



Resistance to Position Change, Motivated Reasoning, and Polarization

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Abstract

People seem more divided than ever before over social and political issues, entrenched in their existing beliefs and unwilling to change them. Empirical research on mechanisms driving this resistance to belief change has focused on a limited set of well-known, charged, contentious issues and has not accounted for deliberation over reasons and arguments in belief formation prior to experimental sessions. With a large, heterogeneous sample ($N = 3001$), we attempt to overcome these existing problems, and we investigate the causes and consequences of resistance to belief change for five diverse and less contentious socio-political issues. After participants chose initially to support or oppose a given socio-political position, they were provided with reasons favoring their chosen position (affirming reasons), reasons favoring the other, unchosen position (conflicting reasons), or all reasons for both positions (reasons for both sides). Our results indicate that participants are more likely to stick with their initial decisions than to change them no matter which reasons are considered, and that this resistance to belief change is likely due to a motivated, biased evaluation of the reasons to support their initial beliefs (prior-belief bias). More specifically, they rated affirming reasons more favorably than conflicting reasons—even after accounting for reported prior knowledge about the issue, the novelty of the reasons presented, and the reported strategy used to make the initial decision. In many cases, participants who did not change their positions tended to become more confident in the superiority of their positions after considering many reasons for both sides.

Keywords Reasoning · Political · Bias · Motivation · Polarization

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Introduction

Although many philosophers and psychologists have argued that it is normatively desirable to engage in even-handed, conscientious deliberation over reasons and arguments to form and revise beliefs (Dewey 1927; Mill 1859; Mullinix 2016), people seem decidedly entrenched in their social and political positions, unwilling to change them even in the face of compelling reasons and arguments for alternative positions (Lodge and Taber 2013; Strickland et al. 2011). Several distinct mechanisms have been posited to explain why people are so resistant to changing their beliefs about social and political issues (Lodge and Taber 2013; Taber and Lodge 2006). However, previous work focuses on a small set of well-known, contentious issues and does not account for deliberation prior to experimental sessions. These problems have impeded progress in understanding whether and to what extent these mechanisms are responsible for resistance to belief change. Here, we attempt to account for these problems, and we investigate the role of a fundamental mechanism—the prior-belief bias (i.e., judging reasons, arguments, and evidence favoring one’s beliefs as better than reasons, arguments, and evidence incongruent with one’s beliefs)—in accounting for why people might be resistant to changing their beliefs for a diverse set of social and political issues. In short, we find that, even for less contentious, charged, well-known issues, relatively few participants who deliberate over reasons change their minds. Our results suggest that this resistance to position change is likely due to a motivated, biased evaluation of the reasons to support their initial decisions (i.e., a prior-belief bias). This motivated, biased evaluation of reasons continues to explain resistance to belief change even after accounting for reported prior knowledge about the issues, the novelty of the reasons evaluated, and participants’ reported strategies in making their initial decisions. Ultimately, those who do not change their positions tend to become more confident in the superiority of their positions, even after examining a balanced set of reasons for both sides of an issue.

When people are deliberating about socio-political issues, two dissociable goals broadly motivate their reasoning (Chaiken and Trope 1999; Kunda 1990). On one hand, *accuracy goals* motivate people to seek out and evenhandedly consider relevant evidence to reach the correct or optimal conclusion (Baumeister and Newman 1994; Fiske and Taylor 1991). Pursuing accuracy goals tends to lead to strategies where people invest cognitive effort into carefully assessing the relevant information, setting aside beliefs that could bias their evaluation (Kruglanski and Freund 1983; Kunda 1990). On the other hand, *directional goals* motivate people to seek out and to evaluate evidence in order to support existing beliefs and perspectives (Kruglanski and Webster 1996; Kunda 1990). Because the aim of directional reasoning is the justification and validation of existing or desired beliefs, people operating with directional goals often dismiss or misinterpret relevant information that is incongruent with those existing or desired beliefs (Druckman and Bolsen 2011; Kunda 1990; Lodge and Taber 2013).

Are people more likely to pursue accuracy or directional goals when deliberating about socio-political issues? Some evidence suggests that people attempt to

be fair-minded when considering reasons and arguments; they at least try to preserve the “illusion of objectivity” (Pyszczynski and Greenberg 1987). Critically, people can be consistently and reliably persuaded to change their beliefs—even their beliefs about socio-political issues (Aldrich et al. 1989; Prior et al. 2014; Rabinowitz and MacDonald 1989; Wood and Porter 2018)—by strong, credible reasons and arguments (Petty et al. 1997). These findings suggest that people do pursue accuracy goals when deliberating about socio-political issues under certain circumstances.

Nevertheless, acquiring and maintaining socio-political beliefs also involves directional goals. For example, to defend their partisan identities, people seek out and favorably evaluate information that supports their party’s positions, while counter-arguing, denigrating, and rejecting information that conflicts with their party’s positions (i.e., partisan motivated reasoning; Bolsen et al. 2014; Cohen, 2003; Ditto et al. 2017; Mullinix 2016; Petersen et al. 2013). A Democrat operating under directional goals might seek out and readily accept evidence that supports a position favored by Democrats and opposed by Republicans; but if that same position had been favored by Republicans and opposed by Democrats, a Democrat might ignore, dismiss, and denigrate that same evidence. Encountering reasons and arguments contrary to their beliefs might even induce people with directional goals to become more strongly entrenched in their existing views (Berinsky 2017; Redlawsk 2002; Lewandowsky et al. 2012; Nyhan et al. 2014; Nyhan and Reifler 2015; although, see Wood and Porter 2018). In a particularly powerful study, Nyhan and Reifler (2010) found that when challenged with information debunking the presence of weapons of mass destruction in Iraq, participants rarely changed their beliefs and tended to become more certain about the veracity of their pre-existing views. Similarly, correcting false beliefs about the supposed link between vaccines and autism can make people *less* likely to intend to vaccinate their children (Nyhan et al. 2014; Nyhan and Reifler, 2015). Fully debunked political myths (e.g., that Barack Obama was born outside the United States) continue to be accepted as true in the face of clear, countervailing evidence (Flynn et al. 2017; Lewandowsky et al. 2012; although, see Wood and Porter 2018). In this way, attempts to change beliefs by presenting countervailing reasons and arguments has the potential to further entrench people in their existing beliefs.

Here, we investigate the likelihood that people change their positions about specific socio-political issues after considering many different reasons meant to strengthen or challenge their previously-endorsed positions, and we investigate whether a prior-belief bias underlies resistance to position change. Widely-cited empirical evidence for the prior-belief bias for socio-political issues comes from Taber and Lodge (2006; although see Lord et al. (1979) for a conceptual and methodological predecessor). In this research, college students were recruited to take part in a study focusing on two contentious, charged, well-known issues: affirmative action and gun control. Participants first reported their attitudes about these issues. They then considered several reasons affirming and conflicting with their attitudes, and then they reported their attitudes again. Participants evaluated arguments that were consistent with their prior attitudes as stronger and more compelling than arguments incongruent with their prior attitudes. Additionally, existing general political

knowledge and prior attitude strength moderated the degree to which individuals engaged in motivated reasoning such that participants who were more knowledgeable about and invested in a topic were more likely to engage in biased, directional reasoning. After evaluating arguments, participants' attitudes became even more extreme in the direction of their priors, indicating a polarization effect. Taber and Lodge (2006) conclude that "people are often unable to escape the pull of their prior attitudes and beliefs, which guide the processing of new information in predictable and sometimes insidious ways" (p. 767).

A notable problem with extant investigations into the prior-belief bias is that they have utilized a small number of issues that tend to be particularly well-known, contentious, emotionally-charged, and morally-laden (e.g., the death penalty or gun control). On these particular issues, individuals are likely to already hold strong beliefs, and they may feel particularly comfortable clinging to polarized positions given well-known partisan divisions (Druckman 2012). So, the social and political issues that have been used to investigate the prior-belief bias seem especially prone to stimulate directional biases. While people might be more likely to pursue directional goals in evaluating arguments for these few issues, it is plausible that they pursue accuracy goals for most other issues, especially when they have had minimal prior exposure to them.

A related problem with existing investigations into the prior-belief bias is accounting for participants' experiences before the experimental session. Experiments investigating a possible prior-belief bias for social and political issues (e.g., Taber and Lodge 2006; Taber et al. 2009) have utilized issues, reasons, and arguments that frequently appear in literature, radio talk shows, news media, social media, blogs, etc. Participants generally reported being knowledgeable about the issues, and their responses in these experiments were likely influenced by prior exposure to reasons and arguments. For example, periods of rational deliberation over certain reasons and arguments could have produced the belief that death penalty is a useful deterrent prior to the experimental session. If this occurred, then, after reporting their beliefs in the experimental session, participants might be exposed to many of the same reasons and arguments over which they had already deliberated. If participants do, in fact, rate the quality of those reasons favoring their own position about the death penalty as better than those favoring the other available position, experimenters would mistakenly characterize this pattern of responses as a biased, motivated evaluation of new reasons that bolster support for previously-made choices in a post hoc fashion. But these reasons and arguments would not be new to participants, and the actual behavior would be far from irrational. Given that those participants more knowledgeable about politics are more likely to succumb to the prior-belief bias, according to Taber and Lodge (2006), it is likely that such participants were equipped with the requisite knowledge to reason to an informed position about gun control or affirmative action on some occasion before the experimental session. This confound might be especially pronounced in experiments that have recruited participants disproportionately likely to possess existing knowledge about these issues (e.g., college students in political science courses, as is the case in Taber and Lodge (2006) and in a follow-up study conducted by Taber et al. (2009)). Because of this prior contamination problem, it is unclear whether and to what

extent people do engage in biased, motivated reasoning to support their pre-existing beliefs about socio-political issues when exposed to new, relevant information.¹

In our study, we recruited a large, heterogeneous sample ($N = 3001$) to investigate causes (prior-belief bias) and consequences (polarization effect) of resistance to position change using diverse socio-political issues—domestic fracking, animal testing for scientific purposes, drone strikes on military targets overseas, the gold standard, and standardized testing in schools—all while attempting to account for these problems inherent in prior studies. Although these socio-political issues are topically relevant, they are not constantly in the news and many citizens may have unsettled opinions about them. As such, these issues may be less likely to stimulate directional biases.

As such, we investigate three specific inter-related questions. First, how likely are people to change their positions about socio-political issues after evaluating different sets of reasons? After choosing initially to support or oppose a presented position, participants evaluate reasons favoring their chosen positions (affirming reasons), reasons favoring the other, unchosen positions (conflicting reasons), or all reasons for both possible positions (reasons for both sides). After evaluating reasons, participants are given the opportunity to change their positions. Because the socio-political issues under investigation are not as charged, contentious, or well-known as the issues employed in other investigations into the prior-belief bias, we expect participants to be more likely to respond to reasons. Those who evaluate conflicting reasons only should be significantly more likely to change their positions than those who evaluate reasons for both sides, and those who evaluate reasons for both sides should, in turn, be significantly more likely to change their positions than those who evaluate affirming reasons only. No matter which reasons are evaluated, however, we expect that a greater proportion of participants will stick with their initial positions than change their minds.

Second, for those who do not change their positions—regardless of the reasons evaluated—we investigate whether this resistance is explained by a biased evaluation of the available reasons in a way that serves to favor their initial judgments. To comprehensively account for the possible influence of reasoning and deliberation occurring before initially choosing a position, participants (1) reported their overall prior knowledge about the issue, (2) indicated which reasons they had considered before making their initial decisions in the experimental session, and (3) reported the strategy they used to make the initial decision. After accounting for the influence of episodes of reasoning and deliberation occurring before initially choosing a position, the magnitude of the prior-belief bias may be reduced or even eliminated. This would indicate that people are actually more likely to pursue accuracy goals for diverse social and political issues once confounds are removed. On the other hand, the pursuit of directional goals might extend to the consideration of these issues even after accounting for periods of reasoning and deliberation occurring before the initial decision is made to support or oppose the issue.

¹ Note that this is also a problem for many investigations into *partisan* motivated reasoning just as it is for investigations into *issue* motivated reasoning.

Finally, do those who stick with their initial positions after evaluating reasons become more confident in the superiority of their positions after considering reasons? If participants engage in a biased, motivated evaluation of reasons in favor of their initial chosen positions, they might become more entrenched in their positions even after evaluating a balanced set of reasons for both sides (i.e., a polarization effect). Numerous attempts to find polarization effects for social and political issues in controlled, experimental settings have failed (Kuhn and Lao 1996; Miller et al. 1993; Pomerantz et al. 1995). The common threads among the relatively few studies that have successfully identified polarization effects (e.g., Taber et al. 2009; Taber and Lodge 2006; Lord et al. 1979) are that they have used contentious, charged, and morally-laden socio-political issues (e.g., the death penalty, gun control, or affirmative action). The prior-belief bias plays a role in driving polarization effects for this small set of previously-examined issues, but it is unclear whether polarization effects generalize across a broader range of social and political issues. When the issues under consideration are less charged, contentious, and well-known, people may not become more confident in the superiority of their beliefs. Moreover, if participants do not engage in a biased, motivated evaluation of the reasons to favor their initial chosen positions, then it is unclear what would drive polarization effects. The many reasons and arguments provided on both sides of the issues might even induce uncertainty about which position is better, thereby reducing confidence that the chosen position is superior.

Materials and Methods

Participants

3030 individuals voluntarily participated in this study via Amazon's Mechanical Turk (AMT) for monetary compensation.² Informed consent was obtained from all individual participants included in the study. Although samples collected via AMT should not be considered representative of the United States population, they outperform in-lab convenience samples in ensuring adequate variation across socio-economic and political characteristics of interest (Berinsky et al. 2012; Mullinix et al. 2015). 29 participants failed to answer at least one question, so data were analyzed with the remaining 3001 individuals ($M_{\text{age}} = 36.67$, $SD = 11.45$, $\text{range}_{\text{age}} = [18-90]$, 1407 females, 1571 males).³

Materials and Procedure

Five different socio-political issues were used in this study: fracking, animal testing, drone strikes, the gold standard, and standardized testing (see Online Appendix

² Participant recruitment was restricted to individuals in the United States with a prior approval rating above 80% on AMT.

³ This study was approved by the Duke University Campus Institutional Review Board.

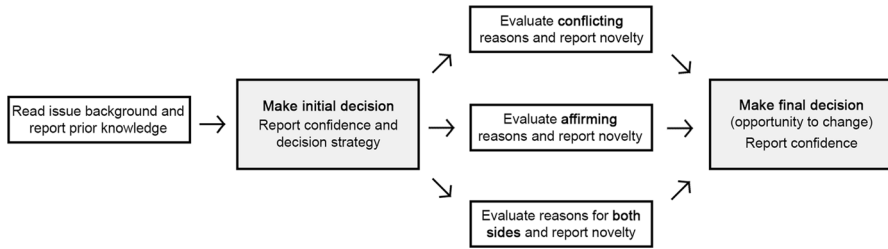


Fig. 1 Schematic of the experimental paradigm

A for exact materials presented). The set of reasons was obtained directly from political interest groups and popular websites (e.g., procon.org), closely following the strategy implemented by Taber and Lodge (2006). The procedure is depicted in Fig. 1, and it closely resembles the procedure used in Stanley et al. (2018) to investigate motivated reasoning about moral dilemmas. The entire study was self-paced. Participants were instructed to carefully read neutral, descriptive, background information about one of five randomly selected socio-political issues. For example, participants in the fracking condition read one short paragraph explaining that fracking is a process by which natural gas is extracted from the Earth. Immediately after reading this background information, participants were asked about their prior knowledge regarding the issue to which they were assigned. For example, participants answered the following question for fracking: “Prior to reading the descriptive information about fracking above, how much did you personally know about fracking?” (1 = *nothing at all*, 9 = *very much*). Participants were then instructed to make an initial choice to either support or oppose the stated position. For example, in the fracking condition, participants could choose between the following: (1) I support the position that fracking for natural gas should be permitted in the United States, or (2) I oppose the position that fracking for natural gas should be permitted in the United States. Then, they provided a judgment about their confidence in the superiority of their initial chosen position (1 = *not at all confident*; 9 = *very confident*). Participants were then instructed to indicate how they made their decision: (1) an immediate reaction or feeling after reading about the issue such that no reasons affected the decision, (2) at least one reason, or (3) some other strategy.

Participants were then randomly assigned to one of three between-subjects conditions: only affirming reasons were evaluated, only conflicting reasons were evaluated, or all reasons for both options were evaluated. For each socio-political issue, we used eight affirming reasons and eight conflicting reasons. The order in which the reasons were presented was randomized (although participants who evaluated reasons for both sides saw blocks of affirming and conflicting reasons, respectively). Participants were asked to rate how compelling each reason was for choosing that particular position on a scale from 1 (*worst possible reason*) to 9 (*best possible reason*). After providing a rating for the quality of given a reason, participants made a judgment (*yes* or *no*) on the same page about the novelty of the reason by answering the following question: “Had you considered the reason above before seeing it just

Table 1 Percentage of participants choosing to support or to oppose the presented positions are depicted before (Initial) and after (Final) evaluating reasons for each socio-political issue and condition (i.e., affirming reasons only, conflicting reasons only, or reasons for both sides)

Issue	Affirming reasons (%)		Conflicting reasons (%)		Reasons for both sides (%)	
	Initial	Final	Initial	Final	Initial	Final
Fracking (<i>n</i> = 590)						
Support	34.7	33.7	32.7	34.2	30.2	29.2
Oppose	65.3	66.3	67.3	65.8	69.8	70.8
Animal testing (<i>n</i> = 592)						
Support	71.2	69.7	63.8	59.6	62.6	64.3
Oppose	28.8	30.3	36.2	40.4	37.4	35.7
Drone strikes (<i>n</i> = 608)						
Support	74.4	74.4	72.4	72.9	74.3	72.8
Oppose	25.6	25.6	27.6	27.1	25.7	27.2
Gold standard (<i>n</i> = 607)						
Support	54.0	53.5	50.7	41.4	51.5	44.6
Oppose	46.0	46.5	49.3	58.6	48.5	55.4
Standardized testing (<i>n</i> = 604)						
Support	44.8	45.3	49.7	45.1	47.6	46.7
Oppose	55.2	54.7	50.3	54.9	52.4	53.3

now?” After providing ratings for reasons, participants were asked to choose again their preferred option (i.e., to support or oppose the presented position). At this stage, participants had the opportunity to change their minds. They then provided a judgment about how confident they were that this final selected position is the superior position (1 = *not at all confident*; 9 = *very confident*). Finally, participants were asked if they considered any additional reasons not presented in the study. If participants considered other reasons, they were instructed to describe those additional reasons. Upon completion, participants were monetarily compensated for their time.⁴

Results

Table 1 shows the percentage of participants indicating they would make each possible choice for each socio-political position as a function of the set of reasons presented and when the decision was made (i.e., the initial decision before seeing reasons or the final decision after seeing reasons). Descriptive statistics are provided for reported prior knowledge about each issue (Online Appendix B) and the number of novel reasons evaluated for each issue (Online Appendix C). Figure 2 depicts the percentages of participants who changed their positions for each socio-political

⁴ All data and materials are available at <https://osf.io/dxt8q/>.

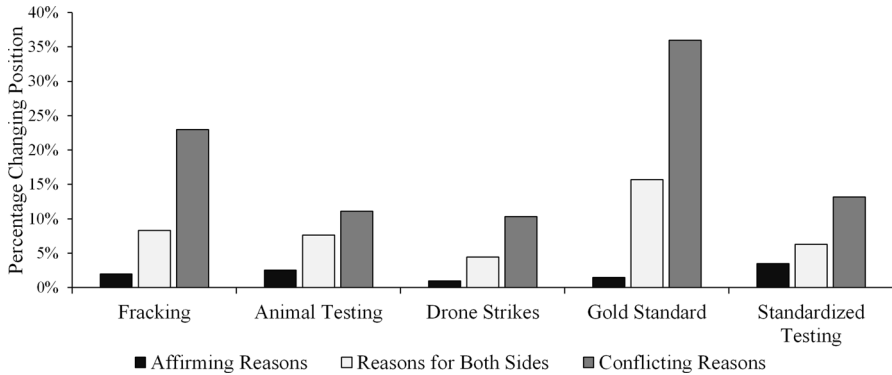


Fig. 2 Percentages of participants changing their decisions for each socio-political issue as a function of the particular reasons evaluated (i.e., affirming reasons only, conflicting reasons only, or reasons for both sides)

issue as a function of the reasons evaluated. Furthermore, because a small proportion of participants who evaluated reasons for both sides considered additional reasons above and beyond the reasons we presented (fewer than 10 % of participants on average across the five socio-political issues), this suggests that our set of reasons is relatively exhaustive.

The Effect of Reasons on Position Change

First, using two-sided Fisher's Exact Tests (FET) in conjunction with Goodman and Kruskal τ , we investigated whether and to what extent participants were more likely to change their initial positions after considering affirming reasons, conflicting reasons, or reasons for both sides. In other words, we sought to determine how likely participants were to change their minds after evaluating different sets of reasons. Evaluating each socio-political issue separately, there were statistically significant relationships between whether or not participants changed their decisions and the particular set of reasons evaluated for fracking (FET: $p < 0.001$; $\tau = 0.079$), animal testing (FET: $p = 0.002$; $\tau = 0.019$), drone strikes (FET: $p < 0.001$; $\tau = 0.030$), the gold standard (FET: $p < 0.001$; $\tau = 0.136$), and standardized testing (FET: $p = 0.001$; $\tau = 0.023$). Employing ransacking (Goodman 1969), we next compared the likelihood of position change between all possible pairs of conditions (i.e., (1) conflicting only relative to affirming only, (2) conflicting only relative to reasons for both sides, and (3) reasons for both sides relative to affirming only). Full results for each socio-political issue are presented in Table 2. For all five socio-political issues, participants who evaluated conflicting reasons only were significantly more likely to change their initial positions than participants who evaluated affirming reasons only. Moreover, for all socio-political issues except for animal testing, participants who evaluated conflicting reasons only were significantly more likely to change their initial decisions than participants who evaluated reasons for both sides. Finally, for all socio-political issues except for standardized testing, participants who evaluated

Table 2 Statistical differences in the likelihoods of position change between all possible pairs of conditions (i.e., (1) conflicting only relative to affirming only, (2) conflicting only relative to reasons for both sides, and (3) reasons for both sides relative to affirming only) are depicted

Conditions Compared	Fracking		Animal testing		Drone strikes		Gold standard		Standardized testing	
	FET	τ	FET	τ	FET	τ	FET	τ	FET	τ
Conflicting compared to Affirming	<0.001	0.102	0.001	0.029	<0.001	0.041	<0.001	0.194	<0.001	0.031
Conflicting compared to Both Sides	<0.001	0.040	>0.10	0.004	0.035	0.013	<0.001	0.054	0.027	0.014
Both Sides compared to Affirming	0.005	0.021	0.022	0.014	0.036	0.011	<0.001	0.064	>0.10	0.004

All results are reported prior to correction for multiple comparisons. FET columns provide *p*-values for Fisher’s Exact Tests (two-sided). τ columns provide estimates of Goodman and Kruskal’s tau for effect size

reasons for both sides were significantly more likely to change their initial positions than participants who evaluated affirming reasons only.

Overall, those who evaluated conflicting reasons only were generally more likely to change their positions than those who evaluated reasons for both sides, and those who evaluated reasons for both sides were, in turn, generally more likely to change their positions than those who evaluated affirming reasons only. However, these effects were consistently small in magnitude for all issues other than the gold standard (see Table 2; Fig. 2). For all five issues, no matter which set of reasons was evaluated, participants were more likely to stick with their initial decisions than to change them.

Biased, Motivated Evaluation of Arguments

Having found that participants are more likely to stick with their initial decisions than to change them for all five issues, we next investigated whether this resistance to position change is likely attributable to a biased, motivated evaluation of the provided reasons. That is, we offer a potential explanation for why so many participants were unwilling to change their minds in the face of reasons. To this end, for participants who considered all reasons for both sides, we first investigated whether, relative to participants who changed their minds, participants who did not change their minds were more likely to evaluate reasons favoring their initial decisions as better than those reasons favoring the other, unchosen position. A linear mixed-effects model was computed with issue included as a random effect (random intercepts only) and with the initial decision ('support' coded as 1 versus 'oppose' coded as 0) and whether participants changed their minds ('yes' coded as 1 versus 'no' coded as 0) included as binary fixed-factors. The outcome variable was computed by first averaging the rated quality of reasons for each possible position separately and then by taking the difference in average ratings for one option relative to the other option (average rating for reasons to choose 'support' *minus* average rating for reasons to choose 'oppose'). There was a significant effect of the initial decision ($b = 3.60$, $SE = 0.13$, $t = 28.28$, $p < 0.001$, 95 % CI [3.36, 3.86]), a significant effect of whether participants changed their minds ($b = 2.26$, $SE = 0.34$, $t = 6.63$, $p < 0.001$, 95 % CI [1.55, 2.94]), and a significant interaction effect ($b = -3.24$, $SE = 0.43$, $t = -7.49$, $p < 0.001$, 95 % CI [-4.12, -2.34]). The significant interaction effect suggests that, relative to participants who changed their minds, participants who did not change their minds exhibited a stronger propensity to evaluate reasons favoring their initial decisions as better than those reasons favoring the other, unchosen position.

To further interrogate this interaction effect, we computed two additional linear mixed-effects models. We first investigated whether those participants who did not change their positions evaluated reasons favoring their initial chosen positions as better than those reasons favoring the other, unchosen position. A linear mixed-effects model was computed with issue included as a random effect (random intercepts only) and with the initial decision ('support' coded as 1 versus 'oppose' coded as 0) included as a binary fixed-factor. As before, the outcome variable was the average rating for reasons to choose 'support' *minus* average rating for reasons to choose

Table 3 Results of separate *t*-tests indicate that participants rated reasons favoring their initially chosen positions as better than reasons favoring the other, unchosen positions for participants who evaluated reasons for both sides

Issue	<i>n</i>	<i>M_{diff}</i>	<i>SE_{diff}</i>	<i>t</i> -statistic	95 % CI
Fracking	176	3.34	0.38	8.76***	[2.59, 4.09]
Animal testing	181	3.45	0.24	14.70***	[2.99, 3.92]
Drone strikes	193	3.47	0.28	12.33***	[2.91, 4.02]
Gold standard	172	2.91	0.27	10.79***	[2.38, 3.44]
Standardized testing	193	4.58	0.26	17.74***	[4.07, 5.09]

***Indicates $p < 0.001$. All 95 % CIs are for the mean difference. The outcome variable in all statistical tests was the average rated quality of reasons to choose ‘support’ minus the average rated quality of reasons to choose ‘oppose’. Initial decisions to support were coded as 1, and initial decisions to oppose were coded as 0. Total $n = 915$

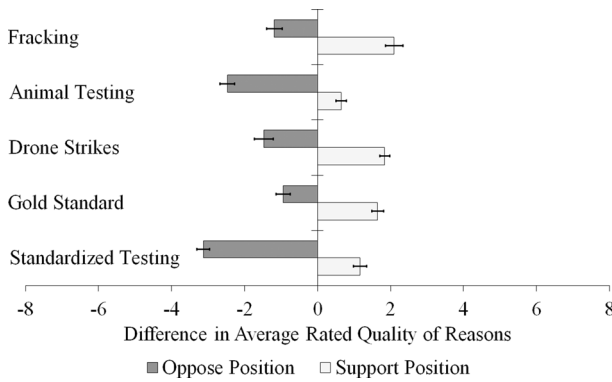


Fig. 3 Means and standard error bars represent the differences in the average rated quality of reasons between the two possible positions from which to choose (i.e., to support or to oppose) for those participants who evaluated reasons for both sides and who did not change their positions ($n = 915$). Difference scores were computed for each individual participant by subtracting the average rating of reasons for choosing ‘oppose’ from the average rating of reasons for choosing ‘support’

‘oppose’. Overall, participants rated those reasons favoring their initial chosen positions as better than those reasons favoring the other, unchosen positions ($n = 915$, $b = 3.58$, $SE = 0.13$, $t = 27.92$, $p < 0.001$, 95 % CI [3.33, 3.83]). Separate *t*-tests for each of the five issues revealed that participants rated reasons favoring their initial chosen positions as better than reasons favoring the other, unchosen positions (see Table 3; Fig. 3). In contrast, another linear mixed-effects model computed only for participants who changed their minds revealed no effect of the initial decision on the difference in the average rated quality of reasons ($n = 85$, $b = 0.40$, $SE = 0.40$, $t = 1.01$, $p = 0.314$, 95 % CI [-0.40, 1.23]). Thus, the effect of the initial decision on reason evaluation is exclusive to those participants who did not change their minds.

Next, for participants who evaluated affirming reasons only or opposing reasons only, we computed another linear mixed-effects model with issue included as a random effect (random intercepts only) and with condition (affirming reasons only

Table 4 Results of separate *t*-tests indicate that participants who evaluated only conflicting reasons rated those reasons less favorably than individuals who evaluated only affirming reasons for each of the five issues

Issue	<i>n</i>	<i>M</i> _{diff}	<i>SE</i> _{diff}	<i>t</i> -statistic	95 % CI
Fracking	349	2.11	0.13	16.44***	[1.86, 2.36]
Animal testing	369	1.34	0.12	11.40***	[1.11, 1.58]
Drone strikes	383	1.73	0.12	14.93***	[1.50, 1.96]
Gold standard	327	1.50	0.13	11.93***	[1.25, 1.75]
Standardized testing	365	2.20	0.13	16.34***	[1.93, 2.46]

***Indicates $p < 0.001$. All 95 % CIs are for the mean difference. The outcome variable in all statistical tests was the average rated quality of reasons evaluated. Those assigned to the affirming reasons only condition were coded as 1, and those who were assigned to the conflicting reasons only condition were coded as 0. Total $n = 1793$

coded as 1 versus conflicting reasons only coded as 0) and whether the participants changed their minds ('yes' coded as 1 versus 'no' coded as 0) included as binary fixed-factors. There was a significant effect of condition ($b = 1.78$, $SE = 0.05$, $t = 32.55$, $p < 0.001$, 95 % CI [1.67, 1.88]), a significant effect of whether participants changed their minds ($b = 1.27$, $SE = 0.09$, $t = 13.35$, $p < 0.001$, 95 % CI [1.07, 1.46]), and a significant interaction effect ($b = -2.79$, $SE = 0.27$, $t = -8.30$, $p < 0.001$, 95 % CI [-2.79, -1.70]). The significant interaction effect suggests that, for participants who did not change their minds relative to participants who did change their minds, participants who evaluated only conflicting reasons rated those reasons less favorably than participants who evaluated only affirming reasons.

To further interrogate this interaction effect, we computed two additional linear mixed-effects models. In both models, the issue was included as a random effect (random intercepts only), and condition (affirming reasons only coded as 1 versus conflicting reasons only coded as 0) was included as a binary fixed-factor. First, for participants who did not change their minds, those who evaluated only conflicting reasons rated those reasons less favorably than participants who evaluated only affirming reasons ($n = 1793$, $b = 1.78$, $SE = 0.06$, $t = 32.09$, $p < 0.001$, 95 % CI [1.68, 1.89]). Separate *t*-tests for each of the five issues revealed that participants who evaluated only conflicting reasons rated those reasons less favorably than individuals who evaluated only affirming reasons (see Table 4; Fig. D1). Second, for participants who did change their minds, there was no difference in the rated quality of the reasons between those assigned to the affirming reasons condition relative to those assigned to the conflicting reasons condition ($n = 208$, $b = -0.45$, $SE = 0.24$, $t = -1.85$, $p = 0.066$, 95 % CI [-0.91, 0.06]). Thus, the effect of condition (affirming reasons only versus opposing reasons only) on reason evaluation is exclusive to those participants who did not change their minds.

Prior Knowledge and Reason Novelty

Even though our selected issues are not as charged, contentious, or well-known as those utilized in previous investigations into the prior-belief bias, rational deliberation over many of the same reasons and arguments could still have causally

Table 5 The effect of the initial decision on the difference in average ratings of reason quality is depicted, after statistically controlling for reported prior knowledge and the number of novel reasons evaluated

Issue	<i>n</i>	<i>b</i>	<i>SE</i>	β	<i>t</i> -statistic	95 % CI
Fracking	176	2.51	0.41	0.42	6.15***	[1.70, 3.31]
Animal Testing	181	3.13	0.23	0.67	13.48***	[2.67, 3.59]
Drone Strikes	193	2.77	0.28	0.53	9.96***	[2.22, 3.32]
Gold Standard	172	2.70	0.30	0.59	8.93***	[2.10, 3.30]
Standardized Testing	193	3.99	0.28	0.69	14.49***	[3.44, 4.53]

***Indicates $p < 0.001$. All 95 % CIs are for unstandardized beta-values. The outcome variable in all statistical tests was the average rated quality of reasons to choose ‘support’ minus the average rated quality of reasons to choose ‘oppose’. Initial decisions to support were coded as 1, and initial decisions to oppose were coded as 0. Total $n = 915$

produced a belief in the superiority of one position over the other position prior to making the initial decision to support or oppose in the experimental session. To begin to account for this possibility, we first investigated the magnitude of the prior-belief bias after statistically controlling for reported prior knowledge and the number of novel reasons evaluated for participants who evaluated reasons for both sides. A linear mixed-effects model was computed with issue included as a random effect (random intercepts only), with the initial decision (‘support’ coded as 1 versus ‘oppose’ coded as 0) included as a binary fixed-factor, and with reported prior knowledge and the number of novel reasons evaluated included as covariates. As before, the outcome variable was computed by taking the average rating for reasons to choose ‘support’ minus average rating for reasons to choose ‘oppose’. Overall, participants rated reasons favoring their initial chosen positions as better than reasons favoring the other, unchosen positions, after statistically controlling for reported prior knowledge and reason novelty ($n = 915$, $b = 3.12$, $SE = 0.13$, $t = 23.35$, $p < 0.001$, 95 % CI [2.88, 3.42]). Separate regression models for each issue revealed that, after statistically controlling for reported prior knowledge and reason novelty, participants rated reasons favoring their initial chosen positions as better than reasons favoring the unchosen positions for all five issues (Table 5).

Another linear mixed-effects model was computed with issue included as a random effect (random intercepts only), with condition (affirming reasons only coded as 1 versus conflicting reasons only coded as 0) included as a binary fixed-factor, and with reported prior knowledge and the number of novel reasons evaluated included as covariates. Participants who evaluated conflicting reasons only rated those reasons less favorably than participants who evaluated affirming reasons only, after statistically controlling for reported prior knowledge and reason novelty ($n = 1793$, $b = 1.78$, $SE = 0.06$, $t = 31.99$, $p < 0.001$, 95 % CI [1.66, 1.88]). Separate regression models for each issue revealed that, after statistically controlling for reported prior knowledge and reason novelty, participants who evaluated only conflicting reasons

Table 6 The effect of condition (affirming reasons only versus opposing reasons only) on the average rated quality of the reasons is depicted, after statistically controlling for reported prior knowledge and the number of novel reasons evaluated

Issue	<i>n</i>	<i>b</i>	<i>SE</i>	β	<i>t</i> -statistic	95 % CI
Fracking	349	2.18	0.13	0.68	16.62***	[1.92, 2.44]
Animal Testing	369	1.33	0.12	0.51	11.40***	[1.10, 1.56]
Drone Strikes	383	1.72	0.12	0.61	14.90***	[1.49, 1.94]
Gold Standard	327	1.43	0.12	0.54	11.98***	[1.20, 1.67]
Standardized Testing	365	2.17	0.13	0.65	16.45***	[1.91, 2.43]

***Indicates $p < 0.001$. All 95 % CIs are for unstandardized beta-values. The outcome variable in all statistical tests was the average rated quality of reasons presented. Those assigned to the affirming reasons only condition were coded as 1, and those who were assigned to the conflicting reasons only condition were coded as 0. Total $n = 1793$

rated those reasons less favorably than individuals who evaluated only affirming reasons for all issues (Table 6).⁵

Reported Decision Strategies

To further address the possibility that unbiased deliberation over reasons causally produced the initial decisions to support or oppose the positions, we investigated whether people evaluate the reasons favoring their initial chosen positions as better than those favoring the other, unchosen positions, even when they report basing their initial decisions on no reasons whatsoever. If those participants who report that reasons did not influence their initial decisions do, in fact, judge reasons favoring their initial chosen positions as better than the reasons favoring the other, unchosen positions, then this would offer strong evidence for a bias in evaluating reasons.

To address this, we isolated the subset of participants who evaluated reasons for both sides and who reported making their initial decisions based on no reasons whatsoever ($n = 234$). With this subset of participants, a linear mixed-effects model was computed with issue included as a random effect (random intercepts only) and with the initial decision ('support' coded as 1 versus 'oppose' coded as 0) included as a binary fixed-factor. As before, the outcome variable was the average rating for reasons to choose 'support' minus average rating for reasons to choose 'oppose'. Overall, participants who reported basing their initial decisions on no reasons whatsoever still rated reasons favoring their initial chosen positions as better than reasons favoring the other, unchosen positions ($b = 2.83$, $SE = 0.28$, $t = 10.10$, $p < 0.001$, 95 % CI [2.34, 3.36]). Separate *t*-tests revealed that participants who reported basing their initial decisions on no reasons whatsoever still rated reasons favoring their initial chosen positions as better than reasons favoring the other, unchosen positions for each of the five issues (see Table 7; Fig. 4). Another linear mixed-effects model was

⁵ The same pattern of results was obtained when subject and reason were included as crossed random-effects in separate linear mixed-effects models for each issue.

Table 7 For participants who evaluated reasons for both sides and who reported basing their initial decisions on no reasons whatsoever, the results of separate t-tests are depicted indicating that participants rated reasons favoring their initial chosen positions as better than reasons favoring the unchosen positions for each of the five issues taken separately

Issue	<i>n</i>	<i>M_{diff}</i>	<i>SE_{diff}</i>	<i>t-statistic</i>	95 % CI
Fracking	35	1.74	0.84	2.07*	[0.01, 3.47]
Animal testing	33	3.78	0.50	7.54***	[2.76, 4.80]
Drone strikes	52	3.35	0.70	4.78***	[1.94, 4.76]
Gold standard	72	1.93	0.42	4.55***	[1.08, 2.78]
Standardized testing	42	4.63	0.59	7.89***	[3.44, 5.81]

*Indicates $p < 0.05$, **indicates $p < 0.01$, ***indicates $p < 0.001$. All 95 % CIs are for the mean difference. The outcome variable in all statistical tests was the average rated quality of reasons to choose ‘support’ minus the average rated quality of reasons to choose ‘oppose’. Total $n = 234$

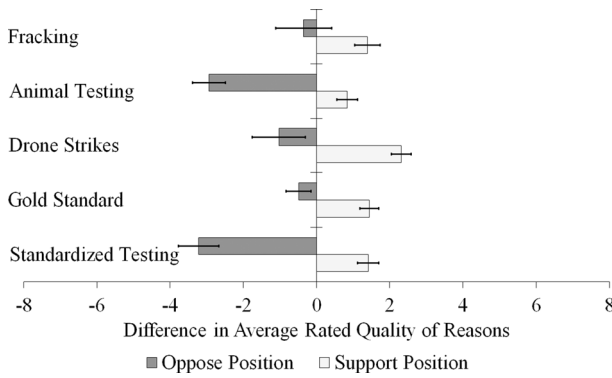


Fig. 4 Means and standard error bars represent the differences in the average rated quality of reasons between the two possible positions from which to choose (i.e., to support or to oppose) for those participants who evaluated reasons for both sides, who did not change their positions, and who reported basing their initial decisions on no reasons whatsoever ($n = 234$). Difference scores were computed for each individual participant by subtracting the average rating of reasons for choosing ‘oppose’ from the average rating of reasons for choosing ‘support’

Table 8 For participants who reported basing their initial decisions on no reasons whatsoever, the results of separate t-tests indicate that participants who evaluated only conflicting reasons rated those reasons less favorably than individuals who evaluated only affirming reasons for each of the five issues taken separately

Issue	<i>n</i>	<i>M_{diff}</i>	<i>SE_{diff}</i>	<i>t-statistic</i>	95 % CI
Fracking	75	1.55	0.30	5.23***	[0.96, 2.13]
Animal testing	78	1.15	0.26	4.50***	[0.64, 1.66]
Drone strikes	87	1.80	0.27	6.66***	[1.26, 2.34]
Gold standard	121	1.08	0.20	5.52***	[0.69, 1.47]
Standardized testing	75	2.00	0.32	6.17***	[1.35, 2.65]

***Indicates $p < 0.001$. All 95 % CIs are for the mean difference. The outcome variable in all statistical tests was the average rated quality of reasons evaluated. Total $n = 436$

Table 9 For participants who evaluated reasons for both sides, the results of separate t-tests for each issue indicate that participants were more confident in their final decisions than in their initial decisions for all issues except animal testing

Issue	<i>n</i>	<i>M_{diff}</i>	<i>SE_{diff}</i>	<i>t</i> -statistic	95 % CI
Fracking	176	0.46	0.10	4.53***	[0.26, 0.65]
Animal testing	181	0.12	0.08	1.50	[-0.04, 0.27]
Drone strikes	193	0.19	0.08	2.34*	[0.03, 0.34]
Gold standard	172	0.62	0.10	6.04***	[0.42, 0.82]
Standardized testing	193	0.44	0.08	5.46***	[0.28 0.60]

*Indicates $p < 0.05$, **indicates $p < 0.01$, ***indicates $p < 0.001$. All 95 % CIs are for the mean difference. Total $n = 915$

Table 10 For participants who evaluated affirming reasons only, the results of separate t-tests indicate that participants were more confident in their final decisions than in their initial decisions for all five issues taken separately

Issue	<i>n</i>	<i>M_{diff}</i>	<i>SE_{diff}</i>	<i>t</i> -statistic	95 % CI
Fracking	198	0.93	0.10	9.75***	[0.75, 1.12]
Animal testing	193	0.43	0.08	5.60***	[0.28, 0.57]
Drone strikes	201	0.73	0.09	8.36***	[0.56, 0.90]
Gold standard	197	1.06	0.11	10.00***	[0.85, 1.26]
Standardized testing	194	0.51	0.08	6.50***	[0.36, 0.67]

***Indicates $p < 0.001$. All 95 % CIs are for the mean difference. Total $n = 983$

computed with issue included as a random effect (random intercepts only) and with condition (affirming reasons only coded as 1 versus conflicting reasons only coded as 0) included as a binary fixed-factor. For the subset of participants who reported basing their initial decisions on no reasons whatsoever, those who evaluated only conflicting reasons rated those reasons less favorably than participants who evaluated only affirming reasons ($n = 436$, $b = 1.49$, $SE = 0.12$, $t = 12.68$, $p < 0.001$, 95 % CI [1.26, 1.72]). Separate *t*-tests for each issue revealed that, for the subset of participants who reported basing their initial decisions on no reasons whatsoever, participants who evaluated only conflicting reasons rated those reasons less favorably than participants who evaluated only affirming reasons for each of the five issues (see Table 8; Fig. D2).

Polarization Effects

Having found strong evidence for a prior-belief bias for all five issues, we next investigated whether participants who do not change their positions become more confident in the superiority of their positions after evaluating reasons (i.e., a polarization effect). To this end, for participants who evaluated reasons for both sides, we first computed a linear mixed-effects model with issue as a random effect (random intercepts only), and with rating period (before versus after evaluating reasons) serving as a binary fixed-factor. Participants were *more* confident in their final decisions after evaluating reasons than they were before evaluating reasons ($b = 0.36$, $SE = 0.04$, $t = 9.03$, $p < 0.001$, 95 % CI [0.28, 0.44]). Separate *t*-tests revealed that, for all issues except animal testing, participants were significantly more confident in their final decisions than in their initial

Table 11 For participants who evaluated conflicting reasons only, the results of separate *t*-tests indicate that participants were less confident in their final decisions than in their initial decisions for fracking and animal testing only

Issue	<i>n</i>	<i>M_{diff}</i>	<i>SE_{diff}</i>	<i>t</i> -statistic	95 % CI
Fracking	151	−0.19	0.09	−2.16*	[−0.37, −0.02]
Animal testing	176	−0.32	0.08	−4.16***	[−0.46, −0.16]
Drone strikes	182	−0.10	0.08	−1.38	[−0.25, −0.05]
Gold standard	130	0.09	0.12	0.79	[−0.14, 0.82]
Standardized testing	171	−0.01	0.09	−0.07	[−0.18, 0.17]

*Indicates $p < 0.05$, **indicates $p < 0.01$, ***indicates $p < 0.001$. All 95 % CIs are for the mean difference. Total $n = 810$

decisions (Table 9; Fig. E1). For all issues except drone strikes, we also obtained this same pattern of effects after statistically controlling for reported prior knowledge and the number of novel reasons evaluated (Table E1).

For participants who evaluated affirming reasons only, we computed a linear mixed-effects model with issue as a random effect (random intercepts only), and with rating period (before versus after evaluating reasons) serving as a binary fixed-factor. Participants were *more* confident in their final decisions after evaluating reasons than they were before evaluating reasons ($b = 0.73$, $SE = 0.04$, $t = 18.04$, $p < 0.001$, 95 % CI [0.66, 0.81]). Separate *t*-tests revealed that, for all five issues, participants were significantly more confident in their final decisions than in their initial decisions (Table 10; Fig. E1). We also obtained this same pattern of effects after statistically controlling for reported prior knowledge the number of novel reasons evaluated (Table E2).

For participants who evaluated conflicting reasons only, we computed a linear mixed-effects model with issue as a random effect (random intercepts only), and with rating period (before versus after evaluating reasons) serving as a binary fixed-factor. Overall, participants were *less* confident in their final decisions after evaluating reasons than they were before evaluating reasons ($b = -0.11$, $SE = 0.04$, $t = -2.88$, $p = 0.004$, 95 % CI [−0.18, −0.04]). Separate *t*-tests revealed that, for fracking and animal testing only, participants were significantly less confident in their final decisions than in their initial decisions (Table 11; Fig. E1). There was not a significant change in confidence ratings for drone strikes, the gold standard, or standardized testing (all $p > 0.05$). However, after statistically controlling for reported prior knowledge and the number of novel reasons evaluated, there were no significant effects of rating period on confidence for any issue (Table E3).

Discussion

The purpose of this study was to investigate the likelihood that individuals change their positions about diverse social and political issues when presented with reasons for or against their existing views, and to examine potential causes and consequences of resistance to position change. In doing so, we account for two problems that have

impeded progress in understanding whether and to what extent the prior-belief bias drives resistance to belief change: (1) a limited, narrow focus on a small set of well-known, contentious issues and (2) a failure to account for deliberation over reasons and arguments in belief formation prior to experimental sessions. Our investigation yielded three main findings. First, participants were more likely to stick with their initial decisions for all five issues (fracking, animal testing, drone strikes, the gold standard, and standardized testing), regardless of which reasons they evaluated. Despite this general tendency to stick with their initial decisions, participants who evaluated conflicting reasons only were generally more likely to change their positions than those who evaluated reasons for both sides. And those who evaluated reasons for both sides were generally more likely to change their positions than those who evaluated only affirming reasons. Second, for participants who did not change their minds—regardless of which set of reasons was evaluated—this resistance to position change was likely due to a motivated, biased evaluation of the reasons to support their initial decisions. That is, reasons favoring their initial chosen positions were rated as better than the reasons favoring the other, unchosen positions—regardless of reported prior knowledge about the issue, the number of novel reasons presented, or the reported strategy used in making the initial decision. Third, participants who did not change their positions tended to become more confident in the superiority of their positions after evaluating affirming reasons or reasons for both sides (a polarization effect), but not when evaluating opposing reasons.

Recent survey results have suggested that Americans are more ideologically divided than ever about social, political, and economic issues (Pew Research Center 2016). Moreover, many people seem entrenched in their views and unwilling to change their minds in the face of strong, countervailing evidence (Flynn et al. 2017; Lewandowsky et al. 2012). Our results show that, after considering many reasons challenging their initial chosen positions for diverse socio-political issues, people are more likely to stick with their initial decisions than to change them. With that being said, there is a more nuanced point to make regarding the propensity for position change after considering reasons. Researchers have typically investigated the percentage of people overall who change their attitudes, beliefs, or opinions about socio-political issues after considering conflicting reasons only. However, it is informative to investigate the percentage of people who change their decisions after considering one set of reasons (e.g., conflicting reasons only) relative to those considering some other set of reasons (e.g., all reasons for both sides). In our study, although a relatively small percentage of participants changed their decisions no matter which reasons were evaluated, those who evaluated conflicting reasons only and reasons for both sides were more likely to change their decisions than those who evaluated affirming reasons only. And participants who evaluated conflicting reasons only were about twice as likely, on average, to change their minds than participants who evaluated reasons for both sides. When the propensity for position change is considered within this context, people do seem responsive to reasons.

Moreover, our results suggest that those participants who did not change their minds after considering reasons tended to engage in a motivated, biased evaluation of reasons to substantiate their initial decisions. Prior research has shown that—at least for highly contentious, emotionally-charged, and morally-laden

political issues—people evaluate reasons and arguments consistent with their existing beliefs as stronger than reasons and arguments incongruent with their existing beliefs (Taber et al. 2009; Taber and Lodge 2009). However, because these studies did not account for prior knowledge, prior deliberation over these issues, or how participants reported having arrived at their initial judgments, it has been difficult to draw clear conclusions about resistance to belief change being caused by motivated, directional reasoning about new information. Our study provides strong, generalizable evidence for a prior-belief bias for socio-political issues. Our results, moreover, suggest that even when some individual (1) reports knowing little or nothing about an issue, (2) has not previously considered many or any of the reasons and arguments we present, and (3) reports basing their initial decision on a feeling or intuition such that reasons played no role in arriving at the decision, it is likely that the individual will evaluate the reasons and arguments in a biased way to support the initially-chosen position.

One potential consequence of the prior-belief bias is an increase in confidence in the superiority of one's views. After considering reasons for both sides, participants who did not change their positions in our study became more confident in the superiority of their positions for four of the five socio-political issues. This finding is consistent with existing research identifying polarization effects after examining reasons for both sides of diverse issues, including: the death penalty (Lord et al. 1979), gun control (Taber and Lodge 2006), and university funding for unpopular groups (Taber et al. 2009). Extending these findings to less contentious, charged, well-known issues, we show that participants tend to become more confident in the superiority of their chosen positions even after accounting for reported prior knowledge and reason novelty. In contrast, for two of the five socio-political issues (the gold standard and drone strikes), participants who evaluated only conflicting reasons became *less* confident in their initial decisions, and these effects were rendered non-significant after statistically controlling for reported prior knowledge and reason novelty—although these effects were rendered non-significant after controlling for reported prior knowledge and reason novelty. There were no issues for which participants became more confident in their initial decisions after considering conflicting reasons only. Several investigations into the so-called “backfire” or “boomerang” effect have shown that existing beliefs are actually reinforced after exposure to countervailing reasons and arguments (Flynn et al. 2017; Lewandowsky et al. 2012). For instance, reasons and arguments meant to change existing beliefs about “death panels” under the Affordable Care Act, the presence of WMDs in Iraq, and the risks of vaccinations just strengthen those existing beliefs (Berinsky 2017; Nyhan and Reifler 2010; Nyhan et al. 2013). However, a recent large-scale investigation of the backfire effect for 52 diverse contemporary social, political, and economic policy issues found little evidence that people become more entrenched in their existing beliefs after considering countervailing reasons and arguments (Wood and Porter 2018). In line with Wood and Porter (2018), our results suggest that when people are presented with conflicting reasons only, they either become *less* confident in their existing beliefs, or there is no change in confidence.

Conclusions and Future Directions

Directional reasoning can lead to an uncompromising adherence to prior beliefs (Chong and Druckman 2010; Druckman 2012). Whether and to what extent individuals engage in biased, motivated reasoning to actively defend their existing views has important ramifications for the very possibility of a properly functioning democracy. A central goal of our future research will be to develop and test strategies for eliminating the prior-belief bias. One possible way to make people more willing to change their positions and even-handedly evaluate evidence is to ensure that they do not explicitly state their positions from the outset. By explicitly choosing an initial position, participants might be more likely to defensively evaluate reasons and arguments. And by changing their positions, they would be effectively admitting that they were wrong. If they do not have to potentially admit they were wrong, then they might be more open to even-handedly considering new reasons and arguments. By exploring strategies for eliminating the prior-belief bias as a driver of resistance to position change, it may be possible to bring about more sincere, fact-based, and open debate.

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Compliance with Ethical Standards

Conflict of Interest The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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