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Environmental Actions, Support for Policy, and Information Provision: Experimental Evidence from the US

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Abstract: While a political divide between Democrats and Republicans persists about the urgency to tackle climate change in the US, growing evidence suggests that individuals' pro-environmental actions and support for green policies are much less politically divided. We investigate which type of information on climate change, and through which mechanism, can promote such actions and policy support. Using an online randomized experiment, we find that providing prospective rather than retrospective information on local climate change has a significant and positive impact on both individuals' behavior and policy support across party lines. The effectiveness of this information provision depends on three main mechanisms: assigning individuals, rather than governments or corporations, the responsibility of addressing climate change; having young children; and expressing trust in the central government. Overall, the results suggest that providing prospective information on local climate change and focusing on individual actions and support for green policies can substantially contribute to raising the necessary support to address climate change.

Key Words: Support for Climate Policy; Pro-environmental Actions; Climate Change; Online Randomized Experiment.

JEL Codes: Q54; D83; C93.

1. Introduction

The most recent 2021 Report of the Intergovernmental Panel on Climate Change (IPCC) highlights the urgency to act to prevent climate breakdown. Well within the next two decades, temperatures are likely to rise by more than 1.5 degree Celsius above pre-industrial levels, breaching the target of the 2015 Paris climate agreement, and setting the stage for extreme weather and potentially increasing devastation. Only rapid and drastic reductions in greenhouse gases in this decade can prevent the worst of this climate disaster. In a recent speech in April 2024, the Executive Secretary of the United Nations Framework Convention on Climate Change warns that we only have two years to save the world from climate disaster, and he calls upon both private and public institutions for immediate policy action and upon every citizen for speaking louder and taking actions to tackle climate change¹.

While more than ninety-nine per cent of scientists agree that climate change is caused by human activities (Lynas *et al.* 2021) and the negative impact of both year-to-year (e.g. Carleton *et al.* 2018) and long run temperature changes (Waldinger 2024) has been extensively documented, public opinion concern about the urgency to tackle climate change varies. In Europe, for example, there is less concern in cooler countries compared to warmer ones (Nowakowski and Oswald 2020). In the United States (US), which is the second biggest carbon polluter in the world and is responsible for about fourteen percent of CO₂ global emissions², perceptions of the seriousness of climate change are mainly driven by partisanship and political ideology (Egan and Mullin 2017), even after controlling for individuals' direct experiences with local, long-term climate change (Binelli *et al.* 2023).

While in several countries the public opinion debate on the urgency to tackle climate change continues, growing evidence suggests that pro-environmental behaviors and support for climate policy are much less politically divided. That is, while stances on anthropogenic climate change and urgent measures to take may differ, people's pro-environmental actions and support for green policies are much more aligned and, crucially, significantly less partisan (Dechezleprêtre *et al.* 2022; Mildemberger *et al.* 2019; Binelli *et al.* 2023; Mayer and Smith 2023).

Acting on pro-environmental behavior and policy support may thus be key to addressing climate change. In this paper, we focus on the US and investigate how to promote pro-environmental behaviour and policy support. Specifically, we focus on the role of information

¹ <https://www.youtube.com/watch?v=fJr8NZ7F0MQ>

² <https://climatetrade.com/which-countries-are-the-worlds-biggest-carbon-polluters/>

provision and assess the relative effectiveness of providing prospective or rather retrospective climate change information, and the mechanisms that can explain this effectiveness.

Various modes of climate change's information provision have been studied (Bruine de Bruin *et al.* 2021; Dechezleprêtre *et al.* 2022) and several studies have stressed the importance of using simple language (Bruine de Bruin *et al.* 2021) and information on local rather than global climate change (Bruine de Bruin and Dugan 2022 and Taylor, Bruine de Bruin and Dessai 2014). However, there has been no investigation on the salience of the prospective or retrospective nature of the information provided.

Most climate change information in the news is retrospective, using historical data on past climate or weather events. However, Binelli *et al.* (2022) find that providing prospective information on future climate change impacts pro-environmental individual actions and support for policy across party lines, consistently with the vast literature that has shown how expectations about the future rather than information about the past drive individuals' choices and behaviors (Manski 2017, 2004). Assessing the potential difference between providing retrospective or rather prospective information is thus essential to promoting a sound and effective pro-environmental communication strategy.

To quantify the impact of information provision on local climate change, and to detect potential mechanisms of transmission, we conduct a randomized online experiment with a large representative sample (N=2,621) of American residents. We use a survey to provide respondents with a concrete description of the long-run changes in temperature and precipitation in the city of residence, that is a local measure of climate change, which is communicated in a simple and direct format. We also elicit information on several individuals' characteristics, including party affiliation and political ideology, and a wide range of support for environmental policies and pro-environmental individual actions. The findings show that, regardless of partisanship, providing prospective information on local climate change is the most effective instrument to promote individuals' pro-environmental actions and support for climate policy. Notably, the effectiveness of the information provision depends on the assignment of responsibility to individuals for taking action to address climate change (rather than to governments or corporations), and it is higher for those respondents with young children and for those with a high degree of trust in government.

These findings indicate the possibility of circumventing the seemingly intractable public opinion divide on taking measures to reduce anthropogenic climate change. Understanding what shapes individuals' orientation to engage in pro-environmental actions and support climate policies is crucial to identify solutions to address the climate crisis.

1.2 Related literature

A growing literature has studied the determinants of individuals' pro-environmental actions and support for green policies. On pro-environmental actions, Li *et al.* (2019) and Kollmuss and Agyeman (2002) present two reviews of this literature. Li *et al.* (2019) use resources conservation and recycling over the past several decades as an indicator of pro-environmental behaviors, and show that identity, demographic variables, and psychological factors are the main determinants of pro-environmental actions. Kollmuss and Agyeman (2002) identify demographic factors, external factors (e.g.: institutional, economic, social, and cultural) and internal factors (e.g.: motivation, pro-environmental knowledge, awareness, values, attitudes, emotion, locus of control, responsibilities, and priorities) as the three main categories of influences on pro-environmental behavior.

For the US, despite the complexity of assessing the impact of many different factors, the most recent research has keyed in on the crucial discovery that, differently from perceptions of climate change, partisanship has little impact both on pro-environmental actions and on support for policy. For example, Mildenerger, Howe and Miljanich (2019) find that in the US households with solar installations are slightly more likely to be Democratic than Republican, but households with solar installations exist across the political spectrum, despite extreme ideological polarization around the anthropogenic nature of climate change. They also find that solar households are more politically active, and that differences in political participation are more substantial than cross-group differences in partisanship (*ibid.* and also Guilbeault *et al.* 2018).

On support for green policies, Drews and van den Bergh (2016) provide a comprehensive summary of the various determinants in empirical and experimental research and draw attention to the importance of perceptions about climate change, climate policy design and its attributes. In a recent study on Italy, Colantone *et al.* (2024) find that the implementation of green policies and public support depend on the redistributive consequences that the policies have on different groups. For the US, Shwom *et al.* (2010) use detailed data from Michigan and Virginia to analyze the reasons given by the public for supporting or rejecting several policies to reduce greenhouse gases. They show that a complex combination of economic, political, technological, and moral rationales drives people to support or reject a specific policy.

In a recent review of the literature on the economic impacts of disasters caused by extreme weather and climate events, Ferreira (2024) discusses how governments can play an important role in adaptation by providing public goods to manage disaster risks or by facilitating private agents' adaptation responses. Using new surveys conducted in twenty countries,

Dechezleprêtre *et al.* (2022) find that support for climate policies is driven by the perception of the effectiveness of the policies in reducing emissions, in addition to their distributional impacts and their impact on respondents' own households.³ Again, as it was the case for pro-environmental actions, common among this literature on support for green policies is the growing and crucial evidence that partisanship has little impact (Mayer and Smith 2023).

At the same time, one consistent and relevant driver of both support for green policy and individual actions is the provision of climate change information. Previous research has shown that both the use of simple and concrete language (Bruine de Bruin *et al.* 2021) and reference to the local impact of climate change (Bruine de Bruin and Dugan 2022; Taylor *et al.* 2014) are crucial for an effective communication strategy. In addition, recent evidence suggests that providing prospective information on future climate change impacts pro-environmental individual actions, once again, across party lines (Binelli *et al.* 2023).

Therefore, our work is related to the literature on information provision, and to the extensive literature that has shown how expectations about the future are significant determinants of individual attitudes and behaviors.⁴ An extensive body of work has established that future expectations significantly affect behavior in different settings and countries (Manski 2017, 2004, and Delavande *et al.* 2011 provide comprehensive literature reviews).⁵ The foremost conclusion of this literature is that what people expect to happen in the future shapes their current choices and behaviors. In the specific case of climate change, to the best of our knowledge, Binelli *et al.* (2022) is the only paper that has tested the impact of providing future information: we find that providing information on expected climate change in the city of residence positively impacts pro-environmental individual actions regardless of partisanship, and that the size of the impact of information provision on individuals' actions is double for Democrats, but it is also positive and sizable for Republicans.

³ However, Rinscheid *et al.* (2020) find that climate policy support is unaffected by norm messages communicating an increased diffusion of pro-environmental behaviors and that norm messages communicating the prevalence of non-sustainable behaviors decrease policy support. They also find that in the presence of policy endorsements by political parties, citizens' trust in these parties influences support for climate policies.

⁴ The provision of prospective and retrospective climate information could also differently affect behavior since survey respondents react to questions' format and wording used to elicit beliefs in anthropogenic climate change (Motta *et al.* 2019).

⁵ Future expectations have been mainly used in empirical studies conducted in the field of Statistics and Economics. However, this type of data is also becoming more common in other fields. Binelli and Loveless (2020), Delavande and Manski (2015), and Ladner and Wlezien (2007) are three examples demonstrating the substantive power of future subjective expectations in Political Science.

2. Methods

2.1 Design of the experiment

To confront these questions, we designed and fielded an online survey experiment which was programmed in Qualtrics and used individuals recruited from the online sample firm Lucid. Lucid provides a pool of respondents that is balanced across demographics such as gender, race/ethnicity, age, region of residence, and partisanship to reflect the demographic profile of the US adult population. Coppock and McClellan (2019) find that Lucid samples respond similarly to experimental treatment effects compared to those from other sample providers such as MTurk and even the General Social Survey.

Importantly, in addition to individuals' demographics, Lucid also provides information on party identification allowing us to avoid prompting respondents on partisanship. Rather, we include in the survey a series of questions to capture traits and attitudes that are typically associated with perceptions of climate change (Egan and Mullin 2017). These include a question on religiosity, a question on world views related to social relationships (whether everyone should have equal opportunities), political ideology, a measure of social trust, a measure of support for egalitarianism, a scale that captures the extent to which respondents assign responsibility for taking action against climate change to individuals, corporations, or governments, a measure of trust in the national (central) government, a measure of confidence in the ability to participate in politics, and a measure of interest in government and public affairs. Section 1 of the online Appendix provides full details on all the variables used in the empirical analysis.

Our subject pool includes 2,621 individuals who completed the survey, passed an attention check item, and gave consistent demographic information (age and gender) on our questionnaire compared to what they had provided to Lucid. Subjects began by answering a series of demographic and attitudinal questions before being randomized into one of four conditions.

Subjects in the prospective local climate information condition ($N = 596$, heretofore referred to as the *prospective condition*) saw an interactive map and were asked to select the city they live in (or live closest to). The map then showed them the place in the US that their city's climate would most closely resemble in 60 years, as well as information on how the temperature and precipitation would change. So, for example, if a respondent selected Indianapolis, IN, the map would indicate that in 60 years the climate of Indianapolis would

most resemble Jonesboro, AR which is 11.3 degrees (F) warmer and 52.5% wetter in winter.⁶ Among subjects assigned to this condition, the median amount of time spent on this task was 90 seconds.

Subjects in the retrospective local climate information condition (N = 669, heretofore referred to as the *retrospective condition*) saw an equivalent interactive map and were also asked to locate their city on the map, but this map then showed respondents information about how their climate had changed during the previous 60 years. So, for example, respondents selecting Indianapolis, IN would see a message indicating that “Winter has become 2.8°F (1.6°C) warmer and 17.1% wetter. Summer has become 0.6°F (0.3°C) warmer and 7.8% wetter.” The difference in retrospective and prospective levels of change – in this case, for Indianapolis, IN – further highlight the exponential change in climate. For those assigned to this condition, the median time spent on this task was 81 seconds. Section 4 of the online Appendix provides full details on the construction of the retrospective and the prospective information treatments.

In a third condition, respondents were not assigned to see information about their local climate, but instead were primed to think about partisan politics (N = 686). In this *party labels condition*, subjects were shown images of the Democratic and Republican Party’s mascots (a donkey and elephant, respectively) and were asked to identify which mascot was associated with which party. This party labels’ treatment is modeled after Guilbeault *et al.* (2018) who show that party logos are highly effective at priming partisan bias based both on party membership and on political ideology. People finished this task much more quickly, with the median time spent on the page at 14 seconds.

Finally, subjects assigned to the control group (N = 670) did not see any task and instead moved directly to the dependent variable questions.

We focus on two main dependent variables. The first variable is a scale constructed from a set of items that gauge each respondent’s support or opposition for seven climate-related policies. The policies are listed here:

- 1) Require that 50% of all vehicles sold in the U.S. by 2030 be electric.
- 2) Require that each State use a minimum amount of renewable fuels (wind, solar, and hydroelectric) in the generation of electricity even if electricity prices increase.
- 3) Repeal the Clean Power Plant Rules, which calls for power plants to cut greenhouse gas emissions by 32 percent by 2030.

⁶ The interactive map can be viewed here: <https://fitzlab.shinyapps.io/cityapp/>

- 4) Withdraw the United States from the Paris Climate Agreement.
- 5) Increase taxes on fossil fuels.
- 6) Increase government subsidies for renewable energy such as solar and wind.
- 7) Ban the sale of household appliances that do not meet energy efficiency standards.

Respondents could indicate that they either supported or opposed each policy. The pro-climate position would be to support items 1, 2, 5, 6, and 7 and to oppose items 3 and 4. These items were combined into a single scale using an Item Response Theory (IRT) two-parameter logistic model. This approach created a single latent variable with a mean of 0 and standard deviation of 1, which we then re-scaled to range from 0 to 1, with higher values representing more support for policies that address climate change.

The second dependent variable captures the extent to which respondents indicate a willingness to take personal actions to address climate change. Respondents were asked about seven actions and could indicate that they had already taken the action, that they were planning to take the action, or that they were not planning to take that action. The individual actions are as follows:

- 1) Install solar panels at your home.
- 2) Purchase a hybrid or electric car.
- 3) Recycle on a daily or weekly basis.
- 4) Take steps to increase your home's energy efficiency.
- 5) Purchase carbon offsets to make up for the carbon you consume.
- 6) Reduce your weekly amount of meat consumption.
- 7) Take fewer trips by plane.

Responses were re-coded so that each item was coded as a 1 if the respondent had taken or was planning to take that action and 0 if they were not planning on taking the action. We then combined the items in a similar way as described above, using an IRT two-parameter logistic model and then re-scaling the variable so that values on the scale closer to 1 indicated respondents who were taking more climate friendly actions and those near 0 indicated individuals who were not taking climate friendly actions. Section 2 of the online Appendix provides full details on how we constructed the individual actions and policy support scales from multiple items.

We also collected information on an item that measures both belief in climate change and support for taking action, which reproduces the identical question that was asked in previous versions of the Cooperative Congressional Election Study (CCES). We use this question to

construct a third dependent variable to assess the effectiveness of the information treatments on affecting perceptions, in addition to individual actions and policy support.

The question reads as follows:

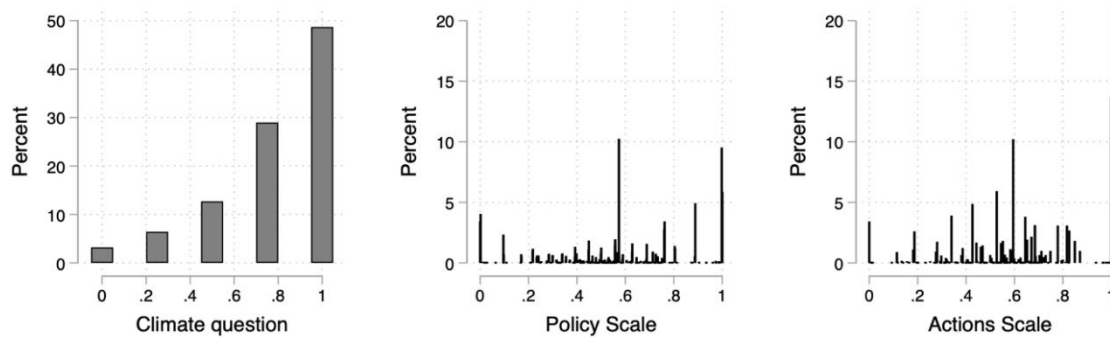
From what you know about global climate change or global warming, which one of the following statements comes closest to your opinion?

- 1) Global climate change has been established as a serious problem, and immediate action is necessary.
- 2) There is enough evidence that climate change is taking place and some action should be taken.
- 3) We don't know enough about global climate change, and more research is necessary before we take any actions.
- 4) Concern about global climate change is exaggerated. No action is necessary.
- 5) Global climate change is not occurring; this is not a real issue.

We recode this variable so that it ranges from 0 (“Global climate change is not occurring; this is not a real issue”) to 1 (“Global climate change has been established as a serious problem, and immediate action is necessary”), with higher values representing more desire to take action on climate change.

The order in which the dependent variables appeared for respondents was randomized to avoid any ordering effects. Figure 1 presents the distribution of responses for the dependent variables, which show substantial variation across the range of the scales. Notably, almost 80% of respondents chose one of the top two categories on the climate change question, making this variable somewhat skewed. However, the other two items produce much more variation across the range of the scales. As expected, both pro-environmental individual actions and support for policy vary by partisanship in the expected way with Democrats reporting consistently higher pro-environmental actions and policy support than Republicans. Tables 1A and 2A in the online Appendix show the distribution of responses categories for each of the seven individual actions and green policies by partisanship. The Tables clearly show a partisanship division where Republicans are systematically providing less support for pro-environmental actions and green policies.

Figure 1: Distribution of responses on the dependent variables.



In the analysis that follows, we first present treatment effects without statistical controls, and we then estimate our treatment effects from models that include controls for the remainder of the analysis. This allows us to increase the precision with which we can calculate the treatment effects. We include partisanship as one of our control variables and we also explore whether our treatment effects vary by party. Partisanship is coded into three groups – Democrats, Republicans, and independents/other. We assign individuals who identified as independents but then indicated that they lean towards one party as partisans. Using this approach, our sample includes 1,211 Democrats, 935 Republicans, and 447 independents. We also include the political ideology of the respondents from a 5-point scale which we recoded to range from 0 (very conservative) to 1 (very liberal).

Additionally, we include four attitudinal items. First, we include a measure of social trust, which is based on the question used in the General Social Survey asking “Would you say that people can be trusted or that you can't be too careful in dealing with people.” The variable is coded so that higher values relate to more trust. Second, we include a measure of support for egalitarianism, which is based on the extent to which respondents agree or disagree with the statement “Society should make sure everyone has equal opportunity.” Higher values indicate more agreement with that statement. Third, we include a measure of government trust by using the question “How much of the time do you think you can trust the government in Washington to do what is right?”. The government trust variable is coded so that higher values relate to more government trust.

Fourth, we include a scale that captures the extent to which respondents assign responsibility for ‘taking action against climate change’ to individuals, corporations, or governments. This is examined through the following question “Please indicate whether you think each group has a responsibility to take action to address climate change: Individual people, Governments, Corporations. If you indicate more than one group rank the groups

according to which have the most responsibility for taking action.” We use the ranking for each of the three groups (individual people, governments, and corporations) to construct three variables with higher values indicating higher ranking based on whether respondents indicated the group as the least (1) or rather the most responsible (3) to address on climate change. We then use these three variables to run a graded response model, and we compute the resulting predicted latent score, which provides an assignment of responsibility scale where higher values indicate individuals assigning more responsibility to governments and corporations rather than to individuals. Section 2 in the online Appendix provides full details on the construction of the responsibility scale.

Finally, we include several demographic items that we also expect to be related to climate change attitudes and actions. These variables include age, gender (coded 0 for men and 1 for women), whether the individual has children under the age of 18, race (whether the individual identifies as white, black, Hispanic, or something else), and what type of community the respondent lives in (urban, suburban, or rural). As an additional variable, we also control for church attendance, which is based on a question asking respondents how often they attend religious services aside from weddings and funerals. We recoded the scale to range from 0 (“never”) to 1 (“at least once a week”).

3. Results

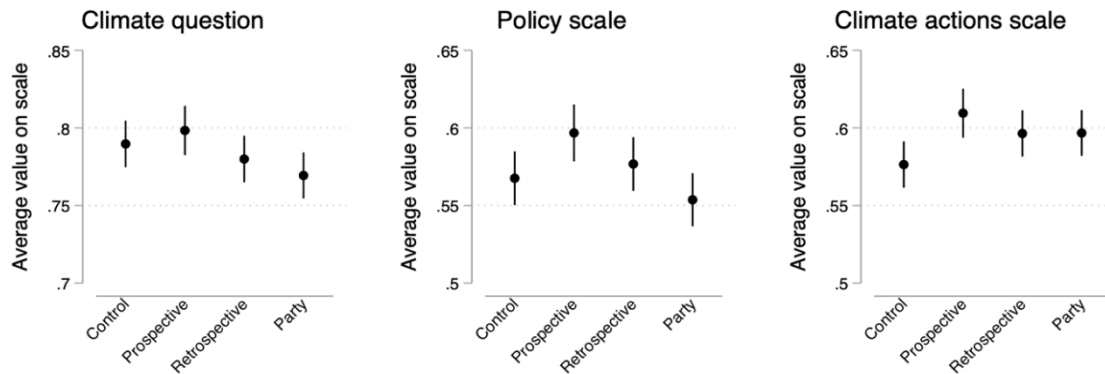
We begin by plotting the values of our dependent variables across each of the four experimental conditions. Figure 2 presents the mean value for each item in each condition along with 84% confidence intervals.⁷

Starting with the first panel in Figure 2, we find very little difference in how subjects answered the climate change perceptions’ question based on which experimental condition they were in. Additionally, none of the differences is statistically significant. Moving from perceptions to support for green policies, the second panel in Figure 2 shows that support for pro-climate policies was marginally higher in the prospective condition, but this 3-point difference was not statistically significant ($p = 0.094$). Turning to the third panel, all three treatment conditions produced higher average intentions of taking individual climate friendly actions, though the effect was just statistically significant ($p = 0.027$) for the prospective

⁷ We plot 84% confidence intervals in this graph to make it easier for the reader to see which estimates are statistically distinguishable. When 84% confidence intervals do not overlap, we can be at least 95% confident that the means are different (Julious 2004).

climate condition (relative to the control group). The difference between the prospective and control groups was 3.3 points.

Figure 2: Mean level of dependent variables across experimental conditions.



Note: Vertical lines represent 84% confidence intervals.

In Table 1, we present our estimates from a model where we include each of the control variables described above. Including control variables helps increase the precision with which treatment effects are estimated (Bloom 2008; Bowers 2011).

The results in Table 1 show the influence of showing local prospective climate information to individuals, which is consistent with the substantive body of literature showing that expected future outcomes drive behavior and inform choices (Manski 2017, 2004). Subjects assigned to this condition scored 3.5 points higher on the pro-climate actions scale ($p = 0.013$) and 3.9 points higher on the climate-friendly policy support scale ($p = 0.014$). Notably, subjects were also more likely to say they would take climate friendly actions when exposed to the local retrospective climate information (3.0 points, $p = 0.013$) and the party priming condition (2.7 points, $p = 0.013$), while exposure to the retrospective climate information and party priming conditions did not lead to significantly higher support for pro-climate policies.⁸ On the contrary, the third column of Table 1 shows that none of the treatments statistically significantly affects perceptions of climate change, which confirms the findings of Binelli *et al.* (2022) that climate change perceptions are unaffected by provision of climate change information and remain primarily driven by partisanship.⁹ Since the goal of our investigation

⁸ The OLS regression results are robust to constructing the dependent variable individual pro-environmental actions' index by using a three-values variable that consider "already done" and "plan to act" as two separate categories instead of combining these two categories into one category.

⁹ The 2021 IPCC Report clearly shows that future changes in temperature and precipitation will be of increasing magnitude. Therefore, when providing prospective information on future changes in temperature and

is assessing the impact of climate change information's provision, the rest of the empirical analysis will focus only on the first two dependent variables: individuals' actions and support for green policies.

Table 1: OLS estimates of treatment effects with control variables.

Variables	Actions Scale	Policy Scale	CC Perceptions
Prospective local	0.0353** (0.0131)	0.0389** (0.0143)	0.0113 (0.0124)
Retrospective local	0.0296* (0.0127)	0.0249 (0.0138)	0.00302 (0.0120)
Party labels	0.0271* (0.0127)	0.00258 (0.0138)	-0.00738 (0.0120)
Ind/other	-0.0408** (0.0137)	-0.121*** (0.0149)	-0.0562*** (0.0129)
Republicans	-0.0486*** (0.0132)	-0.166*** (0.0143)	-0.120*** (0.0125)
Ideology (Liberalism)	0.123*** (0.0207)	0.242*** (0.0225)	0.177*** (0.0196)
Social trust	0.0451* (0.0183)	0.0264 (0.0199)	0.0399* (0.0174)
Egalitarianism	0.136*** (0.0204)	0.183*** (0.0223)	0.143*** (0.0194)
Institutional vs. individual responsibility	0.0462** (0.0169)	0.193*** (0.0184)	0.191*** (0.0161)
Trust in Central Government	0.0378*** (0.00453)	0.0295*** (0.00493)	0.0329*** (0.00429)
Children under 18	0.0608*** (0.0104)	0.0120 (0.0113)	0.0144 (0.00984)
Age	-0.00264*** (0.000303)	-0.0000308 (0.000330)	-0.000996*** (0.000287)
Female	-0.0221* (0.00944)	0.00353 (0.0103)	0.0298*** (0.00893)
Church attendance	0.0995*** (0.0128)	-0.0337* (0.0140)	-0.0207 (0.0122)
Live in suburbs	-0.00211 (0.0110)	0.00500 (0.0120)	-0.00716 (0.0104)
Live in rural areas	-0.0527*** (0.0128)	-0.0296* (0.0139)	-0.0308* (0.0121)
Black	-0.0610*** (0.0155)	-0.0447** (0.0169)	-0.0280 (0.0147)
Hispanic	0.0271* (0.0120)	-0.00295 (0.0131)	0.0125 (0.0114)

precipitation, we are providing information on variables that will increasingly grow over time. In our experiment we cannot disentangle the impact of the size of the expected changes from the impact of providing information about the future per se. However, since future changes in temperature and precipitation are expected to be of increasing size over time, our estimates provide a lower bound of the actual impact of information's provision on future climate change.

Other	0.0396*	0.0375*	0.0122
	(0.0170)	(0.0185)	(0.0161)
Intercept	0.397***	0.202***	0.482***
	(0.0335)	(0.0364)	(0.0317)
Observations	2586	2586	2581
Adjusted-R ²	0.2540	0.3464	0.3333

Note: Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Also worth noting from Table 1 is the relationship between each of the control variables and the dependent variables. As expected, Republicans and Independents are substantially less supportive of climate friendly policies and actions than Democrats (the baseline group). Increasing liberalism on the ideology scale is associated with more climate-friendly actions and policy support, as is social trust, egalitarianism, trust in the central government, and the belief that institutions are more responsible for ‘taking action on climate change’ than individuals. On the latter item, note that this responsibility scale is much more strongly associated with the policy scale than it is with the individual actions’ scale, reflecting the fact that attributing responsibility to government and corporations rather than to individuals is strongly related to demanding governments to take action. The role of liberalism, social trust, egalitarianism, government trust, and the attribution of responsibility to tackle climate change show that normative values play a crucial role in determining pro-environmental actions and support for policies. Being black and living in a rural area are similarly and negatively associated with taking actions and supporting green policies. Finally, age is also negatively associated with the individual actions scale and the climate change question, indicating that older adults are less likely to take climate friendly actions.¹⁰

3.1 Treatment effects by partisanship

So far, we have focused on the effects of our treatments on the full sample of adults. However, given the public opinion partisan divide on climate change in the US, we might expect Democrats and Republicans to respond differently to our information treatments. As we discussed in Section 3.1, there is a strong correlation between intentions to engage in pro-environmental actions and support green policies and partisanship, with Republicans systematically providing less support for pro-environmental actions and green policies. Table 2 presents the treatment effects from the full model estimated separately for Democrats and for Republicans.

¹⁰ As a robustness check of the model, we test for heterogeneous treatment effects among unobservables. The results show that there is no heterogeneity and are presented in Section 3 of the online Appendix.

Table 2 shows that the prospective information treatment positively affects individual actions for both Republicans and Democrats. For Democrats, the prospective information treatment also impacts support for green policies, whereas individual actions are also responsive to both the retrospective information and party labels treatments. As in Binelli *et al.* (2022), we find that the prospective information treatment affects individual climate actions across party lines. Here we find that, when using a richer policy scale, the prospective information treatment also affects support for pro-environmental policy, even if with a decreased level of statistical significance.

Table 2: OLS estimates of treatment effects with control variables by partisanship.

Variables	Actions Scale	Policy Scale
Democrats		
Prospective local	0.0306 [^] (0.0187)	0.0329 [^] (0.0192)
Retrospective local	0.0523 [*] (0.0182)	0.0260 (0.0186)
Party labels	0.0384 [*] (0.0180)	0.0006 (0.0184)
Observations	1206	1206
Adjusted-R ²	0.1842	0.1401
Republicans		
Prospective local	0.0361 [^] (0.0203)	0.0301 (0.0234)
Retrospective local	0.0149 (0.0195)	0.0276 (0.0225)
Party labels	0.0308 (0.0199)	0.0097 (0.0231)
Observations	933	933
Adjusted-R ²	0.2823	0.2942

Note: Standard errors in parentheses, [^] $p < 0.10$, ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$

Size-wise, if we compute the marginal conditional treatment effects by partisanship holding all control variables at their mean values, we find that the treatment effects are consistent for both Democrats and Republicans and in no instance statistically distinguishable across the two partisan groups. In other words, Republicans and Democrats appear to react to the information treatments in similar ways.¹¹ Importantly, this result is robust to news' consumption, thus the effectiveness of the information treatment across party groups does not depend on how much time and attention are spent to follow the news on government and public affairs. Specifically, we use a question that asks respondents how much they follow news on government and public

¹¹ The marginal treatment effects by partisanship are available from the authors.

affairs and we divide our sample into four groups: (1) Democrats who follow news most of the time (N = 558), (2) Democrats who follow news less frequently (N = 653), (3) Republicans who follow news most of the time (N = 439), and (4) Republicans who follow news less frequently (N = 496). The marginal treatment effects, all available upon request, show that, while there are some modest differences in treatment effects across groups, none of these differences is statistically distinguishable at traditional levels of confidence.

3.2 Mechanisms of transmission

The impact of the information treatments on the willingness to take environmental actions across parties brings in some optimism that effective information campaigns could not only sidestep the partisanship divide in public opinion but also directly target individuals' behaviors. As such, we investigate the mechanisms that could explain the effectiveness of the information provision to identify the channels through which the treatments affect the outcome variables.

A first possible channel is family composition and, in particular, the presence of young children. We would expect the effectiveness of the prospective information treatment on someone's willingness to take individual actions and support green policies to depend on this person having children, who will be more greatly affected by the accelerating changes in the world's climate than the respondent themselves. To assess this, we use a survey question asking respondents if they had children under age 18, and we accordingly divided the respondents into two groups.

In our sample, 65% of respondents have no children under age 18. Among the 35% with children under age 18, the age of the youngest child is 3 for 25% of the sample, and 7 for 50% of the sample. We split the same into two sub-samples of those with and without children under age 18, and we estimate the baseline model separately for each sub-sample. Consistently with our expectations, we find that the impact of providing prospective climate change information is stronger on families with young children both for individual actions (0.05 $p=0.04$ vs. 0.03 $p=0.08$) and for policy support (0.06 $p=0.01$ vs. 0.03 $p=0.06$). Interestingly, for families with children under age 18, the retrospective information treatment is also effective for individual actions, and with a similar magnitude to the prospective one. However, if we restrict the sample to those with very young children (families with children under age 18 and the age of the youngest child being up to 7 years old), only the prospective information treatment is statistically significant both for individual actions and for policy support.

A second channel that we expect to affect the intention to take individual actions to fight climate change and the support for green policies is the degree of trust in the central

government. As the central government is the body that proposes and implements all major environmental policies, we would expect that those with higher trust in the government will see government interventions and policies as both justified and effective. Conversely, those with lower trust in the government will be less supportive of government interventions. In the case of support for policy, we would expect the information treatments to be ineffective for those that have little government trust and effective for those with higher trust. On the contrary, for pro-environmental actions, the impact of the information treatment is potentially ambiguous. On one hand, a higher level of trust in government might correlate with a concerted effort at the individual level. That is, people with higher trust in the government might act in a reinforcing or complementary way. On the other hand, a low level of trust in the government might also lead to greater individual actions whether to ‘fill the gap’ left by an untrustworthy or ineffective government or as some form of normative, anti-establishment individualism.

We test for the role of government trust by exploiting the following question “How much of the time do you think you can trust the government in Washington to do what is right?” that had four possible answers “Just about always (1)”, “Most of the time (2)”, “Only some of the time (3)”, and “Never (4)”. We recoded this variable into a dummy variable by grouping the answers in the first two categories as “high trust”, and the answers in the last two categories as “low trust”. We split the same into two sub-samples of those with high and low trust, and we estimate the baseline model separately for each sub-sample. For individual actions, we find that both information treatments are statistically significant only for those with high trust in the government, with a similar impact size for providing prospective and retrospective climate change information (for prospective information 0.07 with $p=0.00$; for retrospective information 0.08 with $p=0.00$). For support for policy, we find that the only statistically significant treatment is the provision of prospective information to those with high trust in the government and the impact size is similar to the one estimated for individuals’ actions (0.09 with $p=0.00$).¹²

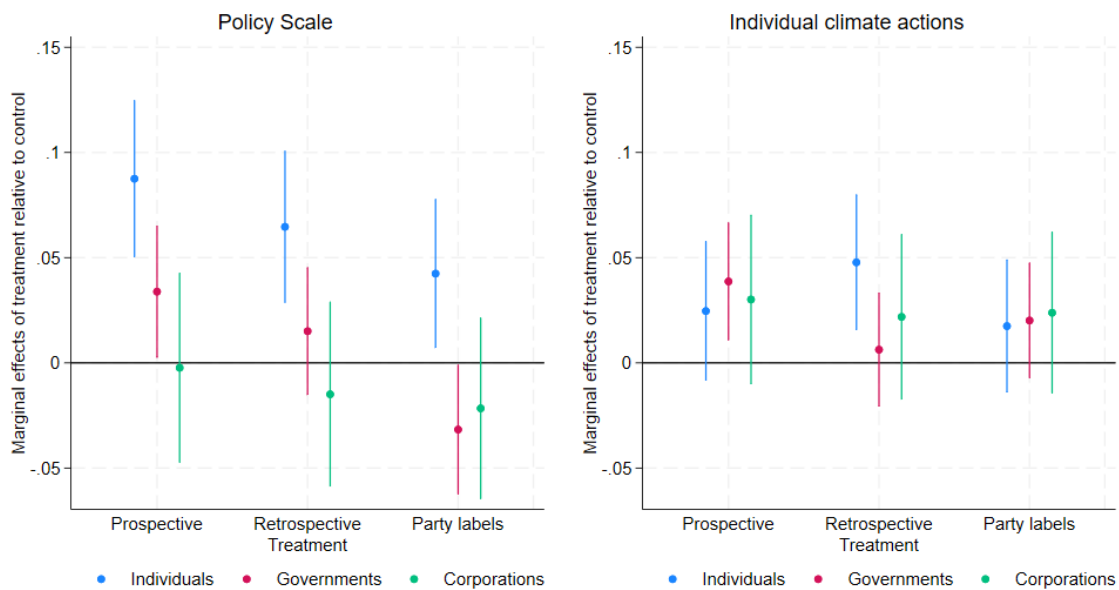
A third channel that could affect the impact of our information treatments is the assignment of responsibility to tackle climate change. Iyengar (1989) identifies the attributions of responsibility that structures political attitudes and discusses how individuals attributing responsibility to themselves are significantly more supportive of government than those attributing responsibility to society-at-large. He shows that perceptions of responsibility for

¹² The results are the same if, instead of two levels of trust, we consider three levels of trust by recoding the four answer categories into three groups: “Just about always” and “Most of the time” as “High trust”, “Only some of the time” as “Some trust”, and “Never” as “No trust”.

four prominent national issues (crime, terrorism, poverty, and racial inequality) are distinct and drive the opinions people take on these issues (*ibid.*). Yet, to the best of our knowledge, the relevance of the assignment of responsibility as a factor affecting environmental actions and support for climate policies has not been investigated.

We use a survey question asking respondents whether they view individuals or rather governments and corporations as the most responsible to take action to address climate change. In our sample, 44% of respondents said governments were most responsible, 33% assigned primary responsibility to individuals, and 22% said corporations were most responsible. Therefore, most of the respondents hold a systemic (responsibility attributed to governments and corporations) rather than an individualistic view of climate change according to which individuals would be the most responsible.

Figure 3: Marginal treatment effects by which actor respondents hold as most responsible for taking action on climate change



Note: Estimates represent average marginal treatment effect for each treatment conditional on assignment of responsibility while holding all other control variables at their mean values. Vertical lines represent 84% confidence intervals.

We estimate the baseline model in Section 3 with interaction terms of the information treatments and the responsibility variable. Figure 3 presents the marginal effects of the three treatments by assignment of responsibility. The results indicate that only people who assign

more responsibility to individuals rather than to governments and corporations were influenced by the experimental treatments responding both to the prospective and to the retrospective treatments when it comes to their policy attitudes (with a larger size effect of the prospective treatment, 0.09, than the retrospective treatment, 0.06) and, albeit with a small impact, to the retrospective treatment when it comes to actions. By contrast, subjects who assigned more responsibility to governments and corporations before our experiment were unaffected by the treatments. Therefore, the effectiveness of the information treatment to promote support for green policies depends on the assignment of responsibility to individuals, which is consistent with Iyengar (1989)'s findings that individuals attributing responsibility to themselves are significantly more supportive of government's actions.

One might expect an interaction effect between partisanship and the assignment of responsibility with Republicans holding a more individualistic (i.e.: 'individuals are responsible to take care of themselves and solve problems alone') rather than systemic (i.e.: 'governments or corporations are more responsible') view of climate change. However, the partisan differences along the assignment of responsibility are small. In our sample, if we consider the first ranked group that respondents assign responsibility to act against climate change, Democrats are only about ten points more likely to say that governments are most responsible (48% versus 38%) and Republicans are about eight points more likely to say that individuals are the most responsible (38% versus 30%), while 22% of Democrats and 24% of Republicans hold corporations as the most responsible. Also, if we test for partisanship and responsibility simultaneously by controlling for interaction terms of the information treatments with both variables, we find that only the responsibility variable produces statistically significant conditional treatment effects, which are of a very similar size and direction of those plotted in Figure 3.

4. Discussion and Conclusion

What is the relative effectiveness of providing prospective rather than retrospective climate change information? And what are mechanisms that can explain the effectiveness of this information provision? Using a randomized online experiment, we find that, consistently with the expanding literature on pro-environmental individual actions and policy support, partisanship is sparingly salient and overpowered by the efficacy of prospective, local information on climate change. This information provision is further enhanced by three main mechanisms: family composition, government trust and assignment of responsibility. Finding which type of information and through which channels does influence climate friendly actions

and policy support is crucial to develop effective ways to raise the necessary public opinion's awareness to bring about significant pro-environmental actions and effective policies.

The results of our study highlight several important findings. The decision to take pro-environmental actions appears to be the most responsive outcome. Respondents were motivated to increase the number of actions both by prospective and retrospective climate information. The support for pro-environmental policies, however, only seemed to respond to the prospective climate change information. These results confirm previous findings on the importance of local climate change information (Bruine de Bruin and Dugan 2022 and Taylor, Bruine de Bruin and Dessai 2014), and on providing future or prospective expectations of the impact of climate change (Binelli *et al.* 2023) for an effective communication strategy. Crucially, despite a partisan divide in public opinion over climate change, there appears to be a motivated majority that can be moved to pro-environmental actions with direct communication strategies that use simple and concrete language and terminology (Bruine de Bruin *et al.* 2021) and local, prospective information (Binelli *et al.* 2023).

Further, when we investigate the mechanisms of transmission of the information's provision, we find that prospective information on local climate change affects more people with young children, those who have a high degree of trust in the central government, and those who assign responsibility to individuals rather than to governments and corporations. We find that each treatment significantly increased support for pro-climate policies and for taking pro-climate actions among those who said individuals were most responsible. By contrast, subjects who assigned more responsibility to governments and corporations before our experiment were mostly unaffected by the treatments. Likewise, only those with a high level of trust in the government respond to the information treatments.

The magnitude of the treatment effects may appear, at first, underwhelming. The most powerful treatment – the information about expected local climate change – produced about a 4-point increase in the pro-climate direction on both the individual actions and policy support scales. In terms of actions, this effect would amount to about a 4-point increase in the probability of a respondent saying they were likely to take a pro-environmental action such as the purchase of a hybrid or electric car. Likewise, the movement on the policy scale would be associated with about a 4-point increase in the probability of supporting a green policy such as a policy that requires 50 per cent of all cars sold in the US by 2030 to be electric. However, perhaps correspondingly, our intervention was relatively modest. That is, people may be more significantly moved by a similar message that is more forceful and sustained over time.

We also highlight that social trust, egalitarian orientation, government trust and responsibility for acting on climate change issues are positively correlated with the outcome variables. This suggests that normative values continue to be relevant determinants of the pro-environmental position. Yet, the public framing of climate change policies and motivations to individual action do not have to derive uniquely from a value perspective or pro-environmental position. The experiment provided respondents with a concrete description of the long-run changes in temperature and precipitation in the city of residence, that is a local measure of climate change, which is communicated in a simple and direct format. The information treatments are examples of effective climate change communication by using a simple message on local climate change that is relevant to the respondents and thus motivates behavior.

This is relevant to local politics, particularly in the US. State legislation can be promoted despite ‘red state’ resistance to the larger public opinion debate (Hess *et al.* 2016; Stokes and Warshaw 2017) as well as sub-state or local legislation corresponding to the observed rural/urban divide here (in which rural residents are uniformly less likely to take pro-environmental actions and support green policies). Practically, in terms of information treatments, recent research has shown that GPT-3 can be very efficient at conveying information by generating text that is easier to read and understand than text written by humans (Spitale *et al.* 2023). Therefore, as one more mechanism to mitigate climate disaster, generative artificial intelligence could offer effective tools to promote information campaigns on local prospective climate change information.

The results point to the provision of prospective rather than retrospective climate change information that affects behavior. This is consistent with the literature on future expectations, and it is crucial to promote climate change adaptation to prepare for and adjust to the current effects of climate change and its predicted impacts in the future. This research contributes to the growing body of work that demonstrates how well-designed provision of information can shape individuals’ intentions to act and support green policies, beyond partisanship.

The next step would be to investigate the impact of providing information on future climate change on actual choices and behavior both in the short and in the long run. Recent research that has focused on consumption of electricity as one important example of pro-environmental behavior suggests that increases in climate change salience can significantly reduce energy consumption, so that episodes that draw attention to climate change may lead to actual behavioral change, even if their effect is short lived (Bonan *et al.* 2023). Future research could assess whether the relevance of climate salience also affects other pro-environmental behaviors, and, crucially, support for green policies.

References

- Binelli, Chiara, Matthew Loveless and Brian F. Schaffner. 2023. "Explaining Perceptions of Climate Change in the US", *Political Research Quarterly*, Vol. 76, Issue 1, pp.365–380.
- Binelli, Chiara, and Matthew Loveless. 2020. "Economic Expectations and Satisfaction with Democracy: Evidence from Italy". *Government and Opposition*. 55(3): 413-429. DOI: 10.1017/gov.2018.31.
- Bonan Jacopo, Daniele Curzi, Giovanna d'Adda, and Simone Ferro. 2023. "Climate Change Salience and Electricity Consumption: Evidence from Twitter Activity", *Resources for the Future Working Paper* 23-24.
- Bruine de Bruin Wandí and Andrew Dugan. 2022. "On the differential correlates of climate change concerns and severe weather concerns: evidence from the World Risk Poll", *Climatic Change* 171(33). <https://doi.org/10.1007/s11069-018-3523-5>
- Bruine de Bruin Wandí, Lila Rabinovich, Kate Weber, Marianna Babboni, Monica Dean, and Lance Igon. 2021. "Public understanding of climate change terminology" *Climatic Change* 167(37). <https://doi.org/10.1007/s10584-021-03183-0>
- Carleton, T., M. Delgado, M. Greenstone, et al. 2018. "Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits." Working Paper no. 2018-51, Becker Friedman Inst. Econ., Chicago.
- Colantone Italo, Livio Di Lonardo, Yotam Margalit, and Marco Percoco. 2024. "The Political Consequences of Green Policies: Evidence from Italy." *American Political Science Review*, 118(1):108-126. doi:10.1017/S0003055423000308
- Coppock, A. and McClellan, O. A. (2019). "Validating the demographic, political, psychological, and experimental results obtained from a new source of online survey respondents." *Research & Politics*, 6(1).
- Dechezleprêtre Antoine, Adrien Fabre, Tobias Kruse, Bluebery Planterose, Ana Sanchez Chico and Stefanie Stantcheva. 2022. "Fighting Climate Change: International Attitudes Toward Climate Policies", NBER Working Paper 30265.
- Delavande, A., Gine, X., and McKenzie, D. 2011. "Measuring Subjective Expectations in Developing Countries: A Critical Review and New Evidence", *Journal of Development Economics*, 94, 151–163.
- Delavande, Adeline and Charles F. Manski. 2015. "Using elicited choice probabilities in hypothetical elections to study decisions to vote" *Electoral Studies* 38: 28-37. <https://doi.org/10.1016/j.electstud.2015.01.006>
- Dietz, T., G. T. Gardner, J. Gilligan, P. C. Stern, and M. P. Vandenbergh. 2009. "Household actions can provide a behavioural wedge to rapidly reduce US carbon emissions." *Proceedings of the National Academy of Sciences*, 106, 18452–18456.
- Ding, P., Feller, A., and Miratrix, L. 2019. "Decomposing treatment effect variation." *Journal of the American Statistical Association*, 114(525), 304-317.
- Drews, Stefan, and Jeroen C.J.M. van den Bergh. 2016. "What Explains Public Support for Climate Policies? A Review of Empirical and Experimental Studies.", *Climate Policy*, 16(7): 855–876.
- Egan, Patrick J. and Megan Mullin. 2017. "Climate Change: US Public Opinion", *Annual Review of Political Science*, 20:209-227.
- Ferreira, S. 2024 "Extreme Weather Events and Climate Change: Economic Impacts and Adaptation Policies" *Annual Review of Resource Economics*, forthcoming. DOI <https://doi.org/10.1146/annurev-resource-101623-095314>
- Guilbeault, Douglas, Joshua Becker, and Damon Centola. 2018. "Social learning and partisan bias in the interpretation of climate trends", *Proceedings of the National Academy of Sciences*, 115(39): 9714–9719.

- Hess, D. J., Q. D. Mai, and K. P. Brown. 2016. "Red states, green laws: ideology and renewable energy legislation in the United States" *Energy Research & Social Science* 11: 19-28.
- IPCC, 2021. *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.
- Iyengar, S. 1989. "How Citizens Think about National Issues: A Matter of Responsibility", *American Journal of Political Science*, Vol. 33, No. 4, pp. 878-900.
- Julious, S.A. 2004. "Using confidence intervals around individual means to assess statistical significance between two means", *Pharmaceutical Statistics*, 3: 217-222. <https://doi.org/10.1002/pst.126>
- Kollmuss, Anja, and Julian Agyeman. 2002. "Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?" *Environmental Education Research*, 8:3, 239-260. DOI: [10.1080/13504620220145401](https://doi.org/10.1080/13504620220145401)
- Ladner, Matthew and Christopher Wlezien. 2007. "Partisan Preferences, Electoral Prospects, and Economic Expectations" *Comparative Political Studies* 40(5): 571-596.
- Li Ding, Luman Zhao, Shuang Ma, Shuai Shao, and Lixiao Zhang. 2019. "What influences an individual's pro-environmental behavior? A literature review", *Resources, Conservation and Recycling*, Volume 146, July 2019, Pages 28-34.
- Liebe, U, J. Gewinner, and A. Diekmann. 2021. "Large and persistent effects of green energy defaults in the household and business sectors.", *Nature Human Behaviour*, pp.576-585;
- Loveless, Matthew and Chiara Binelli. 2020. "Economic Expectations and Satisfaction with Democracy: Evidence from Italy" *Government and Opposition*, 55(3): 413-429. DOI: 10.1017/gov.2018.31.
- Lynas, Mark, Benjamin Z Houlton and Simon Perry. 2021. "Greater than 99% consensus on human-caused climate change in the peer-reviewed scientific literature", *Environmental Research Letters*, Volume 16, Number 11.
- Manski, C. F. 2004. "Measuring Expectations", *Econometrica*, 72(5): 1329-1376.
- Manski, C. F. 2017. "Survey Measurement of Probabilistic Macroeconomic Expectations: Progress and Promise.", *NBER Macroeconomics Annual*, 32(1), 411-471. <https://doi.org/10.1086/696061>
- Mayer, A.P. and E. K. Smith. 2023. "Multidimensional partisanship shapes climate policy support and behaviours" *Nature Climate Change*. **13**, 32-39. <https://doi.org/10.1038/s41558-022-01548-6>
- Mildenberger, Matto, Peter D. Howe and Chris Miljanich. 2019. "Households with solar installations are ideologically diverse and more politically active than their neighbours", *Nature Energy*, <https://doi.org/10.1038/s41560-019-0498-8>.
- Motta, MP, Daniel Chapman, Dominik Stecula, & Kathryn Haglin. 2019. "An Experimental Examination of Measurement Disparities in Public Climate Change Beliefs" *Climatic Change*.
- Mutz, D. 2021. "(Mis)attributing the causes of American job loss. The consequences of getting it wrong", *Public Opinion Quarterly*, Vol. 85, No. 1, pp. 101-122.
- Nisa, Claudia F., Jocelyn J Bélanger, Birga M Schumpe, and Daiane G Faller. 2019. "Meta-analysis of randomised controlled trials testing behavioural interentions to promote household action on climate change.", *Nature Communications*;10(1):4545. doi: 10.1038/s41467-019-12457-2.

- Nowakowski, Adam and Andrew J. Oswald. 2020. "Do European Care about Climate Change? An Illustration of the Importance of Data on Human Feelings", IZA DP No. 13660.
- Rinscheid, Adrian, Silvia Pianta, and Elke U. Weber. 2020. "What shapes citizens' preferences towards climate change policies? The role of social norms and elite cues." *Behavioural Public Policy*, doi:10.1017/bpp.2020.43
- Shwom, Rachel, David Bidwell, Amy Dan, and Thomas Dietz. 2010. "Understanding U.S. public support for domestic climate change policies", *Global Environmental Change*, Volume 20, Issue 3, Pages 472-482, <https://doi.org/10.1016/j.gloenvcha.2010.02.003>.
- Spitale Giovanni, Nikola Biller-Andorno, and Federico Germani. 2023. "AI model GPT-3 (dis)informs us better than humans" *Science Advances*, 9.
- Stokes, L. C. and C. Warshaw. 2017. "Renewable energy policy design and framing influence public support in the United States" *Nature Energy* 2(8): 1-6.
- Taylor, A., de Bruin, W.B. and Dessai, S. 2014. "Climate Change Beliefs and Perceptions of Weather-Related Changes in the United Kingdom.", *Risk Analysis*, 34: 1995-2004. <https://doi.org/10.1111/risa.12234>
- Waldinger Maria. 2022. "The Economic Effects of Long-Term Climate Change: Evidence from the Little Ice Age", *Journal of Political Economy*, 130: 9, pp: 2275-2314.

Online Appendix for:
Environmental Actions, Support for Policy,
and Information Provision:
Experimental Evidence from the US

Contents

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1 Main variables used in the empirical analysis

Dependent variables

1. *Support for Pro-Environmental Policies* (0 oppose, 1 support): mean: 0.573. sd: 0.310
 - 1) Require that 50% of all vehicles sold in the U.S. by 2030 be electric.
 - 2) Require that each state use a minimum amount of renewable fuels (wind, solar, and hydroelectric) in the generation of electricity even if electricity prices increase.
 - 3) Repeal the Clean Power Plant Rules, which calls for power plants to cut greenhouse gas emissions by 32 percent by 2030. [*reverse coded*]
 - 4) Withdraw the United States from the Paris Climate Agreement. [*reverse coded*]
 - 5) Increase taxes on fossil fuels.
 - 6) Increase government subsidies for renewable energy such as solar and wind.
 - 7) Ban the sale of household appliances that do not meet energy efficiency standards.

Using Item Response Theory (IRT) 2-parameter logistic model, we produce a single latent variable with a mean of 0 and standard deviation of 1, which we then re-scaled to range from 0 to 1, with higher values representing more support for policies that address climate change.

2. *Pro-Environmental Actions* (0 not planning on taking the action, 1 had taken or was planning to take that action): mean: 0.594, sd: 0.267
 - 1) Install solar panels at your home
 - 2) Purchase a hybrid or electric car
 - 3) Recycle on a daily or weekly basis
 - 4) Take steps to increase your home's energy efficiency
 - 5) Purchase carbon offsets to make up for the carbon you consume
 - 6) Reduce your weekly amount of meat consumption
 - 7) Take fewer trips by plane

Using Item Response Theory (IRT) 2-parameter logistic model, we produce a single latent variable with a mean of 0 and standard deviation of 1, which we then re-scaled to range from 0 to 1, with higher values representing more pro-environmental actions/intentions.

Table 1A: distribution of pro-environmental actions by partisanship.

	Democrats	Independents	Republicans
Install solar panels			
Done	155	26	60
Plan to do	443	152	264
Not plan to do	609	265	609
Purchase hybrid or electric car			
Done	127	22	56
Plan to do	571	146	244
Not plan to do	510	277	627
Recycle on daily or weekly basis			
Done	873	283	637
Plan to do	252	95	156

Not plan to do	82	68	140
	Increase home's energy efficiency		
Done	554	177	420
Plan to do	501	169	320
Not plan to do	153	97	193
	Purchase carbon offsets		
Done	140	40	78
Plan to do	441	126	187
Not plan to do	626	280	664
	Reduce meat consumption		
Done	503	136	238
Plan to do	315	88	141
Not plan to do	390	222	551
	Fewer trips by plane		
Done	699	245	453
Plan to do	203	70	123
Not plan to do	304	130	356

Table 2A: distribution of support for pro-environmental policies by partisanship.

	Democrats	Independents	Republicans
	50% of vehicles sold in the US by 2030 electric		
Support	879	205	302
Oppose	322	240	628
	Minimum amount of renewable fuels for electricity		
Support	1005	272	483
Oppose	197	171	447
	Repeal the Clean Power Plant Rules		
Support	665	249	524
Oppose	537	194	407
	Withdraw from Paris Climate Agreement		
Support	304	159	532
Oppose	897	283	397
	Increase taxes on fossil fuels		
Support	714	143	193
Oppose	486	299	736
	Increase subsidies for renewable energy		
Support	1024	305	542
Oppose	172	134	391
	Ban sales of energy inefficient household appliances		
Support	867	227	410
Oppose	331	217	521

Independent variables

Treatment variables:

- *Partisanship*: 1 Democrats, 2 Independents/other, 3 Republicans
 - o Respondents who identified as independents but then indicated that they lean towards one party were re-assigned as partisans.
- *Climate Change Information Provision*: 1 Control, 2 Prospective local, 3 Retrospective local, 4 Party labels.

Controls:

- *Assignment of Responsibility*: Please indicate whether you think each group has a responsibility to take action to address climate change: 1 Individuals, 2 Corporations, 3 Governments:
- *Political Ideology*: recoded to 0 Very conservative, 0.25, 0.5, 0.75, 1 Very liberal: mean: 0.489, sd: 0.280
- *Gender*: 0 male, 1 female
- *Children under 18*: 0 No, 1 Yes
- *Church Attendance*: recoded to 0 No, 0.25, 0.5, 0.75, 1 Yes: mean: 0.465, sd: 0.383
- *Race*: White; Black or African-American; Hispanic, Latino, or Spanish origin; or Other
- *Social Trust*: recoded to 0 none, 0.33, 0.67, 1 a great deal: mean: 0.425, sd: 0.272
- *Egalitarianism*: recoded to 0 Not egalitarian, 0.25, 0.5, 0.75, 1 Very egalitarian: mean: 0.842, sd: 0.234
- *Age*: 18-95: mean: 46.7, sd: 17.01
- *Urban/Rural*: 1 Live in city, 2 live in suburbs, 3 live in rural area
- *Perceptions of Climate Change*: From what you know about global climate change or global warming, which one of the following statements comes closest to your opinion? We recode this variable so that it ranges from 0 (“Global climate change is not occurring; this is not a real issue”) to 1 (“Global climate change has been established as a serious problem, and immediate action is necessary”), with higher values representing more desire to take action on climate change.: mean: 0.784, sd.: 0.267
 - o Global climate change has been established as a serious problem, and immediate action is necessary.
 - o There is enough evidence that climate change is taking place and some action should be taken.
 - o We don't know enough about global climate change, and more research is necessary before we take any actions.
 - o Concern about global climate change is exaggerated. No action is necessary.
 - o Global climate change is not occurring; this is not a real issue.

2 Item scaling for the analysis of the experimental results

In our analysis of the experiment, we use two dependent variables that are scales constructed from multiple items. Here we provide full additional details about the scaling of these items.

As discussed in the main text, we re-coded the individual actions' variable so that each item was coded as a 1 if the respondent had taken or was planning to take that action and 0 if they were not planning on taking the action. Since each of the items asking subjects about personal actions that they have taken (or would take) were binary, as it is the case for the policy items' variable, for both dependent variables we combined the items using an Item Response Theory (IRT) two-parameter logistic (2PL) model. The 2PL IRT model is similar to a graded response model but simplified for two category responses. Tables 3A and 4A show the discrimination parameters for each item used to create the policy item and personal actions scale. Discrimination parameters are a measure of how strongly related each item is to the underlying latent variable (akin to factor loadings). The tables show that, except for the fourth item in Table 3A (withdrawal from the Paris climate agreement), each item has a statistically significant association with the latent trait ($p < .001$).

For the policy scale, the items with the strongest relationship are the ones asking respondents whether they support or oppose the requirement that 50% of all vehicles sold in the U.S. by 2030 will be electric and that each US State use a minimum amount of renewable fuels (wind, solar, and hydroelectric) in the generation of electricity even if electricity prices increase.

Table 3A: Discrimination Parameters from IRT Policy Item Scaling

Item	Discrimination parameter	Std. Error
50% of all vehicles sold in the US electric by 2030	2.445	0.162
Minimum renewables for electricity even if prices increase	2.236	0.143
Repeal Clean Power Plant Rules	0.013	0.047
Withdraw from Paris Climate Agreement	-0.798	0.060
Increase taxes on fossil fuels	1.941	0.121
Increase government subsidies for renewable energy	2.033	0.128
Ban sale of appliances that are not energy efficient	1.519	0.089

For the personal actions' scale, the items with the strongest relationship are the ones asking respondents whether they recycle on a daily or weekly basis, and whether they have taken or plan to take steps to increase their home's energy efficiency.

Table 4A: Discrimination Parameters from IRT Personal Actions Item Scaling

Item	Discrimination parameter	Std. Error
Solar panels	1.795	0.112
Hybrid or electric car	1.689	0.103
Recycle on a daily or weekly basis	2.064	0.157

Increase home's energy efficiency	2.000	0.138
Purchase carbon offsets	2.247	0.151
Reduce meat consumption	1.432	0.088
Fewer trips by plane	1.202	0.078

In addition to using an IRT model for the dependent variables, we have also used an IRT graded response model to scale the three items in the assignment of responsibility variable. Table 5A produces the discrimination parameters from the scaling of these items. The discrimination parameter for each item is statistically significant ($p < .001$) and strongly associated with the underlying latent trait.

Table 5A: Discrimination Parameters from IRT Assignment of Responsibility Item Scaling

Item	Discrimination parameter	Std. Error
Individual people	-0.293	0.048
Governments	2.473	0.538
Corporations	0.356	0.049

3 Testing for heterogeneous treatment effects among unobservables

We explore whether our data provides any evidence of heterogeneous treatment effects among unobserved covariates. To do this, we follow the methods developed by Ding, Feller, and Miratrix (2016), which involves comparing the distributions of our dependent variables across the control and treatment groups after adjusting for the overall treatment effect. This approach is based on permuted Fisher randomization tests (FRT) and accounts for the uncertainty regarding the average treatment effect to produce a robust test of the null hypothesis of constant treatment effects across subjects. We implement this test using the *hettx* R package.

Table 6A shows the results from this approach. To reiterate, the null hypothesis for this test is constant (or homogenous) treatment effects across observations. A $p < 0.05$ would indicate that we can reject this null hypothesis with 95% confidence, leading us to conclude that the treatment effects we detect are heterogeneous in nature. Notably, none of the p 's are statistically significant. Thus, we cannot reject the null hypothesis of homogeneous treatment effects for any of the treatments across either of our two main dependent variables.

Table 6A: Testing for heterogeneous treatment effects

Treatment	Individual actions scale	Policy scale
Prospective local information	$p = 0.320$	$p = 0.298$
Retrospective local information	$p = 0.884$	$p = 0.310$
Party labels	$p = 0.552$	$p = 0.176$

Note: Table 6A reports p 's from permuted Fisher randomization tests against the null hypothesis of constant treatment effects (Ding, Feller, and Miratrix 2016).

4 Prospective and retrospective treatments

4.1 Prospective climate change information

To provide information on future changes in temperature and precipitation, we use the online interactive map constructed at the Center for Environmental Science at the University of Maryland. The map is available at the following website: <https://fitzlab.shinyapps.io/cityapp/> Full details on the data, forecast models, and on the methods used to identify the comparison cities are provided in Fitzpatrick, M.C., Dunn, R.R. “Contemporary climatic analogs for 540 North American urban areas in the late 21st century.” *Nat Commun*, 10, 614 (2019). <https://doi.org/10.1038/s41467-019-08540-3>

4.2 Retrospective climate change information

To provide past information on climate change, we constructed the closest retrospective equivalent to the prospective information’s map in Section 4.1 above. The map is available at the following website: <https://fitzlab.shinyapps.io/RecentClimateChangeExplorer/> As for the prospective climate change information map, to compute past changes in temperature and in precipitation, we use historical climate records provided by WorldClim, which is a database of high spatial resolution global weather and climate data (<https://worldclim.org/data/index.html>).

4.2.1 Temperature

For each city on the map, we computed the percentage change in temperature between the twenty-nine years’ period 1991-2019 and the thirty years’ period 1960-1990, separately for the winter season (December-March) and for the summer season (June-September). The construction of the percentage change in temperature involved the following computations:

- Average monthly temperature for each month and for each year between 1960 and 2019.
- Average annual temperature for each year between 1960 and 2019.
- Average temperature for the three periods 1960-2019, 1960-1990, and 1991-2019.
- Percentage difference in average temperature between 1991 and 2019 (with respect to the average change between 1960 and 2019) and percentage difference in average temperature between 1960 and 1990 (with respect to the average change between 1960 and 2019).

4.2.2 Precipitation

For each city on the map, we computed the percentage difference between the average cumulative precipitation in the twenty-nine years’ period 1991-2019 and the average cumulative precipitation in the thirty years’ period 1960-1990, separately for the winter season (December-March) and for the summer season (June-September). The construction of the percentage change in precipitation involved the following computations:

- Yearly cumulative precipitation for each city and for each year between 1960 and 2019.
- Average yearly cumulative precipitation in the period 1960-1990 and in the period 1991-2019.
- Difference in precipitation between the average yearly cumulative precipitation in the period 1991-2019 and the average yearly cumulative precipitation in the period 1960-1990.
- Percentage change of the difference in precipitation computed in the previous step relative to the average yearly cumulative precipitation in the period 1960-1990.