Sorting Fact from Fiction when Reasoning is Motivated

Edoardo Cefala[*] Melis Kartal[†] Sylvia Kritzinger[‡] Jean-Robert Tyran[§]

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Abstract

What drives individuals' ability to discern fact from fiction in complex and highly politicized issues? We combine theory and a multi-country survey-experiment to investigate how sorting fact from fiction and updating from news are influenced by cognitive ability, motivated reasoning, and overconfidence in complex topics such as climate change and science. Consistent with the predictions from our theoretical model, we find that cognitive ability (i.e., both IQ and education) improves news discernment. We also highlight the importance of motivated reasoning in both news discernment and updating from new information. Importantly, we still find the positive effect of cognitive ability to be robust and immune to motivated reasoning. These novel results are good news, suggesting that investments in critical thinking skills could help individuals discern fact from fiction even on complex and polarising issues.

Keywords: fake news, misinformation, cognitive ability, motivated reasoning, overconfidence

[*]Department of Economics, Vienna University of Economics and Business.
[†]Department of Economics, Vienna University of Economics and Business
[‡]Department of Government, University of Vienna
[§]Department of Economics, University of Vienna, Austria; Department of Economics, University of Copenhagen, Denmark; Department of Economics, University of Economics in Bratislava, Slovakia.

1 Introduction

The current times are characterized by an abundance of news stimuli on different important topics, above and beyond the human capacity to handle. The sources of this abundance are both natural and artificial, e.g., due to large-scale circulation of fake content. People are routinely advised to fact-check news. However, the sheer volume they are exposed to every day makes this almost impossible. Therefore, navigating a complex world with a wealth of (mis)information requires on-the-spot thought processes to discern the veracity of news and update from new information, often under biases that colour people's perceptions of truth.

Our study investigates these (possibly biased) thought processes, which are crucial for the formation and evolution of opinions.[1] To that aim, we combine theory and a large-scale survey-experimental study to investigate how sorting fact from fiction as well as updating from new information are influenced by cognitive and psychological factors in various important topics.

The need to improve our understanding of the underlying mechanisms behind news discernment and updating from new information is becoming essential given the increasing complexity of the news environment, with an abundance of fake news, and the increasing degree of political polarisation and politicisation of complex topics.[2]

We focus on the role of cognitive ability, motivated reasoning (e.g., due to existing issue opinions and preference biases) and overconfidence in news discernment as well as updating from noisy information signals. Participants take a news quiz, which provides a measure of their ability to discern true and fake news. To study updating decisions, we give participants the same news quiz twice. The second time they see a news item, they observe a noisy but informative signal concerning its correct answer and may choose to revise their initial assessment. Guided by our theoretical model, we use survey and experimental data to delineate the determinants of news discernment and updating from new information.

Our news quiz has a novel format and satisfies specific criteria. In particular, we systematically chose important topics that are contested and politically charged in many countries: immigration, climate change and environment (hereafter, climate change), inequality, and a fourth theme at the intersection of science, public health, and conspiracy

[1] For example, these discernment processes may determine what is retained in memory (e.g., as"true news") or not (due to being deemed false). The retained information then determines opinions and their evolution.

[2] It is also vital to improve this understanding to promote better resilience to fake news because the wide reach of such news combined with declining trust in institutions can have dramatic societal consequences.

theories (hereafter, science). These are relatively complex societal topics with a constant stream of news, even in the absence of fake news, due to e.g. research, technological progress, new developments, or society-wide shocks. While most people arguably have limited knowledge on these topics relative to the existing stock of knowledge, they may still have opinions and biased viewpoints on them, which in turn affect their perceptions of related news. Therefore, studying jointly the two choice environments (news discernment and updating from objectively informative signals), as we do, provides a more complete picture concerning the mechanisms underlying the processing of news. To fix ideas, consider an individual with anti-immigrant views who believes that most congruent news items (i.e., with an anti-immigrant stance) are correct. Does this stem from exposure to one type of news or does actively discounting the other type of news when exposed play a role? Our survey-experimental design allows us to delve deeper into the sources of biased opinions.

Our news quiz has 16 items in total and includes two neutral items that are not politically loaded. The quiz questions on each news topic are balanced in the bias direction of their correct answers. As an example: assuming four questions on the migration topic, two questions have as correct answer a pro-immigrant bias answer while the other two have as a correct answer an anti-immigrant bias.[3]

We have a novel approach to detecting and studying motivated reasoning because our survey questions allow us to determine the existing issue opinions and predispositions of the participants on each topic covered by the news quiz. Thus, in each news topic, we can classify each respondent as neutral or preferentially biased, and we can specify the direction of the preference bias in the latter case. Our survey-based cognitive ability measure is a validated and commonly used short version of the Raven Advanced Progressive Matrices (APM) Test that measures IQ. We use educational attainment as an additional measure of cognitive ability. Our overconfidence measure is an absolute measure based on the difference between a participant's self-assessment of their news quiz score and their true score. We have conducted the online study via an international survey company with the general population of three countries: Austria, Germany, and the UK.

According to our model, the ability to discern correct and false news increases in cognitive ability. Moreover, the effect of cognitive ability is immune to motivated reasoning. That is, the higher the cognitive ability, the higher the ability to recognize correct (false) news on a topic that is inconsistent (consistent) with one's preference bias on that topic. Finally, our model predicts that overconfidence is an impediment to learning

[3] An unbalanced choice of questions in that respect may result in an artificial relationship between the direction of a respondent's bias and their ability to discern true and false news.

and updating from new information. Empirically, overconfidence may be prevalent.[4] Such overconfidence can generate suboptimal political choices and outcomes (Ortoleva and Snowberg, 2015; Kartal and Tyran, 2022).

As hypothesized, cognitive ability is a highly statistically significant predictor of the ability to discern true and fake news. In fact, both the IQ score (as measured by the APM test) and educational attainment are jointly highly statistically significant. Importantly, the positive effect of cognitive ability is robust and highly significant even when participants are vulnerable to motivated reasoning. That is the ability to make correct assessments that counter one's existing issue opinions and preference biases increases in cognitive ability. Moreover, the counterpart to this statement also holds: that the ability to make correct assessments that are bias-consistent also increases in cognitive ability. The latter result may be surprising but has a theoretical basis, as we show in our model. These novel results are highly robust and hold regardless of whether we use only the IQ score or only educational attainment or both to measure cognitive ability. Overall, these results are good news, suggesting that the ability to discern correct and false news is malleable, and higher cognitive ability mitigates the effect of motivated reasoning on news discernment[5]

We next study the extent to which motivated reasoning and cognitive ability jointly influence participant performance in the news quiz. As hinted by the results above, respondents do make an effort to be accurate and give the correct answer (even when they are biased towards the false answer), and the success of this effort increases in cognitive ability. Still, motivated reasoning plays a highly significant role in explaining respondent decision making[6] We find that the magnitude of the effect of cognitive ability rivals that of motivated reasoning, but only if we vary both educational attainment and the IQ score from very low to very high (or highest) levels.[7] Thus, our results differ from the extant literature (e.g., Pennycook and Rand (2019); Angelucci and Prat (2024)):

[4]For example, according to a survey study by the Pew Research Center in the US, 84% of the respondents are (somewhat or very) confident in their ability to recognize fake news.

[5]Both fluid and crystallized intelligence is malleable, as exemplified by the Flynn effect, which refers to the sustained increase in intelligence test scores in the 20th century due to societal development. A negative Flynn effect may also be observed. For example, Dutton et al. (2017) conclude that increasing religious emphasis in the Kuwaiti school curriculum significantly reduced intelligence test scores (as measured by Standard Progressive Matrices) among 8 to 15 years old. Socioeconomic disparities also matter in explaining the variation in intelligence (see also concluding remarks).

[6]In a nutshell, we estimate the magnitude of motivated reasoning by comparing the likelihood of making a correct assessment of news when the correct assessment is consistent with the respondent's preference bias versus when it is inconsistent. In theory, the former is (weakly) higher than the latter, and we refer to this difference between the two as motivated reasoning.

[7]IQ measure, educational attainment, and motivated reasoning are the most important explanatory variables to explain the news quiz score. Some demographic factors, such as gender and age, play a smaller but robust role in explaining the news quiz score.

in complex topics, motivated reasoning may play a significant role in the evolution of opinions, making polarization easier in the longer term.

On the aggregate, cognitive ability is not associated with the magnitude of motivated reasoning (results disaggregated by news topic are different, as discussed below). Importantly, higher trust in institutions and higher media consumption reduce the magnitude of motivated reasoning in the aggregate. In contrast, voting for an extremist party is associated with higher motivated reasoning.

In the context of updating from noisy but informative signals, the counterpart to motivated reasoning is motivated updating. In addition to a limited willingness to update, we document that respondents do exhibit motivated updating; that is, they are more likely to follow signals that are consistent with their preference bias and thus more likely to change their initial (bias-inconsistent) answers than the other way round. As a result, one-sided news exposure cannot be the sole explanation for opinion biases: respondents do discount unfavourable new information.

Importantly, the aggregate results above conceal some heterogeneity when disaggregated by news topic. In particular, the science topic emerges as distinct from the others. We find the effect of cognitive ability on news discernment in the science theme to be limited relative to other themes and to not increase in educational attainment. We also find that educational attainment increases motivated reasoning in the science theme: respondents with higher education seem to be more likely to follow their preference bias in this topic with respect to the others. In addition, we observe an increased tendency for motivated updating for respondents with a higher IQ score in the science topic, suggesting that for more highly educated or more intelligent people, science attitudes are more strongly associated with their identity, increasing their tendency for identity-consistent decision-making. We do not observe this in other news themes, except for a limited, marginally significant positive effect of the IQ score on motivated reasoning in climate change.

Finally, we document that IQ score has a positive effect while overconfidence has a negative effect on the extent to which participants update from noisy but informative signals. In particular, higher overconfidence is associated with a lower likelihood of updating from noisy but informative signals. However, this result only holds among those who are overconfident or well-calibrated. Among the underconfident participants (i.e., among those who estimate their news quiz score lower than it actually is), being less underconfident has a marginally significant but positive effect on updating. We interpret this as being due to underconfident respondents revising their self-confidence over the course of the updating part. Consistent with the Dunning-Kruger effect, highly

underconfident participants perform better in the news quiz than other participants and thus have more answers that are consistent with the experimental information signals we provide them with. This possibly boosts their confidence during the updating part of the study and increases their tendency to discard signals that differ from their answers. This explanation connects to the literature on self-confidence, which shows that there is an asymmetry in updating from good and bad information concerning one's self (see, e.g., Eil and Rao (2011); Zimmermann (2020); Möbius et al. (2022)).[8] Underconfident participants receive positive information about their performance and likely revise their self-confidence upward over the course of the updating part of the study, which limits their learning from signals. Overconfident participants do not adjust despite receiving negative information.

Our paper relates to a growing literature on news discernment discussed in the next section and complements the recent literature investigating the effects of interventions such as fact-checking, debunking, and nudges to combat fake news (see for example Pennycook et al. (2020); Henry et al. (2022); Ecker et al. (2022); and the references therein). The experimental part of our study relates to fact-checking since the information signal observed, though noisy, informs the respondents about the correct answer with a high probability. In practice, fact-checking is sometimes a noisy procedure. Lim (2018) analyzes two major fact-checkers in the USA, Fact Checker and Politifact, and reports that their agreement rate can be relatively low for statements in an ambiguous scoring range (i.e., statements that are deemed "Half True" or "Mostly False"). The efficacy of noisy fact-checking may be undermined by motivated updating and a low willingness to update in general, both of which we document in our study.[9]

Therefore it is ideal to combine later-stage interventions such as fact-checking, with early interventions designed to improve education and cognitive skills which we show improve news discernment and updating from informativesignals on the aggregate. In addition improvement in the quality of and trust in institutions are likely important factors.[10]

[8]Our regression analysis shows that the total number of experimental information signals that are consistent with a participant's initial answers is a statistically significant explanatory variable for the updating behaviour of underconfident participants. In particular, the higher the number of a participant's initial answers that are consistent with the observed signals, the lower the willingness of the participant to update and change answers in the subsample of underconfident respondents. This is not true in the subsample with well-calibrated and overconfident participants, they are unresponsive to this variable.

[9]There is also a debate whether fact checkers are non-partisan and unbiased. Louis-Sidois (2022) identifies the political affiliation of six main French fact-checkers and reports that these fact-checkers are both less likely to fact-check ideologically close entities and more likely to agree with them.

[10]As stated earlier, we find that trust in institutions reduces the magnitude of motivated reasoning, which likely helps limit polarization of opinions in the long run. Our results suggest that on the aggregate,

This paper thus shows that policies designed to ensure high-quality and accessible education which can also lead to improvement in cognitive skills will still be important arms in the race against misinformation in an increasingly complex and polarised landscape.

2 Literature

Our study presents a novel, theory-guided framework investigating respondents' news opinions and their evolution through the lens of relevant cognitive and psychological mechanisms. According to Kunda (1990), there are two primary motivations when individuals process news: accuracy motives and directional motives. Accuracy motives refer to the effort to assess news as accurately and dispassionately as possible. Directional motives in our context refer to the inclination of a respondent to assess the accuracy of a news item differently when its content is aligned with their existing issue opinions and preference biases than when it is not. Following a dramatic increase in ideological and political polarization in the US, the motivated nature of people's assessments, perceptions, and beliefs has been well-documented in the political science and psychology literature.[11] A closely related strand of the literature has focused on the influence of fake news and how it interacts with motivated reasoning.[12]

Our model and empirical results advance this literature in various ways. Our study focuses on news themes that are politicized but more complex than everyday politics. As a result, the magnitude of motivated reasoning we document is more pronounced than the estimates in the extant literature, for example, Angelucci and Prat (2024) and Pennycook and Rand (2019). Nevertheless, we also find that both IQ (as measured by the APM test) and educational attainment mitigate the negative effect of motivated reasoning on accuracy; i.e., cognitive ability boosts the ability of respondents to make correct

Germany performs better in the news quiz than the other two countries. This is ex-ante what we expected as Germany ranks higher than Austria and the UK in well-known institutional and governance rankings (even if all three are highly advanced, rich democracies).See, e.g., Human Development Index by the UN, the economist Democracy Index, V-Dem Democracy Indices, Global State of Democracy Indices, World Press Freedom Index by Reporters Without Borders, Corruption Perceptions Index by Transparency International, Rule of Law Index by the World Justice Project, U.S. News rankings for best countries, quality of life, and well-developed public education system, as well as the Education Index by the OECD. Germany ranks higher than Austria and the UK in all of these rankings.

[11] See among others Redlawsk (2002); Taber and Lodge (2006); Slothuus and de Vreese (2010); Jerit and Barabas (2012); Bolsen et al. (2014);Flynn et al. (2017); Peterson and Iyengar (2021); and the references therein.

[12] See for example Nyhan and Reifler (2010); Allcott and Gentzkow (2017) ; Berinsky (2017); Flynn et al. (2017); Wood and Porter (2019); Ecker et al. (2022); Thaler (2024); Angelucci and Prat (2024); and the references therein.

news assessments that go *against* their preference biases. Strikingly, IQ and educational attainment also boost the ability of respondents to make correct news assessments that are bias-consistent.[13]

To the best of our knowledge, our study is the first to document that IQ (as measured by the APM test) and educational attainment jointly have a strong positive effect on news discernment. The IQ measure based on the APM test score and educational attainment may be viewed as capturing different cognitive ability dimensions. For example, while education is more associated with crystallized ability, the APM test relates more to fluid intelligence. Pennycook and Rand (2019), Bago et al. (2020), Assenza and Cardaci (Assenza and Cardaci), and Arechar et al. (2023) conclude that higher performance in the cognitive reflection test (Frederick, 2005) is associated with better discernment of correct and fake news; however, they do not report an effect of educational attainment. Concerning the effect of education on news discernment, Angelucci and Prat (2024) and Allcott and Gentzkow (2017) find a positive effect in the US, and Arin et al. (2023) report a positive effect in Germany but a null effect in the UK. These studies do not have an additional cognitive ability measure. Differently from these studies, we delve deep into the interaction between cognitive ability, accuracy, and motivated reasoning as discussed above.

On average (across all news themes), the magnitude of motivated reasoning is not affected by either cognitive ability measure. However, when we disaggregate data by news theme, we find that results are surprisingly heterogeneous and that cognitive ability may increase or reduce the magnitude of motivated reasoning depending on the topic. Relatedly, the highly cited studies by Kahan (2013), Kahan et al. (2012), and Kahan et al. (2017) report that individuals with higher performance in the cognitive reflection test and higher numeracy skills are more likely to engage in motivated reasoning (however, see Persson et al. (2021) for a replication).[14] As stated above, we do not find evidence for an analogous claim on the aggregate. However, cognitive ability increases the magnitude of motivated reasoning and motivated updating in the science theme.

Overall, the empirical literature so far paid limited attention to the role of cognitive biases, such as overconfidence, in the processing of news. To the best of our knowledge, our study is the only one that investigates the role of overconfidence in updating from noisy but objectively informative signals in the discernment of news veracity. Our framework

[13] Angelucci and Prat (2024) show that socioeconomic inequalities are associated with large variations in the ability to discern correct and false news in the context of US politics. Our findings on the role of IQ are related: IQ is malleable as discussed in Footnote 5, and variation in IQ is associated with socioeconomic inequalities. See also the concluding remarks.

[14] We note that Kahan (2013), Kahan et al. (2017), and the follow-up studies use deception in their design (i.e., respondents make assessments on counterfactual scenarios, which is unknown to them).

combines the analysis of news discernment and updating from new information to present a fuller picture concerning opinion formation and evolution. Our findings suggest that opinion biases may arise not only from being (mostly) exposed to one type of news but also from a motivated processing of different types of news, as well as a general unwillingness to change initial assessments, for example, due to overconfidence and cognitive limitations.[15]

We next present our theoretical framework which will function as a guiding principle for our experimental design and empirical analysis.

3 Model

There are two states of the world $S \in \{0, 1\}$ for each news item, where 0 and 1 represent the respective case in which the news item is false and the news item is true. A news item is true (that is, $S = 1$) with prior probability π. Respondent i receives a signal $s_i \in \{0, 1\}$ regarding the veracity of a news item with precision q_i; i.e.,

$$Pr(s_i = 0|S = 0) = Pr(s_i = 1|S = 1) = q_i \geq 0.5.$$

How precision q_i is determined will be explained in detail below. The respondent has two possible choices, $a \in \{0, 1\}$, where $a = 0$ and $a = 1$ represent the case where the news item is assessed to be false and true, respectively.[16]

Our news quiz involves various politicized, contested topics. As a result, in addition to veracity, there is a valence dimension of the news items. For example, each news item on science is consistent with either a pro-science or an anti-science viewpoint. This implies that, depending on their existing issue opinion respondents may derive a higher utility from being correct about certain true news and certain false news. We assume that the valence V_i of a news item for respondent i takes one of two values; i.e., $V_i \in \{0, 1\}$ with the interpretation that an individual has an affinity (i.e., a preference bias) for correct news

[15] As mentioned earlier, a higher IQ is associated with a higher willingness to update.

[16] Our news quiz involves two types of questions: true or false questions and fill-in-the-blank items, where participants select one of two options, 1 and 2. In the main text, we model the decision-making of a respondent assuming that the news item is a true or false question, which is without loss of generality. That is, the model readily applies to the other type of item by means of redefining the state of the world, $S \in \{1, 2\}$, where 1 and 2 represent the respective state where the correct answer is 1 and 2. We redefine the precision q_i, signal $s_i \in \{1, 2\}$ and the choice $a \in \{1, 2\}$ correspondingly. For example, $Pr(s_i = 1|S = 1) = Pr(s_i = 2|S = 2) = q_i$.

with valence $V_i = 1$ and false news with $V_i = 0$. In particular,

$$u(a = 1|S = 1, V_i = 0) = u(a = 0|S = 0, V_i = 1) = 1 - v_i$$
$$u(a = 1|S = 1, V_i = 1) = u(a = 0|S = 0, V_i = 0) = 1,$$

for i, where $v \in [0, \bar{v}]$ with $\bar{v} < 1$. To give an example, the utility that an anti-science respondent i derives from correctly guessing that a news item is true (i.e., $S = 1$) is higher if the news item is anti-science in stance (that is, $V_i = 1$ as i is anti-science) than if it is pro-immigrant (that is, $V_i = 0$). We assume without loss of generality that the utility of a wrong assessment is always 0; i.e.,[17]

$$u(a = 1|S = 0) = u(a = 0|S = 1) = 0.$$

Our utility specifications above reflect the following idea. All respondents want to be *accurate* since $\bar{v} < 1$. However, the optimal value of $a \in \{0, 1\}$ depends on the valence V_i for $v_i > 0$, generating directional motives. For example, an individual with pro-immigrant views may derive a higher utility from being correct in their guess that a news item reporting the positive effect of immigration on the economy is true than being correct in their guess that it is false. This concerns the so-called motivated reasoning, which we formally define below in the language of our model. In a nutshell, motivated reasoning refers in our model to the slant participants exhibit in their news assessments due to their preference over the accuracy (or inaccuracy) of news items depending on their valence.

We assume that $Pr(S = 1|V_i = 1) = Pr(S = 1|V_i = 0) = \pi$, which is without loss of generality for our analysis. Note that directional motives may (also) be associated with biased priors such that $Pr(S = 1|V_i = 1) > \pi > Pr(S = 1|V_i = 0)$, e.g., $Pr(S = 1|V_i = 1) = \pi + v_i(1 - \pi)$. Allowing for this generates qualitatively identical results to those reported below, so we assume for simplicity that $Pr(S = 1|V_i = 1) = Pr(S = 1|V_i = 0) = \pi$. This assumption implies that the valence of a news item is not informative on its veracity. In addition, our news quiz is consistent with the assumption that $Pr(V_i = 1|S = 1) = Pr(V_i = 1|S = 0) = 0.5$; that is, true and false news are balanced in valence. This assumption is also without loss of generality and reflects the intuitive idea that the direction of a respondent's bias is on average unrelated to their news discernment (under the assumption that v and θ_i described below are independent).

The precision $q_i \in [0.5, 1]$ for individual i is associated with i's cognitive ability,

[17] This is to reduce notation. Our results are not affected if we relax the assumption and let the utility of a wrong decision to also depend on the valence of the news item, as with the utility of a correct decision.

which we denote by $\theta_i \in [\underline{\theta}, \infty)$, where $\underline{\theta} > 0$. In particular, θ_i affects the difficulty and the cost of the "cognitive effort" of a news quiz question for participant i as follows. The cost of q_i for i is given by $\frac{C(q_i)}{\theta_i}$, where $C(0.5) = 0$, $C'(0.5) = 0$ $C'(1) = \infty$, and $C(\cdot)$ is an increasing and strictly convex function of q. Thus, the higher θ_i, the lower the cognitive cost of being accurate in a question.

Individual i chooses q_i given θ_i and v_i to maximize expected utility. To understand how expected utility is obtained, first consider the stage after q_i has been chosen.

- Assume that a news item is such that $V = 0$ for participant i. Then, given our utility specification above, it is optimal to follow the signal $s_i = 0$ (i.e., choose $a = 0$) if and only if $q_i \geq \frac{\pi(1-v_i)}{1-\pi v_i}$, and it is optimal to follow the signal $s_i = 1$ and choose $a = 1$ if and only if $q_i \geq \frac{1-\pi}{1-\pi v_i}$.
- Next, assume that a news item is such that $V = 1$ for i. In this case, it is optimal to follow $s_i = 0$ and choose $a = 0$ if and only if $q_i \geq \frac{\pi}{1-v_i+\pi v_i}$, and it is optimal to follow $s_i = 1$ if and only if $q_i \geq \frac{(1-\pi)(1-v_i)}{1-v_i+\pi v_i}$.

We assume for simplicity in the main text that $\pi = 0.5$. From our points above, it follows that (i) if $V_i = 1$ and $s_i = 1$, then $a = 1$ regardless of q_i, and (ii) if $V_i = 1$ and $s_i = 0$, then $a = 0$ if and only if $q_i \geq \frac{1}{2-v_i}$. In addition, (i) if $V_i = 0$ and $s_i = 0$, then $a = 0$ regardless of q_i, and (ii) if $V_i = 0$ and $s_i = 1$, then $a = 1$ if and only if $q_i \geq \frac{1}{2-v_i}$. Combining these results, the ex-ante expected utility of a participant with $\pi = 0.5$ is given by

$$\frac{1}{2}q_i + \frac{1}{2}q_i(1 - v_i) - \frac{C(q_i)}{\theta_i}$$

provided that

$$q_i \geq \frac{1}{2 - v_i}, \tag{1}$$

$$\frac{1}{2}q_i + \frac{1}{2}q_i(1 - v_i) - \frac{C(q_i)}{\theta_i} \geq \frac{1}{2}. \tag{2}$$

Thus, the optimal value of q_i is a function of v_i and θ_i, and is given by the first order condition $C'(q_i) = \frac{\theta_i(2-v_i)}{2}$ provided that q_i satisfies both conditions (1) and (2) (these conditions are surely satisfied for high enough θ_i or low enough v_i). Thus, the first-order condition makes it clear that the higher the magnitude of θ_i, the higher the choice of q_i. That is, the probability of choosing the correct answer is monotone and increasing in cognitive ability.

Note that we could allow the optimal choice of q_i to depend on $V_i \in \{0, 1\}$. This does not affect the main results below. If $\pi = 0.5$, then the optimal value of q_i does not depend on V_i, and the above analysis for $\pi = 0.5$ goes through.

Next, we investigate the disaggregated effect of θ_i on the ability to discern correct and false news in two situations for individuals with a preference bias for a certain type of news (i.e., $v > 0$). The first situation is such that either $V_i = 1$ and $S = 1$ or $V_i = 0$ and $S = 0$. We call this the "motivated state." In the motivated state, the correct assessment regarding the veracity of a news item is consistent with the respondent's preference bias and always results in a utility of 1. The second situation is the counterpart to the first one: either $V_i = 1$ and $S = 0$ or $V_i = 0$ and $S = 1$. We call this the "counter-motivated state." In the counter-motivated state, the correct assessment regarding the veracity of a news item is inconsistent with the respondent's preference bias and always results in a utility of $1 - v_i$ (rather than 1).

It is easy to show that individual i with $v_i > 0$ is (weakly) more likely to be correct in the motivated state than in the counter-motivated state. Thus, motivated reasoning may be particularly problematic in the counter-motivated state, resulting in a relatively low accuracy in that state. Nevertheless, we show that the probability of making the correct assessment in the motivated state increases in cognitive ability. It can be checked that the probability of making a correct assessment in the counter-motivated state, which we denote by P_C, is given by

$$P_C = \frac{1}{2}Pr(a = 1|V_i = 0, S = 1) + \frac{1}{2}Pr(a = 0|V_i = 1, S = 0),$$

which equals 0 if $q_i = 0.5$ and q_i if $q_i > 0.5$. Thus, the higher θ_i, the higher q_i, and the higher the probability of making the correct assessment in the counter-motivated state.

The probability of making a correct decision in the motivated state, which we denote by P_M, is given by

$$P_M = \frac{1}{2}Pr(a = 1|V_i = 1, S = 1) + \frac{1}{2}Pr(a = 0|V_i = 0, S = 0),$$

which equals q_i if $q_i > 0.5$ and 1 otherwise. As a result, the probability of making the correct assessment in the motivated state strictly increases in θ_i provided that $q_i > 0.5$.

Hereafter, we refer to "motivated reasoning" as the magnitude of the slant i displays in their news assessments because $v_i > 0$. That is, we formalize "motivated reasoning" in our model as the difference between P_M and P_C. In our simple setup with $\pi = 0.5$, motivated reasoning (i.e., $P_M - P_C$) takes one of two values: it equals either 0 (for $q_i > 0.5$)

or 1 (for $q_i = 0.5$). However, we can show that fixing $\pi \neq 0.5$ and $v \geq 0$, there exists an interval of θ values such that $P_M - P_C \in (0, 1)$. Moreover, some extensions of the model results in intermediate levels of motivated reasoning also with $\pi = 0.5$. One very simple extension is to assume that the preference bias is stochastic instead of deterministic: for respondent i with preference bias $v_i > 0$, the realized bias equals $v_i \in [0, \bar{v}]$ with some probability $g(v_i)$ and 1 with the remaining probability, where $g(v_i) = 1$ for $v_i = 0$ and $g(v_i) < 1$ for all $v_i \in (0, \bar{v}]$. In this case, the magnitude of motivated reasoning $P_M - P_C$ is an interior value, instead of 0 or 1, if $v_i > 0$ and $q_i > 0.5$. If $q_i = 0.5$ and $v_i > 0$, then $P_M - P_C = 1$ as before. Another simple extension resulting in intermediate levels of motivated reasoning involves distorted perceptions of q_i (i.e., underperceiving q_i with some probability if $s_i = 1$ and $V_i = 0$ or if $s_i = 0$ and $V_i = 1$), which we assume the respondent is ex-ante unaware of (i.e., at the stage where q_i is chosen).

Proposition 1 below holds, regardless of whether v_i is deterministic or stochastic as described in the extended model above. It also holds in the presence of distorted perceptions of q_i, described above.

Proposition 1 (i) Effect of cognitive ability on the ability to discern correct and fake news: *The probability that an individual makes a correct assessment increases in θ.* **(ii) Effect of cognitive ability in the counter-motivated state:** *P_C, the probability that an individual makes a correct assessment in the counter-motivated state, increases in θ.* **(iii) Effect of cognitive ability in the motivated state:** *For θ_i high enough (or v_i low enough), $q_i > 0.5$, and thus, P_M increases in θ.*

The results in parts (i) and (ii) are stronger than the result for P_M in part (iii) because P_M is only piecewise monotone, with a discontinuous decrease at $q_i = \frac{1}{2-v_i}$ if $\underline{\theta} < C'(\frac{1}{2-\bar{v}})\frac{2}{2-\bar{v}}$. If however $\underline{\theta}$ is high enough (or $\bar{v}$ is low enough) so that

$$\underline{\theta} \geq C'(\frac{1}{2-\bar{v}})\frac{2}{2-\bar{v}}$$

or $\underline{\theta} \geq C'(\frac{1}{2-\bar{v}})\frac{2}{(2-\bar{v})g(\bar{v})}$ in the extended model with stochastic v_i, then P_M is strictly increasing in θ for all $\theta \geq \underline{\theta}$ with an interior level of motivated reasoning in the extended model.

Alternatively, we can consider how the average P_M in society depends on θ. P_M is strictly increasing in θ_i for all θ if $v_i \in [0, v(\underline{\theta})]$, where $v(\underline{\theta}) > 0$ solves $\underline{\theta} = C'(\frac{1}{2-v(\underline{\theta})})\frac{2}{2-v(\underline{\theta})}$ (it solves $\underline{\theta} = C'(\frac{1}{2-v(\underline{\theta})})\frac{2}{(2-v(\underline{\theta}))g(v(\underline{\theta}))}$ in the extended model). As a result, if the density of v_i in the society (for either direction of bias), denoted by $f(v)$, is such that $\int_{v(\underline{\theta})}^{\bar{v}} f(v)dv$

is sufficiently small, the expected value of P_M in the society for given θ,

$$P_M(\theta) = \int_0^{\bar{v}} P_M(v, \theta) f(v) dv,$$

is increasing in $\theta \in [\underline{\theta}, \infty)$, where $P_M(v, \theta)$ denotes the probability of making the correct assessment in the motivated state given v and θ. In words, this condition on $f(v)$ roughly translates to the following: the bias is not too strong for most people.

Finally, we consider the effect of overconfidence in q on updating from a noisy but informative report, R, such that

$$Pr(R = 0|S = 0) = Pr(R = 1|S = 1) = r > 0.5.$$

Overconfidence in q may be, for example, due to perceiving a different production function for precision q than the actual one. In particular, an overconfident individual i may assume that the precision is given by $p_i(q_i)$ rather than q_i, where $p_i(q)$ is strictly increasing in q and $p_i(q) > q$ for all q. Thus, overconfident i believes that

$$Pr(s_i = 0|S = 0) = Pr(s_i = 1|S = 1) = p_i(q_i) > q_i.$$

Overconfidence may prove detrimental to learning and updating from new information. For example, consider the case where i has initially chosen $a = 0$ because $s_i = 0$ and $V = 0$. If i then learns that $R = 1$, changing the choice to $a = 1$ is utility maximizing provided that $q_i < \frac{r(1-v_i)}{1+rv_i}$. However, i will not do so and behave suboptimally (i.e., not update although it is utility maximizing given q_i) if $p_i(q_i) > \frac{r(1-v_i)}{1+rv_i} > q_i$.

Proposition 2 Effect of overconfidence on learning *Higher overconfidence is associated with a lower likelihood of updating from new information.*

Propositions 1 and 2 form the basis of our study hypotheses, discussed in Section 4.7.

4 Study Design

Our study has several parts. It combines a survey and an experiment on updating with measures of (i) news discernment (i.e., the probability of making a correct assessment in the model); (ii) cognitive ability (i.e., θ_i); (iii) overconfidence (i.e., $p_i(q_i) - q_i$); and (iv)

preference biases on news topics in our study (i.e., whether $v_i = 0$ or $v_i > 0$, as well as the direction of the preference bias in the latter case).

Invited participants see a brief description of the study, including its expected duration and pay. If they consent to participation, they are directed to our online study. Below, we describe the survey and experimental design in the same order as participants see it during the study.[18]

4.1 Questionnaire on Demographics

First, participants complete a short questionnaire, which includes questions on gender, age, education, and country of residence. We ask screening demographic questions at the beginning of the study to ensure that the sample in each country is representative of the general population along the gender, age, and education dimensions.

4.2 News Quiz

The news quiz provides a measure of the ability to discern correct and false news. The quiz has 16 questions and is incentivized as every correct answer is rewarded with positive probability.[19] There are two types of questions: true or false questions and fill-in-the-blank items, where participants select one of two answer options. We sometimes use the latter format to make the correct answer have an unambiguous bias direction, which is crucial for our analysis of motivated reasoning.[20] The order of questions is randomized for each respondent, and the order of choices is randomized in the fill-in-the-blank items.

The quiz covers four topics, which are some of the most challenging and divisive themes of the last decades: immigration, climate change, science, and inequality. Specifically, what we call science is in the intersection of science, public health, and controversial or conspiratorial content, and what we call climate change concerns climate change and environmental issues. News items are balanced within each topic with respect to the bias direction of the correct answers. For example, out of four questions on science, two

[18] A visual representation of the building blocks of our study design is provided in the Online Appendix in Figure Appendix A.1.

[19] In particular, it is explained to participants that two items will be randomly selected to determine their payoff from the news quiz. Participants receive one euro (one pound in the UK) for each correct answer to the selected questions.

[20] For example, consider the following question. "True or false? According to recent research published in a prestigious scientific journal, average sea levels increased by about 8 cm between 1993 and 2019." If a respondent answers false, it is not clear whether they think that the actual increase is lower than or higher than 8 cm. Therefore, we present this as a fill-in-the-blank item with two answer options, 8 cm and 18 cm, thereby making 8 cm (18 cm) the anti-climate change (pro-climate change) option.

questions have correct answers consistent with pro-science attitudes, and the other two have correct answers consistent with anti-science attitudes. As discussed before, this tries to ensure that on average the direction of preference biases is not associated with news discernment.[21] As a control setting, we also include two neutral news items that are not on politicized topics.

The items were selected from a larger set of 40 questions after a pretest with 587 individuals from Germany and the UK. We applied multiple criteria in the selection of both the pretest and the actual quiz items. We narrowed down the list of 40 pretest questions from more than a hundred questions that we produced by selecting what in our opinion were the most relevant, timely, and important items. Among them, several are highly controversial and concern, for example, the Muslim birth rate, water fluoridation, or 5G, which have been the subject of many (true and fake) news. There were more topics in the pretest than in our final news quiz. We decided to have fewer topics with four items in each of the immigration, climate change, and science topics, and two items in the inequality topic.

Two major criteria for eliminating pretest questions were (i) either a very high or a very low level of difficulty in the pretest, which likely limits variation across respondents and countries; and (ii) maintaining the bias balance of the correct answers in each topic, as explained above. Ex-post, we strived to have relatively balanced subtopics within each topic. For example, we dropped the only question on terrorism (deaths), since it concerns immigration as not only a very grim but also a very rare phenomenon. We also eliminated the pretest items that were ambiguous in their bias direction. Another objective was to limit the number of country-specific questions. Therefore, only the immigration topic involves country-specific questions, and inequality questions concern global inequality.[22] In particular, Austrian and German respondents always see the same items concerning immigration, whereas the UK version differs in two items in that the mentioned statistics concern the UK rather than the EU. Nevertheless, we also ask for a UK-specific item regarding the popularity of the baby name “Muhammad" in the Austrian and German surveys, since similar (true and fake) news circulates very often in Western countries in print and social media.

The news items cite a source, such as “research published in a prestigious scientific

[21] For example, if all respondents always chose the answers that are consistent with their preference biases, they would have the same news quiz score.

[22] While the hyperglobalization of the West since the 1990s has been heavily criticized for valid reasons, it is also argued to be associated with significant reductions in global inequality and global poverty, which could perhaps mitigate some of the resentment against it. However, we find in our news quiz that this is not obvious to or accepted by most people.

journal," or "official statistics" so that the correct assessment cannot change due to new developments.[23] We do not use journal names as the general population may not know them however prestigious they may be. For the same reason, we cite "a prestigious demographic research organization" instead of the *Pew Research Center*.

4.3 Overconfidence measure

After participants complete the news quiz, we elicit their beliefs about their performance in the quiz to obtain a measure of overconfidence. The performance measure is the news quiz score, i.e., the total number of correct answers in the news quiz.

Our measure of confidence is in absolute terms: we ask respondents to guess their news quiz score, which is a number between 0 and 16. The measure of overconfidence then is the difference between a respondent's guess and their actual quiz score. The outcome of this measure can be positive, zero, or negative (classified as overconfident well-calibrated, and underconfident, respectively). Thus, our measure of overconfidence is an average measure: we have not asked participants to report their confidence in their answers to individual news items to keep the study length at around or below 25 minutes for most participants. Also, we opted for unincentivized belief elicitation to limit the study length.

4.4 Experimental treatment: Updating from information

Our experimental treatment is within subject and investigates the influence of cognitive and psychological factors on updating from new information and the evolution of opinions. After participants report their beliefs about their own performance, they take the same news quiz again. In each news item, participants see not only their initial answer but also a noisy but informative binary signal about the correct answer, a sort of noisy fact-checking message. Participants know that a signal shows the correct answer with a probability of 0.75 and the wrong answer with a probability of 0.25. The signals are conditionally independent across participants in each news item. Thus, roughly 75% of the respondents observe a correct signal in each news item. After seeing the signal about a news item, a participant can revise their initial answer.

We choose a signal precision of probability 0.75 because it is neither too high nor too low. 0.75 is not too low, and each signal can be viewed as a "fact check" albeit a noisy one. At the same time, each signal is not too high (i.e., it is false with a nontrivial

[23] Such published research or official statistics may not exist, in which case the news item is false.

probability), and therefore, overconfidence will likely play a role in the updating decisions of respondents.

The order of the news items in this part is the same as the order in which a participant saw the items the first time. The treatment is incentivized as every correct answer is rewarded with positive probability. In particular, for each participant, we randomly select one news item and pay the participant one Euro (one pound in the UK) if their final answer to that item is correct.

4.5 Survey Measure of Cognitive Ability

Following the treatment, subjects take a 12-item version of the Raven's Advanced Progressive Matrices (APM) test, due to Arthur and Day (1994). This is a validated and commonly used short version of the Raven's APM test. The test score of a participant provides us with a measure of their cognitive ability. The order of questions is important in the APM test and therefore not randomized. The test is incentivized, and each correct answer is rewarded with 25 cents (20 pence in the UK). The other measure of cognitive ability in our study is educational attainment, which we ask for at the beginning of the study.

4.6 End Surveys

The end survey has two parts. The first part is an opinion survey providing us with a measure of the preference bias of each respondent in each news theme included in our quiz. In particular, it provides us with the information on whether $v_i = 0$ or $v_i > 0$ in a theme for respondent i, and the direction of i's bias if $v_i > 0$. We use tested items from established sources, such as the World Values Survey and the European Values Survey, to elicit respondents' preference biases concerning the news themes in the quiz. We also measure their ideology (using the 11-point left-right scale) and institutional trust, such as trust in politicians, media, and scientists.[24]

As discussed in the model section, we are interested in not only the overall quiz performance of respondents but also their performance in news items with correct answers that are consistent or inconsistent with their preference biases – the latter relates to P_C and the former to P_M. We can compute a measure of P_C and P_M for each individual with $v_i > 0$ using the news quiz data and the survey data, and analyze how P_C and P_M vary with cognitive ability.

[24]See Table Appendix A.5 in the Online Appendix A for the full list of opinion survey questions.

We now describe how we obtain a measure of v_i (i.e., the preference bias of respondent i in a news theme of our quiz). The construction of the measure in each theme is based on the respondent's self-reports concerning that theme, e.g., reports of agreement, neutrality, or disagreement with relevant statements. For each theme, we use the relevant self-reports to obtain a measure indicating the classification of a respondent in that theme. In particular, this measure indicates the presence and direction of a respondent's preference bias in a theme, e.g., whether the respondent is "biased" (pro-science or anti-science) or neutral in the context of science.

We classify a respondent as preferentially "biased" in a theme (i.e., $v_i > 0$ in one direction or the other) if the respondent provides self-reports that are consistently in the same direction (or neutral) with at least one statement that is not neutral. The rest of the respondents are classified as neutral on that theme (i.e., $v_i = 0$) as they must have provided either at least two self-reports that are inconsistent in their bias direction or always neutral self-reports. This is explained in detail in the Online Appendix.[25]

The second part of the end survey asks participants additional background questions, such as employment status household income, party voting choices, and media consumption.

After the end survey, participants receive feedback on their performance in the different parts of the study and their payoff including the bonus amount.

4.7 Hypotheses

Key outcomes of interest are: (i) news quiz performance (i.e., quiz score); (ii) participant quiz performance in news items with correct answers that are inconsistent with their preference biases (i.e., P_C); (iii) participant quiz performance in items with correct answers that are consistent with their preference biases (i.e., P_M); and (iv) updating from a noisy information signal that is inconsistent with a participant's initial answer in the quiz. We will also explore the determinants of motivated reasoning, and we will check whether respondents exhibit motivated updating, which refers to a respondent's increased tendency to update their answer when the experimental information signal is consistent with the respondent's preference bias than when it is bias inconsistent.

We have three preregistered hypotheses concerning these outcomes, which we obtain from our theoretical model in Section 3. In particular, Hypotheses 1 and 2 derive from Proposition 1, and Hypothesis 4 is based on Proposition 2. While Hypothesis 3 also

[25] See section "Topic Partisanship Coding" in Appendix A.

derives from our model (part (iii) of Proposition 1), it is a weak hypothesis as we discuss below, and therefore, we have not preregistered it.

Hypothesis 1 (Effect of cognitive ability on news quiz score) *The news quiz performance (i.e., news quiz score) increases in cognitive ability.*

While Hypothesis 1 concerns the overall ability to sort fact from fiction, Hypothesis 2 concerns performance in the counter-motivated state, P_C. As described above in Section 4.6, counter-motivated state refers to news quiz items with correct answers that are inconsistent with the preference biases of respondents, as measured by our opinion survey. As discussed earlier, motivated reasoning may impair the ability to sort fact from fiction in the counter-motivated state. To compute P_C for a respondent, we consider only (1) the news themes in which the respondent is classified as biased; and (2) the news items in those themes with correct answers that are *inconsistent* with the bias direction of the respondent.[26] These restrictions stem from the theoretical definition of P_C.

Hypothesis 2 (Effect of cognitive ability in the counter-motivated state) *The likelihood of giving a correct answer in the counter-motivated state (P_C) increases in cognitive ability.*

Hypothesis 3 is based on part (iii) of Proposition 1 and concerns performance in the motivated state, P_M. As described in the previous section, motivated state refers to news quiz items with correct answers that are consistent with the preference biases of respondents, as measured by our opinion survey. Analogous to our computation of P_C, we determine P_M, focusing only on (1) the news themes in which the respondent is classified as biased; and only (2) the news items in those themes the correct answers to which are consistent with the biases of the respondent. Hypothesis 3 is a *weak* hypothesis and not preregistered because, unlike our other hypotheses, it relies on certain theoretical conditions, as discussed in Section 3.

Hypothesis 3 (Effect of cognitive ability in the motivated state) *The likelihood of giving a correct answer in the motivated state (P_M) increases in cognitive ability.*

Finally, Hypothesis 4 concerns the effect of overconfidence on updating. As described in Section 4.3, we focus on cases where respondents' initial answers are inconsistent with the observed signals, from which they may update and revise their answers.

[26] In the preregistration, Hypothesis 2 uses the term "likelihood of making a motivated error", which corresponds to $1 - P_C$, and predicts that the likelihood of making a motivated error decreases in cognitive ability. This is equivalent to our current Hypothesis 2 as the preregistration defines the likelihood of making a motivated error as the share of wrong answers in news quiz items the correct answers to which are inconsistent with the respondents' biases, which is equivalent to $1 - P_C$.

Hypothesis 4 (Negative effect of overconfidence on updating) *Overconfident individuals are less likely to update and change their answers after a signal that conflicts with their initial assessment.*

4.8 Data Collection

Citizen-residents of Austria, Germany and the UK between 18 and 75 years of age participated in the study. The online study links were distributed by Marketagent, a commercial survey company, which partners with online panels of respondents in many countries. Respondents were only paid if they completed the full study. In total, we have data from 3682 respondents (1234 respondents in Austria, 1268 in Germany and 1180 in the UK). The participation fee is two euros (1.80 pounds in the UK). The average payoff including the bonus is about five euros. The study began on June 13, 2023, with a soft launch, and the next phase of the data collection lasted from September 25 to November 5, 2023. The design had a minor change after the soft launch: we slightly increased the payoff per correctly solved APM test question in order to make the average bonus payment closer to our target of 3.

5 Results

We begin with a brief descriptive analysis of the data and then discuss the evidence for our hypotheses as well as additional analysis conducted in order to further test our theory and explore mechanisms.

For the main analysis sample, we drop the data of participants who are either very fast (indicating speeding through the questions without paying attention) and those who are very slow suggesting that they may have been distracted by other activities or searched for answers. Specifically, we drop the data of respondents who spent more than 120 minutes (about 5% of the data) and less than 10 minutes (about 7% of the data). However, our main results are robust to including all observations in the analyses below (see Online Appendix C).

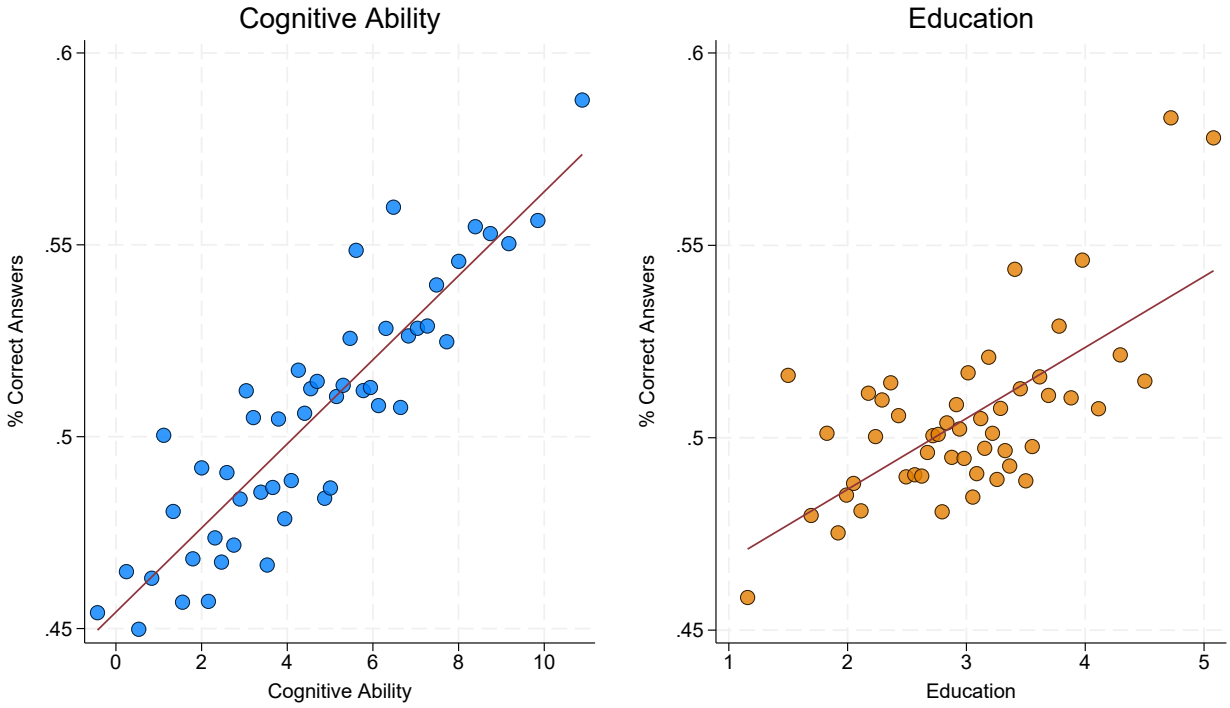
Hereafter, our results in the main text refer to results from the main analysis sample. The average time to complete the survey is 27.7 minutes, and the median completion time is 23 minutes. On average, the news quiz score is 8.08 out of 16 (i.e., the share of correct answers is 50.5% on average). While the quiz is not easy, some questions are easier and some harder (see Online Appendix A, Table A.4 for scores in individual questions). The quiz score after observing informative signals about the correct answers increases to 9.32.

That is, the share of correct answers increases by about 15% (i.e., to 58%). The sample is slightly overconfident in that they believe that they have answered 9.06 items correctly.

5.1 Hypothesis 1: The role of cognitive ability

According to Hypothesis 1, the news quiz score increases in cognitive ability. To address this hypothesis, we study the relationship between the news quiz score and cognitive ability. There are two measures of cognitive ability in our study: our survey measure is based on the APM test score (i.e., IQ score) and educational attainment. The APM test score and educational attainment may be viewed as capturing different cognitive ability dimensions. For example, while education is more associated with crystallized ability, the APM test relates more to fluid intelligence. The left panel of Figure 1 is a binned-scatter plot that illustrates the effect of the IQ score on the news quiz score normalized in percentage terms, controlling for a broad array of respondent characteristics. The right panel replaces IQ score with educational attainment. Both panels are in line with Hypothesis 1.

Figure 1: Effect of cognitive ability on news quiz score



Notes: IQ score varies from 0 to 12. Educational attainment varies from 1 to 5. The left and the right panels are binned-scatter plots showing the respective effect of the IQ measure and educational attainment on the news quiz score. The included controls and fixed effects are : age, gender, income, employment status, indicator variables for being foreign born, having a foreign born mother, and having a foreign born father, country and survey month fixed effects, as well as media usage, divergence from the median position on the left-right scale (denoted by "median dev"), an indicator variable for extremist party voting, and trust. See for the definition of these variables.

Table 1 presents regression estimates of the effect of cognitive ability on the news quiz score in percentage terms. In that table, we report OLS regression specifications with different sets of cognitive ability measures (only IQ score, only educational attainment, and both), different sets of control variables, as well as with and without country and survey month fixed effects. We include survey month fixed effects as data collection started in June 2023 and continued in September, October, and November. The set of controls includes the demographic variables, gender, age, income, employment status, indicator variables for being foreign-born, having a foreign-born mother, and having a foreign-born father, as well as measures of media usage, institutional trust, extremist party voting, and divergence from the median position on the left-right scale, which we denote

by “median dev" in our regression tables.[27]

The coefficients of the primary explanatory variables of interest, IQ score and educational attainment are positive, sizeable, and statistically highly significant in every specification they are included in Table 1. We observe limited variation in the coefficients of either variable across different specifications. Our preferred specification for testing Hypothesis 1 is presented in Column 7. It includes both cognitive ability measures, the full set of controls, and country and survey month fixed effects. Column 7 shows that the IQ score and educational attainment are potentially the most influential determinants of the ability to discern fact from fiction.[28] An increase in the IQ score by one unit increases the share of correct answers in the news quiz by 1.1 percentage points, and an increase in educational attainment by one level results in an increase of 1.8 percentage points (IQ score varies from 0 to 12, and educational attainment varies from 1 to 5).[29]

In addition to cognitive ability, demographic characteristics such as age, gender, and income level turn out to be highly statistically significant factors explaining the news quiz score. In particular, older males with higher income and non-centrist views on the left-right scale perform better in the news quiz. On the aggregate, German respondents performed better in the news quiz, consistent with what we expected. Austria, Germany, and the UK are all highly developed and wealthy, but Germany has a higher ranking than the other two in well-known institutional and governance rankings (see also Footnote 10). While media usage and institutional trust do not affect the news quiz score on the aggregate, we will show that they have a nontrivial impact on the news quiz performance once the score is disaggregated to its motivated and counter-motivated components to analyze motivated reasoning.

We repeat the analysis in Table 1 separately for every theme in Table 2. In every news theme except science, the reported effect of the IQ score and educational attainment on the ability to sort fact from fiction mirrors our findings in Table 1. In Table 2, we present the results of the specification in Column 7 of Table 1 for each news theme separately. Table 2 shows that educational attainment has an insignificant effect in the science theme. The

[27] To be precise, the measure of divergence (i.e., “median dev") is the absolute value of the reported difference from the median position of the survey sample on the left-right scale (from 0 to 10), which happens to be the center position (that is, 5) in our survey. Media usage is the average of TV, radio, newspaper, internet and social media usage to stay informed about current events. Institutional trust (the variable “trust" in regression tables) is the average of trust in politicians, news media, education system, scientists, and social media. Extremist vote is a binary variable indicating whether or not the participant voted for a far-right or a far-left party in the last general election of their country.

[28] See Table C.6 in Online Appendix C for all coefficients.

[29] The coefficients for the IQ score and educational attainment are largely unaffected in the full sample including all observations. See Table C.7 in Online Appendix C.

Table 1: Cognitive ability and Quiz score

	IQ			Education			IQ & Education
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cognitive Ability	0.012***	0.012***	0.012***				0.011***
	(0.001)	(0.001)	(0.001)				(0.001)
Education				0.023***	0.026***	0.024***	0.018***
				(0.003)	(0.003)	(0.003)	(0.003)
Observations	3227	3227	3227	3227	3227	3227	3227
Controls	N	N	Y	N	N	Y	Y
Month FE	N	Y	Y	N	Y	Y	Y
Country FE	N	Y	Y	N	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. IQ score varies from 0 to 12. Educational attainment varies from 1 to 5. The table reports only the coefficients of statistically significant control variables. See Table C.6 in Online Appendix C for the complete set of coefficients. The omitted categories for gender, employment status, and country are male, full-time employee, and Austria. Columns 1 and 4 show the respective effect of our IQ measure and educational attainment on the news quiz score without any controls or fixed effects. Columns 2 and 5 show the respective effect of the IQ score and educational attainment on the news quiz score without any controls, except country and survey month fixed effects. Columns 3 and 6 show the respective effect of the IQ measure and educational attainment with the full set of controls as well as country and survey month fixed effects. The included control variables are age, gender, income, employment status, and indicator variables for being foreign born, having a foreign born mother (denoted as "mother fb"), and having a foreign born father (denoted as "father fb"), as well as media usage, an indicator variable for extremist party voting, divergence from the median position on the left-right scale (denoted by "median dev"), and institutional trust (see Footnote 27 for the explanations of these variables). Finally, Column 7 shows the effect of the IQ measure and educational attainment jointly on the news quiz score with the full set of controls and country and survey month fixed effects.

reason for this is explained in the next section on motivated reasoning. There, we show that higher educational attainment results in higher motivated reasoning in the science theme. In turn, higher motivated reasoning is associated with a lower quiz score in science. In addition, the coefficients for the IQ score and educational attainment are notably lower in the science theme than in the immigration, climate change, and inequality themes, as shown in Table 2.[30]

To summarize, we find strong support for Hypothesis 1 on the aggregate. However, we also document heterogeneity in the effect of cognitive ability on sorting fact from fiction across different themes. In particular, the effect of IQ score and educational attainment is significantly smaller in the science theme than in other themes, with the effect of educational attainment virtually insignificant. These findings concerning science are inherently related to motivated reasoning, as discussed in detail in the next section.

[30]See also Figure Appendix B.7 in Appendix A. Respondents with higher educational attainment and higher cognitive ability are more likely to be coded as pro-science types and they also exhibit higher levels of trust in scientists

Table 2: Cognitive ability and Quiz score by theme

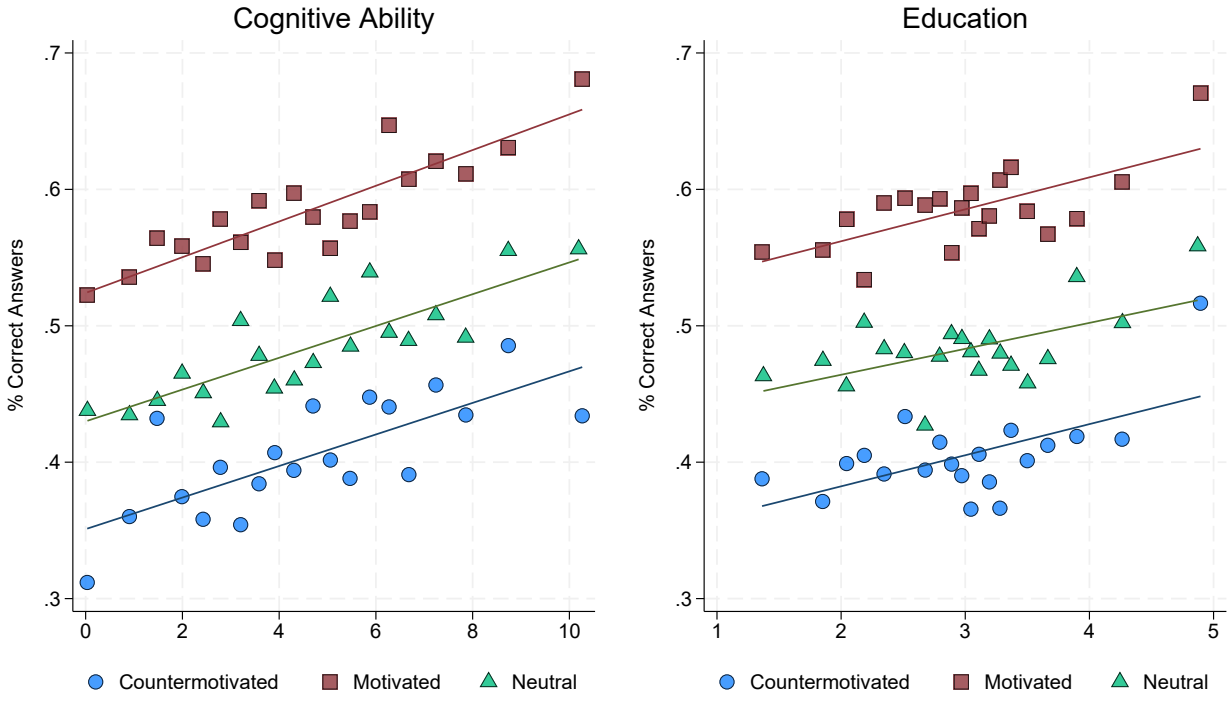
	Immigration	Climate	Science	Inequality	Neutral
	(1)	(2)	(3)	(4)	(5)
Cognitive Ability	0.015***	0.011***	0.006***	0.013***	0.009***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.015***	0.024***	0.008*	0.028***	0.023***
	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Observations	3227	3227	3227	3227	3227
Controls	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. The Table shows the effect of the IQ measure and educational attainment on the news quiz score in each theme and for neutral items with the full set of controls and country and survey month fixed effects. See Table 1 for the full set of control variables and see Tables C.8 for all coefficients.

5.2 Hypotheses 2 and 3: Motivated Reasoning

Hypotheses 2 and 3 concern motivated reasoning, which plays a central role in our study because it has the potential to impair the ability to sort fact from fiction, especially in what we call the counter-motivated state. After addressing Hypotheses 2 and 3, we will explore the extent and the determinants of motivated reasoning on the aggregate and by news theme separately.

Figure 2: Effect of cognitive ability on news quiz score



Notes: Top and bottom left (right) panels are binned scatterplots that show the respective effect of the IQ measure and educational attainment on the motivated (unmotivated) news quiz score. The included controls and fixed effects are the same as in Figure 1.

In this section, we focus on those news themes in which a respondent is classified as biased according to their survey answers because motivated reasoning concerns a respondent's preference biases (see Section 4.6 for the explanation of this respondent classification). In every news theme in which a respondent is classified as biased, half of the questions have correct answers that are consistent with the biases of the respondent, and the remaining half have correct answers that are bias-inconsistent because every news theme is balanced in the bias of their correct answers, as explained earlier. Thus, we obtain two scores for each respondent in questions for which they are classified as biased:

(i) *Motivated news quiz score*: this is the score (normalized in percentage terms) in questions with correct answers that are consistent with the biases of a respondent. This corresponds to P_M in our model in Section 3.

(ii) *Counter-motivated news quiz score*: this is the score (normalized in percentage terms) in questions with correct answers that are inconsistent with the biases of a respondent. Thus, it is the counterpart to the motivated score and corresponds to P_C in our model in

Section 3.

To make the computation of the motivated score and the counter-motivated score more transparent, consider the following question in the science theme: *"True or false? According to a recent survey by the American Medical Association, around 40% of physicians believe that a cure for various forms of cancer already exists but is withheld from the public to increase healthcare industry profits.* The correct answer to this question is "false" and thus pro-science. Suppose that respondent i is classified as pro-science, respondent j as anti-science, and respondent k as neutral based on their survey self-reports. Then, the above question is part of the motivated news quiz score for i and the counter-motivated score for j. No question on the science theme is part of the motivated or counter-motivated score for respondent k.

Hypothesis 2 states that the counter-motivated news quiz score (P_C) increases in cognitive ability. The blue lines with dots on the left and right panels of Figure 2 demonstrate that, as predicted, an increase in the IQ score or educational attainment increases the counter-motivated score. Two general remarks concerning Figure 2 are in order. Comparing the regression lines for the motivated score (red lines with squares) and the counter-motivated score, we note that in each panel the red line is much more elevated than the blue line, which already hints at the significant presence of motivated reasoning: participants seem to be much more successful at those questions with correct answers that are consistent with their preference biases. For reference, Figure 2 also presents the *neutral score* (green line with triangles), which we define as the score of a participant in news themes in which they are classified as neutral according to their responses in the opinion survey. One expects this score to be in between the motivated score and the counter-motivated score, which is indeed the case. Additionally, Figure 3 shows the average quiz score by motivated state. The score increases significantly from the counter-motivated state to neutral and from neutral to motivated.

Table 3 presents regression estimates of the effect of cognitive ability on the counter-motivated score to test Hypothesis 2.[31] Our preferred specification is Column 3, which includes both cognitive ability measures, the full set of controls, and country and survey month fixed effects. The IQ score and educational attainment are potentially the most influential variables explaining the counter-motivated score, analogous to our results in Section 5.1. Increasing the IQ score from 0 to 12 increases the motivated score by more than 13 percentage points, and increasing the level of education from the lowest to the highest level increases the score by about 6.5 percentage points.

[31] See Table C.10 in Online Appendix C for all coefficients.

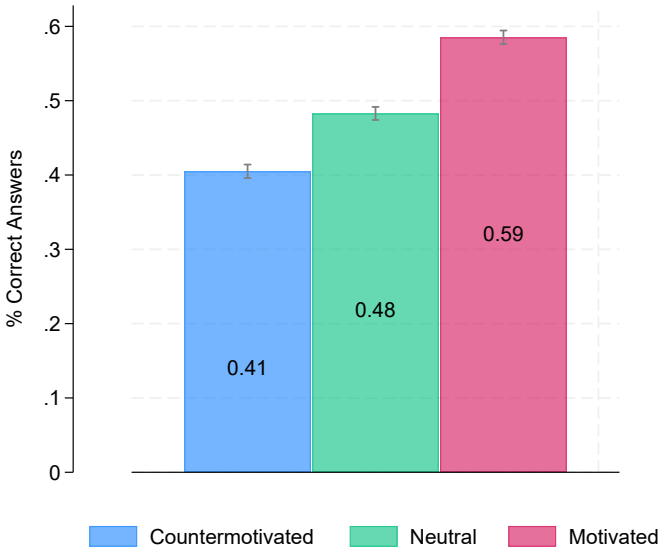


Figure 3: Quiz score by Motivated state

Notes: the plot shows the unconditional means of quiz score by motivated state.

Table 3: Cognitive ability and Quiz score in motivated/countermotivated states

	Countermotivated			Motivated		
	(1)	(2)	(3)	(4)	(5)	(6)
IQ	0.011***	0.011***	0.011***	0.012***	0.012***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.023***	0.023***	0.016***	0.010**	0.012**	0.017***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Observations	3112	3112	3112	3112	3112	3112
Controls	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. See Table C.10 in Online Appendix C for the complete set of coefficients.

According to Hypothesis 3, the motivated news quiz score (P_M) also increases in cognitive ability under certain conditions (e.g., if the preference biases are not too strong for most people). The top and bottom left panels of Figure 2 demonstrate that an increase in the IQ score or educational attainment increases the motivated score. The increasing slope for both IQ score and education in Figure 2 already points in this direction. Column 6 of Table 3 shows that the IQ score and educational attainment are indeed positively associated with quiz scores even when respondents are in the motivated state.

Hence, on the aggregate the effect of cognitive ability is sizeable, highly statistically significant and robust to the presence of motivated reasoning: participants do exert effort

to answer questions accurately despite their biases, and the success of this effort increases in *both* the IQ score and educational attainment.

We now combine the two states to formally document the presence of motivated reasoning and explore the extent to which motivated reasoning and cognitive ability jointly influence the ability to sort fact from fiction. Table 4 presents regression estimates in which the dependent variable is the (motivated or counter-motivated) quiz score for each participant and every specification involves our cognitive ability measures as well a dummy variable called "Motivated", which indicates if the quiz score refers to the motivated score ($= 1$) or its counterpart, i.e., the counter-motivated score ($= 0$). The variable "Motivated" thus estimate the extent of motivated reasoning in our sample.

Table 4: Cognitive ability and Quiz score with motivated reasoning

	(1)	(2)	(3)
Motivated	0.180***	0.180***	0.180***
	(0.006)	(0.006)	(0.006)
IQ	0.011***	0.011***	0.011***
	(0.001)	(0.001)	(0.001)
Education	0.017***	0.017***	0.017***
	(0.004)	(0.004)	(0.004)
Observations	6224	6224	6224
Controls	N	N	Y
Month FE	N	Y	Y
Country FE	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. See Table C.12 in Online Appendix C for the complete set of coefficients.

Table 4 reports that the magnitude of motivated reasoning is 18% and highly statistically significant. Recall from Section 3 that we defined motivated reasoning as the difference between the motivated score and the counter-motivated score, which takes a value between 0 and 1.[32] For example, a respondent who answers *solely* based on their preference biases will have a difference of one between the two values, because the motivated score will be one and the counter-motivated score will be zero. While motivated reasoning has a clearly sizeable impact on decision-making, the difference at 18 percentage points is closer to zero than one, indicating that respondents do make an effort to give the correct answer to a question and their preference biases are on average not too strong.[33]

[32] In Appendix C we show that even including the neutral score as benchmark gives us similar results: respondents are more likely to answer correctly in the motivated state respect to the neutral case and are less likely to answer correctly in the counter-motivated state.

[33] These, in turn, explain why we found support for Hypothesis 3.

The success of this effort increases in cognitive ability as our regression results show. We also note that the magnitude of the effect of cognitive ability (measured jointly by the IQ score and educational attainment) rivals that of motivated reasoning, but only when we vary their levels from very low to very high.

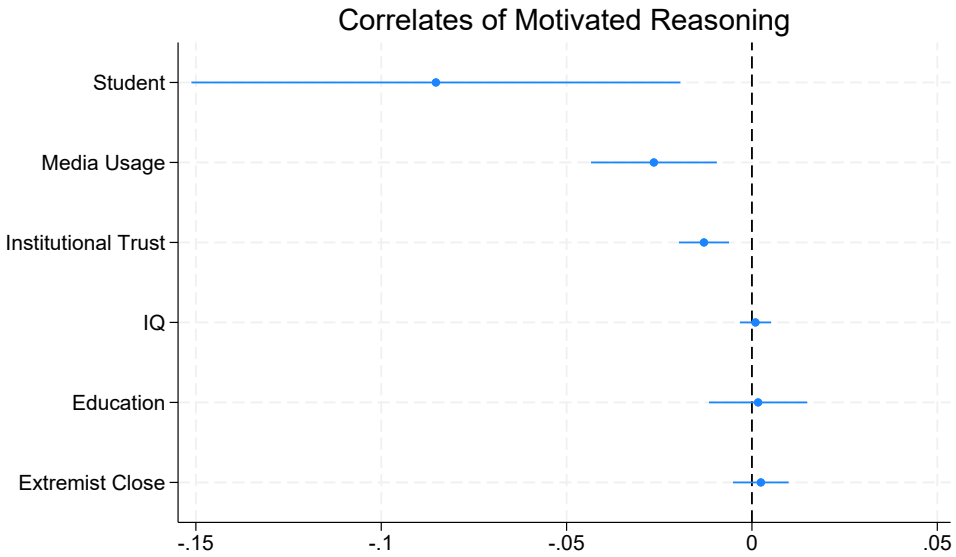
Table 5: Cognitive ability and Quiz score with motivated reasoning by topic

	Immigration	Climate	Science	Inequality
	(1)	(2)	(3)	(4)
Motivated	0.215***	0.090***	0.232***	0.289***
	(0.012)	(0.010)	(0.010)	(0.014)
IQ	0.018***	0.013***	0.007***	0.013***
	(0.002)	(0.002)	(0.002)	(0.003)
Education	0.020***	0.024***	0.008	0.029***
	(0.007)	(0.006)	(0.006)	(0.009)
Observations	3482	4510	4444	4406
Controls	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. The number of observations is twice the one in Table 3 since we now combine the score in the two states to estimate the magnitude of motivated reasoning. See Table C.11 in Online Appendix C for the complete set of coefficients.

Table 5 shows the joint impact of motivated reasoning and cognitive ability for each news theme using the specification in Column 7 of Table 1, which involves both cognitive ability measures and the full set of controls and fixed effects. In every theme, motivated reasoning is a major factor in decision-making. The reported effect of cognitive ability on the news quiz score in Table 5 mirrors our findings in Table 2: the effect of the IQ score and educational attainment are smaller in the science theme than in other themes, with the effect of educational attainment insignificant in science. We will elaborate on this point further below.

Figure 4: Correlates of motivated reasoning.



Notes: We report the significant correlates of Motivated reasoning defined as defined as the difference between the motivated score and counter-motivated score of a respondent. The regression mirrors the one used in Column 3 and 6 of Table 3.

We now explore the correlates of motivated reasoning. For this purpose, we directly use our motivated reasoning definition in Section 3 as the dependent variable: the difference between the motivated score and the counter-motivated score of an individual (i.e., $P_M - P_C$). Figure 4 shows that four variables are associated with motivated reasoning: media usage, trust, extremist party voting, and being a student (versus a full-time employee). The higher the media usage and the higher the trust, the lower the motivated reasoning. Perhaps unsurprisingly, motivated reasoning increases in extremist party voting. Finally, students exhibit less motivated reasoning than full-time employees.

As Figure 4 shows, on the aggregate, cognitive ability is not associated with motivated reasoning. However, when we disaggregate data by theme, the picture concerning the effect of the IQ score and educational attainment is surprisingly heterogeneous. Importantly, the coefficient for educational attainment is positive and economically and statistically highly significant in the science theme in Table 6. This finding connects to our results in Tables 2 and 5, which show that education does not have a significant effect on accuracy in the science theme, unlike in other news themes. These findings complement each other as follows. A regression analysis shows that the quiz score in the science theme decreases in the magnitude of motivated reasoning, which is highly statistically

Table 6: Effect of cognitive ability on motivated reasoning by theme

	Immigration	Climate Change	Science	Inequality
	(1)	(2)	(3)	(4)
IQ	0.004	0.007*	0.007	−0.014**
	(0.005)	(0.004)	(0.004)	(0.006)
Education	−0.044***	−0.008	0.041***	−0.002
	(0.015)	(0.012)	(0.013)	(0.019)
Observations	1741	2255	2222	2203
Controls	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. The dependent variable is motivated reasoning, defined as the difference between the motivated score and the counter-motivated score of a respondent.

significant.[34] In turn, motivated reasoning strongly increases in educational attainment, as shown in Table 6. As a result, educational attainment does not produce a positive effect on accuracy in the science theme, unlike in the other news themes. A similar effect of cognitive ability (this time, the IQ score) on motivated reasoning is present in the climate theme, but it is marginally significant and smaller in magnitude. Table 6 also shows that educational attainment reduces motivated reasoning in the immigration theme, and IQ score reduces motivated reasoning in the inequality theme.

We conjecture that certain news themes, such as science and climate change, are more closely associated with the "identity" of highly educated people than others, such as immigration and inequality. In particular, for many highly educated individuals, it may be a personal norm to have high trust in science.[35] Also, it is sometimes argued that highly educated or smarter people are in a better position to produce evidence for (against) news they are motivated to accept (reject) in science and climate change.

5.3 Hypothesis 4: Overconfidence and Updating

This section addresses Hypothesis 4 and studies whether overconfidence reduces the tendency to revise answers in response to new information. In this part of the study,

[34] We regress the quiz score in the science theme on motivated reasoning in science (i.e., the difference between the motivated and counter-motivated science quiz scores), the IQ score, educational attainment, the full set of controls and fixed effects, and find that the coefficient for motivated reasoning is negative and highly statistically significant. Consistent with Tables2 and 5, the coefficient for educational attainment is not significant, but the coefficient of the IQ score is highly significant.

[35] See also Figure Appendix B.7 in Appendix A

respondents take the same news quiz again. In every question, they are reminded of their initial answer and shown a noisy but informative signal concerning the correct answer, after which they may change their initial answer. Our overconfidence measure is the difference between a respondent's elicited news quiz score and the actual score. If this measure is positive, negative, or 0, then the respondent is overconfident, underconfident, or well-calibrated respectively.[36]

To measure updating, we consider only cases where respondents' initial answers to news items are inconsistent with the observed information signals. Consequently, our measure of updating is the share of revised answers among all news items where the respondent's initial answers differ from the signals they observe.

On average, the share of updated answers is 31%, which seems to be low given that the average share of correct answers (the first time the quiz is taken) is only 50.5%, and the accuracy of a signal is 75%. The low share of updating explains the limited increase in the news quiz score in this part of the study.

The main specification for testing Hypothesis 4 regresses updating (i.e., the share of changed answers in the relevant news items described above) on the overconfidence measure, the control variables mentioned above in the main analysis for Hypotheses 1, 2 and 3, as well as the cognitive ability measure and the news quiz score. Column (1) in Table 7 shows that there is no discernible effect of overconfidence in the overall sample. Nevertheless, the effect of the cognitive ability measure and the actual news quiz score is highly statistically significant: an increase in the APM test score or a decrease in the news quiz score does increase the share of updated answers. These are both intuitive findings. In particular, all else (including the overconfidence measure) equal, those with a higher news quiz score should on average update less than those with a lower score.[37]

[36] As mentioned earlier, this aggregate measure of confidence has costs and benefits. It is noisier but also faster than asking participants to report their confidence in every answer they give.

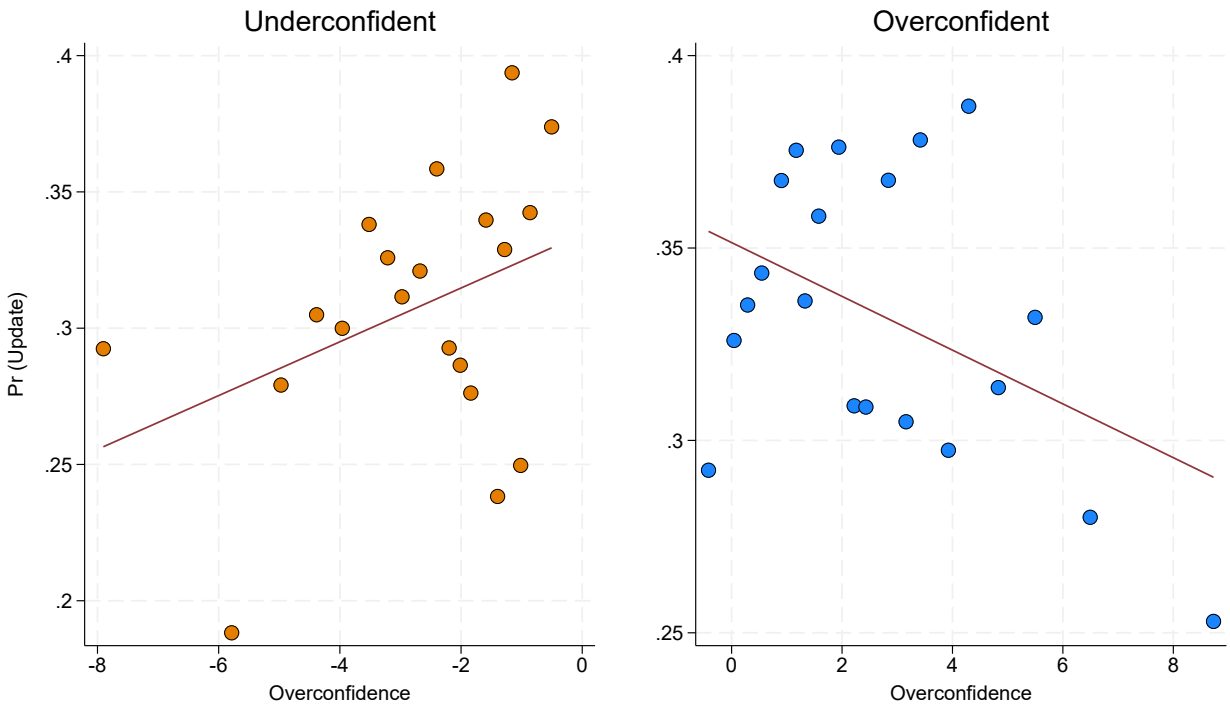
[37] For example, two respondents who overestimate their news quiz score by four may be expected to behave very differently if one of them has an actual score of 10 and the other has a score of five. In particular, we expect the former to revise fewer answers than the latter.

Table 7: Cognitive ability and Quiz score

	All			Overconfident/ well-calibrated			Underconfident		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Overconfidence	0.001	0.000	−0.000	−0.005	−0.008***	−0.010***	0.006	0.008	0.010*
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
consistent	−0.004	−0.004	−0.003	0.000	−0.002	0.002	−0.012**	−0.012**	−0.013**
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)
Observations	3227	3227	3227	2192	2192	2192	1035	1035	1035
Controls	N	N	Y	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Notes: The dependent variable is the share of updated answers among all news items where the respondent's initial answers differ from the signals they observe. The overconfidence measure is the difference between a respondent's elicited news quiz score and the actual score. The controls are the same as in Column 7 of Table 1 with the addition of the number of Answer-signal consistent answers.

Figure 5: Effect of cognitive ability on news quiz score

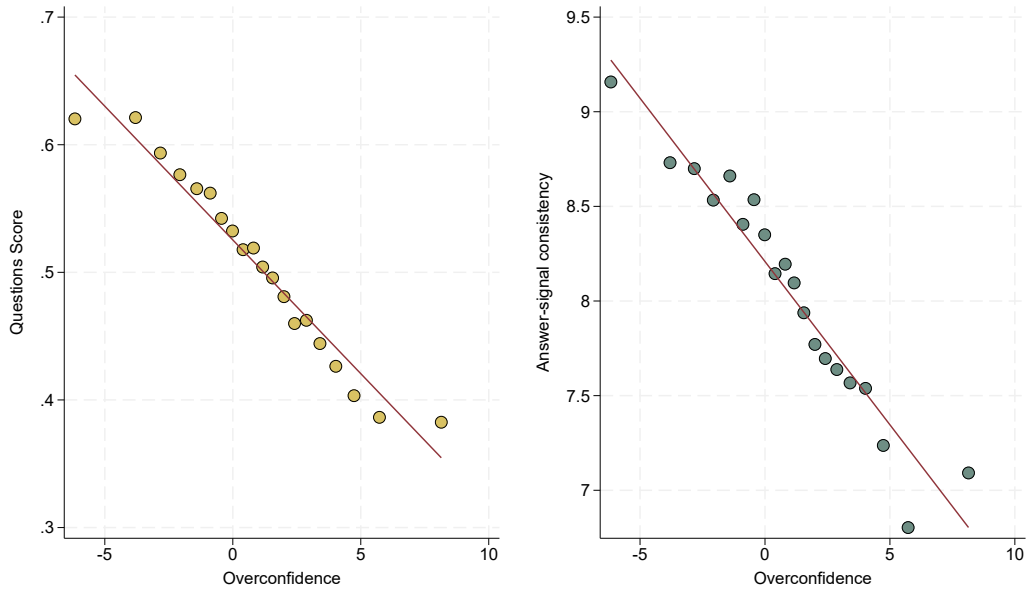


Notes: The left and right panels show the effect of higher (over)confidence in the underconfident and the weakly overconfident sample, respectively. The included controls are all the controls in the main specification in Column (3) of Table 7.

Next, we split the sample into (i) underconfident respondents (i.e., respondents

with negative overconfidence score) and (ii) overconfident or well-calibrated respondents (i.e., respondents with weakly positive overconfidence measure). A different picture emerges with these two groups, as shown in Figure 5. In particular, focusing on overconfident or well-calibrated respondents, the negative effect of overconfidence on updating is evident: the higher the overconfidence, the lower the percentage of updated answers. An increase in the overconfidence score by one reduces updating by 1 percentage points, as shown in Column (6) in Table 7 ($p < 0.001$).[38] Again, an increase in the APM test score or a decrease in the news quiz score does increase the share of updated answers. Additional explanatory variables, such as education and self-placement in the left-right scale do not affect the results. Also, the effect of the education variable is mostly insignificant.

Figure 6: Overconfidence, News quiz score, and Answer-signal Consistency



Notes: The left and the right panels show how overconfidence relates to the news quiz score and answer-signal consistency, respectively. The included controls are all the controls in Column (3) of Table 7 except the news quiz score and answer-signal consistency.

However, results are different for underconfident respondents. Column (4) shows that the coefficient of the overconfidence measure becomes positive, which is marginally significant.[39] To explore the most likely mechanism behind this, we note that respondents may update their confidence during this part of the study, depending on how consistent

[38] Including education as an additional explanatory variable does not affect this result. In addition, its coefficient is insignificant.

[39] Also, the APM test score or the news quiz score no longer matters.

their initial answers and information signals are. Therefore, we include an additional explanatory variable in the regression, which equals the number of signals that are consistent with a respondent's initial answers. Hereafter, we refer to this variable as the answer-signal consistency variable. This variable turns out to be statistically significant in the underconfident sample, and the sign is negative, as we expected (see Column (9) in Table 7). That is, the higher the overall number of initial answers that are consistent with information signals, the lower the likelihood of updating among the underconfident, pointing to a confidence-boosting effect of the answer-signal consistency.

The asymmetry in the effect of the answer-signal consistency variable is not very surprising in light of the literature on self-confidence, which documents an asymmetry in updating from good and bad signals concerning ego-relevant attributes (see, e.g., Eil and Rao (2011); Zimmermann (2020); Möbius et al. (2022)). Consistent with the Dunning-Kruger effect, highly underconfident participants perform better in the news quiz than less underconfident or overconfident subjects (as shown in the left panel of Figure 6) and thus observe higher answer-signal consistency (shown in the right panel of Figure 6). As a result, the underconfident may update from their relatively high answer-signal consistency, but the overconfident does not seem to update from this variable. The positive coefficient of the overconfidence variable suggests that the highly underconfident may have revised their confidence in a way that changes the confidence ordering of respondents, which our confidence measure does not capture as it is elicited only once before the updating part begins.

To summarize, our measure of confidence may be very noisy in the case of (highly) underconfident respondents, who may positively revise their confidence over the course of the updating part of the study. Such revision in turn limits the learning and updating from inconsistent information signals. Thus, we find evidence for Hypothesis 4 in the subsample of overconfident and well-calibrated respondents, by documenting that an increase in overconfidence reduces updating in this subsample.

5.4 Motivated updating

The previous section suggests that respondents exhibit an asymmetry in updating from good and bad signals concerning an ego-relevant attribute, i.e., their news quiz performance. We now consider another form of asymmetry in updating. Respondents who are biased in a theme may be less willing to update in certain cases and more willing to update in others. Recall that we analyze updating in a question only if the initial answer of the respondent is inconsistent with the observed signal, and consider the following mutually

exclusive cases:

(i) The initial answer of the respondent in a news theme is inconsistent with both the observed signal and their bias in that theme.
(ii) The initial answer of the respondent in a news theme is inconsistent with the observed signal but consistent with their bias in that theme.

Motivated updating means that the responsiveness of respondent i to a signal that counters their initial answer is asymmetric when $v_i > 0$; that is, respondents are more likely to change their answer in case (ii) than in (i). To analyze whether respondents exhibit motivated updating when they are biased, we follow an approach that is similar to our analysis of motivated reasoning. In particular, we compute for each individual the share of updated answers in case (i) and the share of updated answers in case (ii). In this case, we lose more observations than in previous analyses, since depending on whether a respondent is biased in a theme, the direction of their biases, their initial answers, and the realization of signals, data may be missing for the case (i) or case (ii) (or for both).

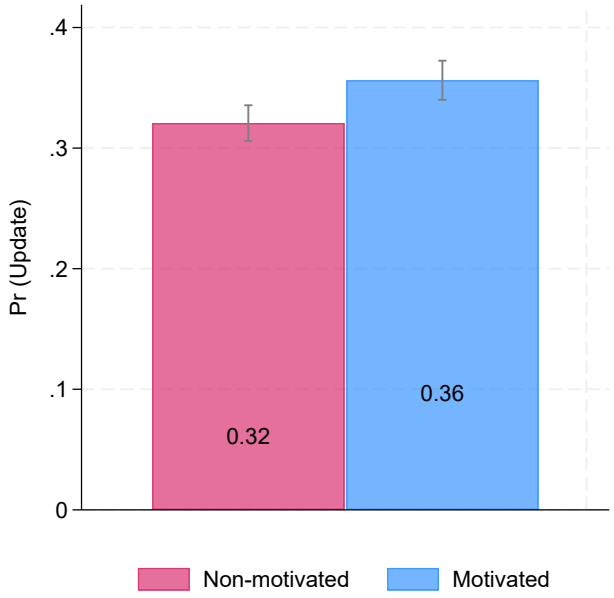


Figure 7: Motivated updating

Figure 7 shows the unconditional effect of respondents' preference bias on updating. Respondents are 4 percentage points more likely to update their answers when updating means changing their answers towards their preference bias.

Table 8 presents the results of a regression in which the dependent variable is the

Table 8: Cognitive ability and Quiz score

	Baseline	FE	Full
	(1)	(2)	(3)
Motivated	0.036***	0.036***	0.036***
	(0.011)	(0.011)	(0.011)
Cognitive Ability	0.008***	0.012***	0.012***
	(0.002)	(0.002)	(0.002)
Education	0.007	−0.004	−0.007
	(0.006)	(0.006)	(0.007)
Observations	4980	4980	4980
Controls	N	Y	Y
Month FE	N	Y	Y
Country FE	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. The dependent variable is the share of updated answers among all news items where the respondent's initial answers differ from the signals they observe. The controls are the same as in Column 7 of Table 1 with the addition of overconfidence. The observations come from a sample which contains the same respondent in both cases (i) and (ii) of motivated updating.

share of updated answers for each participant in case (i) and case (ii), and the regression specifications follow the structure in Table 7, Columns 1-3, except for the addition of a dummy variable called "Motivated", which indicates if the share of updated answers concern case (i) (= 1) or its counterpart (= 0). According to Table 8, the magnitude of motivated updating is 3.6% in every specification, which is highly statistically significant. While 3.6% seems small, the share of updating is also low on average, as mentioned earlier, at 31%. Consistent with Table 7, the IQ score has a positive effect on updating.

In Section 5.3, we found that on the aggregate cognitive ability has no effect on the magnitude of motivated reasoning, but disaggregated by theme, the effect of cognitive ability on motivated reasoning is heterogeneous. In particular, motivated reasoning increases in educational attainment in the science theme. We now explore the effect of cognitive ability on motivated updating by theme. For this analysis, we define motivated updating as the difference between the respective share of updating in case (i) and case (ii) for each participant.

Table 9 shows respondents with higher IQ are more likely to update in a motivated way in the Science topic. The effect is just marginally significant though the coefficient is much larger for science than for any other theme. This result is consistent once again with science being part of the "identity" of respondents with higher cognitive ability.

Table 9: Motivated Updating by theme

	Immigration	Climate Change	Science	Inequality
	(1)	(2)	(3)	(4)
(first) IQ_total	0.003	0.002	0.013*	0.002
	(0.007)	(0.006)	(0.007)	(0.010)
(first) education	0.013	−0.010	−0.032	−0.011
	(0.021)	(0.019)	(0.021)	(0.031)
Observations	798	1055	789	397
Controls	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. The dependent variable is the difference in the share of updated answers between case (i) and case (ii). The controls are the same as in Column 7 of Table 1 with the addition of overconfidence.

6 Robustness

In Appendix C we perform several robustness checks on the main results of this study. In particular in Tables C.7, C.15, C.24 and C.26 we show that our results are not sensitive to the decision to exclude from the sample respondents who spent more than 120 minutes and less than 10 minutes to complete the survey.

Additionally in Tables C.9, C.13, C.23 and, C.25 we use post double selection Lasso to select the relevant controls and we show that results are mainly unaltered.

In addition, we weight our regression with weights constructed with the shares of the population in each education category in Austria, Germany and the UK, also in this case our results were replicated.

We then show in Tables C.14 and C.27 that our results are robust to different rescaling of the answers to our opinion questions. This is important because it shows that even changes in the categorization of respondents in different types still give us similar results when we look at the impact of motivated reasoning on the ability to sort fact from fiction and updating.

Lastly, we abstract from the cognitive ability or other individual characteristics and we estimate the effect of motivated reasoning by just exploiting within-individual variation. In tables C.16 and C.28 we show that our results on motivated reasoning are confirmed even when using individual fixed effects and question fixed effects to control for unobserved heterogeneity. Results in Table C.16 can be also replicated if we include the neutral score as a benchmark, thus showing once again that motivated reasoning is a strong determinant of the ability to sort fact from fiction.

7 Concluding Remarks

An increasingly abundant supply of (mis)information makes news discernment both a challenge and a crucial skill for citizens to navigate complex societal topics, such as climate change, immigration, and science and public health. A complicating factor is that these societal challenges have been politicized and they have become much more polarising as a consequence. Therefore, a combination of cognitive, psychological, and motivated mechanisms must be considered to better understand news discernment in this context.

We find that both IQ and educational attainment strongly increase news discernment in the aggregate. The effect of most other characteristics is either of second order in magnitude or insignificant. These findings may seem to counter the emphasis put on informational inequality along demographic and socioeconomic lines by Angelucci and Prat (2024). However, our findings complement theirs because a large literature has demonstrated that variation in IQ is associated with inequalities. In particular, many studies suggest that the development of a child's IQ is associated with family socioeconomic status and parental investments, that the negative effect of low SES on IQ grows over time, and that (early) interventions can have sustained benefits (see for example Turkheimer et al. (2003), Heckman (2006), Cunha et al. (2006), Cunha et al. (2010), Kendler et al. (2015), von Stumm and Plomin (2015), Tucker-Drob and Bates (2016), Heckman et al. (2017), Sauce and Matzel (2018), and the references therein). See also Footnote 5 on the malleability of IQ.

There are two major caveats to the effect of IQ and educational attainment we document. First, IQ and educational attainment are not the only major factors that influence the ability to sort fact from fiction. The strength of the effect of motivated reasoning is sizeable and highly significant. Angelucci and Prat (2024) find in the context of daily US political news that the effect of motivated reasoning is very limited and smaller than the effect of demographic and socioeconomic variables (including education). Pennycook and Rand (2019) conclude that people fall for fake news due to a failure to think, rather than motivated reasoning. Our news quiz covers various, politicized themes that are relatively complex, and as a result, respondents are likely much more inclined towards motivated decision-making. Indeed, our model makes this prediction if we assume that $C(q)$ is a function of the difficulty of the topic. For example, if two topics, 1 and 2, are associated with respective functions $C_1(q) > C_2(q)$ such that for all $q > 0.5$ (because topic 1 is more complex), the magnitude of motivated reasoning is higher in topic 1 than in topic 2.

Second, we find that the effect of cognitive ability is surprisingly heterogeneous as a determinant of the magnitude of motivated reasoning. In particular, we document

a positive relationship between cognitive ability and motivated decision-making in the science theme, which consists of news items at the intersection of science, public health, and conspiracy theories. As a result, we also find that cognitive ability has a highly muted effect on the ability to sort fact from fiction in science relative to the other news themes in our study. Further research is necessary to elucidate the exact pathways that link cognitive ability to increased or decreased motivated reasoning. Further research is also necessary to investigate how the mechanisms we document here are associated with behaviour and outcomes, for example sharing news with others and its impact on the recipients.

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Appendices

A Descriptive

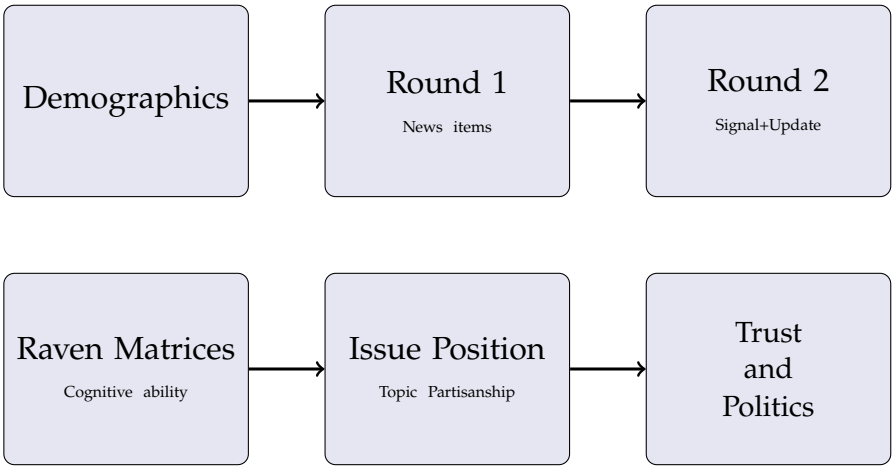


Figure Appendix A.1: Survey Design

	Austria	Germany	UK	Total
June	179	178	153	510
September	839	603	126	1,568
October	216	487	891	1,594
November	0	0	10	10
Total	1,234	1,268	1,180	3,682

Table A.1: Observations by country and month

	Overall Mean	AT Mean	DE Mean	UK Mean
Q15	0.18	0.17	0.16	0.21
Q16	0.16	0.15	0.16	0.17
Q17	0.18	0.16	0.16	0.23
Q18	0.16	0.13	0.15	0.21
Q19	0.14	0.11	0.12	0.19
Q20	0.14	0.12	0.13	0.18
Q21	0.21	0.20	0.20	0.23
Q22	0.19	0.17	0.15	0.25
Q23	0.15	0.13	0.15	0.18
Q24	0.15	0.14	0.15	0.16
Q25	0.15	0.14	0.13	0.19
Q26	0.13	0.11	0.10	0.18
Q27	0.16	0.13	0.12	0.25
Q28	0.17	0.15	0.14	0.22
Q29	0.15	0.12	0.12	0.20
Q30	0.17	0.15	0.13	0.23
Total	0.16	0.14	0.14	0.21
Observations	3227	1098	1113	1016

Table A.2: Updating by country

	Round 1				Round 2			
	Overall Mean	AT Mean	DE Mean	UK Mean	Overall Mean	AT Mean	DE Mean	UK Mean
Q15	0.35	0.29	0.35	0.40	0.46	0.41	0.46	0.53
Q16	0.44	0.39	0.31	0.63	0.53	0.49	0.43	0.68
Q17	0.35	0.30	0.37	0.37	0.48	0.43	0.47	0.53
Q18	0.67	0.72	0.70	0.58	0.71	0.74	0.74	0.64
Q19	0.73	0.77	0.76	0.67	0.74	0.78	0.76	0.69
Q20	0.63	0.62	0.67	0.58	0.69	0.68	0.71	0.66
Q21	0.39	0.37	0.36	0.44	0.50	0.46	0.48	0.57
Q22	0.31	0.29	0.33	0.32	0.45	0.42	0.44	0.50
Q23	0.54	0.52	0.55	0.54	0.59	0.56	0.61	0.61
Q24	0.61	0.62	0.56	0.65	0.66	0.66	0.62	0.70
Q25	0.49	0.46	0.53	0.48	0.57	0.55	0.57	0.59
Q26	0.68	0.73	0.73	0.56	0.71	0.75	0.74	0.63
Q27	0.16	0.14	0.15	0.19	0.30	0.25	0.24	0.41
Q28	0.60	0.64	0.62	0.55	0.67	0.69	0.67	0.65
Q29	0.60	0.62	0.63	0.53	0.63	0.65	0.69	0.55
Q30	0.55	0.59	0.64	0.40	0.63	0.65	0.69	0.55
Total	0.50	0.50	0.52	0.49	0.58	0.57	0.58	0.59
Observations	3227	1098	1113	1016	3227	1098	1113	1016

Table A.3: Quiz score by country and round

Text	Round 1	Round 2	Correct	Slant	Type
In 2017, a prestigious demographic research organisation made a forecast on the number of children for Muslim and non-Muslim women in the EU between 2015 and 2020. According to the forecast, a typical Muslim woman in the EU has: a. 1 more child b. 3 more children	0.35	0.46	a	Pro	migrant
True or false? According to official statistics, Muhammad was the most popular first name for newborn boys in several regions of England in 2020. a.True b.False	0.44	0.53	a	Anti	migrant
True or false? According to the latest UK Census, the share of Muslim population in the UK is higher than 20%. a.True b.False	0.35	0.48	b	Pro	migrant
According to official statistics, a.38% b.18% of migrants in the EU born outside the EU have a low level of education (at most 8-10 years of schooling)	0.67	0.71	a	Anti	migrant
According to recent research published in a prestigious scientific journal, average sea levels increased by about a.18 cm b.8 cm between 1993 and 2019	0.73	0.74	b	Anti	climate
True or false? According to studies published in prestigious scientific journals, the melting of ancient Arctic ice may release radioactive materials and ancient microbes, and endanger human health. a.True b.False	0.63	0.69	a	Pro	climate
A survey of top climate scientists in 2021 found that a.82% b.58% of them expect to see catastrophic changes in their lifetimes due to climate change	0.39	0.50	a	Pro	climate
In Europe, since 1990, air pollution levels and premature deaths due to air pollution have a.decreased considerably b.remained stable	0.31	0.45	a	Anti	climate
A scientific report prepared for the European Parliament in 2021 states that the health effects of the high radio frequencies used in the latest mobile network technology (5G) a.have been well studied and proven to be safe. b.have not been adequately studied.	0.54	0.59	b	Anti	science
True or false? A recent book by a leading scientist documents that scientists in the US deliberately infected more than 1,000 people with hepatitis (from stigmatized groups, such as conscientious objectors, prison inmates, the mentally ill, and developmentally disabled adults and children) between 1942 and 1972. a.True b.False	0.54	0.59	a	Anti	science
True or false? According to a recent survey by the American Medical Association, around 40% of physicians believe that a cure for various forms of cancer already exists but is withheld from the public to increase healthcare industry profits. . a.True b.False	0.49	0.57	b	Pro	science
Factual Information: Many countries used water fluoridation (adding fluoride to tap water in controlled amounts) to prevent tooth decay. Question: Is the following statement true or false? A substantial body of scientific evidence shows that water fluoridation reduces cognitive ability	0.68	0.71	b	Pro	science
The World Bank defines “extreme poverty” as living each day on less than what £2.20 can buy in the UK. In the last 25 years, the number of people in the world living in extreme poverty substantially a. decreased b.increased	0.16	0.30	a	Pro	inequality
According to the World Bank , about a.a quarter b. a half of the world population lives each day on less than what £7 can buy in the UK.	0.60	0.67	b	Anti	inequality
True or false? There is overwhelming scientific evidence that a gluten-free diet is healthier for the average individual. a.True b.False	0.60	0.63	b		Neutral
True or false? The tallest person in recorded history is a man with a height of 2.84 m. a.True b.False	0.55	0.63	b		Neutral

Table A.4: Questions and Bias

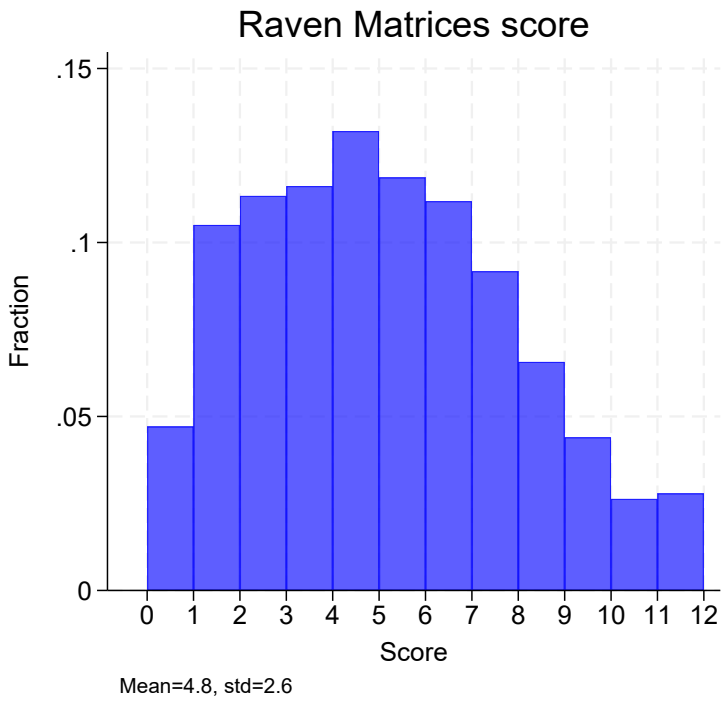


Figure Appendix A.2: Raven Matrices Distribution

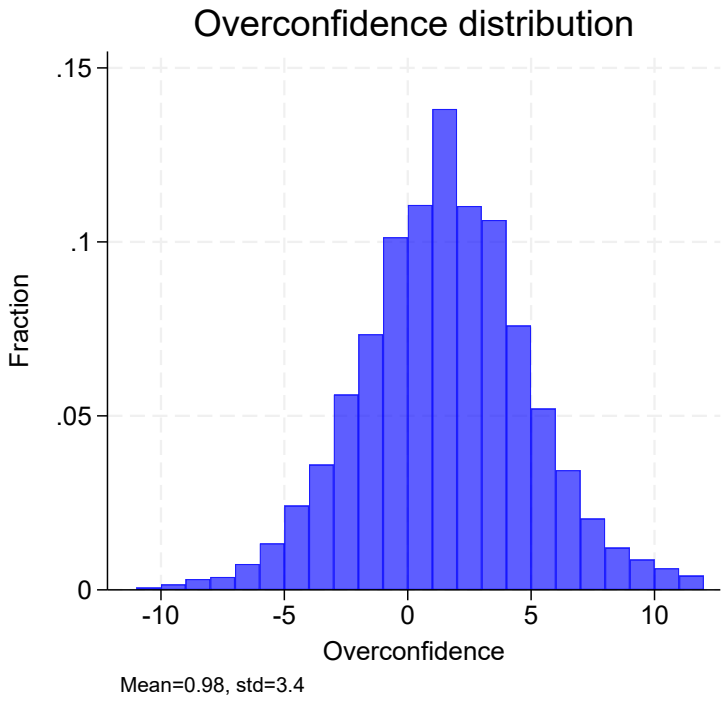


Figure Appendix A.3: Overconfidence Distribution

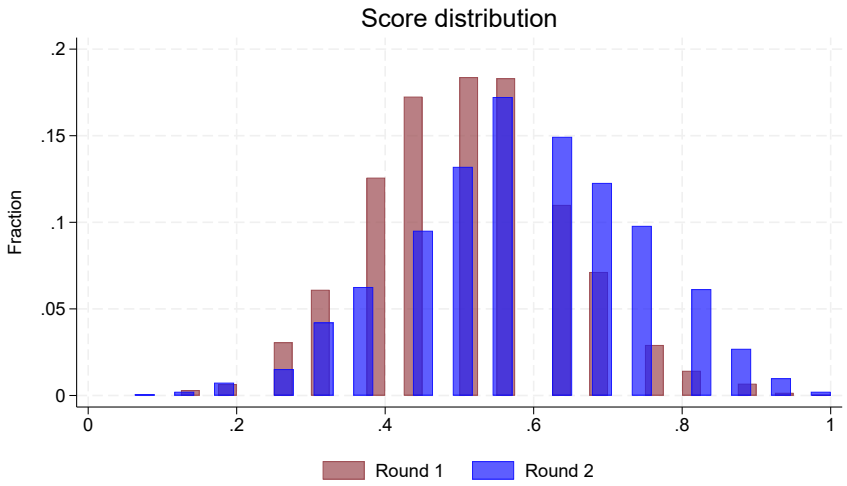


Figure Appendix A.4: Quiz score distribution by round

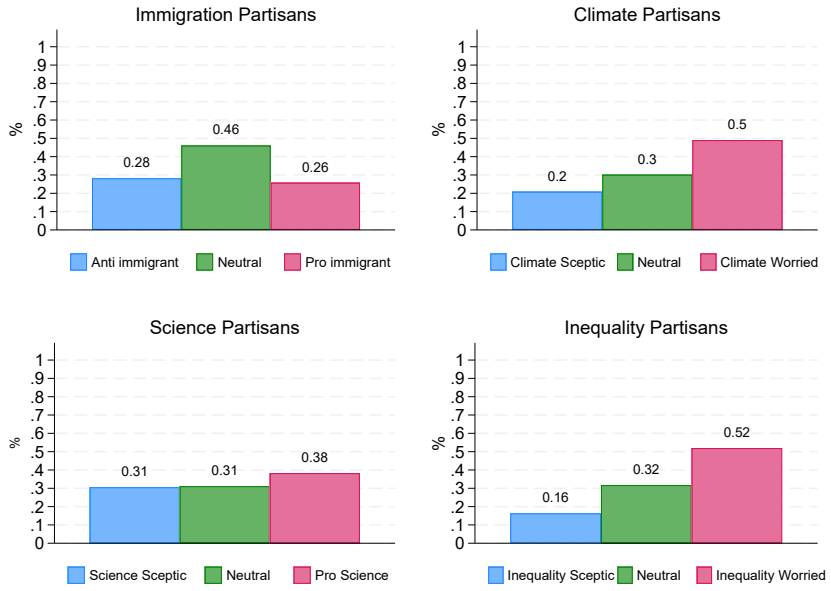


Figure Appendix A.5: Opinion by topic

No.	Statement	Scale
Q66A1	Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs. vs Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent.	1-7
Q66A2	Immigrants take jobs away from the British. vs Immigrants do not take jobs away from the British.	1-7
Q66A3	I am very worried about climate change. vs I am not at all worried about climate change.	1-7
Q66A4	UK's cultural life is enriched by migrants coming to live here from other countries. vs UK's cultural life is undermined by migrants coming to live here from other countries.	1-7
Q67A1	The government should take measures to reduce differences in income levels.	1-5 (agree strongly-disagree strongly)
Q67A2	Many of the claims about environmental threats are exaggerated.	1-5 (agree strongly-disagree strongly)
Q67A3	Large differences in people's incomes are acceptable to properly reward differences in talent and effort.	1-5 (agree strongly-disagree strongly)
Q67A4	Immigrants make crime problems in the UK worse.	1-5 (agree strongly-disagree strongly)
Q67A5	A small secret group of people is responsible for making all major decisions in world politics.	1-5 (agree strongly-disagree strongly)
Q67A6	Immigrants are generally good for the UK's economy.	1-5 (agree strongly-disagree strongly)
Q67A7	The money and wealth in the UK should be more evenly distributed among people.	1-5 (agree strongly-disagree strongly)
Q67A8	When jobs are scarce, employers should give priority to British people over immigrants.	1-5 (agree strongly-disagree strongly)
Q67A9	We can no longer trust scientists on controversial scientific and technological issues because they depend more and more on money from industry.	1-5 (agree strongly-disagree strongly)
Q68A1	Viruses have been produced in government laboratories to control our freedom.	1-6 (very unlikely-very likely)
Q68A2	Climate change is for the most part caused by natural cycles rather than human activities.	1-6 (very unlikely-very likely)

B Topic Partisanship Coding

- We set as neutral the middle values of opinion questions (see Appendix A.5 for the questions and their respective scale). Hence, Opinion (Q_{ij}) rescaled to -1,0,1. Table Appendix A.5 shows the questions used to construct the topic partisanship of the respondents.

- We calculate the average value by topic.

$$\bar{Q_j} = \frac{1}{N}\sum_{i=1}^{N} Q_{ij}$$

- Then we assign individuals to types based on the average score and sub-questions

$$V_i = \begin{cases} \text{Anti} = 1 & \text{if } \bar{Q}_j > 0 \& \nexists Q_{ij} < 0 \\ \text{Neutral} = 0 & \text{Otherwise} \\ \text{Pro} = -1 & \text{if } \bar{Q}_j < 0 \& \nexists Q_{ij} > 0 \end{cases}$$

- We show here the correlates of types and several individual characteristics. Additionally we show that types correlates in the expected way with the self-reported political position, e.g. being more right-wing is associated with being anti-migrant in the migration topic or being more skeptic about climate change in the climate change topic.

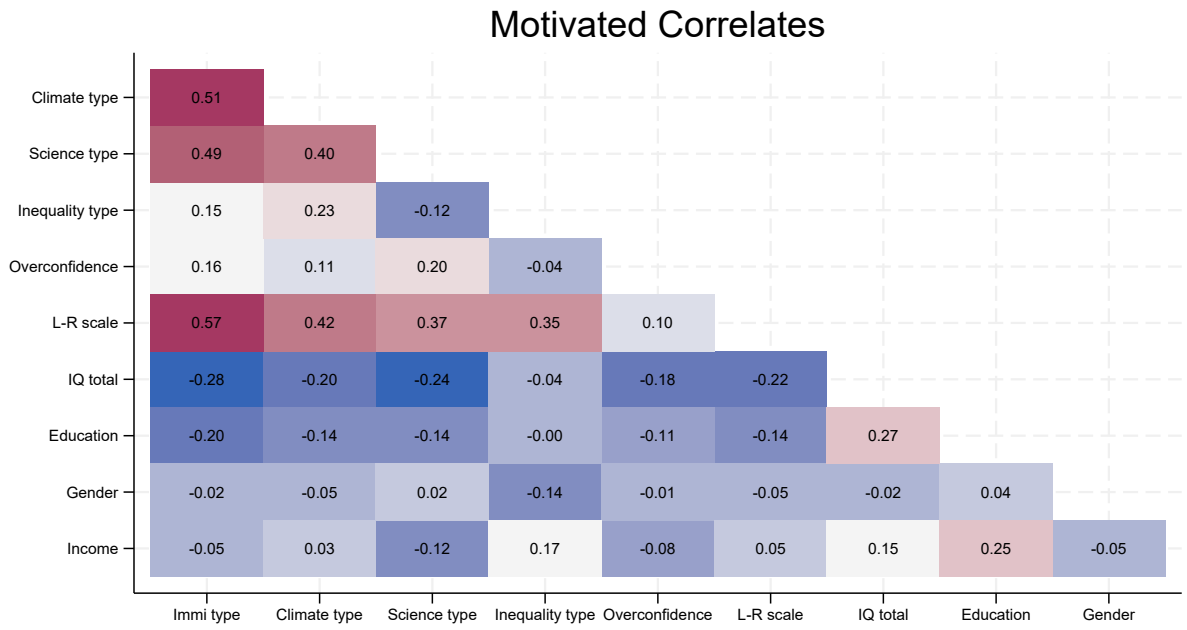
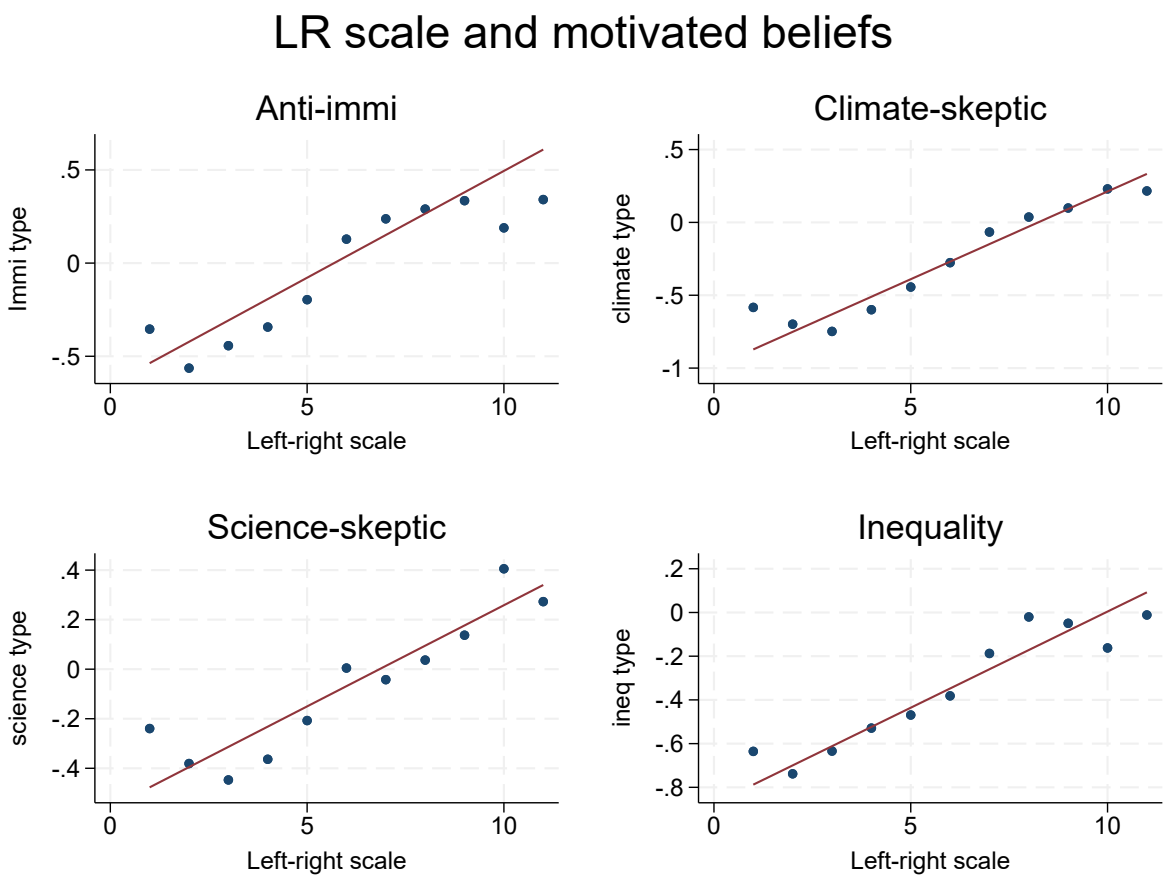


Figure Appendix B.6: Topic partisanship correlates



Left-Right Scale and Types

Table B.5: Types

Type	Immi	Climate	Science	Inequality
Pro	25.8	49.0	38.3	52.0
Neutral	46.0	30.1	31.1	31.7
Anti	28.2	20.9	30.6	16.3
Total	100.0	100.0	100.0	100.0

- As robustness we change the values of the answers which we code as neutral. Given questions with scales: 1-6, 1-5, 1-7, our main variables recode as neutral the values: (3,4);(3);(4). Results are robust to changing this scale. In one alternative definition, we set neutral values (3,4);(2,3,4);(3,4,5). Or alternatively, we set neutral values (2,3,4,5);(2,3,4);(2,3,4,5,6). Additionally, we set as neutral for each opinion question values within mean$\pm\sigma$.

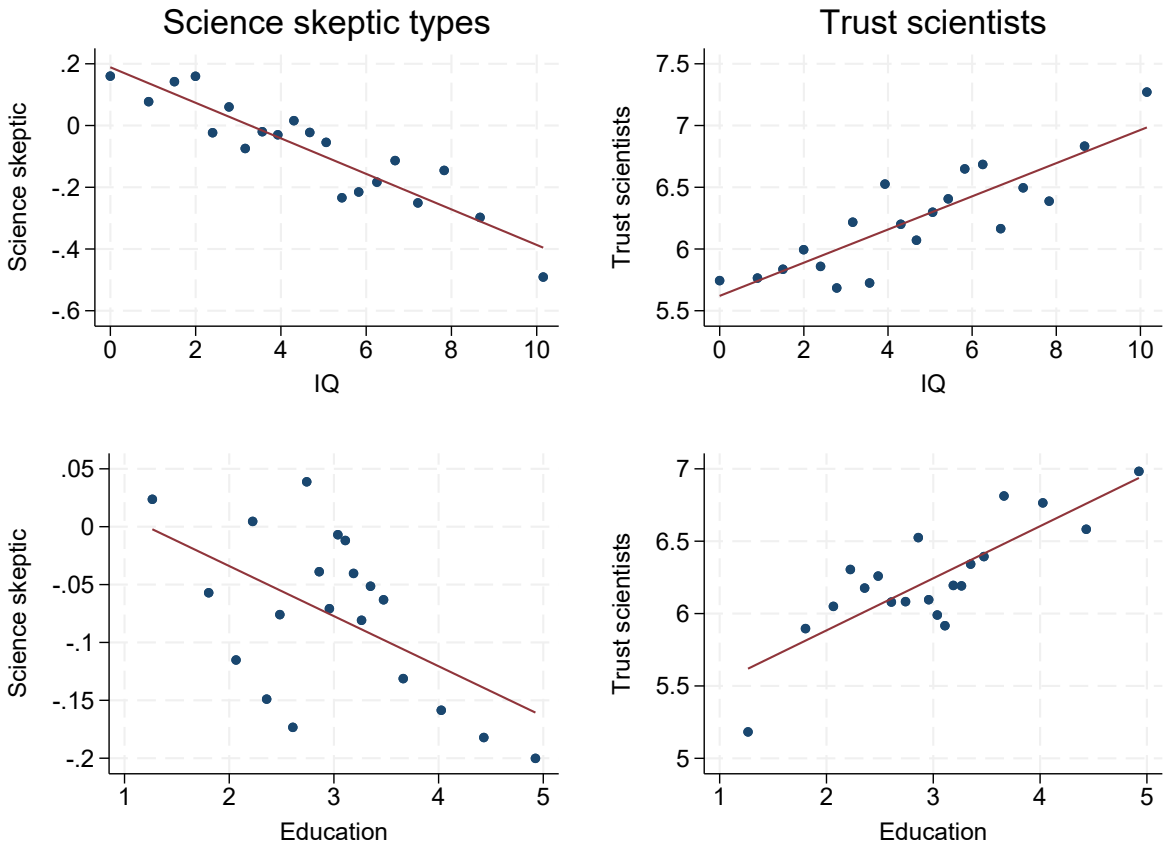


Figure Appendix B.7: Science type

C Robustness

C.1 Hypothesis 1

Table C.6: Hypothesis 1-full controls

	IQ			Education			IQ & Education
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cognitive Ability	0.012***	0.012***	0.012***				0.011***
	(0.001)	(0.001)	(0.001)				(0.001)
Education				0.023***	0.026***	0.024***	0.018***
				(0.003)	(0.003)	(0.003)	(0.003)
September		−0.002	−0.002		0.011	0.011	−0.001
		(0.007)	(0.007)		(0.007)	(0.007)	(0.007)
October		−0.002	−0.000		0.015**	0.015**	0.002
		(0.007)	(0.007)		(0.007)	(0.007)	(0.007)
November		0.024	0.047		0.033	0.047	0.039
		(0.030)	(0.031)		(0.029)	(0.032)	(0.029)
2		0.017***	0.015***		0.019***	0.016***	0.019***
		(0.006)	(0.006)		(0.006)	(0.006)	(0.006)
3		−0.002	−0.007		−0.019***	−0.024***	−0.011
		(0.006)	(0.007)		(0.007)	(0.007)	(0.007)
2			−0.006			−0.004	−0.003
			(0.007)			(0.008)	(0.007)
Self-emplyed			0.022**			0.023**	0.021**
			(0.010)			(0.011)	(0.010)
Unemployed			0.001			0.007	0.006
			(0.010)			(0.010)	(0.010)
Student			0.000			0.010	0.005
			(0.013)			(0.013)	(0.013)
not working			0.001			0.013	0.010
			(0.009)			(0.009)	(0.009)
Retired			−0.007			−0.008	−0.004
			(0.008)			(0.008)	(0.008)
Age			0.001***			0.001**	0.001***
			(0.000)			(0.000)	(0.000)
Female			−0.027***			−0.034***	−0.030***
			(0.005)			(0.005)	(0.005)
Other			−0.004			−0.004	−0.001
			(0.029)			(0.034)	(0.029)
Foreign-born=2			−0.011			−0.013	−0.012
			(0.013)			(0.013)	(0.012)
Mother fb=2			−0.019*			−0.018*	−0.023**
			(0.011)			(0.011)	(0.010)
Father fb=2			0.008			0.003	0.007
			(0.009)			(0.009)	(0.009)
Media Usage			−0.002			−0.010***	−0.003
			(0.003)			(0.003)	(0.003)
Institutional Trust			0.001			0.001	0.000
			(0.001)			(0.001)	(0.001)
1			0.029***			0.025***	0.021***
			(0.006)			(0.006)	(0.006)
2			0.007			0.005	0.005
			(0.007)			(0.007)	(0.007)
Extremist Vote			−0.018***			−0.025***	−0.017**
			(0.007)			(0.007)	(0.007)
Extremist Close			0.007***			0.006***	0.006***
			(0.001)			(0.002)	(0.001)
Constant	0.448***	0.444***	0.415***	0.437***	0.416***	0.432***	0.373***
	(0.004)	(0.007)	(0.017)	(0.008)	(0.010)	(0.018)	(0.018)
Observations	3227	3227	3227	3227	3227	3227	3227
Controls	N	N	Y	N	N	Y	Y
Month FE	N	Y	Y	N	Y	Y	Y
Country FE	N	Y	Y	N	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the full set of control for Table 1 in the paper.

Table C.7: Hypothesis 1 with untrimmed sample

	IQ			Education			IQ & Education
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cognitive Ability	0.012***	0.012***	0.012***				0.011***
	(0.001)	(0.001)	(0.001)				(0.001)
Education				0.023***	0.025***	0.024***	0.018***
				(0.002)	(0.002)	(0.003)	(0.003)
Observations	3682	3682	3682	3682	3682	3682	3682
Controls	N	N	Y	N	N	Y	Y
Month FE	N	Y	Y	N	Y	Y	Y
Country FE	N	Y	Y	N	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. his table replicates Table 1 using the untrimmed sample.

Table C.8: Hypothesis 1 by Topic-full controls

	Immigration	Climate	Science	Inequality	Neutral
	(1)	(2)	(3)	(4)	(5)
Cognitive Ability	0.015***	0.011***	0.006***	0.013***	0.009***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.015***	0.024***	0.008*	0.028***	0.023***
	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
2	0.005	−0.034**	0.020	0.022	−0.026
	(0.014)	(0.014)	(0.014)	(0.017)	(0.021)
Self-emplyed	0.029	−0.007	0.050***	0.037	−0.010
	(0.018)	(0.020)	(0.018)	(0.023)	(0.029)
Unemployed	0.024	−0.002	−0.001	0.017	−0.012
	(0.019)	(0.021)	(0.020)	(0.025)	(0.032)
Student	0.023	0.024	−0.007	−0.013	−0.028
	(0.025)	(0.023)	(0.025)	(0.032)	(0.037)
not working	0.024	−0.013	0.012	−0.016	0.050*
	(0.016)	(0.017)	(0.017)	(0.022)	(0.026)
Retired	0.006	−0.028**	0.009	0.008	−0.018
	(0.013)	(0.014)	(0.014)	(0.018)	(0.021)
Age	0.000	−0.000	0.002***	−0.000	0.003***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Female	−0.065***	−0.024***	0.005	−0.053***	−0.022*
	(0.008)	(0.008)	(0.008)	(0.011)	(0.013)
Other	−0.100*	0.045	0.146***	−0.015	−0.176***
	(0.054)	(0.075)	(0.055)	(0.095)	(0.064)
Foreign-born=2	0.021	−0.007	−0.049**	0.017	−0.042
	(0.024)	(0.022)	(0.024)	(0.030)	(0.034)
Mother fb=2	−0.038*	−0.041**	0.004	−0.035	0.004
	(0.021)	(0.017)	(0.021)	(0.024)	(0.027)
Father fb=2	0.011	0.016	0.014	−0.000	−0.028
	(0.018)	(0.016)	(0.017)	(0.023)	(0.025)
September	−0.015	0.034***	−0.022*	−0.009	0.010
	(0.012)	(0.012)	(0.013)	(0.016)	(0.020)
October	0.002	0.010	−0.004	0.009	−0.011
	(0.013)	(0.013)	(0.013)	(0.017)	(0.020)
November	−0.157**	0.016	0.144**	0.048	0.261**
	(0.072)	(0.106)	(0.058)	(0.113)	(0.107)
2	0.012	0.039***	0.004	0.005	0.039**
	(0.010)	(0.010)	(0.010)	(0.013)	(0.016)
3	0.064***	0.005	−0.034***	−0.027*	−0.131***
	(0.012)	(0.013)	(0.013)	(0.016)	(0.019)
Media Usage	0.001	0.001	−0.008	−0.008	−0.007
	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)
Institutional Trust	0.002	0.000	−0.001	0.005*	−0.007**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
1	0.021**	0.047***	−0.010	0.008	0.046***
	(0.010)	(0.010)	(0.010)	(0.013)	(0.015)
2	−0.003	0.012	−0.006	−0.014	0.046**
	(0.012)	(0.013)	(0.012)	(0.015)	(0.019)
Extremist Vote	−0.022*	−0.029**	0.003	−0.003	−0.035*
	(0.012)	(0.014)	(0.013)	(0.017)	(0.021)
Extremist Close	0.010***	0.011***	−0.000	0.004	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Constant	0.293***	0.363***	0.484***	0.282***	1.425***
	(0.032)	(0.033)	(0.033)	(0.043)	(0.051)
Observations	3227	3227	3227	3227	3227
Controls	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the full set of control for Table 2 in the paper.

Table C.9: Hypothesis 1 weighted and PDS Lasso

	LASSO	Weighted
	(1)	(2)
Cognitive Ability	0.009***	0.011***
	(0.001)	(0.001)
Education	0.015***	0.018***
	(0.003)	(0.003)
Observations	2678	3227
Controls	Y	Y
Month FE	Y	Y
Country FE	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 1 with Controls selected with PDS Lasso in column 1. Regression weighted by education in column 2.

C.2 Hypothesis 2 & 3

Table C.10: Hypotheses 2 & 3-full controls

	Countermotivated			Motivated		
	(1)	(2)	(3)	(4)	(5)	(6)
IQ	0.011***	0.011***	0.011***	0.012***	0.012***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.023***	0.023***	0.016***	0.010**	0.012**	0.017***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
September		−0.007	−0.009		−0.007	−0.007
		(0.014)	(0.014)		(0.014)	(0.014)
October		0.003	0.001		−0.005	0.002
		(0.014)	(0.015)		(0.014)	(0.015)
November		0.053	0.058		0.063	0.093
		(0.087)	(0.083)		(0.106)	(0.107)
2		0.012	0.010		0.019*	0.016
		(0.011)	(0.012)		(0.012)	(0.012)
3		0.013	0.010		−0.004	−0.011
		(0.013)	(0.014)		(0.013)	(0.014)
2			0.009			−0.009
			(0.015)			(0.015)
Self-emplyed			0.016			0.061***
			(0.022)			(0.021)
Unemployed			0.008			0.000
			(0.024)			(0.023)
Student			0.052*			−0.033
			(0.028)			(0.026)
not working			−0.005			0.014
			(0.017)			(0.019)
Retired			−0.001			−0.004
			(0.016)			(0.016)
Age			0.001			0.001*
			(0.000)			(0.000)
Female			−0.035***			−0.027***
			(0.010)			(0.010)
Other			0.026			0.004
			(0.091)			(0.065)
Foreign-born=2			−0.035			0.007
			(0.026)			(0.026)
Mother fb=2			−0.011			−0.056**
			(0.022)			(0.023)
Father fb=2			0.037*			0.029
			(0.020)			(0.021)
Media Usage			0.012*			−0.014**
			(0.007)			(0.007)
Institutional Trust			0.007**			−0.006**
			(0.003)			(0.003)
1			0.027**			0.001
			(0.012)			(0.011)
2			0.007			−0.003
			(0.014)			(0.014)
Extremist Vote			−0.038***			0.017
			(0.014)			(0.015)
Extremist Close			0.004			0.007**
			(0.003)			(0.003)
Constant	0.283***	0.277***	0.207***	0.500***	0.494***	0.515***
	(0.016)	(0.021)	(0.038)	(0.017)	(0.022)	(0.039)
Observations	3112	3112	3112	3112	3112	3112
Controls	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the full set of control for Table 3 in the paper.

Table C.11: Hypotheses 2 & 3 by topic-full controls

	Immigration	Climate	Science	Inequality
	(1)	(2)	(3)	(4)
Motivated	0.215***	0.090***	0.232***	0.289***
	(0.012)	(0.010)	(0.010)	(0.014)
IQ	0.018***	0.013***	0.007***	0.013***
	(0.002)	(0.002)	(0.002)	(0.003)
Education	0.020***	0.024***	0.008	0.029***
	(0.007)	(0.006)	(0.006)	(0.009)
2	0.004	−0.014	0.016	0.016
	(0.019)	(0.016)	(0.018)	(0.023)
Self-emplyed	0.048*	0.026	0.032	0.045
	(0.028)	(0.023)	(0.023)	(0.031)
Unemployed	0.015	0.014	0.014	0.023
	(0.029)	(0.026)	(0.027)	(0.035)
Student	−0.001	0.037	−0.015	−0.011
	(0.038)	(0.031)	(0.031)	(0.041)
not working	0.031	0.006	0.004	−0.013
	(0.023)	(0.021)	(0.021)	(0.027)
Retired	−0.004	−0.014	−0.002	0.010
	(0.020)	(0.017)	(0.019)	(0.024)
Age	0.001**	−0.001	0.002***	0.000
	(0.001)	(0.000)	(0.000)	(0.001)
Female	−0.069***	−0.034***	0.003	−0.057***
	(0.013)	(0.011)	(0.011)	(0.015)
Other	−0.053	−0.018	0.038	0.088
	(0.113)	(0.076)	(0.081)	(0.114)
Foreign-born=2	0.002	−0.009	−0.039	0.010
	(0.037)	(0.030)	(0.031)	(0.043)
Mother fb=2	−0.040	−0.042*	−0.022	−0.033
	(0.029)	(0.024)	(0.026)	(0.034)
Father fb=2	0.035	0.015	0.039*	0.011
	(0.027)	(0.021)	(0.024)	(0.031)
September	−0.012	0.025	−0.030*	−0.002
	(0.018)	(0.015)	(0.016)	(0.022)
October	0.016	−0.004	−0.006	0.014
	(0.019)	(0.016)	(0.017)	(0.023)
November	−0.098	−0.026	0.149	0.216
	(0.126)	(0.131)	(0.092)	(0.154)
2	0.005	0.036***	0.008	−0.006
	(0.015)	(0.013)	(0.013)	(0.018)
3	0.066***	0.007	−0.035**	−0.045**
	(0.019)	(0.015)	(0.017)	(0.022)
Media Usage	0.004	−0.004	−0.014*	−0.008
	(0.009)	(0.008)	(0.008)	(0.011)
Institutional Trust	−0.001	0.002	−0.001	0.002
	(0.004)	(0.003)	(0.003)	(0.004)
1	0.017	0.047***	−0.008	−0.005
	(0.015)	(0.012)	(0.013)	(0.018)
2	0.007	−0.000	0.003	−0.021
	(0.018)	(0.015)	(0.016)	(0.021)
Extremist Vote	−0.037*	−0.027*	−0.002	−0.017
	(0.019)	(0.016)	(0.017)	(0.023)
Extremist Close	0.014***	0.009***	0.004	0.001
	(0.004)	(0.003)	(0.004)	(0.005)
Constant	0.119**	0.351***	0.378***	0.146**
	(0.048)	(0.042)	(0.043)	(0.059)
Observations	3482	4510	4444	4406
Controls	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$.
This table shows the full set of control for Table 5 in the paper.

Table C.12: Hypotheses 2 & 3 with Motivated effect-full controls

	(1)	(2)	(3)
Motivated	0.180***	0.180***	0.180***
	(0.006)	(0.006)	(0.006)
IQ	0.011***	0.011***	0.011***
	(0.001)	(0.001)	(0.001)
Education	0.017***	0.017***	0.017***
	(0.004)	(0.004)	(0.004)
September		−0.007	−0.008
		(0.010)	(0.010)
October		−0.001	0.001
		(0.010)	(0.010)
November		0.058	0.076
		(0.068)	(0.070)
2		0.016*	0.013
		(0.008)	(0.008)
3		0.004	−0.001
		(0.009)	(0.010)
2			0.000
			(0.011)
Self-emplyed			0.039**
			(0.015)
Unemployed			0.004
			(0.017)
Student			0.009
			(0.019)
not working			0.005
			(0.013)
Retired			−0.003
			(0.011)
Age			0.001**
			(0.000)
Female			−0.031***
			(0.007)
Other			0.015
			(0.056)
Foreign-born=2			−0.014
			(0.019)
Mother fb=2			−0.034**
			(0.016)
Father fb=2			0.033**
			(0.015)
Media Usage			−0.001
			(0.005)
Institutional Trust			0.001
			(0.002)
1			0.014*
			(0.008)
2			0.002
			(0.010)
Extremist Vote			−0.010
			(0.010)
Extremist Close			0.005**
			(0.002)
Constant	0.302***	0.295***	0.271***
	(0.012)	(0.015)	(0.027)
Observations	6224	6224	6224
Controls	N	N	Y
Month FE	N	Y	Y
Country FE	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the full set of control for Table 4 in the paper.

Table C.13: Hypotheses 2 & 3 PDS Lasso and weighted by education

	LASSO		Weighted	
	(1)	(2)	(3)	(4)
IQ	0.010***	0.008***	0.011***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.015**	0.018***	0.013*	0.019***
	(0.006)	(0.006)	(0.007)	(0.007)
Observations	2592	2592	3112	3112
Controls	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 3 with Controls selected with PDS Lasso in column 1 and 3. Regression weighted by education in column 2 and 4.

Table C.14: Hypotheses 2 & 3 with alternative definition of topic partisan types

	Countermotivated			Motivated		
	(1)	(2)	(3)	(4)	(5)	(6)
IQ	0.008***	0.007***	0.009***	0.013***	0.012***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.017***	0.018***	0.023***	0.018***	0.018***	0.020***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)
Observations	3080	3090	2877	3080	3090	2877
Controls	yes	yes	yes	yes	yes	yes
Month FE	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 3 using alternative definitions of topic partisan types. See sectionB for an explanation on how the alternative types are constructed.

Table C.15: Hypotheses 2 & 3 with untrimmed sample

	Countermotivated			Motivated		
	(1)	(2)	(3)	(4)	(5)	(6)
IQ	0.011***	0.011***	0.010***	0.011***	0.011***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.020***	0.019***	0.012**	0.009*	0.011**	0.015***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	3526	3526	3526	3526	3526	3526
Controls	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 3 with the untrimmed sample.

Table C.16: Hypotheses 2 & 3 , individual panel estimate

	Base	Individual FE	Question FE
	(1)	(2)	(3)
Motivated	0.193***	0.193***	0.170***
	(0.006)	(0.006)	(0.006)
Observations	29278	29278	29278
Individual FE	N	Y	Y
Question FE	N	N	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the effect of topic partisanship on Quiz score. The estimate is obtained from an individual panel dataset with respondent and question fixed effects. Motivated is relative to countermotivated category.

Table C.17: Hypotheses 2 & 3, individual panel estimate relative to Neutral type

	Base	Individual FE	Question FE
	(1)	(2)	(3)
Countermotivated	−0.085***	−0.092***	−0.093***
	(0.006)	(0.006)	(0.006)
Motivated	0.108***	0.101***	0.075***
	(0.006)	(0.006)	(0.006)
Observations	43568	43568	43568
Individual FE	N	Y	Y
Question FE	N	N	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the effect of topic partisanship on Quiz score. The estimate is obtained from an individual panel dataset with respondent and question fixed effects. Motivated and countermotivated are relative to neutral category.

Table C.18: Hypotheses 2 & 3 , PDS Lasso and weighted by education

	LASSO			Weighted		
	(1)	(2)	(3)	(4)	(5)	(6)
IQ	0.010***	0.008***	0.010***	0.011***	0.011***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.015**	0.018***	0.013**	0.013*	0.019***	0.017***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Observations	2592	2592	1981	3112	3112	2379
Controls	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Controls selected with PDS Lasso or weighted buy education. column 1,2, and 3 are respectively Countermotivated, Motivated and Neutral.

Table C.19: Hypotheses 2 & 3 , alternative definitions of motivated types

	Countermotivated			Motivated			Neutral		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IQ	0.008***	0.007***	0.009***	0.013***	0.012***	0.010***	0.010***	0.010***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.017***	0.017***	0.022***	0.016***	0.017***	0.020***	0.020***	0.021***	0.017***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)
Observations	3080	3090	2877	3080	3090	2877	2528	2518	2539
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table show the robustness of Hypotheses 2 & 3 to alternative definitions of topic partisanship types. see section B for an explanation on how the alternative types are constructed.

Table C.20: Motivated effect and alternative definitions of topic partisanship types, relative to neutral

	(1)	(2)	(3)
Biased_cons_mot1			
Biased_cons_mot2			
Biased_cons_mot3			
0.Biased_cons_mot1	−0.043***		
	(0.006)		
1.Biased_cons_mot1	0.131***		
	(0.006)		
0.Biased_cons_mot2		−0.048***	
		(0.006)	
1.Biased_cons_mot2		0.127***	
		(0.006)	
0.Biased_cons_mot3			−0.079***
			(0.007)
1.Biased_cons_mot3			0.137***
			(0.007)
Observations	8688	8698	8293
Controls	Y	Y	Y
Month FE	Y	Y	Y
Country FE	Y	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. Motivated and countermotivated relative to Neutral type. This table show the robustness to alternative definitions of topic partisan types. see section B for an explanation on how the alternative types are constructed.

Table C.21: Hypotheses 2 & 3, with neutral type

	Countermotivated			Motivated			Neutral		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IQ	0.011***	0.011***	0.011***	0.012***	0.012***	0.012***	0.011***	0.011***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.023***	0.023***	0.016***	0.010**	0.012**	0.017***	0.016***	0.018***	0.015***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	3112	3112	3112	3112	3112	3112	2379	2379	2379
Controls	N	N	Y	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y	N	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the robustness of Hypotheses 2 & 3 with untrimmed sample and neutral type.

Table C.22: Hypotheses 2 & 3, untrimmed sample with neutral type

	Countermotivated			Motivated			Neutral		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IQ	0.011***	0.011***	0.010***	0.011***	0.011***	0.012***	0.010***	0.010***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Education	0.020***	0.019***	0.012**	0.009*	0.011**	0.015***	0.018***	0.020***	0.017***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	3526	3526	3526	3526	3526	3526	2728	2728	2728
Controls	N	N	Y	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y	N	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the robustness of Hypotheses 2 & 3 with untrimmed sample and neutral type.

C.3 Hypothesis 4

Table C.23: Hypothesis 4 PDS Lasso and weighted by education

	Overconfident		Underconfident	
	(1) LASSO	(2) Weighted	(3) LASSO	(4) Weighted
Overconfidence	−0.012***	−0.011***	0.008	0.008
	(0.004)	(0.004)	(0.006)	(0.006)
consistent	0.002	−0.000	−0.012**	−0.015**
	(0.004)	(0.005)	(0.006)	(0.007)
Observations	1819	2192	859	1035
Controls	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 7 with Controls selected with PDS Lasso in column 1 and 3. Regression weighted by education in column 2 and 4.

Table C.24: Hypothesis 4 with untrimmed sample

	All			Overconfident/ well-calibrated			Underconfident		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Overconfidence	0.002	0.001	0.001	−0.005*	−0.008***	−0.009***	0.007	0.009*	0.011**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
consistent	−0.002	−0.002	−0.003	0.001	−0.000	0.002	−0.010**	−0.009*	−0.014***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
Observations	3682	3682	3682	2461	2461	2461	1221	1221	1221
Controls	N	N	Y	N	N	Y	N	N	Y
Month FE	N	Y	Y	N	Y	Y	N	Y	Y
Country FE	N	Y	Y	N	Y	Y	N	Y	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 7 on the untrimmed sample.

C.4 Motivated Updating

Table C.25: Motivated updating PDS Lasso and weighted by education

	LASSO	Weighted
	(1)	(2)
Motivated	0.038***	0.034***
	(0.012)	(0.013)
Cognitive Ability	0.008***	0.009***
	(0.003)	(0.003)
Education	−0.001	0.001
	(0.008)	(0.009)
Observations	4156	4980
Controls	Y	Y
Month FE	Y	Y
Country FE	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 8 with controls selected with PDS Lasso in column 1. Regression weighted by education in column 2.

Table C.26: Motivated updating with untrimmed sample

	Baseline	FE	Full
	(1)	(2)	(3)
Motivated	0.031***	0.031***	0.031***
	(0.011)	(0.010)	(0.010)
IQ	0.011***	0.015***	0.015***
	(0.002)	(0.002)	(0.002)
Education	0.009	−0.001	−0.001
	(0.006)	(0.006)	(0.006)
Observations	5568	5568	5568
Controls	N	Y	Y
Month FE	N	Y	Y
Country FE	N	Y	Y

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 8 on the untrimmed sample.

Table C.27: Motivated Updating using alternative definition of topic partisan types

	Motivated				Correct Motivated			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Motivated	0.023**	0.024**	0.039***	0.021**				
	(0.011)	(0.011)	(0.011)	(0.009)				
IQ_total	0.010***	0.010***	0.013***	0.011***	0.011***	0.012***	0.014***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
education	−0.002	−0.003	−0.003	−0.001	0.004	0.003	−0.009	−0.004
	(0.007)	(0.007)	(0.007)	(0.006)	(0.010)	(0.010)	(0.010)	(0.008)
Observations	4894	4932	5142	6172	2724	2743	2789	3155
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Month FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes

Robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table replicates Table 8 with different definitions of topic partisan types. See sectionB for an explanation on how the alternative types are constructed.

Table C.28: Motivated Updating, individual panel estimate

	Baseline	Individual FE	Question FE
	(1)	(2)	(3)
Motivated	0.048***	0.039***	0.026***
	(0.008)	(0.007)	(0.007)
Observations	13293	13293	13293
Individual FE	N	Y	Y
Question FE	N	N	Y

Standard errors clustered by respondent in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$. This table shows the effect of topic partisanship on Updating. The estimate is obtained from an individual panel dataset with respondent and question fixed effects.