer = head; heuristic answer = arms]

Conjunction Fallacy Question 1:

"Richard is 31 years old. On his way to work one day, he accidentally backed his car into a parked van. Because pedestrians were watching, he got out of his car. He pretended to write down his insurance information. He then tucked the blank note into the van's window before getting back into his car and driving away."

Which is more likely?

a) Richard is self-empolyed
b) Richard is self-employed and (1 of three conditions)

The three conditions would be "ex-convict", "ex-convict who was arrested for corporate fraud", and "ex-convict who was arrested for drug dealing"

Wason Selection Task:

The prompt would ask subjects to evaluate the claim that a few politicians had sent out tweets recently and none of the ones sent out by _____ had been factual. The three politicians would be Paul Ryan, Barrack Obama, and David Cameron as a reference condition. In the Trump condition, the cards would read Obama, fact, Ryan, lies. The correct cards to turn over would be fact and Ryan, and the assertion would turn out to be false.

Conjunction Fallacy Question #2:

"Sarah was walking down the street when a man in front of her dropped his wallet. She was about to call to him when she saw that the wallet had $200 in it. She kept the money, and threw the wallet in the trash."

Which is more likely?

c) Sarah is a clerk
d) Sarah is a clerk and (1 of three conditions)

The three conditions would be "atheist", "liberal", and "conservative"

Base-rate Neglect:

"Of the _____ population, 1 in 10,000 are terrorists. The FBI has a watch list to survey suspected terrorist. If a person is a terrorist there is a 99% chance they will be on the list. If the person is not a terrorist there is a 99% chance they will not be on the list.

A person realizes their neighbor is on the list, how likely are they to be a terrorist?"

Pick one:
(0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%, 60-70%, 70-80%, 80-90%, 90-100%)

The three conditions would be different populations: alt-right, Muslim, and general. The correct answer is 0-10% but the heuristic answer is 90-100%.

The future study proposed will be in a similar format and will seek to clarify many of the questions that came up in this study, and to further examine motivated reasoning and political bias. Again the survey will be started with the original CRT. We are also proposing our own questions that have the potential to be added to the CRT. Finding more questions that correlate with the original test, and that can be used to add or replace the test will be important for future research, so we want to try a few new ones in the study. These questions most likely easier than the ones on the current CRT, but the hope is that they correlate with increased CRT performance, but provide trait discrimination at lower levels.

Next we wished to investigate prejudice and worldview effects. Building off of the results in the ex-convict condition, we hope to look at rule breaking, and the effects of worldview. The implement would be similar to the conjunction fallacy question in the study, but all three conditions all about rule breaking. The first reference condition would be “ex-convict”, the second condition would be “ex-convict who was arrested for corporate fraud”, and the third condition would be “ex-convict who was arrested for drug dealing”. This result would most likely be polarized, as liberals are more communitarian and are wary of corporate greed, while conservatives are generally more anti-drugs. The hypothesis would be that this polarization would increase with CRT as well. This question would continue to investigate the narrative richness of intelligent partisans.

The next question on the test would be a three condition Wason Selection Task as used in the survey, but with simpler conditions focused on Cheater Detection. The

hypothesis would be that subjects would undergo motivated reasoning to help their candidate, and polarization would increase with CRT. The effect may be weaker though as in this instance they are protecting a candidate they may agree with rather than protecting an opinion they feel is necessary to their group identity. Cheater detection could provide some interesting results in this situation, and could continue to demonstrate the relationship between confirmation bias and the task. When a partisan hears that the opposing candidate lies, they may be likely to accept that result and will not search farther. This simpler version is proposed to see if the task is even a viable tool for biased information processing. This would be a helpful discovery as the task has been used in the past to examine bias in the population and in judges, so the usefulness of the test should be examined.

There would then be another conjunction fallacy question, again about immoral behavior, and this time trying to determine whether people view others of differing ideology as immoral. The description would be of an immoral Sara, and subjects would then be asked if she was more likely to be a sales clerk, or a sales clerk and one of three conditions: a liberal, a conservative, or an atheist. As the indirect method did not work too well in producing rich representations we thought we would try being more direct in the implement. The effect of CRT and of intelligence would become clearer if the more direct prompt is more representative. This is not necessarily the case, but would be interesting to check.

Finally, we wanted to test logical processes in another context, so we created a base rate neglect (Bar-Hillel, 1980) problem to test motivated reasoning. People often neglect the base-rate of the population and report a high probability of the event occurring, in this

case that the person is a terrorist. The goal would be to see if looking at different groups would alter people's ability to reason properly, and continue to look at motivated reasoning in judgments of others. The prediction would be that conservatives would be more likely to ignore the base-rate in the Muslim condition, as that would fit with their world-view. Liberals would be more likely to ignore the base-rate in alt-right conditions, as that result would fit with their world-view.

The study aims to explore other areas where motivated reasoning may be a factor besides information processing. It is logical to assume it would be relevant in cheater detection, as this involves logic, but these new instruments would also continue to explore whether motivated reasoning is relevant in how other political groups are viewed. The question remains whether the American citizen views other political views as fundamentally less moral, and is more expectant of bad behavior. It will also be interesting to see the role of intelligence in a variety of contexts outside of logical processes. Intelligence may holistically increase polarization by allowing people to be more confident in their opinions.

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APPENDIX

APPENDIX A
SYSTEM 1 VS SYSTEM 2

People think in different ways depending on the situation. Recent literature has sought to characterize thinking into a fundamental dichotomy between fast automatic processes and slower more deliberate modes. They first type of thinking is known as System 1 thought, and the second is System 2.

The first system relies on heuristics, which are quick ways to form judgments, easily retrievable knowledge structures that can be called to mind quickly. This system is relatively effortless (Sloman, 2002, Kahneman & Frederick 2002). This system is slowly and generally trained over time, by creating unconscious general representations through association (Smith & DeCoster, 2000, Chaikan & Trope, 1999). These general knowledge structures create an autonomous set of systems that are used for most of day to day thinking. The autonomous and effortless nature is the defining feature of these systems (Stanovich, 2004, Kahneman, 2011).

The second system is slower and more effortful, and is used less often for this reason. It is often called in when something violates expectation, or more reflection is necessary on certain task. While this helps keep control in unknown situations, it takes effort (Kahneman, 2011). System 2 processes use specific rules, and logic, that can then be applied to situations. It also is what allows for complex processes such cognitive decoupling, or the ability to sustain secondary representations, and therefore simulation (Stanovich, 2004). It also heavily related to consciousness and the understanding of self (Kahneman, 2011). System 2 is associated with what is generally considered human cognition, as opposed to System 1, which shares more cognitive features with other animals (Evans, 2003).

Type 1 Processes	Type 2 Processes
Holistic	Analytic
Automatic	Controlled
Relatively undemanding of cognitive capacity	Capacity demanding
Relatively fast	Relatively slow
Acquisition by biology, exposure, and personal experience	Acquisition by culture and formal tuition
Parallel	Sequential
Evolutionarily old	Evolutionarily recent
Implicit	Explicit
Often unconscious or preconscious	Often conscious
Lower correlations with intelligence	Higher correlations with intelligence
Short-leashed genetic goals	Long-leashed goals that tend toward personal utility maximization

Figure 24: A chart initially from Stanovich 1999 outlining various System 1 and System 2 processes.

The two systems work together in a way that maximizes cognitive efficiency. Due to the high effort associated with thinking, people are cognitive misers (Taylor, 1991), and will avoid using effortful processes if possible. System 1 is often not optimal though, as heuristics are general rules that can be misapplied and lead to bias. Due to energy constraints people will often use the less effortful, but less exact system. This makes sense, as to make day-to-day decisions people don't want to have to always calculate probabilities, or do complicated cost benefit analysis, and will often use heuristics to make natural assessments (Tversky & Kahneman, 1983). These heuristics may oversimplify the world though and lead to bias.

APPENDIX B
COGNITIVE REFLECTION TEST

The Cognitive Reflection Test (CRT), developed by Shane Frederick in 2005, is a study instrument used to determine how reliant people are on System 1 processing. It is a series of three questions, each with an answer that easily springs to mind, but is actually wrong. The idea is that System 2 processes should override the intuitive response in individuals who rely less heavily on intuition and heuristics. Each question is quite easy once explained, so the reason people get the question wrong is due to a lack of reflection, not an inability to solve it. The test is as follows:

1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost? [correct answer = 5 cents; heuristic answer = 10 cents]
2. If it takes 5 minutes for five machines to make five widgets, how long would it take for 100 machines to make 100 widgets? [correct answer = 5 minutes; heuristic answer = 100 minutes]
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? [correct answer = 47 days; heuristic answer = 24 days]

The test is understandably correlated with intelligence, numeracy, self-reported SAT scores, and wonderlic personality tests. This makes sense, as both would require critical reasoning, as well as reading comprehension skills, even if the math is not difficult. Yet the CRT is more than a simple intelligence test (Gerrans, 2014), as it more a test of reliance on type of cognitive processes, whereas intelligence tests are tests of ability to use the second type of processes (Toprak, West & Stanovich, 2014, Pennycook, et al., 2012, Paxton, Ungar & Green, 2012, Paxton, Ungar & Green, 2012, Pennycook, Cheyne, Barr, Koehler & Fugelsang, 2014, Pennycook, Cheyne, Barr, Koehler & Fugelsang, 2014, Campitelli & Labollita 2010).

While the CRT may be a strong predictor of cognitive style, it is not without its flaws. It has been widely used and once people know of the correct answers it is obviously no longer useful. This is especially true on survey sites like Mechanical Turk where participants will often have already taken the test. There is also a floor effect in non-well-educated populations, as the test is very hard and more than 50% of people get none of the questions right (Frederick, 2005). This makes it impossible to differentiate between half of the population. In our study, 59% of participants answered 0 out of the 3 questions right, so there is definitely a need for lower trait discrimination problems.

There have been a few prominent efforts to add questions to the CRT. One such effort was undertaken by Toplak, West, and Stanovich in 2004. They added 4 new questions with the hope of adding questions to the original measure, while also providing an alternative. They found the new 7-question measure was a better predictor of rational thinking tasks than the original CRT. It also discriminated among lower trait individuals more so than the original due to the increased number of questions and was easier than the CRT. The mean percent of answering a question correctly on the original CRT was 17, while on the four new questions the mean was 24. One drawback is that one question is multiple choice so a correct answer could be reached by chance. The proposed four questions were as follows:

1. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? _____days [correct answer = 4 days; heuristic answer = 9]
2. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are there in the class? _____ students [correct answer = 29 students; heuristic answer = 30 students]
3. A man buys a pig for $60, sells it for $70, buys it back for 80$, and sells it finally for $90. How much has he made? _____dollars [correct answer = $20; heuristic answer answer = $10]
4. Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down %50. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point Simon has: a. broken even in the stock market, b. is ahead of where he began, c. has lost money [correct answer = c, because the value at this point is $7,000; heuristic answer = b]

Another attempt to increase the length of the CRT was undertaken by Primi, Morsanyi, Chiesi, Donati, and Hamilton in 2015. They tested a multitude of questions and reported an additional three they believed would be a good addition to the test. Their new test showed a greater ability to differentiate among lower trait individuals. They also suggested using Item Response Theory (IRT) analysis in future studies in order to gain more differentiation using the same number of questions. Basically, it is a way to weight questions and provide greater linkage between items and latency characteristics. Ultimately they found their new questions, along with the original questions, could create a score through IRT analysis that was a better predictor of risk seeking behavior than intelligence, demonstrating their test was again a test that measured method of thinking.

1. If three elves can wrap three toys in an hour, how many elves are needed to wrap six toys in 2 hours? [correct answer = 3 elves; heuristic answer = 6 elves]
2. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are there in the class? [correct answer = 29 students; heuristic answer = 30 students]
3. In an athletics team, tall members are three times more likely to win a medal than short members. This year the team has won 60 medals so far. How many of these have been won by short athletes? [correct answer = 15 medals; heuristic answer = 20 medals]

The final relevant attempt to expand the CRT was undertaken by Baron et al. in 2015. The group attempted to add word problems in an effort to expand the scope of the CRT as well as correct for the gendered nature of the original test, and on the new test women scored as well as men. They also found their test was a valid predictor of moral judgment. The test had 11 word problems, along with the original CRT, and 3 new

arithmetic problems. Some examples of the word problems are as follows (to see the full test see end of appendix A):

> All flowers have petals. Roses have petals. If these two statements are true, can we conclude from them that roses are flowers. Yes **No**
> All mammals walk. Whales are mammals. If these two statements are true, can we conclude from them that whales walk. **Yes** No
> In a box, some red things are square, and some square things are large. What can we conclude? [a. Some things are large b. All things are large c. **We can't conclude anything about red things and large things**]

This paper takes data from a study that seeks to expand the CRT. Participants were asked the original CRT questions as well as the best performing ones from previous CRT expansion papers. Professor Kahan added some questions of his own in an effort to analyze the predictive power of the various CRT tests. What has shown the most promise is an inclusive measure of all of the tests, and it has been shown to be both internally consistent and discriminative across the latency variable. The problem with the test is that unlike the original CRT it is very long.

Baron et al., 2015 - PROPOSAL FOR NEW CRT
Belief bias items with lures

1. All flowers have petals.
   Roses have petals.
   If these two statements are true, can we conclude from them that roses are flowers (no).
2. All mammals walk.
   Whales are mammals.
   If these two statements are true, can we conclude from them that whales walk (yes).
3. All things that have a motor need oil.
   Automobiles need oil.
   If these two statements are true, can we conclude from them that automobiles have a motor (no).
4. All living things need water.
   Roses need water.
   …, can we conclude from them that roses are living things (no).
5. All vehicles have wheels.
   Boats are vehicles.
   …, can we conclude from them that boats have wheels (yes).

Syllogisms

1. In a box, some red things are square, and some square things are large. What can we conclude? [a. Some red things are large. b. All red things are large. c. **We can't conclude anything about red things and large things.**
2. In a box, no green things are round, and all round things are large. What can we conclude? [a. No green things are large. b. Some green things are not large. c. **We can't conclude anything about green things and large things**.
3. In a box, no blue things are triangular, and no triangular things are large. What can we conclude? [a. No blue things are large. b. Some blue things are not large. c. **We can't conclude anything about blue things and large things.**]

Original CRT Questions

…

New Arithmetic Questions

1. If it takes 2 nurses 2 minutes to measure the blood pressure of 2 patients, how long would it take 200 nurses to measure the blood pressure of 200 patients? [correct answer = 2 minutes; heuristic answer = 200 minutes]
2. Soup and salad cost $5.50 in total. The soup costs a dollar more than the salad. How much does the salad cost? [correct answer = $3.25 and $2.25]
3. Sally is making sun tea. Every hour, the concentration of the tea doubles. If it takes 6 hours for the tea to be ready, how long would it take for the tea to reach half of the final concentration? [correct answer = 5 hours; heuristic answer = 3 hours]

Other items

1. Jack is looking at Anne but Anne is looking at George. Jack is married but George is not. Is a married person looking at an unmarried person? [**a. Yes** c. No c. Cannot be determined]
2. Ann's father has a total of five daughters: Lala, Lele, Lili, Lolo, and _____. What is the name of the fifth daughter? [Ann]
3. On the side of a boat hangs a ladder with six rungs. Each rung is one foot from the next one, and the bottom rung is resting on the surface of the water. The tide rises at a rate of one foot an hour. How long will take the water to reach the top rung? [a. 5 hours b. 6 hours **c. never**]

APPENDIX C
MODEL SUMMARIES

Model Wason Selection task correct answer

```
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  -0.34538    0.08677  -3.981 6.87e-05
skep         -0.23321    0.15411  -1.513    0.130
alarm         0.08085    0.15103   0.535    0.592
is           -0.12337    0.09033  -1.366    0.172
crt           0.25036    0.10193   2.456    0.014
skep:is       0.17770    0.15700   1.132    0.258
alarm:is      0.22348    0.15283   1.462    0.144
skep:crt      0.26422    0.17370   1.521    0.128
alarm:crt     0.04295    0.17073   0.252    0.801
is:crt       -0.07034    0.10195  -0.690    0.490
skep:is:crt   0.02569    0.17012   0.151    0.880
alarm:is:crt  0.02449    0.16947   0.145    0.885
```

Model Wason Selection task use of logic

```
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  -3.43368    0.26139 -13.136  < 2e-16
skep          0.35460    0.40623   0.873  0.38271
alarm        -1.41873    0.83983  -1.689  0.09116
is           -0.01627    0.27001  -0.060  0.95196
crt           0.67489    0.24266   2.781  0.00542
skep:is       0.08106    0.41332   0.196  0.84451
alarm:is     -0.27398    0.84168  -0.326  0.74479
skep:crt     -0.02928    0.36846  -0.079  0.93667
alarm:crt     0.91274    0.60569   1.507  0.13182
is:crt       -0.20588    0.24124  -0.853  0.39344
skep:is:crt   0.23750    0.36242   0.655  0.51226
alarm:is:crt  0.14591    0.59294   0.246  0.80561
```

Model of conjunction fallacy using CRT

```
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -0.51942    0.07261  -7.154 8.44e-13
supp         1.99983    0.11664  17.145  < 2e-16
opp          1.77125    0.11113  15.939  < 2e-16
is          -0.26883    0.07349  -3.658 0.000254
crt          0.24333    0.09275   2.624 0.008702
supp:is      0.17311    0.11950   1.449 0.147466
opp:is       0.42350    0.11234   3.770 0.000163
supp:crt    -0.11665    0.15314  -0.762 0.446214
opp:crt     -0.11986    0.14591  -0.821 0.411376
is:crt      -0.19421    0.09304  -2.088 0.036840
supp:is:crt -0.03813    0.15094  -0.253 0.800540
opp:is:crt   0.17815    0.14342   1.242 0.214169
```