Mind over bias: How is cognitive control related to politically motivated reasoning?

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Abstract

People often favour information aligned with their ideological motives. Can our tendency for directional motivated reasoning be overcome with cognitive control? It remains contested whether cognitive control processes, such as cognitive reflection and inhibitory control, are linked to a greater tendency to engage in politically motivated reasoning, as proposed by the "motivated reflection" hypothesis, or can help people overcome it, as suggested by cognitive science research. In this pre-registered study (N = 504 UK participants rating n = 4963 news messages), we first provide evidence for motivated reasoning on multiple political and non-political topics. We then compare the relative evidence for these two competing hypotheses and find that for political topics, it is 20 times more likely that cognitive reflection is associated with less motivated reasoning – in contrast to the prediction from the influential "motivated reflection" hypothesis. Our results highlight the need for more nuanced theories of how different cognitive control processes interact with motivated reasoning.

Introduction

Rather than being truth seekers, people often evaluate the veracity of information in line with non-truth seeking motives, and their reasoning is directionally motivated towards desired or identity-protective conclusions (Kahan, 2016; Kunda, 1990). In today's political landscape, it is not just opinions that differ along ideological lines, but also beliefs about factual questions (Rekker & Harteveld, 2022; Van Bavel & Pereira, 2018). Politically motivated reasoning can lead people away from accurate judgements, resulting in polarised (Su, 2022) or misinformed beliefs (Ecker et al., 2022). One key question that remains unanswered is whether cognitive control processes, such as cognitive reflection and inhibitory control, can allow people to better resist politically motivated reasoning, or on the contrary, make them more likely to engage in it (e.g., Tappin et al., 2020b). Two alternative hypotheses have been put forward.

According to the “motivated reflection” hypothesis, people use cognitive control processes to construct reasonable justifications that lead them towards desired conclusions. In other words, they are better at coming up with rational arguments to justify their directional biases (Kahan, 2013; Kahan et al., 2017). A series of studies provide evidence for this in the political domain where people higher in cognitive sophistication appear more susceptible to motivated reasoning. In one seminal study (Kahan, 2013), participants who scored high on the Cognitive Reflection Test, a measure of the ability to suppress intuitive but incorrect answers in favour of more deliberate reasoning (Frederick, 2005), were also more prone to motivated reasoning when the information they received conflicted with their beliefs about climate change. A similar pattern for higher motivated reasoning on different political issues (e.g., effects of gun control, CO_2 emissions, immigration) was found for participants high in numerical ability (Kahan et al., 2017; Kahan & Peters, 2017; Nurse & Grant, 2020; Sumner et al., 2023).

However, recent studies have challenged this “motivated reflection” hypothesis. First, the relationship between cognitive control processes and motivated reasoning varies across topics (Strömbäck et al., 2024), and the aforementioned seminal finding has proven difficult to replicate (Bago et al., 2023; Persson et al., 2021; Stagnaro et al., 2023). Furthermore, when accounting for differences in the prior beliefs between opposing partisans, the “motivated reflection” effect is not well-evidenced (Tappin et al., 2021). In one study, those with higher cognitive reflection were even found to update their beliefs closer to the (rational) Bayesian ideal (Tappin et al., 2020a). After all, could it be that the effect is in the opposite direction, and cognitive control processes are associated with less motivated reasoning?

An alternative hypothesis from cognitive sciences that focuses on specific components of executive functioning, such as cognitive flexibility and inhibitory control (i.e., the ability to inhibit automatic responses; Diamond, 2013) suggests that cognitive control processes should be

associated with less ideological and dogmatic thinking (Zmigrod, 2021; Zmigrod et al., 2021). Neuroscientific evidence offers complementary support of the view that cognitive control processes can mitigate ideological biases (Németh et al., 2024; Zmigrod, 2021). Prefrontal brain regions implicated in cognitive control play a crucial role in regulating habitual, impulsive, and affective responses (Mevel et al., 2019; Németh et al., 2024). When judging political content, stronger engagement of these regions, resulting in the ability to override automatic responses, may make people less susceptible to the automatic influences of motivated reasoning (Zmigrod, 2022). Connecting these insights from cognitive psychology and neuroscience to recent developments in the literature on politically motivated reasoning offers a promising interdisciplinary framework to disambiguate the often conflicting findings.

We here test these two alternative hypotheses using a “Fake News Task” to assess motivated reasoning (Thaler, 2024b). Previous work examining the association between cognitive control processes and motivated reasoning has used tasks that are confounded with prior beliefs and provided mixed results (Stagnaro et al., 2023; Tappin et al., 2021). In contrast, the task we use is immune to this confounding (*see* Figure 1). Participants provide a median guess about a numerical quantity (e.g., the number of immigrants in the UK). They then receive a news message randomly telling them that the correct answer is higher or lower than what they had guessed, and rate how likely it is that this message is true. As both "higher" and "lower" news messages (and thus also True and Fake News) are equally likely in reference to the median, the “unbiased” Bayesian inference that messages are true is 50%, irrespective of whether they are in line with participants’ motives. Thus, systematic differences in the ratings for messages that are aligned vs. conflicting with participants (political) stances can be attributed to motivational influences. This design provides a much cleaner foundation and a more stringent test of the association between cognitive control processes and politically motivated reasoning, thereby helping to resolve the mixed findings in the existing literature (see Tappin et al., 2020b).

As a measure of cognitive control processes, we use both the Cognitive Reflection Test and the Go / No-Go task. These two tasks allow us to assess the inhibition of automatic responses at different levels. The Cognitive Reflection Test, commonly used in previous research, taps into cognitive control in complex reasoning. The Go / No-Go task, a neurocognitive inhibitory control task, can provide a more fine-grained understanding of which cognitive control processes are linked to motivated reasoning.

We use these measures to compare the relative evidence in favour of the following competing hypotheses:

H1a. Cognitive reflection is associated with more motivated reasoning

H1b. Cognitive reflection is associated with less motivated reasoning

H2a. Inhibitory control is associated with more motivated reasoning

H2b. Inhibitory control is associated with less motivated reasoning.

Methods

Participants

We recruited *N* = 504 participants from Prolific (https://www.prolific.com/). Participants were from the United Kingdom and stratified across three age groups (18-24, 25-31, and 32-38 yrs.) and political ideology (left/right-wing) to ensure a broad distribution of political opinion. The final sample comprised 42.7% women, with age M = 28.1 years (SD = 6.1, range: 18–51) and political ideology distributed as 52.6% left-leaning, 4.6% moderate, and 42.8% right-leaning. Detailed demographics are provided in the Supplementary Materials.

Procedure

Tasks were administered online using Gorilla Experiment Builder (https://www.gorilla.sc). After providing informed consent, participants completed demographic questionnaires, followed by the Cognitive Reflection Test, Go/No-Go Task, and Fake News Game. As pre-registered, we excluded two participants who failed an initial attention check. While not pre-registered, four additional participants had to be excluded due to technical issues causing missing or duplicate trials in the main tasks. In line with our pre-registered protocol, we thus recruited six new participants to maintain a sample size of *N* = 504. This sample size was determined by resource constraints. However, an a-priori power simulation indicated 80% power to detect medium effects (β = .30) on the logit scale to detect main effects of motivated reasoning (details in pre-registration). The study received ethical approval from the Research Ethics Committee of Royal Holloway, University of London (Reference ID: 342).

Measures

Cognitive Reflection Test

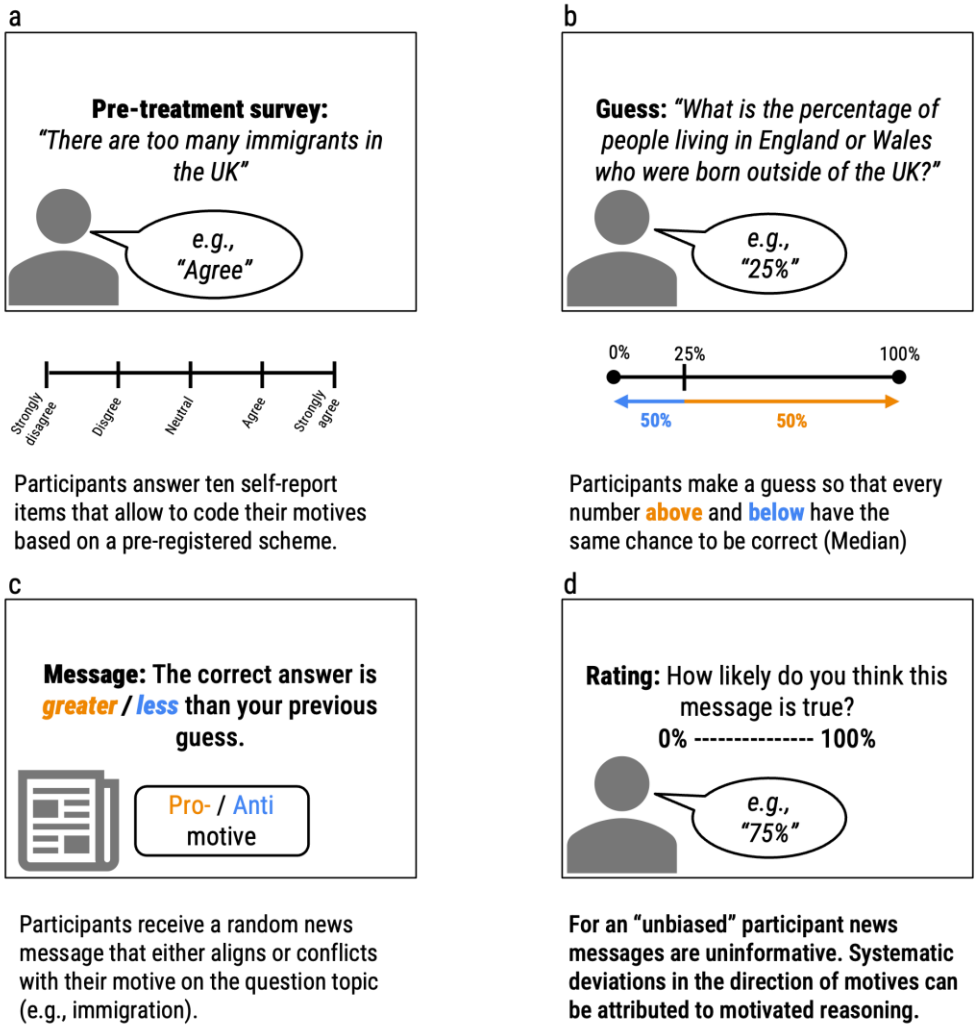
Participants completed a 3-item version of the Cognitive Reflection Test (Frederick, 2005), which measures the capacity to inhibit intuitive, but incorrect, in favour of deliberative correct answers. The predictive validity of the Cognitive Reflection Test appears robust to repeated testing (Bialek & Pennycook, 2018), and to have high test-retest reliability (Stagnaro et al., 2018). To further ensure our online sample was not overly familiar with the items, we used a less common set of problems (for items see OSF). We summed the number of correct answers to a score ranging from 0 to 3, with higher scores indicating higher cognitive reflection.

Go / No-Go Task

We used a fast-paced Go/No-Go task to measure inhibitory control (Wessel, 2018). Participants had to press the spacebar in response to frequent Go stimuli (letters “M” or “P”; 80% of trials) and withhold responses to infrequent No-Go stimuli (letters “W” or “R”; 20% of trials), resulting in an automatic tendency to respond that had to be inhibited during No-Go

trials. The task comprised two runs with different letter combinations, counterbalanced across participants, with practice trials before each run. Stimuli were presented briefly (250 ms) with a short response window (500 ms) and inter-trial interval (1000 ms; *see* Supplementary Materials). Our main measure of interest was the reverse-coded number of commission errors (false alarms during No-Go trials), with higher scores indicating greater inhibitory control.

Figure 1. Schematic display of the Fake News Game



Note. (a) Participants' motives on different topics are assessed through pretreatment self-report items (e.g., "There are too many immigrants in the UK"). Participants who agree with this item are classified as holding anti-immigration motives and assumed to be more likely to perceive messages indicating higher immigrant numbers as true, as this would allow them to protect their political identity or or advocate for their political party's goals (Kahan, 2016; Williams, 2023). (b) In the Fake News Game, for each topic, participants first provide their median guess to a numerical question, i.e., a guess for which they believe that it is equally likely that the correct answer falls above or below. (c) Participants then receive a news message randomly stating that the correct answer is greater or less than their guess. This random assignment serves as the primary experimental manipulation, as it determines whether a message aligns with (Pro), conflicts with (Anti), or is neutral regarding the participant's inferred motives.

(d) Finally, participants rate the likelihood of the message being true on a slider from 0-100%. For “unbiased” Bayesian observers the news messages provided no new information. Systematic deviations in ratings between “Pro” and “Anti”-motive messages can thus be attributed to motivated reasoning.

Fake News Game

We developed a gamified task (*see* Figure 1) based on a validated experimental paradigm to assess motivated reasoning (Thaler, 2024b). Participants played the role of "Fake News Detectives" and on each round of the game responded to a numerical question about a political or non-political topic. Participants then received a news message randomly stating that the correct answer is greater or less than their guess. Messages could come from either a True or Fake News source – both equally likely – and participants had to “detect the deception” and rate the likelihood of each message being true. Importantly, the news messages provided no new information for an “unbiased” Bayesian observer (*see* Figure 1). Motivated reasoning can thus be operationalised as differences in ratings between Pro-motive and Anti-motive messages. This aspect of the task design has been shown to be robust against potential participant misunderstandings of the concept of the median when providing guesses (Thaler, 2024b). Participants' motives were assessed through self-report items administered at the beginning of the study (see Supplementary Materials for questionnaires).

In total, participants played 11 rounds: a practice trial (excluded from analysis), six political trials (questions on climate change, immigration, reconviction of criminals, racial discrimination, gender stereotypes, and adoption by same-sex partners), two trials asking about their performance in the Go / No-Go Task and the current Fake News Game compared to 100 other participants, and two neutral trials (questions about grey matter proportion in the brain and tea with milk preferences). The order of trials was randomised, aside from the trial on the performance of the Fake News Game, which was always presented last, to ensure all participants rated the question based on the same amount of knowledge.

Statistical analyses

We fit separate Bayesian ordered beta regression models in R 4.4.1 (R Core Team, 2024) using the ordbetareg package (Version 0.7.2; Kubinec, 2023) for three vignette types (political, performance-related, neutral) and three parameter specifications: (1) the main effect of motivated reasoning (Pro-motive > Anti-motive), (2) its interaction with cognitive reflection, and (3) its interaction with inhibitory control. This modelling approach takes the upper and lower bounds of response variables into account, a particularly useful feature shown to be more efficient than common alternatives (e.g., linear probability model) for 0-100% slider ratings as used in this study (Kubinec, 2023). We used marginaleffects to compute posterior predictions and comparisons on the percentage scale (Arel-Bundock et al., 2024).

In all pre-registered models, motivated reasoning was operationalized as the difference between Pro- and Anti-motive message ratings using a dummy-coded predictor. Our primary inferential estimand of interest was the interaction of the assessed cognitive variables (cognitive reflection, inhibitory control) with motivated reasoning. We also modelled varying intercepts by participant and question topics, and varying slopes for motive by participant and topic.

In secondary analyses (reported in the Supplementary Materials), we investigated whether motivated reasoning increases with motive strength. We also provide insights from an alternative motive-coding scheme. Finally, we conducted post-hoc robustness checks, excluding participants with low accuracy (< 50%) on the Go/No-Go Task, failing a post-treatment attention check, or reporting being inattentive or dishonest. Results from this robustness analysis were highly similar to those reported in the main text.

Open practices

The study was pre-registered at https://osf.io/x6fkm. We openly provide all task materials, raw and cleaned data, and analysis scripts at https://osf.io/uztn7/.

Deviations from pre-registered protocol

The preregistered models for performance and neutral topics faced computational issues (e.g., divergent transitions, max treedepth limits) due to insufficient factor levels and data to estimate the variance components. To address this, we deviated from the preregistration by removing varying intercepts and slopes by question topic and instead modeled question topic as a scaled sum-coded binary fixed effect (-0.5, 0.5). This resolved the issues and improved model robustness.

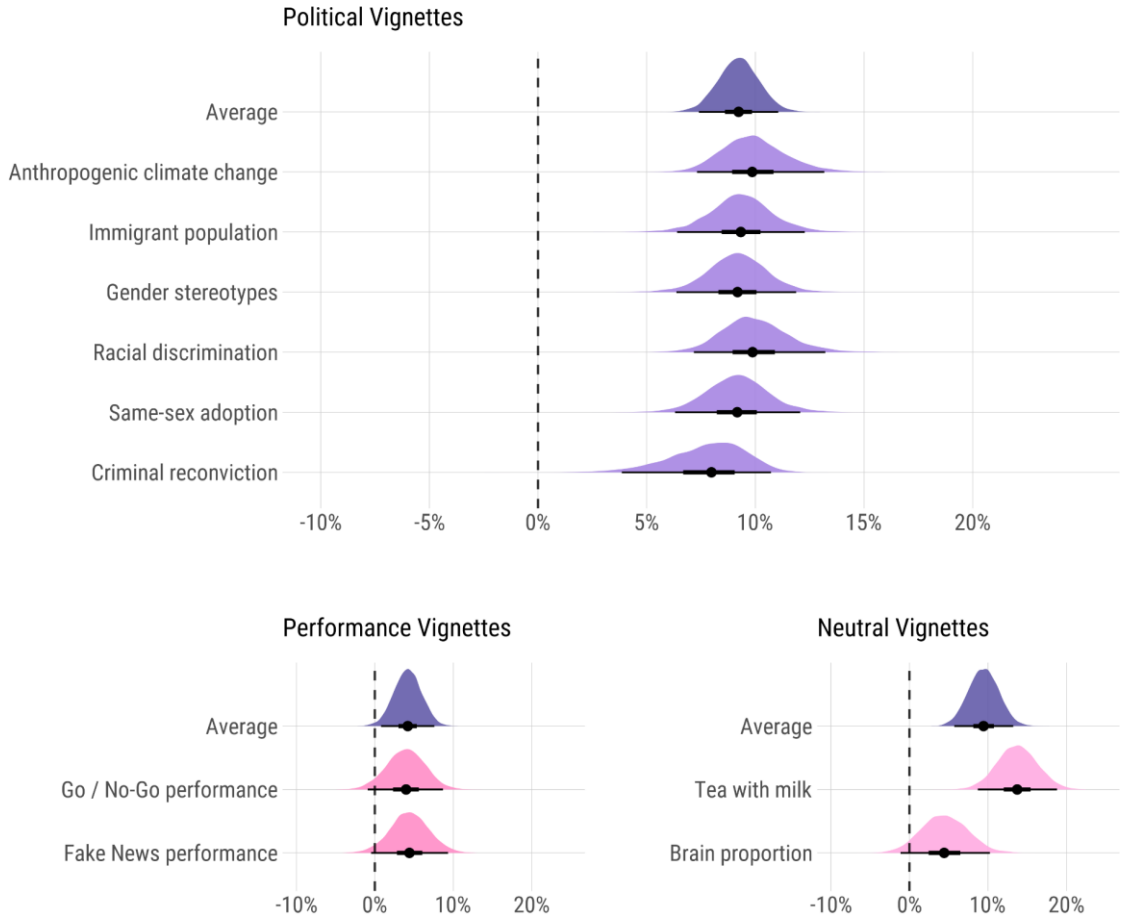
Results

In total, we analysed the ratings of *N* = 4963 news messages (Pro-motive: 41.0%, anti-motive: 40.2%, neutral: 18.8%), of which *n* = 3018 were for political vignettes, *n* = 1008 for performance vignettes, and *n* = 937 for neutral vignettes.

We start by presenting results for the basic motivated reasoning effect – to establish its presence – before moving onto examining whether and how it is associated with our cognitive performance variables.

Motivated reasoning on political, performance, and neutral vignettes

Figure 2. Motivated reasoning on different topics



Note. Visualisation of posterior predicted comparisons between ratings of Pro- and Anti-motive messages in percentage. For political topics, differences between topics are modelled with a variance term (motive | topic). For performance and neutral topics, we modelled a fixed effect interaction between motive and topic. Thick error bars indicate 50% CIs, thin bars 95% CIs, dots the median, and slabs the distribution of the posterior draws.

Models predicting message ratings based on motives converged well (R-hat < 1.01 for fixed effects, R-hat < 1.05 for random effects). On political topics, participants rated pro-motive messages as more true than anti-motive messages (see Table 1), with an average predicted effect of motivated reasoning of 9.2 percent (95% CI [7.4, 11.1]). This effect is consistent across political topics (*see* Figure 2) and increases monotonically with the strength of participants' motives (see Supplementary Materials).

For performance topics, the predicted average effect of motivated reasoning was 4.2 percent (95% CI [0.8, 7.6]). The effect was again consistent across the two items (*see* Figure 2). On neutral topics, the predicted average effect was 9.4 percent (95% CI [5.7, 13.2]). However, in this case there was a large difference between items: While the effect of motivated reasoning about the proportion of grey matter in the brain was small and not credibly different from 0, the effect was large on a vignette about the prevalence of the preference of tea with milk in the UK (*see* Figure 2). Overall, these results indicate strong evidence of directional motivated reasoning across topics, with particularly consistent effects on political vignettes.

Table 1. Parameter estimates from ordered beta regression models

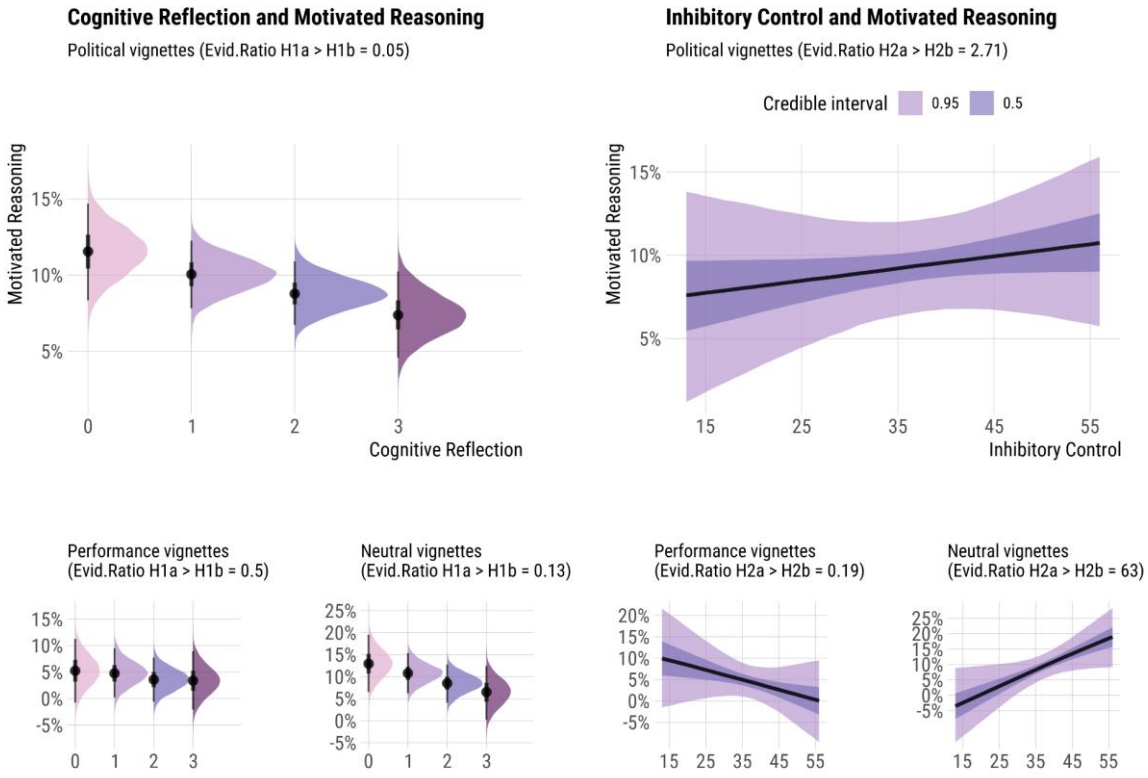
		95% CI		Evidence Ratio	
Parameter	Median	LL	UL	β > 0	β < 0
Political Vignettes					
Motive (Pro > Anti)	0.363	0.258	0.475	Inf	0.000
Motive x Cognitive Reflection	-0.063	-0.139	0.010	0.049	20.333
Motive x Inhibitory Control	0.024	-0.049	0.100	2.714	0.368
Performance Vignettes					
Motive (Pro > Anti)	0.169	0.025	0.312	90.954	0.011
Motive x Cognitive Reflection	-0.033	-0.180	0.116	0.499	2.005
Motive x Inhibitory Control	-0.075	-0.232	0.075	0.191	5.245
Neutral Vignettes					
Motive (Pro > Anti)	0.361	0.209	0.517	Inf	0.000
Motive x Cognitive Reflection	-0.097	-0.261	0.060	0.130	7.696
Motive x Inhibitory Control	0.173	0.012	0.329	63.000	0.016

Note. We fit separate ordered beta regression models, each corresponding to a combination of three vignette types (political, performance-related, and neutral) and three parameter specifications: (1) the main effect of motivated reasoning (Motive (Pro > Anti)), (2) its interaction with cognitive reflection, and (3) its interaction with inhibitory control. All estimates are reported on the logit scale. 95% CI are equal tail intervals. Evid.Ratio indicates the posterior probability of the direction of an effect compared to its alternative.

Cognitive Variables and Motivated Reasoning

Models investigating the interaction between cognitive variables and motivated reasoning converged well (R-hat < 1.01 for all fixed effects, R-hat < 1.05 for all random effects).

Figure 3. Cognitive Reflection, Inhibitory Control, and Motivated Reasoning



Note. Association of cognitive reflection (left) and inhibitory control (right) with motivated reasoning across different question types (political, performance, neutral).

On political vignettes, the interaction between motive and cognitive reflection was negative (*see* Table 1 and Figure 3). Participants with higher Cognitive Reflection Test scores engaged less in politically motivated reasoning, although based on the 95% CI, zero cannot be ruled out as a credible effect. As our main inferential measure, we then calculated the evidence ratio for the hypothesis that higher cognitive reflection is associated with less, compared to more motivated reasoning. The evidence ratio is the ratio of the posterior probabilities under each hypothesis, and thus different from Bayes Factors that compare posterior probabilities with the prior probability under the null hypothesis (Makowski et al., 2019). While providing limited information about the null, the evidence ratio is particularly useful for distinguishing between competing directional hypotheses and is equivalent to a directional Bayes Factor: values above 1 favour a negative association, and values between 0 and 1 favour a positive association. Here, the evidence ratio of 20.33 indicates considerable relative evidence in favour of a negative, rather than a positive ("motivated reflection") association.

To make this finding more intuitive, for participants high in cognitive reflection (i.e., three correct answers on the Cognitive Reflection Test) the predicted effect of motivated reasoning was on average 4.2 percent (95% CI [-0.6, 9.2]) smaller than for participants with a low Cognitive Reflection Test score of 0. Effects were smaller but directionally consistent for performance-related and neutral vignettes (see Table 1).

The interaction between motive and inhibitory control was positive, but negligible. Participants with higher inhibitory control, on average, engage in more motivated reasoning, but the posterior distribution of the coefficient was centred around 0, and the evidence ratio provided inconclusive evidence in favour of a positive vs. negative effect direction. For neutral vignettes, the model indicated that participants high in inhibitory control engaged in more motivated reasoning, and here a positive effect was more likely than a negative one. In turn, for performance vignettes, the effect was negative (see Table 1). It is thus unclear whether and to what extent inhibitory control is associated with motivated reasoning, and the effect may differ depending on the context of reasoning.

Discussion

We set out to understand whether cognitive control processes are linked to greater motivated reasoning, as some political psychology theories would suggest, or, on the contrary, to less motivated reasoning as cognitive science theories would suggest. Our results indicate that people engage in directionally motivated reasoning on both political and non-political topics. Moreover, people high in cognitive control processes, as operationalized by the cognitive reflection task, engage in less motivated reasoning. This finding further questions the "motivated reflection" hypothesis and opens up new research directions. Rather than using cognitive control processes to construct reasonable justifications for desired conclusions, cognitive reflection may help people to resist automatic and affective response tendencies that underlie motivated reasoning.

We developed a novel gamified version of an experimental task originally designed by Thaler (2024) to assess politically motivated reasoning. Participants take on the role of "Fake News Detectives" to "detect the deception" in news messages randomly telling them that the correct answer on factual questions is either greater or less than what they had previously guessed. From the information they have, participants cannot infer whether the messages are more likely true or false. Thus, if people were rational Bayesians, there should be no systematic deviations in their veracity ratings. Nonetheless, our UK-based participants, in line with past studies conducted in the US (Thaler, 2024b, 2024a), showed systematic deviations in their veracity ratings, indicative of motivated reasoning. Specifically, they rated messages that align with their political stances and motives as more likely to be true, than messages going against their political stances.

We then compared the relative evidence for two competing hypotheses on the link between motivated reasoning and cognitive control processes. Contrary to the influential "motivated reflection" hypothesis, our model and data suggest that the relationship between cognitive reflection and motivated reasoning is more likely negative — in other words, the more reflective, the less motivated reasoning. This is in line with cognitive science theories that cognitive control processes can mitigate ideological biases (Németh et al., 2024). This result is all the more compelling given the clear evidence of motivated reasoning observed with our design. With the Go / No-go task, we also used a well-established neuroscientific paradigm to assess the ability to inhibit prepotent and impulsive responses (Wessel, 2018). However, for inhibitory control, our analyses yielded inconclusive results, and it remains to be clarified if and how it is linked to motivated reasoning.

Recent work has shown that good performance in reaction-time-based cognitive control tasks can be driven by accurate intuitive processing rather than controlled correction of automatic

responses (Voudouri et al., 2023). While the Cognitive Reflection Test primarily reflects strategic information processing on a longer timeframe, showcasing the ability to override intuitive responses in favour of more deliberative reasoning, the Go / No-Go task could thus assess speeded information processing (Eisenberg et al., 2019). These two cognitive factors, strategic and speeded information processing, could be differentially linked to motivated reasoning. While strategic and careful information processing could generally be related to more accurate judgments, the role of speeded information processing remains to be clarified. Future research should leverage computational models of decision-making to isolate specific components of the decision process (e.g., Lin et al., 2023), providing insights into how fast, accurate responding interacts with other factors, such as on different topics, to contribute to motivated reasoning. Additionally, employing multiple cognitive tasks to derive latent cognitive factors could provide robust insights into the differential effects of strategic and speeded information processing, as demonstrated in an investigation of the cognitive correlates of ideological attitudes (Zmigrod et al., 2021).

These investigations can build on the foundations we provide here. The task we used to assess motivated reasoning overcomes limitations of previous study designs that likely contributed to inconclusive findings (for review, see Tappin et al., 2020b). Specifically, the task avoids confounding the influence of prior beliefs with motivated reasoning by having participants judge news messages that directly refer to their own, individually-elicited beliefs. (Thaler, 2024b). Importantly, our design and analysis also allow better generalisation of our effects, as we included a variety of political and non-political topics, in contrast to classical studies that mainly focused on the same climate- and gun-control-related stimuli (Kahan, 2013; Kahan et al., 2017; Kahan & Peters, 2017).

In conclusion, we provide novel insights into the link between cognitive control processes and motivated reasoning by synthesising interdisciplinary perspectives. We challenge the influential hypothesis that cognitive control processes are linked to more motivated reasoning, as we find that cognitive reflection is more likely linked to less, rather than more motivated reasoning. Understanding the foundations of motivated reasoning is crucial, as it can drive politically polarised (Su, 2022) and misinformed beliefs (Ecker et al., 2022; Thaler, 2024b). The key question going forward is not whether highly reflective individuals can set aside their ideological biases, but rather which, when and how cognitive factors mitigate or reinforce politically motivated reasoning.

Limitations

Several limitations should be acknowledged. First, we did not experimentally manipulate cognitive control processes. While other studies have attempted such manipulations (e.g., limiting response time), it remains unclear how such manipulations affect the specific cognitive strategies participants use. For example, time pressure did not have an effect on motivated reasoning, whereas trait measures did (Strömbäck et al., 2024). It remains a challenge for future research to manipulate specific cognitive control processes and investigate the effects on motivated reasoning. Second, motivated reasoning effects depend on how well participants' motives can be inferred. We used self-reported opinions and stances as indices of motives, and this appeared to work well on political topics. Smaller effects for certain topics could also be attributed to these motives being harder to assess, or our items or coding being inadequate. Overall, we think this is only of limited concern for our results, as for most topics effects go in the expected directions. However, our estimates may be considered as lower bounds of motivated reasoning effects. Testing which items or strategies are best to capture motives is an interesting avenue for future research that can build on the analyses and open materials we provide here. Finally, the higher variance observed in motivated reasoning on neutral and performance vignettes may be due to the limited number of items per vignette type. Using more items could enable more systematic investigation of these effects.

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