Jul, 2025
GRINS DISCUSSION PAPER SERIES DP N° 39/2025 ISSN 3035-5576

GRINS

Narratives and Opinion Polarization: A Survey Experiment

DP N° 39/2025

Authors:
Armenak Antinyan, Thomas Bassetti, Luca Corazzini, Filippo Pavesi

Jul, 2025
GRINS DISCUSSION PAPER SERIES DP N° 39/2025 **ISSN 3035-5576**

Narratives and Opinion Polarization: A Survey Experiment

Armenak Antinyan, Thomas Bassetti, Luca Corazzini, Filippo Pavesi

ACKNOWLEDGEMENTS

This study was funded by the European Union - NextGenerationEU, in the framework of the GRINS - Growing Resilient, INclusive and Sustainable project (GRINS PE00000018). The views and opinions expressed are solely those of the authors and do not necessarily reflect those of the European Union, nor can the European Union be held responsible for them.

CITE THIS WORK

Title: Narratives and Opinion Polarization: A Survey Experiment . Publication Date: 2025.

We explore the impact of narratives on beliefs and policy opinions through a survey experiment that exposes US subjects to two media-based explanations of the causes of COVID-19. The Lab Narrative ascribes the pandemic to human error and scientific misconduct in a Chinese lab, and the Nature Narrative describes the natural causes of the virus. First, we find that both narratives influence individual beliefs about COVID-19 origins. More precisely, individual beliefs tend to be swayed in the direction of the version of the facts to which one is more exposed generating a potential source of polarization by exposure. Second, only the Nature Narrative unidirectionally affects policy opinions by increasing people's preferences toward climate protection and trust in science, therefore representing a channel for one-sided polarization by exposure. Finally, we also explore the existence of heterogeneous effects of our narratives, finding that the Lab Narrative leads to opinion polarization between Republican- and Democratic-leaning states on climate change and foreign trade. This indicates the existence of an additional channel that can lead policy opinions to diverge, which we denote polarization by social context.

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani
GRINS FOUNDATION

GRINS FOUNDATION

Discussion Paper Series

Narratives and Opinion Polarization: A Survey Experiment

Discussion paper n. 39/2025

Armenak Antinyan (a), Thomas Bassetti (b), Luca Corazzini (c), Filippo Pavesi (d): (a) Thames Water Utilities; (b) University of Padua; (c) University of Milano-Bicocca; (d) LIUC (Universita Carlo Cattaneo)

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani
GRINS FOUNDATION

ISSN 3035-5567

Narratives and Opinion Polarization: A Survey Experiment

Armenak Antinyan (a), Thomas Bassetti (b), Luca Corazzini (c), Filippo Pavesi (d): (a) Thames Water Utilities; (b) University of Padua; (c) University of Milano-Bicocca; (d) LIUC (Universita Carlo Cattaneo)

Discussion Paper DP nº 39/2025

We explore the impact of narratives on beliefs and policy opinions through a survey experiment that exposes US subjects to two media-based explanations of the causes of COVID-19. The Lab Narrative ascribes the pandemic to human error and scientific misconduct in a Chinese lab, and the Nature Narrative describes the natural causes of the virus. First, we find that both narratives influence individual beliefs about COVID-19 origins. More precisely, individual beliefs tend to be swayed in the direction of the version of the facts to which one is more exposed generating a potential source of polarization by exposure. Second, only the Nature Narrative unidirectionally affects policy opinions by increasing people's preferences toward climate protection and trust in science, therefore representing a channel for one-sided polarization by exposure. Finally, we also explore the existence of heterogeneous effects of our narratives, finding that the Lab Narrative leads to opinion polarization between Republican- and Democratic-leaning states on climate change and foreign trade. This indicates the existence of an additional channel that can lead policy opinions to diverge, which we denote polarization by social context.

We thank Viola Angelini, Marco Bertoni, Eugenio Levi, Rupert Sausgruber, Francesco Sobbrio, Stefan Trautmann, Dmitri Vinogradov, Huan Xie, participants at the 2021 LEM Seminar in Lille, the ESA 2021 Global Online Conference, the 2021 AFES Meeting in Abidjan, the 2021 NAMES Meeting in Montréal and the 2020 CPEG Conference for useful discussions and comments. Financial support from VERA, University of Venice "Ca' Foscari," and LIUC University is gratefully acknowledged. Finally, the authors would like to thank two anonymous reviewers for their careful reading of the manuscript and their many insightful comments and suggestions. The views in this paper do not reflect the views or opinions of Thames Water. Authors take full responsibility for the content presented herein.

Narratives and Opinion Polarization: A Survey Experiment

Armenak Antinyan[1], Thomas Bassetti[2], Luca Corazzini[3], and Filippo Pavesi[4,*]

[1]Thames Water Utilities, Clearwater Court Vastern Rd, Reading, Berkshire, RG1 8DB, United Kingdom
[2]Department of Economics and Management "Marco Fanno", University of Padua
[3]Department of Economics, Management and Statistics, University of Milano-Bicocca
[4]School of Economics and Management, LIUC (Università Carlo Cattaneo), C.so Matteotti 22, 21053 Castellanza (VA), and Stevens Institute of Technology, Hoboken, NJ
[*]fpavesi@liuc.it

ABSTRACT

We explore the impact of narratives on beliefs and policy opinions through a survey experiment that exposes US subjects to two media-based explanations of the causes of COVID-19. The *Lab Narrative* ascribes the pandemic to human error and scientific misconduct in a Chinese lab, and the *Nature Narrative* describes the natural causes of the virus. First, we find that both narratives influence individual beliefs about COVID-19 origins. More precisely, individual beliefs tend to be swayed in the direction of the version of the facts to which one is more exposed generating a potential source of polarization by exposure. Second, only the *Nature Narrative* unidirectionally affects policy opinions by increasing people's preferences toward climate protection and trust in science, therefore representing a channel for one-sided polarization by exposure. Finally, we also explore the existence of heterogeneous effects of our narratives, finding that the *Lab Narrative* leads to opinion polarization between Republican- and Democratic-leaning states on climate change and foreign trade. This indicates the existence of an additional channel that can lead policy opinions to diverge, which we denote polarization by social context.

Introduction

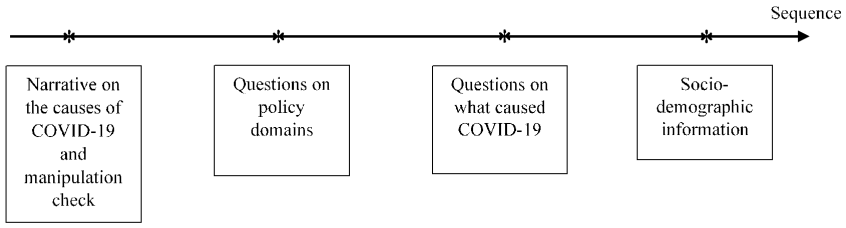
In both Europe and the U.S. there is well documented evidence of a divergence in public opinion regarding how society operates. The data on political beliefs illustrates that these differing positions have been widening over time, thus potentially undermining the proper functioning of democratic institutions[1, 2]. In this setting, when designing policies aimed at bridging these divides, it is important to take into account the coexistence of competing stories or representations used to interpret a specific society or period, which can be defined as narratives[3, 4]. Indeed, opposing narratives can emerge as a natural outcome of the process through which a society forms collective beliefs[5]. Moreover, there is mounting evidence that individuals are subject to selective exposure to news, and the advent of social media has amplified this trend [6, 7, 8]. A relevant question is, therefore, whether marginal exposure to one of two contrasting narratives can influence individual opinions in a distinct way, thus potentially constituting an additional channel for opinion polarization, which we denote as polarization by exposure. Furthermore, does this effect of narratives also spill over to opinions about policy issues that are not explicitly mentioned by the story that is being portrayed?

The breakout of COVID-19 pandemic represents an ideal setting to examine these issues, since in the early days of the pandemic, two prominent stories emerged to explain the origins of the disease. The *Lab Narrative* essentially suggested that the pandemic originated as a result of human error and scientific misconduct in a laboratory in China.

The *Nature narrative* described the biological and genetic origin of the disease (without explicitly attributing its cause to human actions). In this context, we conducted a survey experiment to see whether narratives about the origin of the COVID-19 pandemic influenced people's opinions on both the origin of the pandemic and on relevant policy issues that are not explicitly mentioned by the narratives. In this respect, the present study contributes to the literature on priming [9] since we study how priming subjects with specific narratives can subsequently affect the way in which they interpret and form their opinions about different policy domains. However, the novel feature of our study is that these policy dimensions are not directly related to the stories subjects are exposed to. Thus, considering these indirect effects allows us to explore whether COVID-19 explanations can evoke wider narratives that have an influence on policy opinions.

The survey experiment was conducted on US nationals in the early days of the COVID-19 pandemic in May 2020. Subjects were randomly exposed to one of the two alternative media-based explanations of the origin of the pandemic that appeared on media outlets on both sides of the political spectrum (see the supplementary material for details). We analyze the impact of these narratives on opinions concerning the origin of the pandemic as well as on three relevant policy issues: trade openness, climate change, and trust in science. An illustration of the structure of the survey experiment is presented in Figure 1.

Figure 1. The structure of the questionnaire used in the survey experiment



Notes: This figure shows the structure and the implementation timeline of the questions constituting our questionnaire.
1st Block: subjects were randomly assigned to a narrative treatment or a control group. Those in the narrative treatment were either assigned to the *Lab Narrative* or *Nature Narrative*, and exposed to two extracts about the same story, based respectively on coverage from Fox News and CNN. Subjects in the control group did not observe any narrative.
2nd Block: for each of three policy domains (foreign trade, climate change prevention, scientific progress) subjects were asked to indicate how much they agreed or disagreed with a statement affirming its social desirability on a 5-point Likert scale (with 1 indicating agreement and 5 disagreement). These issues were presented in a randomized order.
3rd Block: participants were asked to allocate 100 points across four potential causes of COVID-19, the greater the number of points allocated to a given cause, the more the subject believed in a specific explanation. The potential causes considered were: (i) the virus originated from an accident in a lab; (ii) the virus originated in nature as a result of natural processes; (iii) the virus is a weapon the countries use against each other; (iv) other (free form text indicating which).
4th Block: we gathered information on the subjects' state of residence, and they were asked other socio-demographic questions, including gender, age, occupational and educational status, income situation, and whether lockdown restrictions were active in the state where they were living.

The selected policy issues are not explicitly related to the origin of the pandemic but are more broadly related to larger narratives that the *Lab narrative* and *Nature Narrative* could activate. Our claim is that, if the *Lab Narrative* and *Nature Narrative* are connected to wider narratives, then they can also succeed in influencing opinions on relevant policy issues. More specifically, the *Lab narrative* that portrays China's negative role in political and economic processes in the US, implicitly sheds negative light on policies favoring international trade as well as casting doubt on the reliability of scientific progress. On the other hand, the *Nature Narrative* reflects the view that, as humans, we are often unaware of our limited understanding of how nature operates and implicitly encourages the adoption of more respectful behavior to reduce negative environmental consequences, such as climate change, and highlights the merits and importance of science in identifying the genetic characteristics of the virus. Moreover, these narratives may also be considered as

political cues, where the *Lab Narrative* may echo a wider conservative view of the world [10, 11], while the *Nature Narrative* is more likely to be associated with a liberal perspective. This means that narratives can also affect opinions on policies which are not explicitly referred to in the story. So, the *Lab Narrative* could have a negative impact on the perceived relevance of climate change, if this stance reflects a conservative view, while the *Nature Narrative* can positively affect the opinions on the importance of trade openness as this may resonate with a more liberal outlook. To test these claims, we examine whether marginal exposure to one of the two narratives generates diverging views on both the causes of the pandemic and on the three specific policy issues as mentioned above.

Our study has the following distinguishing features that allow us to adequately address empirical issues related to endogeneity problems and difficulties in tracking the origin and evolution of narratives, that limit the possibility of using observational data to isolate their causal effect on opinions and behaviors[12]. First, we use existing alternative explanations that naturally emerged from the US society instead of using simulated/artificial narratives built *ad hoc*, as in other studies exploring the role of narratives on individuals' evaluations and choices[13, 14, 15].

With respect to previous contributions, this feature, which we share with two recent studies, increases the external validity of our findings [16, 17]. Second, our design is especially adequate for analyzing the impact of narratives on policy opinions, since we elicit these opinions right after the narrative treatment, as well as randomizing the order with which the policy issues are presented. Third, in order to identify the role of the narration itself rather than the explicit political or ideological slant of the media outlet, we focus on narratives that appeared on media outlets on both sides of the US political spectrum and remove all references to the outlets themselves.

Experimental context

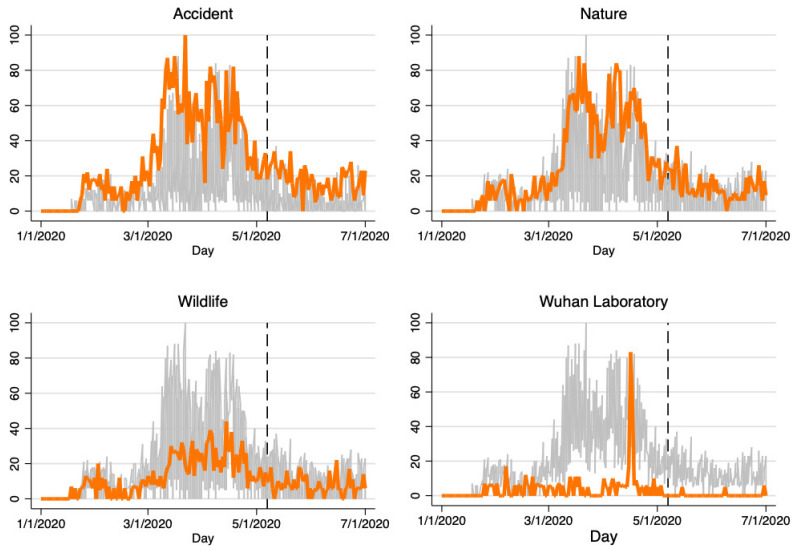
The main reason for exploiting the COVID-19 outbreak to study the impact of narratives is that its exceptional nature triggered a genuine demand for explanations, leading to the emergence of different stories describing the origin of the pandemic. Indeed, there is evidence that quickly spreading diseases that increase the risk of serious illness or death can be great sources of anxiety, and there is robust evidence that anxiety positively affects information seeking[18, 19]. Moreover, the health emergency was universally salient and, to some degree, impacted everyone's life through lockdown restrictions as well as producing severe socio-economic and psychological consequences. These conditions were further exacerbated by the lack of scientific consensus on the real causes of COVID-19 and the absence of clear-cut scientific evidence to test and compare alternative conjectures. In fact, the origins of COVID-19 remained uncertain even during the Biden administration[20].

Although it may be argued that the explanations about the origin of the pandemic that we consider as treatments are not the only existing ones, we focused on these for three different motives. First, as previously mentioned, each of these stories represents a cue or a reminder of an existing, bigger narrative. Second, each story was covered by well-established existing media networks on both sides of the US political spectrum (CNN and Fox News). This implies that, although each story could be perceived as being related to a specific political ideology, it is reasonable to assume that subjects of different political orientations were exposed to both, although possibly with different intensity. Therefore, our treatments recall existing or recurrent views that a substantial number of people were aware of, but given the lack of scientific consensus, it was unlikely that a significant share of the population had already established firm beliefs about. Third, as can be seen from the Google Trends evidence reported in Figure 2, both narratives appeared almost simultaneously in the US public discourse at the end of January 2020 and, since then, coexisted following a similar temporal pattern of diffusion.

In terms of policy issues, we chose to focus on trade openness, climate change, and trust in science for two main reasons. First of all, because, as mentioned previously, both explanations may activate much larger narratives, and thus they may influence public opinion on relevant policy issues related to those larger narratives. Second, these issues are animating a vivid public debate in the US. As stated by a recent Gallup Poll, trade openness and climate change are two

of the ten issues Americans believe to be of the utmost importance[21], and trust in science has proven essential for addressing epidemics and health problems that may arise[22].

Figure 2. Narratives and Google Trends



Notes: These graphs report the Google daily search trends for each of the four terms in the headline. The peak popularity of each term over the reported period is normalized to 100. On March 17, 2020, *Nature Medicine* published an article that affirms that COVID-19 originated in wildlife, while on April 15, 2020, Fox News released a report promoting the lab origin of COVID-19.

Predictions

We formulate our empirical predictions for the impact of narratives on beliefs and policy opinions by grounding them on the relevant literature. Research in behavioral economics and psychology suggests that narratives can enhance mental representations of reality (frames) and provide effective reference points in forming opinions and making decisions that individuals constantly confront with [23, 24, 25]. More specifically, the availability and representative heuristics[26] provide the behavioral foundations for our predictions. According to the availability heuristic, when presented with a question on an issue for which subjects do not have a well-defined opinion, they will refer to the closest available memory they can recall. In line with this idea, exposing subjects to alternative stories could alter their opinions about the origin of COVID-19 accordingly. Another documented effect, known as persuasion bias, confirms that individuals tend to be influenced by the repetition of messages, even if these do not contain new information [27]. These considerations lead to our first prediction:

*H*1 Exposing individuals to an existing narrative on the causes of the COVID-19 pandemic will affect subjects' beliefs on the causes of the pandemic, in line with the story they are exposed to.

Regarding our second prediction, the rational framework suggests that, as long as the information on the true cause of the pandemic also provides policy-relevant information, an informative message on the cause also rationally affects beliefs on these policy issues. In terms of behavioral mechanisms these could operate again through the availability and representative heuristics for those issues on which the narrative implicitly contains policy indications (i.e. the *Lab Narrative* on trade and trust in science and the *Nature Narrative* on climate change and trust in science), or alternatively the narratives may act as political or cultural cues. In this latter case, the story evokes a wider political narrative that contains policy indications even if they are not explicitly mentioned in the extract that the experimental subjects are

exposed to. Thus, the *Lab Narrative* should negatively affect support for climate change prevention since this stance may be associated to a conservative view, and the *Nature Narrative* should positively affect support for trade openness in line with a more liberal perspective. These considerations lead to our second prediction:

*H*2 Exposing individuals to an existing narrative on the causes of the COVID-19 pandemic will affect subjects' opinions on policy issues as implied by the narrative they are exposed to:

a. *Lab Narrative* - less support for trade openness, climate change prevention, and scientific progress;

b. *Nature Narrative* - more support for trade openness, climate change prevention, and scientific progress.

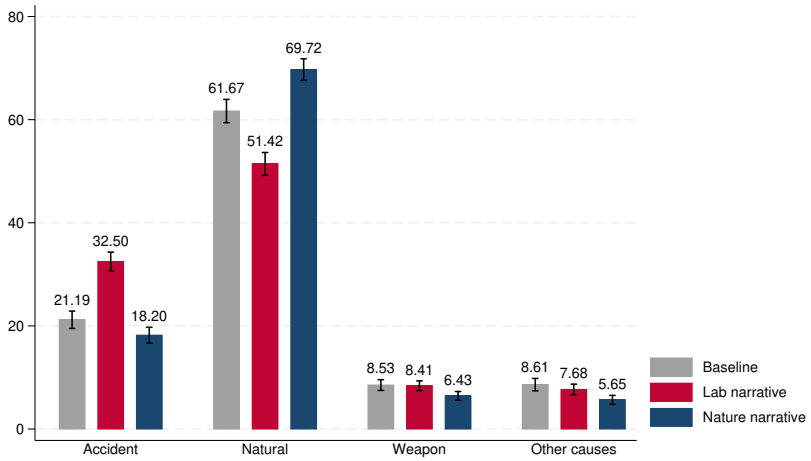
Results

Narratives and causes of COVID-19 - testing *H1*

We used a constant-sum scale question to measure individual beliefs on the causes of COVID-19. More precisely, the respondents were asked to allocate 100 points among four potential causes: the virus was the result of a laboratory accident, the virus originated from a natural process, the virus was a weapon used by countries against each other, and other causes. The greater the number of points assigned to a particular cause, the stronger the belief that a cause is responsible for the emergence of COVID-19.

Figure 3 illustrates the unconditional means of the points assigned to each listed cause of COVID-19 and their 95% confidence intervals. The descriptive analysis seems to suggest that our narratives are effective in convincing subjects about the causes of COVID-19. More specifically, those exposed to the *Lab Narrative* allocate more points to the hypothesis that COVID-19 is a consequence of a laboratory accident than those exposed to the *Nature Narrative* or no story. In a similar vein, those facing the *Nature Narrative* allocate more points to the option that COVID-19 is a natural phenomenon than those facing the *Lab narrative* or no story. Finally, those facing no story or the *Lab narrative* are more likely to think that COVID-19 is a secret weapon than those exposed to the *Nature Narrative*. According to the Kruskal-Wallis test reported in the supplementary material, the differences across treatments are statistically significant ($\chi^2(2)$ is 182.647 ($p = 0.000$) for the accident hypothesis, 138.661 ($p = 0.000$) for the nature hypothesis, and 13.815 ($p = 0.001$) for the weapon hypothesis).

Figure 3. Average points assigned to COVID-19 causes



Notes: Bar chart indicating the average points that respondents assigned to the listed causes of COVID-19 and their 95% confidence intervals for each treatment group.

Since the points assigned to COVID-19 potential causes are linearly dependent, we assess the effects of covariates on individual beliefs by using a choice modeling approach. Specifically, we estimate a multinomial logit model using the number of points assigned to each listed cause as weights[28]. Based on the estimates reported in the supplementary material (Table S2), Figure 4 illustrates, for each treatment group, the predicted probabilities assigned by individuals to the four different hypothetical causes of COVID-19. The capped spikes indicate the corresponding 95% heteroskedastic-robust confidence intervals.

Panel A of Figure 4 reveals that when individuals are exposed to the *Lab Narrative*, the probability they assign to the hypothesis that COVID-19 resulted from a lab accident significantly increases by 12 percentage points ($p \leq 0.001$), passing from a probability of 0.21 to 0.33. In contrast, this probability slightly decreases by 3 percentage points ($p \leq 0.05$) when subjects read the *Nature Narrative*.

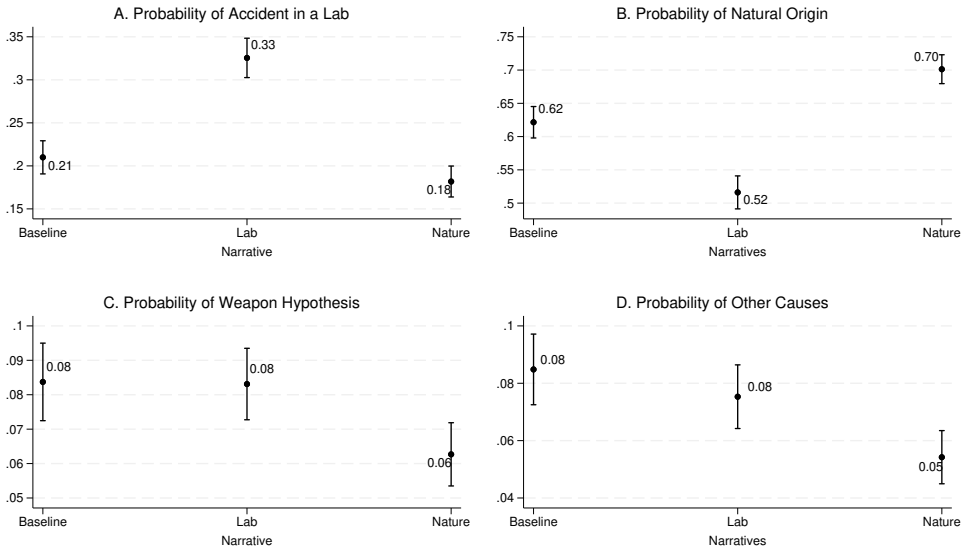
Panel B of Figure 4, on the other hand, shows the opposite effects. The probability that subjects assign to the hypothesis that COVID-19 was the result of a natural phenomenon decreases by 10 percentage points ($p \leq 0.001$) with exposure to the *Lab Narrative* and increases by 8 percentage points ($p \leq 0.001$) with exposure to the *Nature Narrative*. Finally, while the *Lab Narrative* does not significantly affect the probability that subjects assigned to the other two listed causes of COVID-19, the *Nature Narrative* reduces these two average probabilities. In other words, while participants exposed to the *Lab Narrative* tend to replace the natural origin hypothesis with the lab-accident hypothesis without affecting the perceived likelihood of the other causes, exposure to the *Nature Narrative* is also associated with a decrease in the points assigned to the conspiracy hypothesis that COVID-19 is a weapon used by countries against each other (-2 percentage points, $p \leq 0.01$) or other alternative causes (-3 percentage points, $p \leq 0.001$).

In summary, we find that participants respond positively to our narratives. Specifically, those exposed to the *Lab Narrative* tend to allocate more points to the hypothesis that the virus originated from a lab accident. Conversely, those exposed to the *Nature Narrative* tend to assign more points to the hypothesis of a natural origin of COVID-19.

Result 1: Consistent with hypothesis $H1$, narratives on COVID-19 origins influence subjects' beliefs about the causes of the pandemic.

This result suggests that incremental exposure to one of the two contrasting narratives shifts beliefs in different directions, therefore representing a potential cause for polarization. We refer to this as two-sided polarization by exposure, as both narratives have an impact on beliefs.

Figure 4. Narratives and COVID-19 causes



Notes: This graph shows the predicted probabilities of each hypothetical cause of COVID-19 for each treatment group. Capped spikes indicate the 95% confidence intervals derived from heteroskedastic-robust standard errors and based on z-scores.

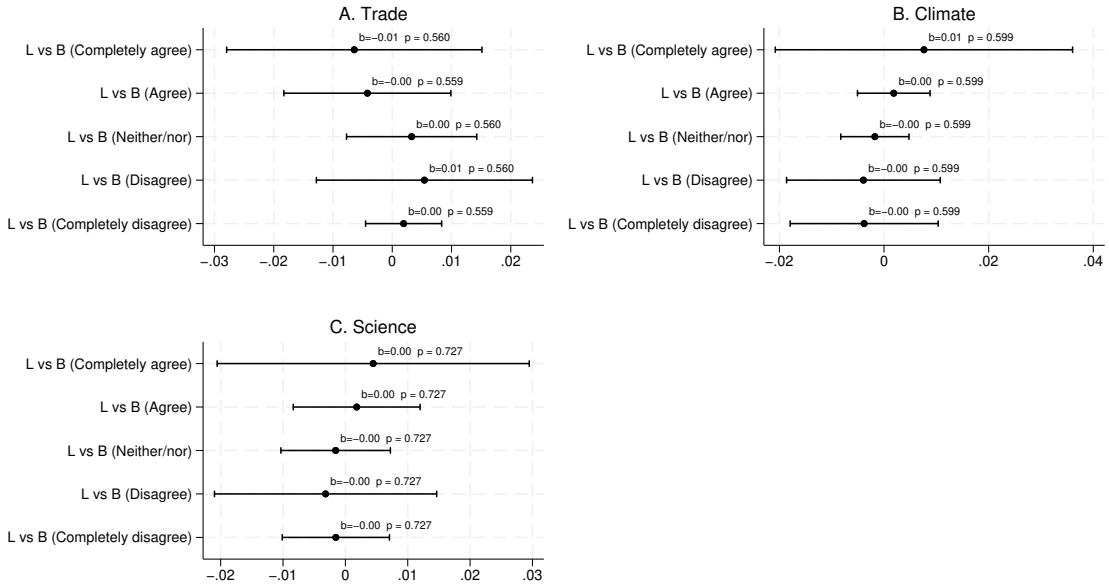
Narratives and policy domains - testing *H2*

Because we measured individuals' policy opinions using a 5-point Likert scale – in which the lower scores indicate a more positive view of foreign trade, climate change prevention, and scientific progress– we estimated the average treatment effects by using three ordered probit models in which the socio-demographic characteristics described in the Methods section enter as control variables.

Figures 5 and 6 illustrate how the predicted probabilities of each category of response on policy questions change when individuals are exposed to the *Lab Narrative* and the *Nature Narrative*, respectively. According to Figure 5, the *Lab Narrative* does not exert a significant treatment effect on average opinions. This conclusion is confirmed by OLS and ordered Probit results reported in the supplementary material (Table S3). Hence, the *Lab Narrative* does not influence people's views on foreign trade, climate change prevention, or trust in science. We summarize this result as follows:

Result 2: The *Lab Narrative* has no impact on policy opinions.

Figure 5. *Lab Narrative* and policy opinions



Notes: This graph shows the marginal effect of the *Lab Narrative* on the predicted probabilities for each class of response. Capped spikes indicate the 95% confidence intervals derived from heteroskedastic-robust standard errors and based on z-scores.

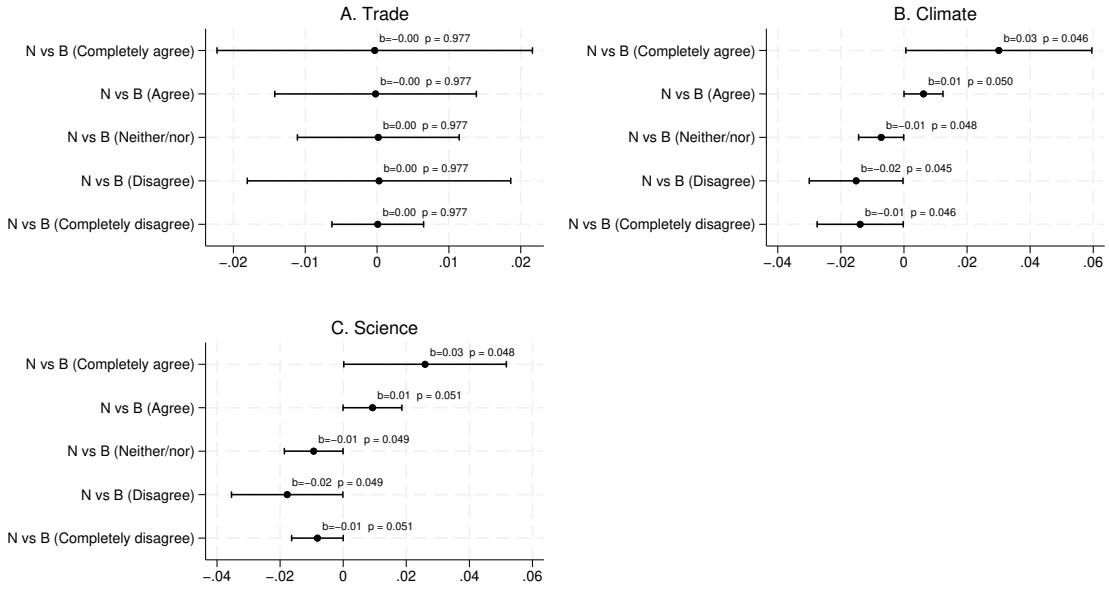
According to Figure 6, the *Nature Narrative* enhances people's trust in scientific progress and their acceptance of climate change defense. In particular, compared to the baseline group, the probability that subjects declare to "completely agree" with the statement that preventing climate change should be a priority in the post COVID-19 recovery, even if it causes slower economic growth and some job losses, increases by 3 percentage points ($p \leq 0.05$) when they are exposed to the *Nature Narrative*. According to the adjusted risk ratios presented in Table S4 of the supplementary material, subjects exposed to the *Nature Narrative* have a 12-14% higher probability of completely agreeing with climate change prevention policies than subjects in the baseline group. Moreover, subjects treated with the *Nature Narrative* are more likely to "agree" with climate change prevention policies by 1 percentage point ($p \leq 0.05$). This effect corresponds to an increase of 2% in the probability of agreeing to prevent climate change in terms of risk ratio. As a result, the remaining answers (i.e., "neither agree nor disagree", "disagree", and "completely disagree") are given lower percentage points. Results are essentially the same when we consider responses to the statement that science is improving our quality of life. The OLS estimates reported in the supplementary material (Tables S3 and S5) confirm that on average the *Nature Narrative* enhances consensus towards climate change prevention policies and trust in science (-0.09 points, $p \leq 0.05$). Despite the relatively modest magnitude of the effect, we should remember that our subjects had previously heard these narratives several times. It is therefore unlikely that a single, additional repetition of the narrative will have a significant impact on individuals' opinions. Indeed, a narrative must be repeated and recalled continuously in order to influence a large number of people [29].

Thus, reading that the COVID-19 outbreak originated from natural causes leads to mildly more favorable positions regarding the fact that, in the post-COVID-19 recovery period, scientific progress should continue as well as climate change should be contrasted.

Result 3: The *Nature narrative* mildly increases consensus for climate change prevention and trust in scientific progress.

Unlike beliefs regarding the causes of the pandemic, when considering policy opinions, only one narrative has a significant impact on beliefs. We therefore denote this effect of narratives as one-sided polarization by exposure.

Figure 6. *Nature Narrative* and policy opinions



Notes: This graph shows the marginal effect of the *Nature Narrative* on the predicted probabilities for each class of response. Capped spikes indicate the 95% confidence intervals derived from heteroskedastic-robust standard errors and based on z-scores.

Additional results: narratives and the social context

The previous results suggest that narratives have the power to convince people about the causes of COVID-19 (Result 1). Moreover, people exposed to the *Nature Narrative* tend to express more favorable positions about climate change protection and scientific progress (Result 3). In contrast, the *Lab Narrative* does not seem to produce any significant effect on policy opinions (Result 2). In this section, we further analyze this evidence by exploring the existence of possible heterogeneous effects of our narratives in different social contexts. A natural question is indeed whether certain narratives may have a different impact based on the underlying cultural orientation. To capture these contextual features, we focus on the division between Republican- and Democratic-leaning states that is at the root of the so-called "American cultural divide"[30].

Since the 2000 elections, political analysts split the US into red (Republican) and blue (Democratic) states. This division was intended to emphasize that states were sharply divided along party lines, and parties' state-level margins of victory were increasing over time [31]. Despite the myths surrounding state-level political polarization, two relevant facts emerged[32]. First, there are remarkable differences among states in terms of habits and beliefs that are not fully explained by the spatial sorting on relevant characteristics for which we control including socio-demographic characteristics such as income or education, or proxies of political preferences such the distinction between urban or rural or communities. These differences involve opinions and habits about religion, civil rights, health behaviors, military policy, and consumption. Indeed, the social context explains many differences across US states, with Republican states tending to exhibit tighter social contexts, that is, social contexts characterized by little tolerance for deviance and strongly enforced rules[33]. In contrast, Democratic states can usually be described as loose societies, that is, societies

with greater tolerance for deviance and few strongly enforced rules. Second, political parties and politicians have shown an increasing tendency to divide the electorate on cultural and religious issues rather than on economic differences. In this respect, some studies illustrate how cultural divisions are necessary to mobilize inframarginal voters and increase politicians' chances of victory[30, 34, 35]. In these models, social cleavages allow politicians to send targeted messages. This strategy may be even more effective if we consider that people can exhibit behavioral biases such as "confirmation bias" or "self-serving information avoidance." These biases occur when individuals devalue or ignore information that contrasts with their pre-existing beliefs, especially in uncertain contexts [36].

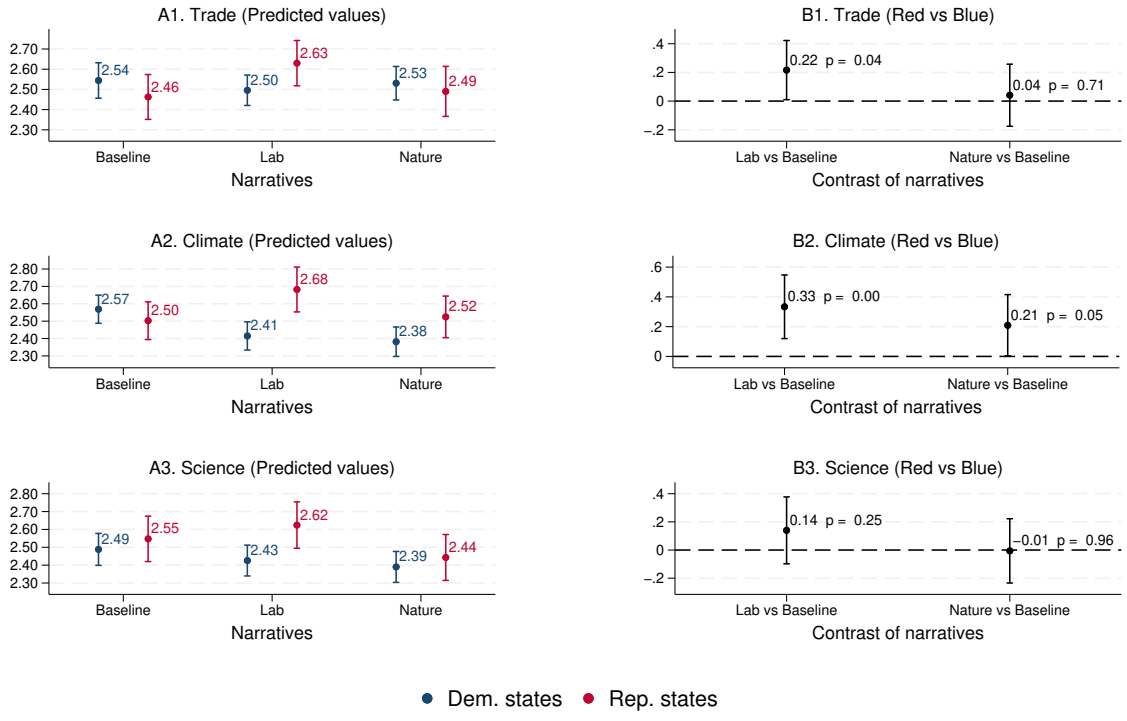
In principle, both narratives on COVID-19 origins could deliver a targeted message and thus have the potential to produce polarizing effects on policy opinions. On the one hand, by evoking a view of the world that is more consistent with the underlying social context, the *Lab Narrative* could be more effective than the *Nature Narrative* in enhancing the conservative positions of those living in Republican states. On the other hand, the *Nature Narrative*, which is more closely related to liberal values, could have a greater impact on those that live in Democratic states where this view of the world has more solid foundations. In this regard, it is important to emphasize that, in our sample, respondents living in Republican-leaning states do not differ significantly from respondents living in Democratic-leaning states in terms of their pre-treatment political preferences. In the supplementary material, we show that individuals in the baseline group are homogeneous across red and blue states in terms of their political orientation. Therefore, any heterogeneous treatment effect associated with state-political orientation is the result of a social context effect rather than a pre-treatment imbalance in political orientation. Nonetheless, as described in the Methods, we use a regression-with-residuals approach in order to ensure the robustness of our findings. This method involves adjusting for post-treatment ideology after residualizing this variable with respect to treatments and pre-treatment variables.[37] Lastly, in the supplementary material, we replace the Rep dummy with a continuous measure of socio-cultural context and show that both measures capture the key features of social context.

Using the OLS coefficients estimated in the supplementary material (Table S5), we test whether the effect of the two narratives on participants' policy opinions depends on the social context in which they live. For each treatment group, Panels A1-A3 of Figure 7 illustrate the predicted opinions of subjects living in red and blue states regarding the three policy issues considered in the study. In the baseline group, especially for foreign trade and climate change protection policies, individuals living in Republican-leaning states and those living in Democratic-leaning states expressed similar opinions regarding policy preferences. However, when exposed to the *Lab Narrative*, individuals living in Republican-leaning states are less supportive of free trade policies and climate change prevention policies than those living in Democratic-leaning states. In contrast, the effect of the *Nature Narrative* on the opinion gap between subjects residing in blue and red states seems to be less pronounced. To determine whether the effect of the two narratives on the three policy domains examined in the study is moderated by the participant's state of residence, we must compare the difference in policy opinions between individuals living in red and blue states who have not been exposed to any narrative with the same difference between participants exposed to one of the two narratives. For this reason, in Panels B1-B3, we have reported the causal differential effect of each treatment on the opinion gap between individuals living in red and blue states. According to Panels B1 and B2, the *Lab Narrative* significantly increases the gap between individuals living in Republican-leaning states and those living in Democratic-leaning states in terms of their policy preferences on foreign trade and climate change prevention. The causal differential effect of the *Lab Narrative* on the free trade opinion gap between individuals living in red and blue states is 0.22 ($p \leq 0.05$), while the causal differential effect of the *Lab Narrative* on the climate change opinion gap is 0.33 ($p \leq 0.01$). Thus, the *Lab Narrative* must be repeated more than once in order to observe a one-category increase in the opinion gap between red and blue states. Results in the supplementary material (Tables S8 and S9) indicate that the heterogeneous treatment effects found here are larger in magnitude than the average treatment effects described in Result 3. We denote this effect

of narratives as polarization by social context, since the single narrative has opposing effects in different social contexts.

Hence, it can be concluded that, compared to residents of Democratic states, subjects residing in Republican states are more likely to disagree with the statement that foreign trade represents an opportunity rather than a threat to the US economy once they have been exposed to the *Lab Narrative*. In a similar manner, subjects residing in Republican states and exposed to the *Lab Narrative* have less favorable opinions regarding the idea of preventing climate change in comparison to those living in Democratic states. In other words, for two out of three policy issues (namely, foreign trade and climate change), the *Lab Narrative* causes a significant increase in the opinion gap between individuals residing in Republican and Democratic states, resulting in more polarized opinions among subjects living in different states. We can observe a similar polarization tendency for trust in science; however, since there seems to be some polarization in the baseline group, we cannot reject the null hypothesis that the *Lab Narrative* does not have any polarizing effect on trust in science. On the contrary, the *Nature Narrative* has no polarizing effect on the policy opinions of Americans living in red and blue states. In the supplementary material, we also conducted a multiple-testing analysis to control for type-I errors when multiple hypotheses are tested. Our conclusions regarding the polarizing effects of the *Lab Narrative* on trade and climate change policies remain qualitatively valid.

Figure 7. Heterogeneous effects of living in red vs blue states



Notes: For each treatment group, Panels A1-A3 illustrate the difference in opinions between subjects living in red and blue states regarding the three policy issues considered in the study. Panels B1-B3 display the causal differential effect of each treatment on the opinion gap between individuals living in red and blue states. Capped spikes indicate the 95% confidence intervals derived from t-statistics (Panels A1-A3) and $\tilde{\chi}^2$-statistics (Panels B1-B3).

Discussion

By exploiting the surge of the COVID-19 pandemic as a source for the emergence of alternative explanations about the causes of the pandemic, we conducted a survey experiment to determine whether narratives can influence individual

opinions and potentially affect polarization. Our analysis allows us to identify two different channels of polarization, the first is generated by additional exposure to one of the two competing stories (polarization by exposure) and the second is driven by the same narrative producing opposing reactions on opinions in different social contexts (polarization by social context).

More specifically, we document the existence of two-sided polarization by exposure when considering beliefs on the origin of the pandemic. Relative to a baseline situation in which subjects are not presented with any story, the alternative explanations of the origins of COVID-19 exert their convincing impact by swaying subjects' beliefs in the direction of their underlying argument independently of the social context. However, this effect is not confirmed when considering policy opinions. While we find that the narrative describing the origin of COVID-19 origins as a natural phenomenon mildly increases popular consensus towards scientific progress and interventions in favor of climate change prevention, the narrative that attributes the breakout of the pandemic to a human error originating from a lab in China does not affect individual opinions on policy issues. This result apparently suggests that only some narratives are moderately effective in influencing policy opinions, implying that competing narratives lead to one-sided polarization by exposure. Namely, the divergence of opinions is one-sided and driven by a mild shift in positions of those that are incrementally exposed to the *Nature Narrative*.

Further exploring the moderating role of the social context reveals a more complete picture of the results. Indeed we find that while the effect of the *Nature Narrative* on policy opinions does not depend on the social context, exposure to the *Lab Narrative* induces subjects living in Republican-leaning states to express less favorable opinions about trade openness and the relevance of climate change prevention, relative to those living in Democratic-leaning states. The latter phenomenon documents the existence of polarization by social context of the narratives, and highlights that some narratives lead to polarization by having a contrasting effect on policy opinions in different social contexts. More specifically, the absence of an unconditional effect of the *Lab Narrative* on policy opinions can be explained precisely by the fact that, the opposing effects compensate each other if the social context is not taken into consideration.

An important finding emerges from the baseline data, namely that each of the two narratives is correlated with a different political orientation (see supplementary material). More specifically, the nature explanation receives more weight by liberal individuals, while the accident explanation is assigned more points by conservatives. Based on this observation, it is worth commenting how our results on the impact of narratives on policy opinions may be influenced by the fact that sample respondents are generally more educated, younger and more skewed towards liberal political orientation with respect to the population. The finding that the *Nature Narrative* shifts policy opinions in both democratic- and republican-leaning states (i.e., one-sided polarization by exposure), could be due to the fact that on average, this version is more aligned with the liberal perspective that is more prominent in our sample, while the opposite holds for the *Lab Narrative*, since the conservative view of the world is underrepresented. Thus, considering a more balanced sample should attenuate the impact of the *Nature Narrative* and increase the impact of the *Lab Narrative*, possibly generating two-sided polarization by exposure also in relation to policy opinions.

Similarly, the result on polarization by social context may extend to both narratives when considering a sample in which individual preferences are generally more aligned with those of their social context. For example, if respondents residing in Republican-leaning states had individual preferences that were more skewed towards a conservative stance, the impact of the *Nature Narrative* could very well be contrarian, pushing them towards even more conservative positions. Indeed, our results provide evidence that this backfiring force is at play in Democratic-leaning states, where individual preferences of respondents are more liberal, and exposure to the *Lab Narrative* shifts policy opinions more toward the left. Thus, there is reason to believe that if this force were also relevant in Republican-leaning states, considering individuals whose preferences are more aligned with the social context would also lead the *Nature Narrative* to generate polarization by social context.

Finally, it is worth mentioning that the present work is closely related to the literature that investigates media persuasion[38, 39]. According to this literature, media consumption can lead to one-sided or two-sided political polarization through the creation of "echo chambers" which restrict people's exposure to information that contradicts their preexisting beliefs [40]. With respect to these studies, our research focuses more on the impact of narratives that provide alternative versions of facts rather than on the impact of being repeatedly exposed to the ideological slant of a print or digital news outlet. Indeed, our design explicitly considers narratives that appeared on both sides of the political spectrum to address the specific power of the narration rather than the role of ideology or slant.

Methods

Experimental design

Our experimental protocol was pre-approved by the Ethical Committee of the University of Venice "Ca' Foscari" in May 2020 and is aimed at assessing how exposing subjects to specific narratives about potential causes of COVID-19 affects their policy opinions. The study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki regarding the treatment of human participants in research. All participants provided their informed consent and were compensated after completing the experiment. Specifically, the questionnaire was structured in four consecutive blocks as shown in Figure 1.

Experimental manipulation and treatments. The first block, included in two of the three treatments of our experiment, represents our experimental manipulation. It includes extracts based on coverage from two major news networks in the US. In each treatment, the extracts put forward a distinct narrative about what caused the COVID-19 outbreak. The text of the extracts, as well as the link to the published articles and all the questions included in the questionnaire, can be found in the supplementary material. More specifically, the treated subjects were presented with one of the following explanations:

(*i*) *"COVID-19 was caused by a lab accident in Wuhan"*: the extracts claim that, despite official denials from Chinese authorities, there exists (unconfirmed) evidence that the COVID-19 outbreak was caused by human error in a laboratory located near the Wuhan wet market.

(*ii*) *"COVID-19 originated in wildlife"*: the extracts refer to scientific evidence supporting the natural origin of the COVID-19 virus as a genetic mutation of pathogens transmitted across animals, presumably bats and pangolins, in wildlife.

Our experimental design includes three distinct treatments, depending on the presence and content of the first block. The first baseline treatment, labeled *No story*, simply does not include the first block, and subjects are immediately presented with the subsequent questions included in the other blocks. In the other two treatments, *Lab Narrative* and *Nature Narrative*, subjects were initially presented with extracts about the *Lab Narrative* and *Nature Narrative*, respectively. As shown in Figure 2, both the *Lab Narrative* and *Nature Narrative* coexisted in the four months before our experiment, which took place on May 7 and 8, 2020.

After having read the two extracts and before answering the questions in the last three blocks, subjects completed a manipulation check. Specifically, they were required to briefly summarize in no more than two sentences what caused COVID-19 according to the extracts in the previous screen.

Four features of our experimental design were specifically conceived to filter out the following possible confounding factors: the source of information, the interaction of partisan preferences with the information source, and the existing political biases of the news networks.

First, subjects assigned to a narrative treatment, either *Lab narrative* or *Nature Narrative*, were exposed to two extracts about the same story, based respectively on coverage from Fox News and CNN. These were among the most popular news networks in the US during the outbreak of the pandemic. By referring to Nielsen's data, an article in Forbes dated June 2, 2020 [41] reports that, during the COVID-19 pandemic, Fox News was the most chosen news network, and CNN registered the largest year-over-year variation in viewership (+117%). Furthermore, there is robust evidence showing that the two news networks strongly differ in the political preferences of their audiences, where Fox News is mainly chosen by conservative/Republican viewers and CNN by liberal/Democratic users [42, 43]. Thus, we made sure that each narrative was covered by both Democratic and Republican popular media outlets.

Second, despite the original news network they were taken from, the two extracts in each treatment were otherwise similar, claiming the same origin of the COVID-19 outbreak and using qualitatively equivalent framing and wording to convey the story.

Third, participants received no information about the original media source, as they were simply told that the two extracts were taken *"from articles in the US media about COVID-19"*.

Fourth, the extracts were presented to subjects by using the original text of the published articles. The only changes made in the original texts were confined to removing graphical elements and precise references to the scientific sources (journal titles and names of researchers). These minimal interventions were aimed at preserving the exposition of the two stories without altering their perceived reliability through precise scientific references.

Policy domains. The second block contained questions on the three policy issues: foreign trade, climate change, and trust in science.

As described in the introduction, the three specific policy issues were selected stemming from i) our predictions that public opinion on each of these policy domains could be indirectly related to the narratives about the causes of the pandemic and; ii) their social and political salience in the US policy debate. In what follows, we provide more detail on both of these motivations.

Concerning trade openness, the economic crisis triggered by the COVID-19 outbreak has caused a decline in the attitude towards globalization [44] and fueled public animosity around protectionism and commercial relations with China. For instance, according to an IPSOS survey conducted during the pandemic, 50% of Americans thought that, in the long run, COVID-19 would disrupt trade with China [45]. Thus, the *Lab Narrative* could intensify the anti-trade sentiment among the American public.

Similar considerations apply to the debate on climate change. Gallup survey data revealed that about two-thirds of Americans thought that climate change was a real problem [46], and another IPSOS survey finds that 59% of respondents in the US thought that climate change was as serious a crisis as COVID-19 is [47]. In addition, climate change shares a number of similarities with the COVID-19 emergency [48]: they both involve externalities, are grounded in a complex scientific debate, and require international cooperation as well as political and public support to find viable solutions. Furthermore, it is claimed that there exist connections between COVID-19 and the climate crisis [49], whereby climate change could increase the probability of pandemics occurring through inter-species contact resulting from deforestation. In essence, on the one hand, the *Nature Narrative* could trigger a pro-environmental sentiment among Americans and enhance climate change awareness. On the other hand, the *Lab Narrative* could downplay the relevance of climate change by making the competition with China more salient, echoing the conservative agenda in support of fossil fuels.

Considering trust in science, although survey data suggest that most Americans trust science, the attitude towards adopting a scientific approach to social issues is strongly heterogeneous and varies considerably with age, education, gender, race, and state of residence [50]. In this respect, the *Lab Narrative* could induce distrust in science as it points out the risks and potential harm of scientific misconduct. Instead, the *Nature Narrative* highlights the merits of science in improving knowledge about the genetic origin of COVID-19.

We acknowledge that the list of policy domains is not conclusive; nonetheless, for the feasibility of implementing the experiment, we were induced to reduce as much as possible the number of policy domains.

For each policy domain, subjects were asked to indicate how much they agreed or disagreed with a stated policy stance on a 5-point Likert scale (with 1 indicating agreement and 5 disagreement). More specifically, the three statements are reported as follows:

(*ii*) Foreign trade: *"Foreign trade represents more of an opportunity than a threat for the US economy in the post COVID-19 recovery"*.

(*i*) Climate change: *"Preventing climate change should be given priority in the post COVID-19 recovery, even if it causes slower economic growth and some loss of jobs"*.

(*iii*) Trust in science: *"Science is improving our lives, and, in the post COVID-19 recovery, scientific progress should rapidly continue despite potential ethical and safety concerns"*.

Questions on what caused the COVID-19. The third block consisted of two questions. The first question specifically asked participants to allocate 100 points across four potential causes of COVID-19, indicating that the greater the number of points allocated to a given cause, the more the subject believed in a specific explanation. The potential causes considered in this block were: (i) the virus originated from an accident in a lab; (ii) the virus originated in nature as a result of natural processes; (iii) the virus is a weapon the countries use against each other; (iv) other reasons.

The hypothesis that the virus was a weapon used by some countries against others aimed to distinguish those who believe in a pure conspiracy theory from participants that associate COVID-19 with a lab accident deriving from a human error. The second question asked those who believe that COVID-19 originated from "other reasons" to indicate these reasons. In this way, the questionnaire did not exclude *a priori* the existence of a common belief incidentally excluded by researchers.

Socio-demographic information. In the fourth (and last) block, we gathered information on the subjects' state of residence, and they were asked other socio-demographic questions, including gender, age, occupational and educational status, income situation, and whether lockdown restrictions were active in the state where they were actually living, their political view (on a 5-point scale moving from very conservative to very liberal), and, finally, how much time (in minutes) they spent watching, reading or listening to news about politics and current affairs on a typical day.

Procedures

The survey experiment was conducted on May 7 and 8, 2020, and administered via Qualtrics (www.qualtrics.com). Participants were recruited via the online platform Prolific [51]. Two restrictions were imposed in selecting participants: they were required to be US nationals residing in the US. Several reasons justify our selection criteria. First, they are aimed at attenuating the potential influence of the (unobservable) social and cultural heterogeneity across participants on the results of the survey experiment. Second, based on these conditions, it can be reasonably expected that, at the time when the experiment was carried out, participants were physically located in the US and, therefore, equally exposed to the social, political, and media attention for the COVID-19 emergency.

To limit potential response biases that are due to wording used in the questions, their ordering, the presence of (apparently irrelevant) formatting elements, and other context effects, we designed the questions on the policy domains in the second block by following two important experimental features. First, all of the three statements explicitly referred to the post COVID-19 recovery, thus making responses in the baseline *No story* treatment (in which subjects

were not exposed to any story about the cause of the COVID-19) comparable with those in the other two treatments, *Lab Narrative* and *Nature Narrative* (in which, before the questions on the policy domains, subjects were induced to think about the COVID-19 causes). Second, within treatment, the order in which the questions on the socio-economic domains were presented was randomized across subjects.

All questions in the questionnaire appeared on separate and consecutive screens. After proceeding to the next questions in the questionnaire, the respondents had no chance to move back to previous questions and revise the corresponding answers. Each subject was randomly allocated to one of the three treatments and could participate in the survey experiment only once. The survey experiment lasted for 5.45 minutes on average, and the participants were paid £0.84 (around $1.1) for their participation.

The subject pool

At the time of our study, 3,091 subjects (out of an eligible population of $29,273$) participated in the survey experiment. On May 7, 2020, a pilot study with 241 participants was conducted. The main experiment took place on May 8, 2020, with 2,850 participants. We pooled the samples since both the pilot and main experiments followed the same experimental protocol. Due to the lack of age and state information, 5 observations were discarded. Overall, 3,086 observations entered the study: $1,053$ in the baseline treatment *No Story* , $1,016$ in *Lab Narrative*, and $1,017$ in *Nature Narrative*.

Table 1 summarizes the socio-demographic characteristics of the subjects entering our sample.

Table 1. Sociodemographic characteristics and descriptive statistics

Variable	Description	Mean	SD
Rep	Dummy variable taking value 1 if the state is a lean Republican state and 0 otherwise.	0.35	0.48
Urban	Dummy variable taking value 1 if the subject lives in a metropolitan county with more than 250,000 population. Data comes from USAFacts (2020), available at http://usafacts.org/visualizations/coronavirus-covid-19-spread-map (accessed on May 15, 2020).	0.85	0.36
Male	Dummy variable taking value 1 if the subject is a male and 0 otherwise.	0.49	0.50
Age	Respondent's age.	34.61	12.88
Income	Self-reported income level on a ten-point scale where 10 is the highest income class.	6.07	1.81
High school	Dummy variable taking value 1 if the highest level of education the respondent achieved is lower than or equal to high school.	0.35	0.48
Bachelor	Dummy variable taking value 1 if the highest level of education the respondent achieved is a bachelor's.	0.46	0.50
Master	Dummy variable taking value 1 if the highest level of education the respondent achieved is a master's.	0.14	0.35
Doctorate	Dummy variable taking value 1 if the highest level of education the respondent achieved is a doctorate.	0.05	0.21
Self-employed	Dummy variable taking value 1 if the subject reported to be self-employed or other.	0.16	0.36
Student	Dummy variable taking value 1 if the subject reported to be a student.	0.16	0.37
Unemployed	Dummy variable taking value 1 if the subject reported to be unemployed.	0.16	0.37
Employed	Dummy variable taking value 1 if the subject reported to be (part-time or full-time) employed.	0.52	0.50
No restriction	Dummy variable taking value 1 if no lockdown restrictions were in place at the time of the survey.	0.02	0.15
Advisory order	Dummy variable taking value 1 if only an advisory order was in effect at the time of the survey.	0.28	0.45
Person at risk	Dummy variable taking value 1 if, at the time of the survey, lockdown restrictions were in place only for persons at risk.	0.11	0.31
Lockdown	Dummy variable taking value 1 if lockdown restrictions were in place for all residents at the time of the survey.	0.59	0.49
COVID-19	Ratio between the cumulated number of COVID-19 cases officially confirmed in each state till the day before the survey experiment and the corresponding population.	0.10	0.12

Notes: This table describes the socio-demographic variables used as controls in the study and provides the mean and the standard deviation of each variable.

We used Gallup's data[52] on the average party affiliation of each state's residents throughout 2018 to classify the states into Republican or Democratic. In particular, we classified as Republican-leaning those states with a fraction of affiliations greater or equal to the fraction of Democrats. With respect to other potential classifications, there are two important advantages in using data from Gallup: it compares states over the same period of time and includes nonvoters' political opinions. Moreover, in the supplementary material, we perform a robustness check by re-classifying states with the same fractions of Republicans and Democrats according to the relative number of Republican seats in the US Congress. About 35 percent of respondents reside in states classified as Republican.

Moreover, to control for the fact that the state election map may mask an urban-rural divide within states, we also include a dummy variable taking value 1 if the respondent lives in a metropolitan county with more than 250,000 inhabitants and zero otherwise. To distinguish between metro and non-metro counties, we used the "2013 Rural-Urban Continuum Codes" provided by the US Department of Agriculture. Indeed, rural voters are more likely to be morally and socially conservative, even if they may vote for Democrats for a variety of reasons.[53] In line with the 2020 US census, 85 percent of respondents are located in metropolitan areas. Male participants constitute 49 percent of the sample,

while the age of the subjects ranges from 18 to 80, with a mean age of 34.61 years. Self-reported income classification indicates that, on average, individuals perceive themselves in a class of income equal to 6, given a ten-point scale where 10 is the highest income class. The use of a self-reported income class is based on three considerations. First, policy preferences depend more on the self-perceived relative status than on effective income[54]. Second, different groups of individuals might be differently equipped to provide their income based on a specific time horizon (e.g., annual, monthly, or weekly). In contrast, a ten-point scale does not depend on any given periodicity. Third, people are sensitive about disclosing their income, while a scale can make people feel more comfortable about sharing information. Human capital is measured using the highest level of education the respondent achieved. According to this variable, most of the individuals have a high school diploma or less (35 percent) or a bachelor's degree (46 percent). The majority of respondents were working, either part-time or full-time.

To take into account lockdown restrictions that could influence subjects' attitudes towards COVID-19 narratives, we consider four different official stay-at-home restrictions imposed by states: no restriction; advisory order; mandatory for persons at risk; mandatory for all. At the time of the survey, most respondents were living in a location subject to lockdown restrictions. Finally, we also control for the COVID-19 incidence rate measured as the ratio between the cumulated number of COVID-19 cases officially confirmed in each state until the day before the survey experiment and the corresponding population.

Estimation strategy

Testing H1 and H2

We are interested in investigating whether the proposed narratives influence respondents' opinions on the causes of COVID-19 as well as on vital policy domains in the post-pandemic world.

Since we elicit beliefs about COVID-19 potential causes using a constant-sum scale question, we address linear dependency issues by adopting a choice modeling approach. In particular, we use the number of points assigned to each listed cause as weights and estimate a multinomial logit model[28]. Denoting with $j = B,\ L, N$ the baseline treatment, the *Lab Narrative*, and the *Nature Narrative*, respectively, we test $H1$ by estimating the following model:

$$Pr\left[Y_{i,j,m}\right] = \frac{\exp\left[\hat{\beta}_{B,m} + \sum_{j\neq B}\hat{\beta}_{j,m}\cdot d_{i,j} + X_i\hat{\phi_m}\right]}{1+\sum_{k=2}^{4}\exp\left[\hat{\beta}_{B,k} + \sum_{j\neq B}\hat{\beta}_{j,k}\cdot d_{i,j} + X_i\hat{\phi}_k\right]}, \tag{1}$$

where $Pr\left[Y_{i,j,m}\right]$ is the probability that the subject i, exposed to treatment j, will respond m to the question (the reference category is $m = 1$), $d_{i,j}$ is a dummy variable indicating whether a subject has been randomly assigned to narrative j (the baseline group that received no narrative is the omitted group), X_i is a matrix of individual socio-demographic characteristics. This model allows us to use a linear function to estimate the logarithm of the probability ratio for the m-th category of Y:

$$ln\frac{Pr\left[Y_{i,j,m}\right]}{Pr\left[Y_{i,j,1}\right]} = \hat{\beta}_{B,m} + \sum_{j\neq B}\hat{\beta}_{j,m}\cdot d_{i,j} + X_i\hat{\phi_m}. \tag{2}$$

This result can be used to interpret each coefficient as the increase in log-odds ratios of the m-th category versus the reference category (i.e., "other causes") when the corresponding covariate increases by one unit and the other covariates

remain at their mean values. Therefore, $H1$ implies:

$$H1 : \hat{\beta}_{j \neq B} > 0, \;\; for\, Y = cause\, in\, line\, with\, j, \tag{3}$$

Considering that policy preference variables are ordered categories, we test $H2$ using both an OLS and an ordered probit model. Moreover, in the supplementary material, we estimate an adjacent category model to investigate if our narratives influence the probability of observing a certain category relative to the previous one. Denoting with $Z_{i,j}$ the policy opinion of individual i exposed to narrative j, the linear model for policy opinions can be written as follows:

$$Z_{i,j} = \hat{\beta}_B + \sum_{j \neq B} \hat{\beta}_j \cdot d_{i,j} + X_i \hat{\phi} + \varepsilon_i. \tag{4}$$

where ε_i is the error term. Because of the randomization procedure, we estimate Equation (4) with and without the set of socio-demographic controls.

Using $\overline{Z}$ to denote the expected value of Z, we can write hypothesis $H2$ as follows:

$$H2 : \begin{cases} a. \left(\overline{Z}_L - \overline{Z}_B\right) = \hat{\beta}_L > 0, & for\, Z = trade, climate, and\, science; \\ b. \left(\overline{Z}_N - \overline{Z}_B\right) = \hat{\beta}_N < 0, & for\, Z = trade, climate, and\, science, \end{cases} \tag{5}$$

Regarding the ordered probit model, we estimate the probability of declaring a policy opinion equal to c as follows:

$$P[Z_{i,j} = c] = F(\mu_c - \mathbf{W_{i,j}}\hat{\delta}) - F(\mu_{c-1} - \mathbf{W_{i,j}}\hat{\delta}), \tag{6}$$

where F is the standard normal cumulative distribution function, $\mathbf{W_{i,j}}\hat{\delta}$ represents the right-hand side of Equation (4), with the exclusion of the error term, and μ_c is the cut point of class c. To make heteroscedasticity-consistent inference, all estimates are based on White standard errors. Moreover, our inference is rather conservative since we use two-tailed tests even though one-tailed tests could have been used to test our hypotheses.

The social context as a moderator of narratives

We also exploit our randomized design to test the hypothesis that our narratives affect people differently depending on the social context in which they live. More precisely, by using a full interaction regression method[55], we estimate the causal moderation effect (CME) of subjects' state of residence. Due to randomization, treated and untreated individuals living in red states are expected to have similar observed and unobserved characteristics. The same applies to individuals living in blue states. Therefore, any significant difference in the within-treatment coefficient of the Rep dummy represents the CMEs of the social context on policy issues.

Even though successful randomization should ensure that pre-treatment political orientation is balanced across treatments, narratives may have a different impact on the post-treatment political orientation of individuals living in red and blue states. This heterogeneous effect may be due to an important variable that has been omitted, namely political partisanship. If partisanship also affects individual reactions to narratives, we can have endogeneity problems even in a randomized setting.

To address this issue, we use a regression-with-residuals method, which consists of adjusting for post-treatment ideology only after having residualized this variable with respect to treatment and pre-treatment variables.[37] Notice

that any question about political orientation or partisanship is highly endogenous in these types of survey experiments. Indeed, asking political questions before the main survey questions can cause respondents to think about the study from a partisan perspective.[56] On the other hand, asking the question after the manipulation and policy questions could result in conditioning political orientation on the responses to the policy questions for the sake of consistency. In other words, respondents could adjust their political orientation after having read the narratives and having expressed an opinion on relevant socio-economic issues. Thus, even if we measured the post-treatment ideological orientation of respondents, controlling for this using the conventional covariate method may result in biased results, since the post-treatment covariate may also contain part of the effect of narratives on policy questions.

We first estimate the following equation:

$$L_{i,j} = a + \hat{b}_j \cdot d_{i,j} + \hat{c}_j \cdot Rep_{i,j} + \hat{h}_j \cdot d_{i,j} \cdot Rep_{i,j} + W_{i,j}^{\perp} \hat{m}_j + W_{i,j}^{\perp} d_{i,j} \hat{n}_j + u_{i,j}, \tag{7}$$

where $L_{i,j}$ is the self-reported political orientation of subject i exposed to treatment j, and $W_{i,j}^{\perp}$ is the vector of control variables excluded the *Rep* dummy. Subsequently, we estimate the CME as follows:

$$Z_{i,j} = \hat{\alpha} + \hat{\beta}_j \cdot d_{i,j} + \hat{\gamma}_j \cdot Rep_{i,j} + \hat{\delta}_j \cdot d_{i,j} \cdot Rep_{i,j} + W_{i,j}^{\perp} \hat{\phi}_j + W_{i,j}^{\perp} \hat{\theta}_j d_{i,j} + L_{i,j}^{\perp} \hat{\varphi}_j + L_{i,j}^{\perp} \hat{\psi}_j d_{i,j} + \varepsilon_{i,j}, \tag{8}$$

where $L_{i,j}^{\perp} \equiv L_{i,j} - E[L_{i,j} | d_{i,j}, Rep_{i,j}, W_{i,j}^{\perp}]$ is the residual term for the post-treatment ideology.

Robustness checks

The supplementary materials contain a series of analyses aimed at assessing the robustness of our findings. After having carried out a battery of tests devoted to verifying the validity of our randomization process and the effectiveness of our manipulations, we report the results of a Kruskal-Wallis test aimed at confirming the unconditional results depicted in Figure 3. We, therefore, estimate an adjacent category model to examine whether our narratives influence the likelihood of observing a certain category compared to the previous category. The rationale for doing this is that conventional cumulative probability models ignore the likelihood of treated subjects falling within a particular category relative to a previous category. Then, we reclassify uncertain states (i.e., states with the same percentage of Democratic and Republican affiliates) according to the relative number of federal representatives belonging to the Republican party. This allows us to test the robustness of the heterogeneous treatment effects presented in the additional results. Subsequently, we investigate whether our main effects are influenced by the order in which we present our randomized statements. We also conduct a multiple-testing analysis to control for the combined probability of rejecting a true null hypothesis. This allows us to take into account the probability of committing any type-I error among all the hypotheses tested. Lastly, we construct an alternative measure of socio-cultural context to determine whether the distinction between red and blue states is a proxy for social context or if it captures other confounding factors.

References

1. Brunnermeier, M. K., James, H. & Landau, J.-P. *The Euro and the battle of ideas* (Princeton University Press, Princeton, NJ, 2018).

2. Gentzkow, M., Shapiro, J. M. & Taddy, M. Measuring group differences in high-dimensional choices: method and application to congressional speech. *Econometrica* **87**, 1307–1340 (2019).

3. Shiller, R. J. *Narrative economics: How stories go viral and drive major economic events* (Princeton University Press, Princeton, CA, 2019).

4. Roos, M. & Reccius, M. Narratives in economics. *J. Econ. Surv.* (2021).

5. Eliaz, K. & Spiegler, R. A model of competing narratives. *Am. Econ. Rev.* **110**, 3786–3816 (2020).

6. Della Vigna, S. & Kaplan, E. The Fox News effect: Media bias and voting. *Q. J. Econ.* **122**, 1187–1234 (2007).

7. Bakshy, E., Messing, S. & Adamic, L. A. Exposure to ideologically diverse news and opinion on facebook. *Science* **348**, 1130–1132 (2015).

8. Levy, R. Social media, news consumption, and polarization: Evidence from a field experiment. *Am. Econ. Rev.* **111**, 831–70 (2021).

9. Krupka, E. & Weber, R. A. The focusing and informational effects of norms on pro-social behavior. *J. Econ. Psychol.* **30**, 307–320 (2009).

10. Silver, L., Devlin, K. & Huang, C. Unfavorable views of China reach historic highs in many countries. *Pew Res. Cent.* **6** (2020).

11. Tollefson, J. How Trump damaged science—and why it could take decades to recover. *Nature* **586**, 190–194 (2020).

12. Kwa, K. X. Experiments and qualitative methods: towards a methodological framework. *Res. Handb. on Motiv. Public Adm.* 105–120 (2022).

13. Kaufmann, E. Can narratives of white identity reduce opposition to immigration and support for hard Brexit? A survey experiment. *Polit. Stud.* **67**, 31–46 (2019).

14. Cattaneo, C. & Grieco, D. Turning opposition into support to immigration: The role of narratives. *J. Econ. Behav. Organ.* **190**, 785–801 (2021).

15. Bolsen, T. & Shapiro, M. A. The US news media, polarization on climate change, and pathways to effective communication. *Environ. Commun.* **12**, 149–163 (2018).

16. Gehring, K. & Grigoletto, M. Analyzing climate change policy narratives with the character-role narrative framework. *CESifo Work. Pap.* **10429** (2023).

17. Balafoutas, L., Libman, A., Selamis, V. & Vollan, B. Exposure to conspiracy theories in the lab. *Econ. Polit. Stud.* **9**, 90–112 (2021).

18. Brader, T., Valentino, N. A. & Suhay, E. What triggers public opposition to immigration? Anxiety, group cues, and immigration threat. *Am. J. Polit. Sci.* **52**, 959–978 (2008).

19. Gadarian, S. K. & Albertson, B. Anxiety, immigration, and the search for information. *Polit. Psychol.* **35**, 133–164 (2014).

20. Hyde, M. (2021). The Guardian, http://theguardian.com/world/2021/jan/28/white-house-great-concern-over-covid-origin-misinformation-from-within-china, accessed on January 29, 2021.

21. Hrynowski, Z. Several issues tie as most important in 2020 election. *Retrieved from Gallup website: www.news. gallup. com/poll/276932/several-issues-tie-important-2020-election.aspx* (2020).

22. Stevens, L. & Ron-Levey, I. Trust in science essential in battle against COVID-19. *Gallup Blog* (2020).

23. Tversky, A. & Kahneman, D. *Choices, values, and frames* (Cambridge University Press, 2000).

24. Brañas-Garza, P. Promoting helping behavior with framing in dictator games. *J. Econ. Psychol.* **28**, 477–486 (2007).

25. Thaler, R. H. Behavioral economics: Past, present, and future. *Am. Econ. Rev.* **106**, 1577–1600 (2016).

26. Tversky, A. & Kahneman, D. Availability: A heuristic for judging frequency and probability. *Cogn. Psychol.* **5**, 207–232 (1973).

27. DeMarzo, P. M., Vayanos, D. & Zwiebel, J. Persuasion bias, social influence, and unidimensional opinions. *Q. J. Econ.* **118**, 909–968 (2003).

28. McFadden, D. *et al.* Quantal choice analysis: A survey. *Annals economic social measurement* **5**, 363–390 (1976).

29. Andrews, K. T. & Caren, N. Making the news: Movement organizations, media attention, and the public agenda. *Am. sociological review* **75**, 841–866 (2010).

30. Makowsky, M. D. Religion, clubs, and emergent social divides. *J. Econ. Behav. & Organ.* **80**, 74–87 (2011).

31. Abramowitz, A. I. & Saunders, K. L. Is polarization a myth? *J. Polit.* **70**, 542–555 (2008).

32. Glaeser, E. L. & Ward, B. A. Myths and realities of American political geography. *J. Econ. Perspectives* **20**, 119–144 (2006).

33. Harrington, J. R. & Gelfand, J., Michele. Tightness–looseness across the 50 united states. *Proc. Natl. Acad. Sci.* **111**, 7990–7995 (2014).

34. Murphy, K. M. & Shleifer, A. Persuasion in politics. *Am. Econ. Rev.* **94**, 435–439 (2004).

35. Glaeser, E. L., Ponzetto, G. A. & Shapiro, J. M. Strategic extremism: Why Republicans and Democrats divide on religious values. *Q. J. Econ.* **120**, 1283–1330 (2005).

36. Momsen, K. & Ohndorf, M. Information avoidance, selective exposure, and fake (?) news: Theory and experimental evidence on green consumption. *J. Econ. Psychol.* **88**, 102457 (2022).

37. Wodtke, G. T. & Zhou, X. Effect decomposition in the presence of treatment-induced confounding: A regression-with-residuals approach. *Epidemiology* **31**, 369–375 (2020).

38. Chen, Y. & Yang, D. Y. The impact of media censorship: 1984 or brave new world? *Am. Econ. Rev.* **109**, 2294–2332 (2019).

39. Allcott, H., Braghieri, L., Eichmeyer, S. & Gentzkow, M. The welfare effects of social media. *Am. Econ. Rev.* **110**, 629–76 (2020).

40. Bail, C. A. *et al.* Exposure to opposing views on social media can increase political polarization. *Proc. Natl. Acad. Sci.* **115**, 9216–9221 (2018).

41. Joyella, M. Fox News dominates May ratings, but CNN prime time jumps 117%. *Forbes* (2020).

42. Iyengar, S. & Hahn, K. S. Red media, blue media: Evidence of ideological selectivity in media use. *J. Commun.* **59**, 19–39 (2009).

43. Schroeder, E. & Stone, D. F. Fox News and political knowledge. *J. Public Econ.* **126**, 52–63 (2015).

44. Garrett, G. The post-covid-19 world will be less global and less urban. *Knowledge@Wharton, www-knowledge. wharton. upenn. edu/article/post-covid-19-world-will-less-global-less-urban* (2020).

45. IPSOS, M. O. R. I. Coronavirus: Opinion and reaction. Results from a multi-country poll. February 14, 2020. *Ipsos* (2020).

46. Saad, L. Americans as concerned as ever about global warming. *News, Gallup* (2019).

47. Gray, E. & Jackson, C. Two thirds of citizens around the world agree climate change is as serious a crisis as coronavirus. *Ipsos* (2020).

48. Hepburn, C., O'Callaghan, B., Stern, N., Stiglitz, J. & Zenghelis, D. Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change? *Oxf. Rev. Econ. Policy* **36**, S359–S381 (2020).

49. Mendiluce, M. & Siri, J. The covid-19 recovery can be the vaccine for climate change. In *World Economic Forum* (2020).

50. AAAS. *Perceptions of science in America. A report from the public face of science initiatives* (American Academy of Arts & Sciences: Cambridge, MA, 2018).

51. Palan, S. & Schitter, C. Prolific. ac—A subject pool for online experiments. *J. Behav. Exp. Finance* **17**, 22–27 (2018).

52. Jones, J. Democratic states exceed republican states by four in 2018. *Gallup* **22** (2019).

53. Gimpel, J. G. & Karnes, K. A. The rural side of the urban-rural gap. *PS: Polit. Sci. & Polit.* **39**, 467–472 (2006).

54. Karadja, M., Mollerstrom, J. & Seim, D. Richer (and holier) than thou? The effect of relative income improvements on demand for redistribution. *Rev. Econ. Stat.* **99**, 201–212 (2017).

55. Bansak, K. Estimating causal moderation effects with randomized treatments and non-randomized moderators. *J. Royal Stat. Soc. Ser. A: Stat. Soc.* **184**, 65–86 (2021).

56. Deaton, A. & Stone, A. Do context effects limit the usefulness of self-reported wellbeing measures. *Res. Program Dev. Stud. Work. Pap.* **288** (2013).

Acknowledgments

We thank Viola Angelini, Marco Bertoni, Eugenio Levi, Rupert Sausgruber, Francesco Sobbrio, Stefan Trautmann, Dmitri Vinogradov, Huan Xie, participants at the 2021 LEM Seminar in Lille, the ESA 2021 Global Online Conference, the 2021 AFES Meeting in Abidjan, the 2021 NAMES Meeting in Montréal and the 2020 CPEG Conference for useful discussions and comments. Financial support from VERA, University of Venice "Ca' Foscari," and LIUC University is gratefully acknowledged. Finally, the authors would like to thank two anonymous reviewers for their careful reading of the manuscript and their many insightful comments and suggestions. The views in this paper do not reflect the views or opinions of Thames Water. Authors take full responsibility for the content presented herein.

Ethical approval

The Ethical Committee of the University of Venice "Ca' Foscari" pre-approved the experimental protocol in May 2020.

Competing interests

The authors have no conflict of interest to declare.

Author contributions

All authors equally contributed to the sections of the paper.

Data availability

The dataset generated and analyzed during the current study has been deposited in the Harvard Dataverse repository and is publicly available with the following DOI: doi.org/10.7910/DVN/QNCA02