

## **Ideology, Motivated Reasoning, and Cognitive Reflection: An Experimental Study**

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**Note: this is a preliminary draft and is subject to revision**

## Abstract

Social psychologists have identified various plausible sources of ideological polarization over climate change, gun violence, national security, and like societal risks. This paper reports a study of three of them: the predominance of heuristic-driven information processing by members of the public; ideologically motivated cognition; and personality-trait correlates of political conservatism. The results of the study suggest reason to doubt two common surmises about how these dynamics interact. First, the study presents both observational and experimental data inconsistent with the hypothesis that political conservatism is distinctively associated with closed-mindedness: conservatives did no better or worse than liberals on an objective measure of cognitive reflection; and more importantly, both demonstrated the same unconscious tendency to fit assessments of empirical evidence to their ideological predispositions. Second, the study suggests that this form of bias is not a consequence of overreliance on heuristic or intuitive forms of reasoning; on the contrary, subjects who scored highest in cognitive reflection were the *most* likely to display ideologically motivated cognition. These findings corroborated the hypotheses of a third theory, which identifies motivated cognition as a form of information processing that rationally promotes individuals' interests in forming and maintaining beliefs that signify their loyalty to important affinity groups. The paper discusses the normative significance of these findings, including the need to develop science communication strategies that shield policy-relevant facts from the influences that turn them into divisive symbols of identity.

## 1. Introduction

Ideological polarization is a conspicuous but peculiar feature of American democracy. No one is surprised when conservatives and liberals fight about tradeoffs between wealth and equality or between security and liberty. Differences in the value attached to such goods *define* those political outlooks.

But ideological conflicts over policy aims seem less common, and certainly less spectacular, than ones over policy-relevant *facts*. Democrats (by and large) fervently believe that human activity is responsible for global warming, Republicans (by and large) that it is not (Pew Research Center 2012). Conservatives are confident that the wastes generated by nuclear power plants can be safely disposed of by deep geologic isolation; liberals dispute that (Jenkins-Smith, Silva, Nowlin & deLozier 2011). People who value equality and community believe that vaccinating schoolgirls against the human papillomavirus is essential to protecting women's health—and that permitting private citizens to carry concealed hand guns increases crime. Those who value hierarchy and individualism, in contrast, reply that universal HPV vaccination will *undermine* young girls' health by lulling them into unprotected sex, and that gun *control* increase crime by making it harder for law-abiding citizens to protect themselves (Kahan 2010).

Political polarization on empirical issues like these occurs not only despite the lack of any logical connection between the contending beliefs and the opposing values of those who espouse them. It also persists despite apparent scientific consensus on the answers to many of these disputed questions.

Social psychology is replete with explanations for why dueling assertions of fact occupy the frontline in the U.S. culture wars. Members of the public, it is pointed out, tend to rely on heuristics or mental shortcuts that can generate systematic biases in their risk perceptions. They also tend to seek out and assess evidence in biased patterns that reinforce the positions that they, or those who share their ideological predictions, already hold. Some psychologists maintain, too, that these effects are intensified by particular ideologies, which are correlated with dogmatism, aversion to complexity, and like traits that interfere with open-minded consideration of evidence.

All of these positions are rooted in empirical evidence, but relatively little testing has been done on how they relate to one another. More than one plausible account exists of how the various dynamics that connect ideology and factual perceptions interact. Empirical testing of these competing surmises is necessary, not only to advance understanding of ideological polarization over policy-relevant facts but also to guide practical action aimed at mitigating it.

This paper seeks to contribute to the necessary testing process. It synthesizes three competing theories of how *dual process reasoning*, *ideological predispositions*, and *motivated cognition* combine to generate polarization over risks and other policy consequential facts. It then presents both observational and experimental data that bear on the relative strength of these three theories.

## **2. Empirical and Theoretical Background**

Social psychology links public controversy over risk and related policy-consequential facts to three principal dynamics: (1) heuristic-pervaded information processing; (2) motivated cognition; and (3) morally or ideologically grounded personality traits. By way of context for the study design and results, this section briefly reviews each dynamic, and then identifies three alternative theoretical accounts of their relationship to one another.

### **2.1. Three psychological dynamics**

*a. Heuristic-pervaded information processing.* Dual-process theories have figured centrally in the study of social psychology for decades (Chaiken & Trope 1999). “The common distinction in dual-process models is between a fast, associative information-processing mode based on low-effort heuristics, and a slow, rule based information processing mode based on a high-effort systematic reasoning” (Chaiken & Trope 1999, p. ix).

In his influential position, Kahneman (2003) labels these two modes of reasoning “System 1” and “System 2,” respectively. System 1, which is characterized by a system of intuitive, affect-driven heuristics, serves people well on account of its speed but is subject to recurring biases, the avoidance or correc-

tion of which demands the more effortful, conscious forms of information processing associated with System 2.

Many scholars who use dual process theory to explain controversy over societal risks emphasize the predominance of System 1 reasoning in the public generally. The centrality of visceral, emotion-guided modes of perception, it is suggested, predictably leads the public to overestimate the incidence and harm associated with more sensational risks—such as terrorist acts and gun accidents—relative to more remote, less gripping hazards such as climate change and swimming pools (Loewenstein, Weber, Hsee & Welch 2001; Slovic, Finucane, Peters & MacGregor 2004; Sunstein 2006b). Expert opinion does not reliably correct these distortions because members of the public lack the inclination or ability to engage in the System 2 forms of reasoning necessary to understanding the technical evidence that experts use to assess risks (Margolis 1996; Sunstein 2005).

*b. Motivated cognition.* Motivated cognition refers to the tendency of people to conform assessments of information to some goal or end extrinsic to accuracy (Kunda 1990). In a classic study involving this phenomenon, researchers showed students from two Ivy League colleges a film of a football game between teams representing their respective schools and instructed them to assess the accuracy of the referee's penalty calls; students from each college reported that the referee had assessed more unwarranted penalties against *their* school's team than against their opponent's. The emotional stake the students had in experiencing solidarity with their institutions and fellow students unconsciously *motivated* them to see—or at least take note of and assign opposing forms of significance to—different things when they watched the film (Hastorf & Cantril 1954).

Political psychologists have identified a like form of “identity-protective” cognition as responsible for political controversy over risks and other policy-consequential facts. Even among modestly partisan individuals, shared ideological or cultural commitments are likely to be intertwined with membership in communities of one sort or another that furnish those individuals with important forms of support—emotional and psychic as well as material. If a proposition about some risk or policy-relevant fact comes to be commonly associated with membership in such a group, the prospect that one might form a contrary

position can threaten one's standing within it. Individuals are thus unconsciously resist evidence that challenges factual propositions of that sort as a form of identity self-defense (Sherman & Cohen 2006; Cohen 2003; Binning, Sherman, Cohen, & Heitland 2010). Studies predicated on this species of motivated cognition have found evidence that it shapes individuals' engagement with diverse sorts of evidence—from scientific data to arguments to credibility assessments to brute sense impressions—across a wide expanse of policy debates (Kahan 2012b).<sup>1</sup>

*c. Neo-authoritarian personality theory.* The original “authoritarian personality” theory of Adorno (1950) and his collaborators identified right-wing ideologies with personality traits productive of intolerance and hostile to reasoned resolution of disputes. The validity of this work provoked intense debate. However, a substantial body of empirical study generated in the last decade has revived interest in, and compelled respectful scholarly engagement with, the hypothesis that right-wing ideology is a manifestation of settled dispositions akin to those featured in the original authoritarian personality work (Jost, Blaser, Kruglanski & Sulloway 2003).

This “neo-authoritarian personality” theory has also been advanced as an explanation for public conflict over risk and other policy-relevant facts. The neo-authoritarian personality position connects right-wing ideology, including “conservatives” of the sort familiar to contemporary American political life, not only with personality traits such as “fear of change” and in-group “dominance” over out-groups, but with also with cognitive dispositions such as dogmatism, aversion to complexity, and a craving for certainty or “closure” in argumentation. The cognitive style that comprises these dispositions, it is surmised, generates reflexive closed-mindedness toward empirical evidence hostile to the factual premises of policies that reflect conservative values or gratify right-wing personality traits (Mooney 2012; Kruglanski 2004; van Hiel, Pandelaere & Duriez 2004).

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<sup>1</sup> The contribution of identity-protective cognition to perceptions of societal risk, moreover, is only a particular instance of two more general and pervasive forms of motivated reasoning: the tendency of people to construe information in a manner that is self-flattering or self-serving (Dunning 2003, 1999); and their tendency to construe information—particularly about contingent, factual matters—in a manner that promotes their moral evaluations (Ditto, Pizarro & Tannenbaum 2009; Liu & Ditto 2012), particularly of behavior that deviates from social norms (Gutierrez & Giner-Sorolla 2007; Alicke 1992, 2000).

## 2.2. Three theoretical syntheses

The empirical foundation of heuristic-pervaded information processing, motivated cognition, and the personality-trait correlates of conservatism are well established. But the relationship between these dynamics and the manner in which they contribute to political conflict over policy-relevant facts are unsettled.

What follows are three competing theoretical syntheses: the “Public Irrationality Thesis”; the “Republican Brain Hypothesis”; and the “Expressive Rationality Thesis.” They are in the nature of analytical composites of related positions advanced by like-minded scholars, and are constructed for the purpose of focusing empirical inquiry.

*a. Public irrationality thesis (PIT).* PIT treats dual-process reasoning as foundational and uses motivated cognition to explain individual differences in risk perception. The predominance of heuristic or System 1 reasoning styles among members of the general public, on this view, accounts for the failure of democratic institutions to converge reliably on the best available evidence as reflected in scientific consensus on issues like climate change (Weber 2006). Dynamics of motivated cognition, however, help to explain the ideological character of the resulting public controversy over such evidence. Many of the emotional resonances that drive system 1 risk perceptions, it is posited, originate in (or are reinforced by) the sorts of affinity groups that share cultural or ideological commitments. Where the group-based resonances that attach to putative risk sources (guns, say, or nuclear power plants) vary, then, we can expect to see systematic differences in risk perceptions across members of ideologically or culturally uniform groups (Lilienfeld, Ammirati, Landfield 2009; Sunstein 2007).

*b. Republican Brain hypothesis (RBH).* RBH—so designated here in recognition of the synthesis constructed in Mooney (2012); see also Jost & Amado (2011)—treats the neo-authoritarian personality findings as foundational and links low-quality information processing and motivated cognition to them. Like PIT, RBH assumes motivated cognition is a heuristic-driven, System 1 form of reasoning. The mental dispositions that the neo-authoritarian personality research identifies with conservative ideology—dogmatism, need for closure, aversion to complexity, and the like—indicate a disposition to rely predo-

minantly on System 1. Accordingly, the impact of ideologically motivated cognition—even if not confined to conservatives—is disproportionately associated with that ideology by virtue of the negative correlation between conservatism and the reflective, analytical System 2 forms of reasoning that would otherwise check and counteract it (e.g., Jost, Blaser, Kruglanski & Sulloway 2003; Kruglanski 2004; Thórisdóttir & Jost 2011).

It is primarily this strong prediction of *asymmetry* in motivated reasoning that distinguishes RBH from PIT. PIT does predict that motivated reasoning will be correlated with the disposition to use System 1 as opposed to System 2 forms of information processing. But nothing intrinsic to PIT furnishes a reason to believe that these dispositions will vary systematically across persons of diverse ideology.

*c. Expressive rationality thesis (ERT).* ERT lays primary emphasis on identity-protective motivated reasoning, which it identifies as a form of information processing that *rationality* advances individual ends (Kahan, Peters, Wittlin, Slovic, Ouellette, Braman & Mandel 2012). The link it asserts between identity-protective cognition, so conceived, and dual-process reasoning creates strong points of divergence between ERT and both PIT and RBH.

One conception of “rationality” applies this designation to mental operations when and to the extent that they promote a person’s ends defined with reference to some appropriate normative standard. When individuals display identity-protective cognition, their processing of information will more reliably guide them to perceptions of fact congruent with their membership in ideologically or culturally defined affinity groups than to ones that reflect the best available scientific evidence. According to ERT, this form of information processing, when applied to the sorts of facts at issue in polarized policy disputes, will predictably make ordinary individuals better off. Any mistake an individual makes about the science on, say, the reality or causes of climate change will not affect the level of risk for her or for any other person or thing he cares about: whatever she does—as consumer, as voter, as participant in public discourse—will be too inconsequential to have an impact. But insofar as opposing positions on climate change have come to express membership in and loyalty to opposing self-defining groups, a person’s formation of a belief out of keeping with the one that predominates in hers could mark her as untrustworthy or stupid,



and thus compromise her relationships with others. It is therefore “rational” for individuals in that situation to assess information in a manner that aligns their beliefs with those that predominate in their group whether or not those beliefs are correct—an outcome that could nevertheless be very bad for society at large (Kahan 2012b).

It is important to recognize that nothing in this account of the individual rationality of identity-protective cognition implies that this process is *conscious*. Indeed, the idea that people will *consciously* manage what they believe about facts in order to promote some interest or goal extrinsic to the truth of their beliefs reflects a conceptually incoherent (and psychologically implausible) picture of what it means to “believe” something (Elster 1983). Rather the claim is simply that people should be expected to converge more readily on styles of information processing, including unconscious ones, that promote rather than frustrate their individual ends. At least in regard to the types of risks and policy-relevant facts typically at issue in democratic political debate, ordinary people’s *personal* ends will be better served when unconscious modes of cognition reliably focus their attention in a manner that enables them to form and maintain beliefs congruent with their identity-defining commitments. They are thus likely to display that form of reasoning at the individual level, whether or not it serves the collective interest for them to do so (Kahan et al. 2012).

Individuals disposed to resort to low-level, System 1 cognitive processing should not have too much difficulty fitting in. Conformity to peer influences, receptivity to “elite” cues, and sensitivity to intuitions calibrated by the same will ordinarily guide them reliably to stances that cohere with and express their group commitments.

But *if* individuals *are* adept at using high-level, System 2 modes of information processing, then they ought to be even *better* at fitting their beliefs to their group identities. Their capacity to make sense of more complex forms of evidence (including quantitative data) will supply them with a special resource that they can use to fight off counterarguments or to identify what stance to take on technical issues more remote from ones that that figure in the most familiar and accessible public discussions.

ERT thus *inverts* the relationship that PIT posits between motivated cognition and dual-process reasoning. Whereas PIT views ideological polarization as evidence of a deficit in System 2 reasoning capacities, ERT predicts that the reliable employment of higher-level information processing will *magnify* the polarizing effects of identity-protective cognition (Kahan et al. 2012).

Again, the argument is not that such individuals will be consciously managing the content of their beliefs. Rather it is that individuals who are disposed and equipped to make ready use of high-level, conscious information processing can be expected to do so in the service of their unconscious motivation to form and maintain beliefs that foster their connection to identity-defining groups.

ERT's understanding of the source of ideologically motivated reasoning also puts it into conflict with RBH. To begin, identity-protective cognition—the species of motivated reasoning that ERT understands to be at work in such conflicts—is not a distinctively political phenomenon. It is likely to be triggered by other important affinities, too—such as the institutional affiliations of college students or the team loyalties of sports fans. Unless there is something distinctive about “liberal” political groups that makes them less capable of underwriting community attachment than all other manner of group, it would seem odd for motivated reasoning to display the asymmetry that RBH predicts when identity-protective cognition operates in the domain of politics.

In addition, because RBH, like PIT, assumes motivated reasoning is a feature of low-level, System 1 information processing, ERT calls into question the theoretical basis for RBH's expectation of asymmetry. Like PIT, ERT in fact suggests *no* reason to believe that low-level, System 1 reasoning dispositions will be correlated with ideological or other values. But because ERT asserts that high-level, System 2 reasoning dispositions *magnify* identity-protective cognition, the correlations featured in the neo-authoritarian-personality research would, if anything, imply that *liberals*—by virtue of their disposition to use systematic reasoning—are all the more likely to succeed in resisting evidence that challenges the factual premises of their preferred policy positions. Again, however, because ERT is neutral on how System 1 and System 2 dispositions are in fact distributed across the population, it certainly does not entail such a prediction.

### **3. Study Design**

This section describes a study designed to test PIT, RBH and ERT. The study involved both an observational component, which measured the cognitive reasoning dispositions of subjects of diverse ideologies, and an experimental one, which assessed the interaction between cognitive-reasoning dispositions, subjects' ideologies, and their display of ideologically motivated reasoning.

#### **3.1. Sample**

The subjects for the study consisted of a nationally diverse sample of 1600 U.S. adults. The subjects were recruited to participate by Polimetrix/YouGov, which administered the study via that firm's online testing facilities. The sample was 54% female, and the average age of the subjects was 52 years. Seventy-six percent of the subjects were white, and 11% African-American. Twenty-eight percent of the sample self-identified as Republican, 36% as Democrat, and 30% as independent. Twenty-five percent identified themselves as either "Liberal" or "very Liberal": 37% as "Conservative" or "very Conservative"; and 29% as "Moderate." The mean education level was "some college"; the mean annual income was \$40,000 to \$49,000. The study was administered in July 2012.

#### **3.2. Observational study measures and hypotheses**

*a. Measures.* Subjects furnished standard demographic data, including political affiliations and outlooks. Party self-identification ("dem\_repub") was measured with a seven-point Likert item ("Strong Democrat, Democrat, Independent Lean Democrat, Independent, Independent Lean Republican, Republican, Strong Republican"). Political ideology ("libcon") was measured with a five-point Likert item ("Very liberal"; "Liberal"; "Moderate"; "Conservative"; "Very Conservative"). Responses to these two items formed a reliable aggregate Likert scale ( $\alpha = 0.82$ ), which was labeled "Conserv\_Repub" and transformed into a z-score to facilitate interpretation.

Subjects also completed the Cognitive Reflection Test (CRT). CRT is a three-question test that measures the disposition to engage in the higher-level forms of reasoning associated with System 2 (Frederick 2005). Unlike most other common measures of reasoning-style dispositions (such as Need for

Cognition), CRT is performance-based measure of subjects' disposition to engage intellectual problems in a reflective and open-minded manner, and it has been shown to be superior to self-evaluation measures in predicting vulnerability to the various cognitive biases associated with low-level information processing (Toplak, West & Stanovich 2011; Hoppe & Kusterer 2011; Liberali, Reyna, Furlan & Pardo 2011).<sup>2</sup>

The mean CRT score for the study sample was 0.65 ( $SEM = 0.02$ ). This score is in line with those observed in diverse general population samples (e.g., Weller, Dieckmann, Tusler, Mertz, Burns & Peters 2012).

*b. Hypotheses.* As will be explained presently, results from the observational component of the study furnish maximum insight in conjunction with those of the experimental component. It is when the two are combined that the relative strength of the three theoretical syntheses—PIT, RBH, and ERT—are most instructively assessed.

Nevertheless, RBH suggests one fairly straightforward hypothesis relating to the observational study considered alone: that a “right-wing” (i.e., conservative and Republican) disposition should be associated with a lower CRT score. RBH is based on the neo-authoritarian personality scholarship, which finds that self-identifying as Republican and as “conservative” are associated with dogmatism, fear of complexity, need for cognition, need for closure, and like reasoning traits. Because these reasoning traits are opposed to reflection and open-mindedness, one would expect right-wing disposition to be negatively correlated with CRT. The absence of such a finding would be surprising and would complicate interpretation of the finding that conservatism is negatively associated with the personality-trait tests featured in the neo-authoritarian personality research.

Only a modest amount of work exists on the relationship between CRT and political ideology, but it is not inconsistent with this hypothesis. Two studies report finding CRT scores to be slightly lower in

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<sup>2</sup> *Numeracy*, a measure of quantitative and technical reasoning capacity (Peters, Västfjäl, Slovic, Mertz, Mazzocco & Diekert 2006), predicts these biases even more powerfully (Liberali et al. 2011). CRT is a subcomponent of the Numeracy scale, however, and is highly correlated with it (Weller, Dieckmann, Tusler, Mertz, Burns & Peters 2012).

self-identified conservatives than in self-identified liberals (Iyer, Koleva, Graham, Ditto & Haidt 2012; Pennycook, Seli, Koehler & Fugelsang 2012).

Nevertheless, these studies (like all studies, actually) cannot be viewed as definitive. In the first, subjects of all ideologies achieved remarkably high mean scores (Iyer et al. 2012, table 3)—ones higher than those recorded among students at elite universities such as Carnegie Mellon, Princeton, and Harvard (Frederick 2005, table 1). It is possible, then, that the sample (individuals who voluntarily accessed a web site for the purpose of obtaining getting evaluations of their their moral personalities) could have been skewed heavily toward highly reflective individuals, complicating inferences about the relationship between ideology and reflectiveness in the general population.

That study also reported that *libertarians* are more reflective than either liberals or conservatives. This is an important finding that complicates any straightforward interpretation of how reflectiveness and left-right ideology relate to one another.

In the second study (Pennycook et al. 2012, p. 5), liberals were significantly overrepresented and conservatives underrepresented relative to their numbers in the general population.<sup>3</sup> It is thus conceivable that the recruitment procedure involved an element likely to entice more reflective liberals or discourage participation by more reflective conservatives (such as the ones whose conscious decisions to participate in psychological studies is correlated with their ideology).

Finally, one study that did use a sample stratified to reflect the national population has found that strength of affiliation with *either* the Democrat or Republican party is *negatively* correlated with openness to new ideas (Gerber, Huber, Doherty & Dowling 2012). This result seems discordant with the suggestion that conservatism is uniquely associated with closed-mindedness.

In sum, the negative correlations between CRT and conservatism reported in Iyer et al. (2012) and Pennycock et al. (2012) are definitely plausible and consistent with the correlations between conser-

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<sup>3</sup> Pennycook et al. (2012, p. 5) report that 53% of the subjects in their sample self-identified as liberal and 25% identified as conservative. Stratified national surveys suggest that approximately 40% of the general population self-identifies as conservative and that only around 20% identify as liberal (Gallup 2012).

vativism and the personality measures featured in the neo-authoritarian personality scholarship. But it remains useful to explore the relationship between CRT and ideology in general population samples.

A finding that CRT scores correlate with ideology in the general population would have inconclusive significance for PIT and ERT. PIT does not suggest any basis to expect an ideological asymmetry in the dynamics that result in political conflict over policy-consequential facts, but does not necessarily rule it out. ERT, in contrast, does assert that such dynamics should be symmetric. However, it does not identify the source of ideological conflict over fact with the predominance of lower-level, System 1 forms of information processing.

### **3.3. Experimental study measures and hypotheses**

*a. Experimental manipulation and measure.* In the experimental component of the study, subjects' reported their own perceptions of the *validity* of the CRT upon completion of it. They did so by indicating (on a six-point Likert item) their level of agreement or disagreement with the statement "I think the word-problem test I just took [i.e., the CRT test] supplies good evidence of how reflective and open-minded someone is" (CRT\_valid).<sup>4</sup>

Subjects responded to this item after being assigned to one of three experimental conditions. In the "control" condition, subjects were advised simply that "psychologists believe the questions you have just answered measure how reflective and open-minded someone is." In the "skeptic-is-biased" condition, subjects were told in addition that "in one recent study, a researcher found that people who *accept evidence of climate change* tend to get more answers correct than those who *reject* evidence of climate change," a "finding [that] would imply that those who believe climate change is happening are more open-minded than those who are skeptical that climate change is happening." In contrast, in the "nonskeptic-is-biased" condition, subjects were advised that "in one recent study, a researcher found that *people who reject evidence of climate change* tend to get more answers correct than those who *accept* evidence

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<sup>4</sup> The wording of the instructions supplied in each experimental condition is reproduced in the Appendix.

of climate change,” a “finding [that] would imply that those who are skeptical climate change is happening are more open-minded than those who believe that climate change is happening.”

*b. Testing motivated reasoning generally (including the asymmetry of it across ideological groups).* Testing for vulnerability to motivated reasoning is not straightforward. Simply asking individuals whether they would change their mind if shown contrary evidence, e.g., is inconclusive, because motivated reasoning is unconscious and thus not reliably observed or checked through introspection (cf. West, Meserve & Stanovich 2012; Pronin, Yin & Ross 2002).

Nor is it satisfactory simply to measure reasoning dispositions or styles—whether by an objective performance test, such as CRT, or by a subjective self-evaluation one, like Need for Cognition. None of these tests has been validated as a predictor of motivated cognition. Indeed, early work in dual-process reasoning theory—research predating Kahneman’s “System 1”/“System 2” framework—supported the conclusion that motivated reasoning can bias higher-level or “systematic” information processing as well as lower-level, heuristic processing (Giner-Sorolla, Chaiken & Lutz 2002; Chen, Duckworth & Chaiken 1999; Giner-Sorolla & Chaiken 1997).

For these reasons, experimental study is more satisfactory. Nevertheless, proper experiment design can be complicated too.

One common design involves furnishing subjects who disagree on some issue (e.g., climate change or the death penalty) with balanced information and measuring whether they change their positions. The inference that they are engaged in motivated reasoning if they do not, however, is open to dispute. For one thing, the subjects might have previously encountered equivalent information outside the context of the experiment; being exposed to the same information again would not furnish them with reason to alter their positions no matter how open-mindedly they assessed it. Alternatively, subjects on both sides of the issue might have given open-minded consideration to the evidence—indeed, even given it exactly the same weight—but still failed to “change their minds” or to reach a shared conclusion because of how strongly opposed their prior beliefs were before the experiment (Bullock 2009).

Variants of this design that assess whether subjects of opposing ideologies change their positions when afforded with counter-attitudinal information on the same or across different issues are even more suspect. In those instances, it will not only be unclear whether subjects who stuck to their guns failed to afford the information open-minded consideration. It will also be unclear whether the counter-attitudinal information supplied respectively to the opposing sides was comparable in strength, thereby defeating any inference about the two groups' relative disposition to engage in motivated reasoning.

It is possible to avoid these difficulties with an experimental manipulation aimed at changing the motivational stake subjects have in crediting a single piece of evidence. In Bayesian terms, the researcher should be measuring neither subjects' priors nor their posteriors but instead their *likelihood ratios*—to determine whether subjects will opportunistically adjust the significance they assign to information (Kahan, Jenkins-Smith & Braman 2011; cf. Koehler 1993) in a manner that promotes some interest or goal collateral to making an accurate judgment. This is not to say that researchers should literally elicit “likelihood ratios” from subjects. Rather, as a conceptual matter, they should focus on that part of their subjects' information processing operation that is akin to the likelihood ratio to determine whether subjects are adjusting the weight they assign one and the same item of evidence conditional on its congeniality to their ideologies.

For example, subjects of diverse ideologies can be instructed to determine whether a demonstrator in a video—represented in one condition as an “anti-abortion protestor” and in another an “gay-rights protestor”—“blocked” or “screamed in the face” of a pedestrian trying to enter a building. If the perceptions of subjects vary in a manner that reflects the congeniality of the protestors' message to the subjects' ideologies, that would be convincing evidence of motivated reasoning (Kahan, Hoffman, Evans, Braman & Rachlinski 2012). If the film of the protestors' behavior is itself evidence relevant to some other issue—whether, say, the protestors broke a law against use of “coercion” or “intimidation”—then the impact of ideologically motivated reasoning of this sort will necessarily bias subjects' assessment of that issue in directions congenial to their ideologies (Kahan 2012c).



In such a design, moreover, it is the subjects' *ideologies* rather than their priors that are being used to predict their assessments of evidence conditional on the experimental manipulation. This element of the design bolsters the inference that the effect was generated by ideological motivation rather than a generic form of confirmation bias (Kahan 2012c; Kahan, Jenkins-Smith & Braman 2011).<sup>5</sup>

Such a design also enables straightforward testing of any hypothesized asymmetry in motivated reasoning among subjects of opposing ideologies. The corroboration of motivated reasoning in this design consists of the *interaction* between the experimental manipulation and subjects' ideology: the direction or magnitude of the weight assigned to the evidence must be found to be conditional on the experimental manipulation, which is hypothesized to determine the congruence or noncongruence of the evidence with subjects' ideologies. The additional hypothesis that this effect will be asymmetric—that it will, say, be *greater* among more conservative than liberal subjects, as RHB would assert—is equivalent to predicting that the size of the interaction will *vary* conditional on ideology. Such a hypothesis can be tested by examining whether a polynomial model—one that posits a “curved” rather than a “linear” effect—confirms that the magnitude of the interaction varies in the manner predicted and furnishes a better fit than a model that treats such an effect as uniform across ideology (Cohen, Cohen, West & Aiken 2003).

*c. Hypotheses.* The design of the experimental component of the study reflected this strategy for testing motivated reasoning. That is, subjects' assessed the validity of a single piece of evidence conditional on a manipulation of the congruency of such an assessment with their ideological predispositions.

Presumably, individuals who are ideologically motivated have a stake in believing that people who share their ideologies are more open-minded and reflective than those who do not. Here subjects were presented evidence relevant to that issue: the respective performance on an “open-mindedness test” of people who either *accepted* or *rejected* a position strongly associated with membership in the subjects' own ideological groups. The subjects were in fact supplied relatively sparse information about the validity

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<sup>5</sup> Of course, *if* subjects, in response to an experimental manipulation, *are* shown or are merely assumed to be assigning weight to one and the same piece of information conditional on its fit with their priors (Koehler 1993), that *is*, necessarily, a form of confirmation bias (Rabin & Schrag 1999).

of CRT: only the representation that psychologists view it as valid, plus the subjects' own experience in having just taken it. The prospect that they would engage in motivated reasoning, though, supplied a basis for them to treat that evidence as establishing the test's validity conditional on whether doing so would gratify or disappoint their stake in believing that members of their ideological group were more open-minded than members of an opposing one.

At a very concrete level, the experiment might be viewed as a model of how ordinary people process information about studies like those that are featured in the neo-authoritarian personality research. Such readers will have little to go on besides scholars' or commentators' representations that the tests of open-mindedness featured in such studies are valid. If such readers are inclined to credit such representations only when the studies' results gratify their interest in forming and maintaining the belief that people who share their own ideology are more open-minded, then their assessments of that research will itself be biased by ideologically motivated reasoning.

But abstracting from the particulars, the study design can be thought of as modeling how ideologically motivated reasoning might bias considerations of empirical evidence generally. On policy debates over matters as diverse as climate change, gun control, the death penalty, and fiscal policy, ordinary citizens are presented with evidence, often in the form of second-hand characterizations of the findings of "scientific studies." If their assessments of the validity of such evidence is conditional on its fit with their ideological predispositions, then citizens will not converge on the best available evidence on but rather will polarize on policy-relevant facts (Kahan, Jenkins-Smith & Braman 2011).

All three of the synthesis theories—RBH, PIT, and ERT—predict motivated reasoning in this study. They disagree, however, about the form that such reasoning will take.

RBH implies that the observed motivated reasoning should be asymmetric with respect to the subjects' ideologies. Reflecting their disposition to dogmatism and closed-mindedness, relatively right-wing subjects, RBH predicts, should be more inclined to see CRT as a valid test in the nonskeptic-is-biased condition than in the skeptic-is-biased condition. RBH depicts more liberal or left-wing individuals as relatively more open-minded and reflective and thus less subject to motivated cognition. Accordingly,

in the study, RBH should predict that relatively left-wing subjects' assessments of the validity of CRT should be comparable in both the skeptics-biased and non-skeptic-is-biased condition. This finding would be a particularly compelling affirmation of RBH, moreover, in conjunction with a finding in the observational component of the study that right-wing dispositions correlate with a lower CRT score.

PIT understands motivated reasoning to be an artifact of the disposition to use low-level, System 1 information processing. Unlike RBH, PIT does not (or does not necessarily) predict that motivated reasoning will be ideologically asymmetric. But PIT does predict that it will be higher among subjects who score relatively low in CRT than it will be in those who score relatively high.

ERT supports predictions strikingly different from those of either RBH or PIT. Not only does ERT fail to predict ideological asymmetry in motivated reasoning. It predicts that the tendency of both right-wing and left-wing subjects to credit the "validity" of CRT conditional on the ideological congeniality of doing so will *increase* with the CRT scores of subjects with those ideologies. *All* subjects, ERT posits, will have a rational stake in forming ideologically congenial assessments of the validity of the CRT. Nevertheless, their *success* in achieving this end will depend on their comprehension of the questions being posed and their appreciation of what differing answers signify about the open-mindedness of individuals who share their ideologies. Because subjects who are high in CRT assess information more methodically and reflectively, they are less likely to *misunderstand* the question, and thus less likely to avoid the unconscious pressure to fit their assessments of the evidence at hand to the conclusion that fits their expressive interests.

### **3.4. Statistical power**

Certain of the competing hypotheses associated with the three theories turned on whether or not an observational correlation or experimental effect would be observed. The strength of inferences drawn from "null" findings depends heavily on statistical power. The large size of the sample furnished adequate power to detect even small effect sizes (e.g.,  $r = .10$ ) with a probability well over .80 at  $p \leq .05$  (Cohen 1988). As a result, findings of nonsignificance could be equated with lack of effect with low risk of Type II error (Streiner 2003).

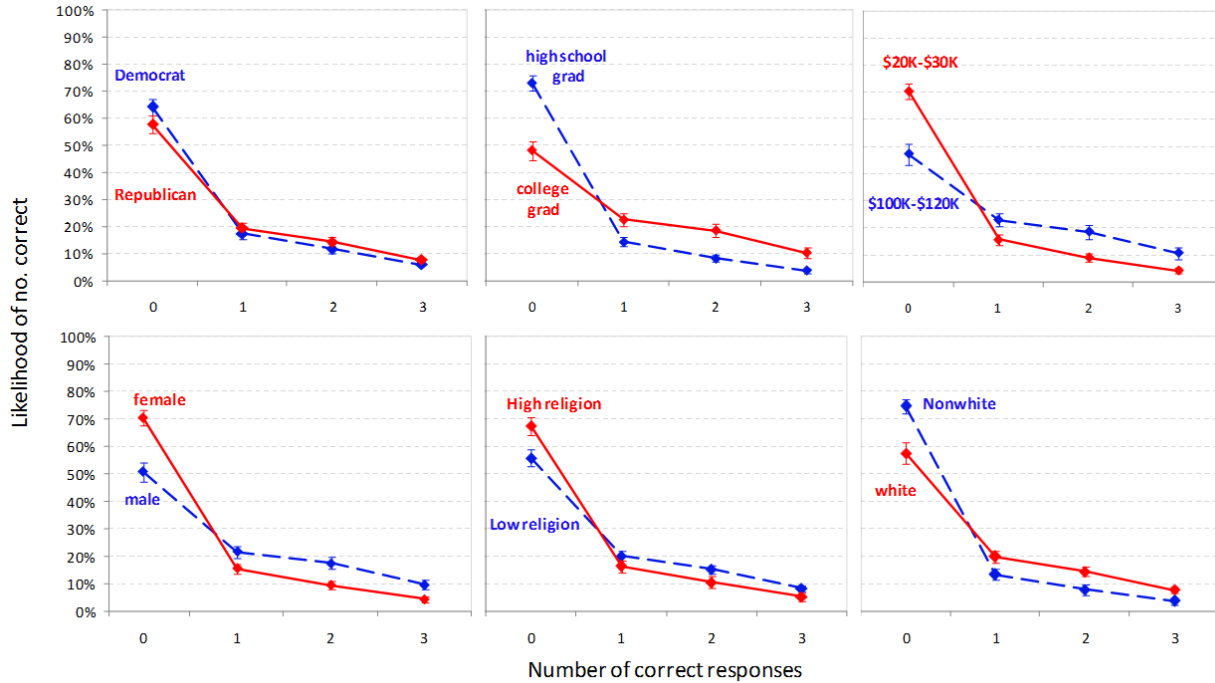
## 4. Results

### 4.1. Observational component

The relationship between CRT scores and ideology was assessed in several ways. The subjects' CRT scores were first correlated with their scores on Conserv\_Repub, the composite Likert scale formed by aggregating subjects' party self-identification and self-reported liberal-conservative ideology scores. There was no meaningful or statistically significant relationship ( $r_s = 0.03$ ,  $p = 0.21$ ).

Although the Conserv\_Repub scale is presumably a more reliable measure of the subjects' ideological dispositions than either of its components alone, the relationships between CRT and the components were also measured. The correlation with self-reported liberal-conservative ideology (libcon) was negative—indicating a decline in score as conservatism increases. The size of the effect, however, was only trivially different from zero and statistically nonsignificant ( $r_s = -0.02$ ,  $p = 0.45$ ). When the subjects who self-identified as “Moderates” were excluded, and the remainder split into groups who identified as either “Very liberal” or “Liberal,” on the one hand, or “Very conservative” or “Conservative,” on the other, there was a slightly larger but still statistically nonsignificant difference ( $\Delta M = 0.09$ ,  $t = 1.41$ ,  $p = 0.16$ ) in the mean scores of “liberals” ( $M = 0.75$ ,  $SEM = 0.05$ ) and “conservatives” ( $M = 0.67$ ,  $SEM = 0.04$ ).

The correlation with self-reported party affiliation ( $r_s = 0.08$ ,  $p < 0.01$ ) was positive and significant, indicating that CRT *increased* with the strength of subjects' identification with the Republican party (dem\_repub). When subjects who self-identified as either “Independents” or “Independents” who “Lean” either Democrat or Republican were removed, and the remainder split into ones who identified as either “Democrat” or “Republican,” the difference in the mean score of “Republicans” ( $M = 0.66$ ,  $SEM = 0.04$ ) and “Democrats” ( $M = 0.51$ ,  $SEM = 0.03$ ) was also statistically significant ( $\Delta M = 0.15$ ,  $t = 3.06$ ,  $p < 0.01$ ). Subjects who identified as “Independent,” including ones who “leaned” toward either party, had the highest mean CRT score ( $M = 0.85$ ,  $SEM = 0.04$ ) (and by a margin that was statistically significant in relation to each of the other two groups of subjects).



**Figure 1. CRT performance.** Derived (via Monte Carlo) simulation) from ordered logit regression in which indicated characteristic is the predictor and score on CRT the outcome variable. Y-axis indicates predicted likelihood of answering either 0, 1, 2 or 3 questions correctly. For “Democrat” and “Republican,” predictor values are set at 2 and 6, respectively, on the seven-point partisan self-identification scale; for “religion,” predictor is set at +1 SD for “high” and -1 SD for “low” on composite religiosity scale formed by aggregation of frequency of prayer, frequency of church attendance, and importance of religion ( $\alpha = 0.81$ ). CIs reflect 0.95 level of confidence.

To gauge the practical importance of the difference in the CRT scores of Republicans and Democrats, it is useful to compare it to the difference in scores of other groups known to vary in CRT performance. A set of ordered logistic regression models was constructed in order to facilitate the comparison and also to promote insight into the nature of the differences in the compared groups.<sup>6</sup> In the model based on self-identified party affiliation, the difference in performance was associated almost entirely with the likelihood of getting zero of three answers correct, which the model estimated to be 64% ( $\pm 3\%$ )<sup>7</sup> for a Democrat ( $dem\_repub = 2$ ) and 59% ( $\pm 3\%$ ) for a Republican ( $dem\_repub = 6$ ). This effect was considerably smaller and less uniform than ones associated with education and gender, and race. It was comparable in effect to the one observed with religion (Figure 1).

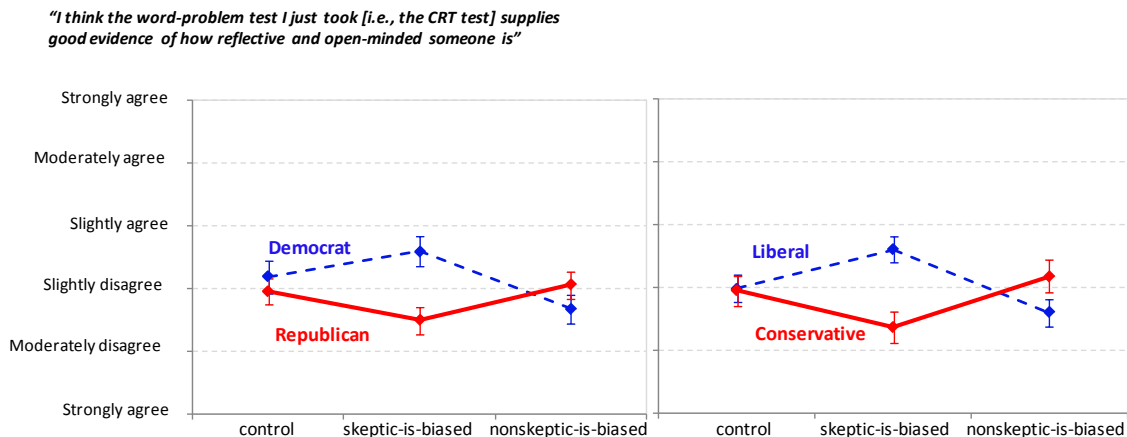
<sup>6</sup> Brant’s test indicated that the parallel line assumption was not violated.

<sup>7</sup> The margin of error for all regression-model point estimates reported in the text reflects a 0.95 level of confidence.

Based on the neo–authoritarian personality research, RHB predicted that CRT would be *negatively* correlated with right-wing ideology. This hypothesis was not confirmed.

## 4.2. Experimental component

*a. Ideologically motivated reasoning generally.* As hypothesized by all three theories, subjects displayed ideologically motivated reasoning in their assessments of the validity of the CRT. In the control condition, right-wing and left-wing subjects (identified by their scores relative to the mean on Conserv\_Repub), formed comparable judgments of the validity of the CRT as a measure of how “reflective and open-minded” people are. Those assigned to the “skeptical-is-biased” condition, in contrast, divided on ideological lines: right-wing subjects (those with higher than average scores on Conserv\_Repub) were *less* inclined to accept the CRT’s validity, and relatively left-wing ones *more* so, when told that climate-change skeptics generally score lower on the test. This effect was reversed in the “nonskeptical-is-biased” condition: told that climate skeptics generally score higher on the test, relatively right-wing subjects were now *more* inclined, and relatively left-wing ones *less*, to judge the CRT to be valid.



**Figure 2. Means on CRT\_valid.** Connected-line plot of means on six-point CRT\_valid ( $M = 2.96$ ,  $SD = 1.96$ ) item. “Democrat” includes subjects ( $n = 634$ ) who selected “Democrat” on a 3-point party self-identification measure; “Republican” includes those ( $n = 491$ ) who selected that designation. “Liberal” consists of those ( $n = 442$ ) who selected “Very liberal” or “Liberal” on the 5-point ideology measure (Libcon); “Conservative” those ( $n = 657$ ) who selected either “Very conservative” or “Conservative.” CIs reflect 0.95 level of confidence.

This effect, evident in the mean scores on CRT\_valid (Figure 2), was confirmed by multivariate regression (Table 1, model 1). The analysis showed that subject ideology, as measured by Conserv\_Repub, had a small and marginally significant effect ( $b = -0.13$ ,  $p = 0.10$ ) in the control condition.

There was no meaningful main effect associated with being assigned to either the skeptic-is-biased ( $b = -0.16, p = 0.15$ ) or the nonskeptic-is-biased condition ( $b = -0.09, p = 0.43$ ) relative to being assigned to the control condition. The significant *interaction* of Conserv\_Repub with each experimental-assignment predictor, however, confirmed that the inclination to view the CRT as valid *decreased* in the skeptic-is-biased condition ( $b = -0.55, p < 0.01$ ), and *increased* in the nonskeptic-is-biased condition ( $b = 0.41, p < 0.01$ ), as subjects' ideologies became more right-wing.

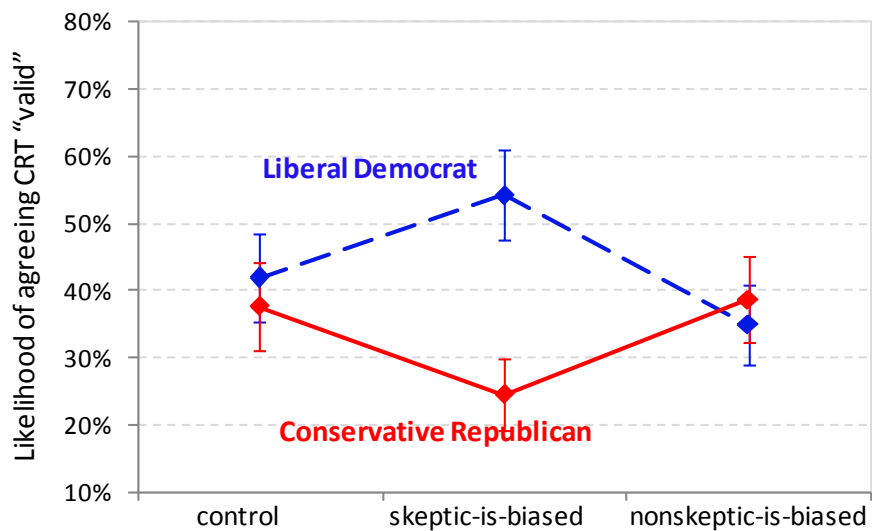
	Model 1	Model 2	Model 3
Conserv_Repub	-0.13 (-1.64)	0.08 (-1.51)	-0.13 (-1.59)
Skeptic-is-biased	-0.09 (-0.78)	0.16 (-1.02)	-0.08 (-0.76)
Nonskeptic-is-biased	-0.16 (-1.44)	<b>0.16</b> (-1.97)	-0.14 (-1.30)
Con_Rep_x_skeptic	<b>-0.55</b> (-4.83)	<b>0.11</b> (-4.91)	<b>-0.55</b> (-4.83)
Con_Rep_x_nonskeptic	<b>0.41</b> (3.72)	<b>0.11</b> (3.64)	<b>0.39</b> (3.48)
Con_Rep^2		0.09 (-1.33)	
Con_Rep^2_x_skeptic		0.13 (0.71)	
Con_Rep^2_x_nonskeptic		0.12 (1.38)	
zCRT			0.04 (0.59)
C_R_x_zcrt			-0.04 (-0.33)
zCRT_x_skeptic			-0.03 (-0.32)
zCRT_x_nonskeptic			-0.05 (-0.69)
Con_Rep_x_zCRT_x_skeptic			0.02 (0.16)
Con_Rep_x_zCRT_x_nonskeptic			<b>0.31</b> (2.94)
LR $\chi^2$	<b>90.77</b>	<b>93.03</b>	<b>103.78</b>
G-test (delta LR $\chi^2$ )		2.26 (model 1)	<b>13.01</b> (model 1)

**Table 1. Ordered logistic regression analysis of experimental component.**  $N = 1577$ . Outcome variable is CRT\_valid. Predictor estimates are ordered-logit coefficients with z-test statistic indicated parenthetically. **Bolded** typeface indicates predictor coefficient, model LR  $\chi^2$ , or G-statistic (incremental change in model  $\chi^2$ ) is significant at  $p < 0.05$ . Model with reference to which G-statistic is calculated is indicated parenthetically. Observations with missing values were omitted from analysis. “Skeptic-is-biased” and “Nonskeptic-is-biased” are dummy variables that reflect the experimental assignment. CRT score (“zCRT”) and Conserv\_Repub are both centered at 0 to promote ease of interpretation.

The practical impact of these effects can be graphically illustrated. The regression model used to measure the effect of the experimental manipulation predicts a 42% likelihood ( $\pm 7\%$ )<sup>8</sup> that a typical “liberal Democrat” (an individual who scores -1 on the Conserv\_Repub scale) will view the CRT as valid in

<sup>8</sup> As in the previous section, the margins of error reported for regression-model point estimates in this section reflects a 0.95 level of confidence.

the control condition. In the skeptic-is-biased condition, the likelihood a liberal Democrat will judge the CRT to be valid rises to 54% ( $\pm 7\%$ ),<sup>9</sup> and in the nonskeptic-is-biased condition it drops back down to 35% ( $\pm 6\%$ ). For a typical “conservative Republican” (+1 on the Conserv\_Repub scale), the likelihood of judging the CRT to be valid is 38% ( $\pm 6\%$ ) in the control condition, 25% ( $\pm 5\%$ ) in the skeptic-is-biased condition, and 39% ( $\pm 6\%$ ) in the nonskeptic-is-biased condition.



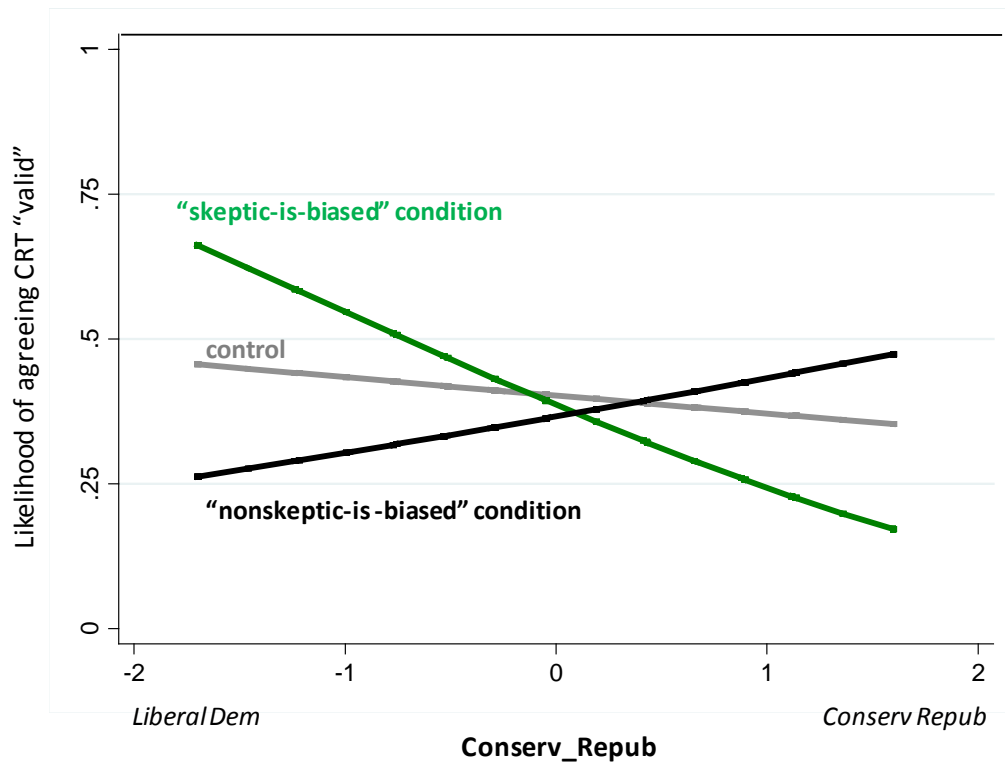
**Figure 3. Motivated reasoning effect for typical partisans.** Derived (by Monte Carlo simulation) from regression model reported in Table 1, model 1. Point estimates indicate predicted likelihood of agreeing either “slightly,” “moderately,” or “strongly” with CRT\_valid. The predictor values for “Liberal Democrat” and “Conservative” Republican are +1 and -1 respectively on Conserv\_Repub. CIs reflect 0.95 level of confidence.

It can be seen that individuals with these ideology scores polarize only in the skeptic-is-biased condition, and that both form comparable judgments of the CRT’s validity in the control and nonskeptic-is-biased conditions. This is not a misleading picture of the experimental effect, but it is an incomplete one. As shown in Figure 4, the interaction measured in the regression model does predict political polarization in the nonskeptic-is-biased condition relative to the control condition. This level of disagreement,

<sup>9</sup> The difference—12% ( $\pm 5\%$ )—is statistically significant. It is a surprisingly common mistake to believe that the difference in two means is significant only if their confidence intervals do not overlap (Schenker & Gentleman 2001; Cumming & Finch 2005). Don’t make it!



however, is confined to individuals more partisan than the ones whose predicted judgments are reported in Figure 3.



**Figure 4. Interaction of ideology and experimental assignment.** Locally weighted regression lines were fit to the data after computing the predicted values for sample observations based on regression model reported in Table 1, model 1. Y-axis reflects likelihood of agreeing either “slightly,” “moderately,” or “strongly” with CRT\_valid.

*b. Symmetry.* The regression analysis used to measure the effect of the experimental treatment modeled the impact of the experimental treatment as linear.<sup>10</sup> It thus necessarily assumed that the extent of the motivated reasoning displayed by the subjects was uniform across the left-right ideological spectrum measured by Conserv\_Repub.

The means reported in Figure 2 support this modeling choice, but a more precise analysis can be used to test whether the motivated-reasoning effect was genuinely symmetric with respect to subjects’ ideological dispositions or instead asymmetric, as predicted by RHB. A quadratic regression model, in

<sup>10</sup> This is *not* to say the model was an OLS linear regression; it was an ordered logistical one, reflecting the categorical nature of the dependent variable (CRT\_valid). The *parameter estimates* for the predictors in a logistic regression are modeled as linear—unless one exponentiates them to reflect curvilinear effects (Pampel 2000, pp. 19-20).

which terms were added to reflect a curvilinear impact for ideology and its interaction with the experimental treatment, was fit to the data (Table 1, model 2). The addition of these terms did not result in a significant improvement in fit relative to the model that treated the impact of all the predictors as linear. Thus, contrary to RHB, the experimental component results were more consistent with a finding of *symmetry* than one of *asymmetry* with respect to ideologically motivated reasoning.

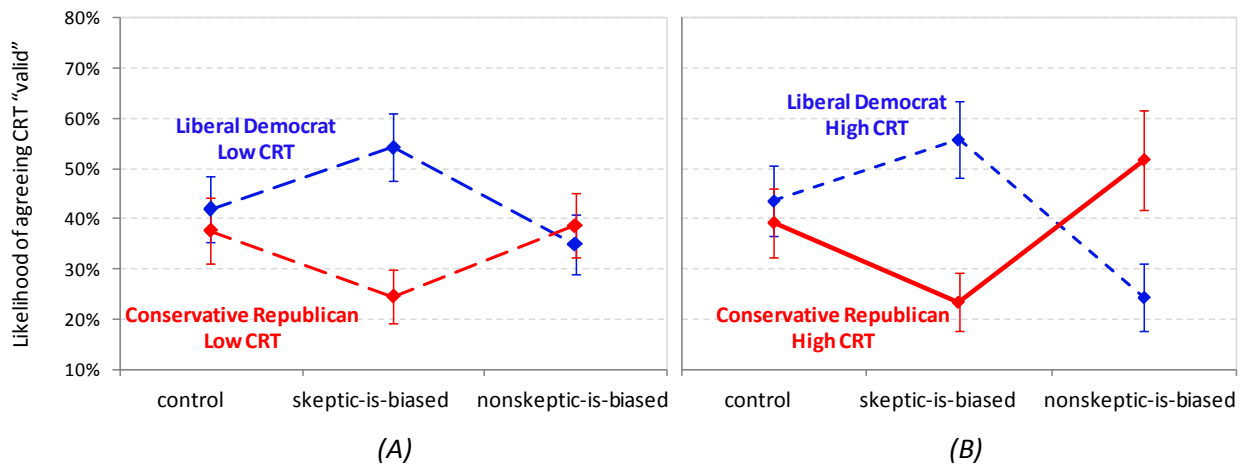
*c. Interaction with CRT.* The final experimental hypotheses concerned the relationship between CRT and motivated reasoning. Subjects' CRT scores along with appropriate interaction terms were thus added to the regression model.

The results are reported in Table 1, model 3. Overall model fit improved significantly. The coefficient for Conserv\_Repub\_x\_nonskeptic\_x\_CRT, the interaction term added to assess the relationship between CRT scores and assignment to the nonskeptic-is-biased condition, was positive and significant ( $b = 0.31, p < 0.01$ ). Thus, in the nonskeptic-is-biased condition, subjects of opposing ideologies polarized to a greater extent as their CRT scores increased. The coefficient for Conserv\_Repub\_x\_skeptic\_x\_CRT--the interaction term added to assess the relationship between CRT scores and assignment to the skeptic-is-biased condition--was only trivially different from zero and nonsignificant ( $b = 0.02, p = 0.88$ ). Thus, in the nonskeptic-is-biased condition, the degree of ideological polarization did not vary in relation to subjects' CRT scores.

The analysis also revealed that subjects CRT scores did not influence their assessments of the validity of the CRT test independently of their ideologies. The coefficient for CRT represents the impact of CRT scores on subjects' assessments of validity in the control condition, holding ideology constant: it is trivially different from zero and nonsignificant CRT ( $b = 0.04, p = 0.56$ ). The 2-way interaction terms included to measure the impact of CRT scores in the skeptic-is-biased and nonskeptic-is-biased condition relative to their impact in the control condition were also only trivially different from zero and nonsignificant.

Graphic illustration again enables practical assessment of this analysis. In Figure 5, the likelihood of viewing the CRT as valid is estimated both for a "Liberal Democrat" and a "Conservative Republican"

getting 0 answers correct (the score for 62% of the subjects) and for a “Liberal Democrat” and a “Conservative Republican” getting “1.6” answers correct, a score that is one standard deviation from the mean and that would place those individuals in between the 80<sup>th</sup> and 90<sup>th</sup> percentile for the sample. As can be seen, the impact of CRT on motivated reasoning is concentrated in the non-skeptic-is-biased condition: the difference in likelihood for high CRT partisans in that condition is 23 percentage points ( $\pm 8\%$ ) *greater* than the difference in likelihood for low CRT partisans, whose likelihoods of judging the CRT as “valid” do not meaningfully differ in that condition.



**Figure 5. Interaction between CRT and experimental treatment.** Derived (by Monte Carlo simulation) from regression model reported in Table 1, model 3. Point estimates indicate predicted likelihood of agreeing either “slightly,” “moderately,” or “strongly” with CRT\_valid. The predictor values for “Liberal Democrat” and “Conservative” Republican are +1 and -1 respectively on Conserv\_Repub. The predictor values for “low” and “high CRT” are 0 and “1.6,” respectively. CIs reflect 0.95 level of confidence.

This result is with consistent ERT and inconsistent with both PIT and RBH. Whereas the latter both see ideologically motivated reasoning as a consequence of lower-level information processing, ERT sees it as reasoning strategy rationally suited (in this context, at least) to an individual’s well-being. The effect of motivated reasoning should, on this account, be expected to increase in tandem with CRT by virtue of the contribution higher-level reasoning can make to the fitting of complex forms of information to a persons’ motivating predispositions. The interaction between CRT, ideology, and the experimental treatment can be seen as implying that the ideological significance of the information on the relative performance of climate skeptics and nonskeptics was likely to be understood equally well by low-scoring

and high-scoring subjects in the skeptic-is-biased condition, but more likely to be appreciated by high-scoring ones in the nonskeptic-is-biased condition.

## **5. Discussion**

### **5.1. Summary of results**

The motivation (consciously, at least) for this study was to assess three dynamics understood to be relevant to political contestation over risk and policy relevant facts: heuristic-driven reasoning, motivated cognition, and ideologically grounded personality traits. All of these dynamics have been empirically supported in previous studies; the goal of this study was to test competing theories about how the three *relate* to one another and what their interaction contributes to political polarization.

The study results were inconsistent with two of these theories. The “Public Irrationality Thesis”—PIT—asserts that public conflict over risk and other policy relevant facts is a consequence of the predominance of low-level, System 1 information processing, which interferes with the public’s understanding of complicated evidence and motivates it to assess evidence consistently with ideological predispositions. The experimental component of the study, however, demonstrated that in fact the disposition to engage high-level, System 2 cognitive processing—as measured by the CRT test—actually *magnifies* the impact of motivated reasoning in the assessment of empirical evidence.

The study results were also inconsistent with the “Republican Brain Hypothesis” or RBH. RBH attributes public conflict over policy-relevant facts to an affinity between conservative ideology and traits such as dogmatism and aversion to complexity, which fuel the motivated rejection of evidence incompatible with conservative policy aims.

The study findings pose three distinct challenges to RBH. First, the study found no meaningful correlation between right-wing ideology and CRT, an objective measure of open-mindedness and reflection that has been shown to be the best predictor of high-level information processing (Toplak, West & Stanovich 2011; Hoppe & Kusterer 2011; Liberali, Reyna, Furlan & Pardo 2011). Indeed, individuals who consciously resist identifying themselves with *either* major political party—“Independents”—scored

highest on the CRT test. This is consistent with the research finding that the personality trait of “openness,” which includes an appetite to engage new ideas, is *negatively* correlated with intensity of partisan identity (Gerber, Huber, Doherty & Dowling 2012). It is also consistent with the finding that self-described “libertarians,” who are more likely to identify with neither the Democratic nor Republican parties, score higher than either conservatives or liberals (Iyer et. Al 2012).

Second, and even more important, the finding that CRT *magnifies* ideologically motivated reasoning suggests that there is little basis for treating scores on any general measure of high-level information processing as an indicator of the disposition to engage in ideologically motivated reasoning. This finding supplies reason to doubt that any link between traits such as “closed mindedness” and “aversion to complexity” are related to motivated reasoning. Thus, if polarization over risk and other policy-relevant facts is indeed fueled by ideologically motivated cognition—as it widely understood to be—then the link between such conflict and the personality correlates of conservatism featured in the neo-authoritarian personality research would seem to be attenuated.

Finally, this study used an experimental design and a statistical testing strategy specifically fitted to testing whether the force of ideological motivated reasoning varies in intensity across the right-left political spectrum. It found that when assessing evidence of the other group’s propensity to consider evidence in an open-minded and reflective way, liberals and conservatives were *uniformly* vulnerable to ideologically motivated reasoning.

Only the third theory—the “Expressive Rationality Thesis” or ERT—was fully supported by the study. That theory alone predicted *both* that ideologically motivated reasoning would be symmetric *and* that it would be amplified by higher CRT. Those hypotheses reflect a theory that sees ideologically motivated reasoning not as a reasoning deficiency but as a reasoning strategy suited to the interest that individuals have in conveying their membership in and loyalty to affinity groups central to their personal wellbeing. Because individuals use this strategy to protect their stake in all manner of groups—including ones not connected to politics—there is no reason to expect it to be more pronounced among people who subscribe to any particular ideology. In addition, because this dynamic is *rational*—at the individual, if

not the collective, level—there is plenty of reason to expect it to be used with even greater determination and consistency by individuals disposed to engage in higher-level forms of information processing. The experimental results corroborate this expectation.

## **5.2. Implications for understanding ideologically motivated reasoning**

Many commentators assume that ideologically motivated cognition is an outgrowth of “System 1” reasoning (e.g., Westen, Blagov, Harenski, Kilts & Hamann 2006; Lilienfeld, Ammirati, Landfield 2009; Taber, Cann & Kucsova 2009; Sunstein 2006). This study supplies additional evidence for questioning that assumption.

In fact, grounds for doubting it are not new. The early work on dual-process theory by Chaiken and her collaborators suggested that motivated reasoning should not be assigned to lower-level, “heuristic” forms of reasoning. On the contrary, motivated reasoning, this work suggested, should be expected to recruit higher-level, systematic forms of cognition as well when employing them would advance an agent’s ends, including his or her goal in maintaining status within an identity-defining group (Chaiken & Maheswaran 1994; Giner-Sorolla & Chaikien 1997; Chen, Duckworth & Chaiken 1999; Giner-Sorolla, Chaiken & Lutz 2002).

Chaiken and her collaborator’s findings inform the “expressive rationality” hypothesis tested in this paper. That same hypothesis figured in a previous observational study, which found that cultural polarization over climate-change and nuclear-power risks are greatest among individuals who are higher in scientific literacy and in Numeracy, a technical reasoning measure of which CRT is a subcomponent (Kahan et al. 2012). The experimental results of the present study help corroborate the inference that the correlations reported in that earlier study are properly attributed to the power of motivated cognition to penetrate the forms of information processing associated with Kahneman’s System 2. Together, moreover, these two studies make it clear that the startling and exhilarating advances in decision theory that are synthesized in the “System 1”/“System 2” framework have are not at all at odds with the powerful insights into motivated cognition associated with an earlier version of dual-process theory.

## **5.2. Implications for neo–authoritarian personality research**

This study raises two general issues for the neo–authoritarian personality research that informs RHB. First, the finding that conservative ideology is *not* negatively correlated with CRT is contrary to what one might have expected based on that work. This finding should thus be viewed as supplying impetus to investigate the relationship between CRT—and the sorts of reasoning dispositions for which it is clearly a compelling and valid measure—and the measures of closed-mindedness featured in the neo–authoritarian personality research.

Second, this study raises doubts about the relevance of the neo–authoritarian personality work to political polarization over risk and related facts. The proposition that this form of conflict reflects the impact of ideologically motivated cognition is amply supported. The assumption that the personality traits featured in the neo–authoritarian personality research have any connection to ideologically motivated cognition is not.

## **5.3. Implications for counteracting ideologically motivated reasoning**

The goal of empirically investigating the sources of political conflict over risk and other policy-consequential facts is not merely to explain this phenomenon but also to aid in discovery of devices that might help to counteract it. The study described in this paper makes a contribution to that end as well.

It does this primarily by helping to inform hypotheses about how such dynamics might be combated. Many scholars have suggested “debiasing” strategies aimed at correcting the distorting effect of System 1 reasoning on public perceptions of risk (e.g., Lilienfeld, Ammirati, Landfield 2009). Because such distortions are real—and interfere with human wellbeing in myriad domains—such research is unquestionably worthwhile. Nevertheless, if, as the present study implies, ideologically motivated cognition is *not* a consequence of the pervasive use of System 1 reasoning, System 1 debiasing strategies should not be expected to help abate polarization over climate change, nuclear power, the HPV vaccine or like issues.

What is needed instead are interventions that remove the *expressive incentives* individuals face to form perceptions of risk and related facts on grounds unconnected to the truth of such beliefs. Extending the analysis of previous papers, this one has suggested that ideologically motivated reasoning is in fact *expressively rational* at the individual level, because it conveys individuals' membership in and loyalty to groups on whom they depend for various forms of support, emotional, material, and otherwise.

This account, however, presupposes that beliefs on risks and related facts bear *social meanings*—that they are, in fact, generally understood (tacitly, at least) to cohere with outlooks and other characteristics that identify the individuals who espouse them as reliably committed to one group *rather than* another (Lessig 1995). Not all risks and policy-relevant facts have this quality; indeed, relatively few do, and on the vast run of ones that do not (pasteurization removes infectious agents from milk; fluoridation of water fights tooth decay; privatization of the air-traffic control system would undermine air safety), we do not observe significant degrees of ideological or cultural polarization.

There is little reason to believe, moreover, that the meanings of highly contested facts are insusceptible of revision in a manner that would disconnect particular positions on them from membership in identity-defining groups (Nisbet & Mooney 2007). One can understand the historical shift in public opinion toward the risks posed by cigarettes (including third-party ones from passive smoke exposure or from the societal expenditures necessary to treat individuals with lung cancer) as having been mediated by informational campaigns aimed at altering the positive meanings that dismissing evidence of the health hazards of smoking expressed in certain subcommunities (Kahan 2007; Gusfield 1993).

The ERT account of ideological polarization, then, underscores the value of forming and testing hypotheses about how to regulate the social meaning of risks and related policy-relevant facts. Indeed, research focusing on forecasting techniques for identifying technologies vulnerable to polarizing meanings, on governmental processes for protecting the “science communication environment” from influences that cause such meanings to take hold, and on framing and other strategies for cleaning up that environment once it has been contaminated with polarizing meanings, is already well underway (Corner,



Whitmarsh & Xenias 2012; Druckman & Bolsen 2011; Ferrari 2009; Finucane 2002; Nisbet & Scheufele 2009).

The expressive rationality of ideologically motivated reasoning is intrinsic to a collective action problem (Lessig 1995). When societal risks become suffused with antagonistic social meanings, it is (often if not always, and with respect to many if not all issues) *individually rational* for ordinary members of the public to attend to information in a manner that reliably connects them to the positions that predominate in their identity-defining groups. Nevertheless, if ideologically diverse individuals all follow this strategy simultaneously, they will be *collectively worse off*, since under these conditions, democratic institutions are less likely to converge, or to converge as rapidly as they otherwise would, on policies that reflect the best available evidence on how to protect everyone from harm. But because what any ordinary individual believes about policy will not make a difference, the *collective irrationality* of ideologically motivated reasoning does not create any reliable incentive for any individual to process information in a different, and morally and politically superior, way (Kahan et al. 2012; Kahan 2012b).

Overcoming ideological polarization on risk and related facts demands collective action specifically geared at dissolving this “tragedy of the science communications commons.” The value of ERT, and of empirical research informed by it, comes from the insight that it yields on how that might be done.

## **6. Conclusion**

The occasions for the study described in this paper were two-fold. One—the more particular and immediate—is the need for greater understanding of the sources of ideological polarization surrounding policy-relevant facts, particularly ones that admit of scientific investigation. We know a great deal about the class of psychological mechanisms that are relevant to this phenomenon, but not as much as we need to about how those mechanisms interact. The study described in this paper was designed to furnish evidence that would enable a curious person to adjust her assessment of the relative likelihood of three theories of how heuristic-driven reasoning, motivated cognition, and the personality correlates of conservative ideology fit together to generate states of persistent controversy over societal risks.

The second impetus—more general, more enduring, and no less compelling—is the conversational logic of scholarly inquiry. As a device for bringing a set of scholarly accounts into greater contact with one another, the paper presented three theories of how dual-process reasoning, motivated cognition, and the personality correlates of conservative ideology cohere. For the sake of promoting greater engagement within and across these basic accounts, it presented evidence aimed at informing a determination of which of these three accounts comes closest to the truth. There was no expectation, however, that this one study would conclusively settle the scholarly disagreements that set these accounts apart.

Indeed, it would be a misunderstanding of how empirical testing works to think that *any* number of studies ever *conclusively* resolves *any* interesting claim. *Good* empirical studies simply furnish more evidence than one would have had without them. Any study that does that, moreover, *is* good—even though, of course, additional corroborating evidence would make the supported proposition even more worthy of confidence, and even though the production of *contrary evidence* remains fully possible. What’s more, *if* a good study, in addition to furnishing more reason to believe a proposition, *also* inspires other scholars to conceive of additional testing strategies that might ultimately show that same proposition to be *less* worthy of belief—that makes a good study even better (Popper 1959).

The study described in this paper was animated by surmises formed, and designs constructed, with the benefit of exactly that type of intellectual spur. The goal was not to “overturn” or vanquish the claims toward which this paper has expressed doubt but rather to reciprocate the contribution that those who advanced these claims have made to the process of conjecture and refutation that fuels scientific insight (Popper 1962).

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## Appendix. Experimental Stimulus

A. *RANDOMLY ASSIGN to condition 1 or 2 or 3.*

### 1. control condition

Psychologists believe the questions you have just answered measure how reflective and open-minded someone is.

### 2. Skeptic-is-biased condition

Psychologists believe the questions you have just answered measure how reflective and open-minded someone is.

In one recent study, a researcher found that people who accept evidence of climate change tend to get more answers correct than those who reject evidence of climate change. If the test is a valid way to measure open-mindedness, that finding would imply that those who believe climate change is happening are more open-minded than those who are skeptical that climate change is happening.

### 3. Nonskeptic-is-biased condition

Psychologists believe the questions you have just answered measure how reflective and open-minded someone is.

In one recent study, a researcher found that people who reject evidence of climate change tend to get more answers correct than those who accept evidence of climate change. If the test is a valid way to measure open-mindedness, that finding would imply that those who are skeptical that climate change is happening are more open-minded than those who believe climate change is happening.

B. CRT\_valid. How strongly do you agree or disagree with this statement? [strongly Disagree, moderately disagree, slightly disagree, slightly agree, moderately agree, strongly agree]

I think the word-problem test I just took supplies good evidence of how reflective and open-minded someone is.