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How information about historic carbon emissions affects support for climate aid: evidence from a survey experiment

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Abstract

In recent years, international climate negotiations have reached increasing consensus that the wealthiest countries should make significant financial contributions to offset the damages caused by the climate crisis in poorer countries. Proponents have justified such action based on wealthy countries' disproportionate responsibility for global warming in the form of past emissions. However, in democratic countries such as the United States, it remains uncertain whether such messages can affect public opinion, especially across partisan lines. We conducted a pre-registered survey from a national online pool ($N=5,002$) with a built-in experiment to evaluate the effectiveness of alternative communications strategies associated with historic carbon emissions in increasing support for climate aid. We find that specific attribution claims that reflect a *climate justice* perspective do boost support for more generous climate aid, but the effects are largely driven by Democrats. We also find that global solidarity frames emphasizing shared responsibility did not affect support for climate aid. Our results have important implications for climate advocacy and our understanding of climate-related attitudes.

1 Introduction

Over the past several years, international climate negotiators have increasingly agreed that the wealthiest countries should make significant financial contributions to offset damages in poorer countries arising from the climate crisis. A compelling argument that has gained traction in a wide range of climate communications, including from international organizations, is that because countries in the Global North developed through industrialization

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processes that caused global warming, they should finance the costs of adaptation for the poorer countries of the Global South (Hockenos 2022). During the December 2023 COP28 meetings held in Dubai, the leaders of several wealthy countries made pledges for financial contributions in tacit acceptance of such appeals (Harvey and Lakhani 2023).

However, as with other types of foreign aid, subsequent concrete action on those commitments may depend on levels of public support (Milner and Tingley 2013). We ask whether citizens are likely to embrace this increasingly prevalent "climate justice"- based justification for climate aid to the developing world. Such a question is particularly salient in the United States, given its relative wealth, outsized contribution to emissions, and increasing polarization over the issues of climate change and foreign aid (Ansah et al 2023; Egan and Mullin 2017). Specifically, Republican opposition to climate-related policies has consistently posed a critical barrier to more aggressive action, motivating the need to learn about not just how messages affect "average" Americans, but the potentially different effects among supporters of each of the two major political parties. Moreover, most extant survey research on attitudes towards climate policy has focused on *mitigation* (e.g., Tingley and Tomz 2014; Anderson et al. 2017; Beiser-McGrath and Bernauer 2019). However, as the harsh effects of climate change on more vulnerable developing countries have become a pressing reality, more attention must be paid to the determinants of attitudes about foreign aid for climate *adaptation*, including with respect to the effects of climate communications.

In this article, we contribute to scholarship on attitudes about climate adaptation policies and foreign aid by detailing the findings of an original national survey from an online pool, in which we examine the causal effects of alternative messages about CO_2 emissions on American citizens' support for climate aid to poor countries. There is good reason to believe that communicating to citizens about their country's historic emissions might be motivating as a moral justification for support. In other contexts, researchers have shown that believing that one's group is responsible for the harm done to others can produce collective guilt and increase support for corrective measures (Wohl et al. 2006). While most research on collective guilt has focused on intergroup conflict, several recent studies applied this framework to climate change. Ferguson and Branscombe (2010) find that Americans can feel collective guilt for the U.S. contributions to greenhouse gas emissions and that collective guilt increases their willingness to conserve energy and to pay green taxes. If the same factors drive attitudes about both mitigation and adaptation policies, the political dynamics surrounding such policies may be more similar than previously suggested (e.g. Keohane 2015).

The remainder of the article is organized as follows: First, we provide background for our study, by reviewing some of the existing scholarly literature on related climate communications and the moderating effect of partisanship, highlighting gaps in the literature and detailing our hypotheses. Second, we describe the methods employed in our survey experiment, including the various climate messaging frames that were randomly assigned to subjects, and details from our pre-registered analysis plan. Third, we report the results of our analyses, in which we find modest positive effects for a climate justice frame, but when considered separately for each party the effects are significant only among Democrats. We conclude by discussing the implications of our findings, their relevance for scholarship and climate communications, and avenues for future research.

2 Background

2.1 Prior research

Several studies have yielded important preliminary evidence that emphasizing a "climate justice" principle with respect to historic carbon emissions– i.e., those who emitted more should contribute more– had substantial motivating effects on attitudes about mitigation policies. In a multi-country conjoint survey experiment, Bechtel and Scheve (2013) found that respondents in several advanced industrialized countries, including the United States, were more likely to support international climate agreements when richer countries were expected to pay more, and when the distribution of costs was proportional to current and historic emissions.

A set of studies based on behavioral games also support the finding that emphasizing differential levels of historic carbon emissions can motivate pro-social attitudes and behaviors on climate-related policies. For example, Gampfer (2014) studied the resonance of fairness principles by having pairs of respondents, a proposer and a responder, decide how to share climate mitigation costs in an ultimatum game. They experimentally assigned the ability to pay, vulnerability, and historical emissions to each player in order to understand the extent to which various principles for allocating the cost of climate change mitigation would resonate with citizens. The study found that contributions to climate risk mitigation increased with historical emissions and ability to pay. Anderson et al (2017) also used an ultimatum game in an online environment, and found that individuals responded more generously to proposals to pay when their historic emissions were relatively higher. Ponte et al (2023) added further nuance to this line of research by modeling the historic development of industrial development and emissions over generations in yet another experimental game. They assigned players to identities of developed or developing countries and to a first or second generation, and found that second-generation players whose predecessor was responsible for the high carbon output were willing to pay more for climate mitigation, relative to players with a low-carbon predecessor.

While this body of careful experimental research supports the conclusion that the climate justice principle should be a motivating factor for generating public support for pro-climate policies, particularly those focused on mitigation of CO2 emissions, at least two key questions remain open:

First, how does communication of this principle affect support for aid for *adaptation* in developing countries? While mitigation policies aimed at generating global public goods raise profound free-rider problems, foreign aid for climate adaptation similarly demands that citizens and governments share resources without any promise of direct benefit. As most citizens may prioritize their own group's interests (including national interests), the prospect of using scarce and valued resources to support foreign countries with climate-related aid is likely to require an especially compelling motivation.

When considering the potential drawbacks of climate justice messaging about historic carbon emissions, we note that in other domains, reminders about ingroup responsibility have sometimes failed to evoke collective guilt and backfired by reinforcing divisions between groups (Doosje and Branscombe 2003). Shame and guilt are particularly rare in international politics, where denial of responsibility is the dominant response (Bassan-Nygate

and Heimann 2024). With respect to climate change, many elites and citizens in developed countries reject the idea that they should be held accountable for historic emissions.

An alternative approach that is perhaps less divisive involves emphasizing *shared* global responsibility and solidarity around carbon emissions. We note that even some leaders from the Global South have endorsed such messaging over climate justice framing. For example, at the 2023 Summit for a New Global Financing Pact in France, Kenya's President, William Ruto, criticized the narratives that portray Africans as "victims," and emphasized the need to shift the narrative from one that focused on blame to one that emphasized shared responsibility (Sheldrick 2023). From such a perspective, the disproportionate financial burden of the richest countries might be attributable simply to their relative size and wealth, but with the expectation that everyone will "pay their fair share." Moreover, an experimental study demonstrates that highlighting *collective* responsibility increases monetary donations to climate change advocacy and intent to reduce carbon emissions, relative to messages that emphasize personal responsibility (Obradovich and Guenther 2016). Our study raises the question of whether a *shared responsibility* (solidarity) campaign might be more effective than one that emphasizes *differentiated responsibility* (climate justice).

Moreover, a large literature in social psychology suggests that building a superordinate identity can increase prosocial behavior across ethnic and national boundaries (Gaertner et al 1993; West et al 2009). Within countries, political science research has further demonstrated that priming a superordinate national identity can increase prosocial behavior toward ethnic outgroups (Transue 2007; Charnysh et al. 2015; Robinson 2014). In an international context, Rosenzweig and Zhou (2021) showed that creating a superordinate (pan-African) identity can ameliorate out-group animosity toward non-nationals. We thus ask: Does emphasizing the need for *global* solidarity in light of shared responsibility and vulnerability to climate change increase Americans' support for climate aid to the Global South? And to what extent does their affect towards foreigners moderate this effect?

With respect to both types of messages, a second key question is whether climate communications have different effects across the crucial partisan divide. Indeed, it is now well understood that Americans have become remarkably polarized along party lines, and numerous studies have shown the extent to which party attachments are associated with widely varying climate attitudes. In reviewing the scholarly literature on attitudes towards climate change, Bugden (2022: 2, 12) identifies a "partisan climate gap," that emerges as far and away the most important predictor of American views on climate change, with Republicans being far less supportive of a wide range of climate policies, including on international aid, than Democrats. In an earlier review, Egan and Mullin (2017, 216) note that when partisanship and political ideology are included in models of US public opinion, they "typically dominate all other relationships." Chan and Lin (2022) further find that climate messaging can have heterogeneous effects across the partisan divide, sometimes leading to unintended consequences.

To date, and for a variety of reasons, studies on historic carbon emissions appeals have not accounted for the possibility of this consequential heterogeneity in treatment effects. Most of the aforementioned studies present estimates of *average* treatment effects and tend to be based on samples that do not allow for such an investigation. For example, Gampfer (2014) largely recruited university students from Zurich, Switzerland; Anderson et al (2017) recruited 414 American respondents from a Qualtrics panel, in which just 17.6% of those reporting their political ideology described themselves as being on the right or "mostly

right" (their appendix). In their regression estimates, they did not find a significant effect for the role of politics, let alone estimate heterogeneous treatment effects. Ponte et al (2023) did not measure political attachments, and the mean and maximum age of participants in their experiment was 22.3 and 34 years, respectively. Considering a wider set of studies beyond the focus on historic carbon emissions, Bernauer and McGrath (2016) found no partisan effects in a climate framing experiment, but that was in the context of a study that otherwise only found null effects.

We consider whether effects from messaging about historic carbon emissions might vary across this critical political divide. Because Democrats have tended to be more willing and Republicans less willing to embrace the idea that human activity is to blame for the emerging climate crisis (Funk and Hefferon 2019), we anticipate that the disproportionate responsibility (climate justice) frame might backfire when presented to Republicans, leading to decreased support for climate-related foreign aid.

2.2 Hypotheses

Summarizing the claims discussed above, we advance several hypotheses (all pre-registered), which our study was designed to test:

1. A framing emphasizing America's *disproportionate* responsibility for carbon emissions and contributions to climate change (climate justice) will increase support for climate aid to the Global South, relative to control.
2. A framing highlighting *shared* responsibility for historic climate emissions (solidarity) will increase support for US climate aid to the Global South, relative to control.
3. The climate justice treatment will have a positive effect among Democrats.
4. The climate justice treatment will have a negative effect among Republicans.
5. The effects of the *shared responsibility* treatment will vary based on affect toward foreigners: we expect positive effects only among respondents scoring above 50 on the feeling thermometer.

3 Methods

In order to learn about the effects of messaging on attitudes towards climate-related foreign aid, we fielded a national online survey of 5,002 American respondents. Within that survey, subjects were randomly assigned to one of three treatment conditions, which varied in terms of messages about the motivation for providing climate-related aid, followed by a series of questions about their support for different forms of assistance.

We fielded such a large survey in order to investigate how such impacts might vary across segments of the population, particularly across party identification. We conducted the survey on Prolific, a platform for online subject recruitment designed for researchers. Researchers have concluded that respondents on Prolific were "more likely to pass various attention checks, provide meaningful answers, follow instructions, remember previously presented information, have a unique IP address and geolocation, and work slowly enough to be able to read all the items" when compared to other online platforms as well as university undergraduates (Douglas et al 2023).

Individuals recruited into the online panel were told they would participate in an approximately 10-min survey, sharing their views about a number of challenges facing the US government. After providing consent and confirmation that they were 18 and older, they began the questionnaire.

The study contained a number of attention checks,[1] and we randomized the order of some questions to mitigate against unintended priming effects. We asked a battery of demographic questions, including about race, income, gender, and partisan attachment. As we detail in the Appendix, our sample was– like most online panels (Douglas et al 2023: Table 1)– disproportionately Democratic, but the number of Republican respondents was large enough to conduct meaningful analyses of heterogeneous effects by political party. The sample was reflective of national demographics with respect to gender, age, and geography.[2]

Our experimental intervention consisted of three treatment arms. In all three, we introduced the idea that Americans might provide climate-related foreign aid for adaptation using the following text:

> Some say that Americans should contribute to helping poor countries adapt to the changing climate

In the control condition, no additional text or graphics were included.

In the two treatment conditions, we supplemented this text with additional information, designed to deliver one of two motivational messages:

In the *climate justice* frame, respondents were shown an image of cumulative CO2 emissions over time,[3] which highlights that the United States has emitted exponentially more than a few key middle-income countries and the low-income countries combined, along with text that says:

> … because the United States is the biggest polluter in history. It contributed more than any other country to current levels of greenhouse gases in the atmosphere, as shown in the figure.

In the *solidarity* frame, respondents were also shown a figure depicting historic carbon emissions, which takes a similar shape as the figure in the first treatment. However, in this figure, the data were aggregated for the entire world. The justification text in this treatment read:

> … because we are all in this together. We must act in solidarity as we all face the current levels of greenhouse gases in the atmosphere as shown in the figure.

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[1] We report the robustness of our findings based on various levels of attention in our Appendix.

[2] We note that the experimental intervention and outcome questions analyzed in this study were presented following a distinct-but-related module investigating the role of race and nationality in support of assistance for poor communities affected by extreme weather events. In the present study, we include controls in our analyses for treatment assignment in the first study– specifically, the identity (Black or White) and location (United States or Brazil) of a family displaced by flooding. Given the ubiquitous nature of such images and messages in the media, we do not believe that this context was materially consequential for the findings in the present study. A pre-analysis plan was registered with OSF for both studies prior to data collection and is available in the Appendix.

[3] The images were created by the authors at the website https://ourworldindata.org/explorers/co2, which provides permission to use resulting materials under a Creative Commons license.

The overall look and text length of these treatments were similar (see Fig. 1).

As compared with the lab studies described in the previous section, our informational treatment is "thinner," in the sense that exposure to information about emissions is relatively fleeting and does not take the form of strategic play. As a result, it is arguably more realistic, and provides a better test of the type of real-world treatment citizens might encounter. Virtually no citizens actually engage in strategic international negotiations, but most are routinely exposed to information about climate change in various media outlets, in a manner that is akin to our study's treatment. Importantly, we test the impact of simple, realistic messages that leverage information about historic emissions on attitudes toward climate aid among distinct segments of the American population, which has been highly polarized in both climate attitudes as well as support for foreign aid (Ansah et al 2023).
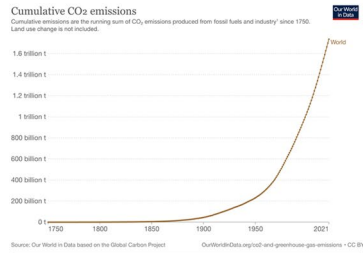
Following the presentation of the assigned motivational message, we measured respondents' support for climate-related foreign aid with two questions:

First, respondents were asked, "Do you believe that the United States should contribute to helping poor countries adapt to the changing climate?" and offered a 5-point scale ranging from Strongly agree to Strongly disagree. All responses were subsequently recoded on a 0–1 scale.[4] Second, respondents were asked a question that detailed specific possibilities for U.S. government aid with a vignette that reflected actual news / policy developments:

> On April 20, 2023, the President pledged $1 billion per year to a global Climate Fund to help the poorer countries suffering most from climate change. The President had previously pledged $11.4 billion per year in climate aid to poorer countries. Some highlight that this is much less than what was originally pledged; while others say that the U.S. should not be providing this aid at all. What do you think the U.S. government should provide?
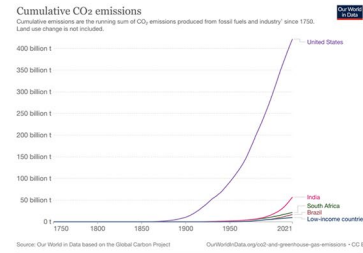
For that question, respondents were offered 6 response options, anchored at the extremes of, 0 = "No aid," and 1 = "More than $15bn."[5]

Fig. 1 Climate justice (left) and solidarity (right) treatment conditions

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[4] 0 = Strongly disagree;.25 = Disagree;.5 = Neither agree nor disagree;.75 = Agree; 1 = Strongly agree.

[5] Other options included,.2 = "Between $0.5bn and $1.5bn(the recent proposal);".4 = "Between $2bn and $5bn;".6 = "Between $6bn and $10bn;".8 = "Between $11bn and $15bn (the original proposal)."

Based on our pre-registered analysis plan, we took the average of the standardized (0-to-1) responses to the two questions to create a single index for analysis (responses to the questions are correlated at $R=0.68$, $p<0.001$). Specifically, we re-coded the range of response options for each question on 0-to-1 scale, and then calculated the average of those two quantities.[6]

In addition, as a supplementary question about private support, we asked respondents about their propensity to make personal climate-related donations. This question serves to assess whether, in addition to shaping support for governmental action, our treatment also affects perceptions of *personal* responsibility for assisting developing nations with climate adaptation. As several studies on collective guilt highlighted, collective and personal responsibility are analytically distinct and only weakly correlated in empirical settings (Branscombe et al. 2004; Wohl et al. 2006). We measure respondents' willingness to personally contribute using the following question:

> Imagine that you received $100 today. You have the option to donate this money to a leading charity fighting climate change in poor countries. About how much would you personally donate to counter the effects of climate change in the developing world? [Response options from $0 to $100 in increments of $10.]

We also asked a series of questions about possible hypothesized mechanisms: Anticipating a mechanism for the climate justice treatment, we focused on "collective guilt," and asked respondents whether they agreed with the statement, "As an American, I feel a moral responsibility to assist developing nations suffering from the changing climate." And anticipating a mechanism for the solidarity treatment, we focused on "social proximity," and asked respondents whether they agreed with the statement, "People in poor countries and Americans are more similar than different." Finally, we also asked about respondents' (dis) agreement with two statements related to "Concern about global warming" that we pre-registered to be constructed into an index: "I am extremely worried about the effects of global warming," and, "There is too much talk about global warming– there are other big problems to be worried about." These statements were included as a placebo test, to verify that our treatments affected respondents' sense of responsibility for who should take action rather than their sense of the *magnitude* of the climate problem and thus their concerns about climate change, which has been shown to increase support for climate policy (Bouman et al. 2020).

In the body of the article, we present results from bivariate regressions of treatment on outcome, but as we show in the Appendix, none of our substantive findings are changed by the inclusion of a set of pre-registered control variables.[7] We standardize all outcome vari-

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[6] We report in the main text estimates for the index as that was our pre-registered analysis. In appendix 1.8, we show the estimated effects for each component separately. While the magnitudes of those effects are essentially the same as for the index, the statistical significance of the treatment effect of climate justice on support for the presidential pledge is only significant at the 90% confidence level.

[7] We make just one deviation from our pre-analysis plan: we indicated that we would analyze the data for this study separately by race group because, as indicated, we assumed that baseline views about climate aid would vary across race groups. In fact, analyzing responses among respondents in the control condition, we found no substantive or statistically significant differences across race groups among Democrats; and although Black Republicans were much more supportive of climate aid than White Republicans, we note that the sample of Black Republicans is very small ($N=109$ for entire study; $N=30$ in control condition) and so statistical analyses of that subgroup are extremely unreliable. For the sake of transparency, in the Appendix we report estimates separately by race group

ables to be centered at mean=0 and standard deviation=1, so all estimated treatment effects are reported in terms of standard deviations of the outcome variable.

4 Findings

First, we detail our observational (non-experimental) analyses in attitudes about foreign aid for climate adaptation. This helps to validate our measurement as we confirm strong partisan differences, which in turn, highlights the need to distinguish the effects of climate messaging across audiences. Second, we report on our experimental findings for the overall sample, and separately for Democrats and Republicans.

Figures 2, 3, and 4 show the distribution of responses to our three outcome variables by party. Consistent with conventional wisdom and the findings reported by Ansah et al (2023), partisan differences are large and in the expected direction, with much higher levels of support for climate aid among Democrats. More than five times as many Democrats strongly agreed that the US should provide climate aid to poor countries as Republicans, and over 80% of Democrats agreed, compared with just under 33% of Republicans.

On the question about the preferred size of the US contribution to a Global Climate Fund (Fig. 3), 38% of Republicans said there should be no aid at all, compared with less than 4% of Democrats. By contrast, the modal response in the Democratic sample (29.4%) was to support the original, much larger climate aid proposal. Even in terms of hypothetical personal donations, just under 50% of Republicans said they would contribute $0, while less than 25% of Democrats selected that option. In Fig. 5, we report estimates of the effects of the *climate justice* frame and the *solidarity* frame, in both cases relative to the control con-
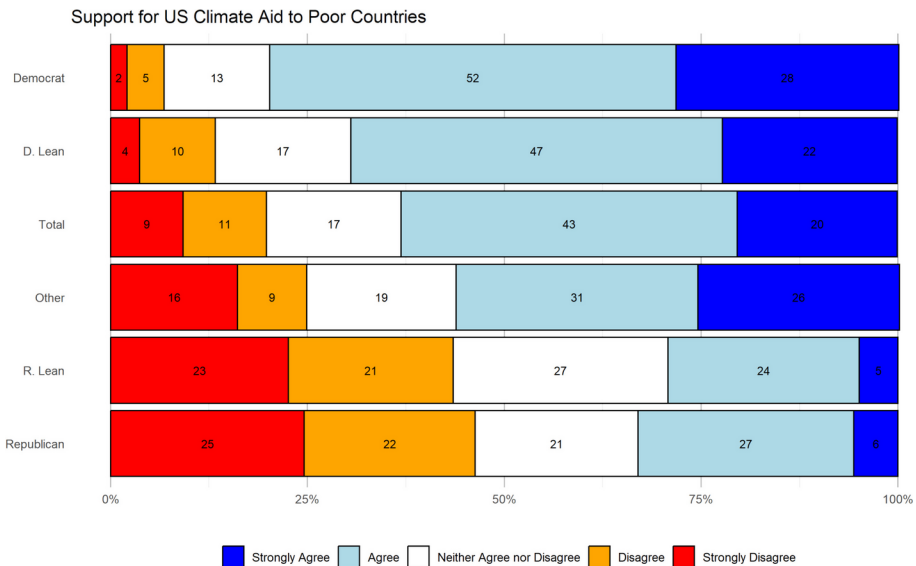

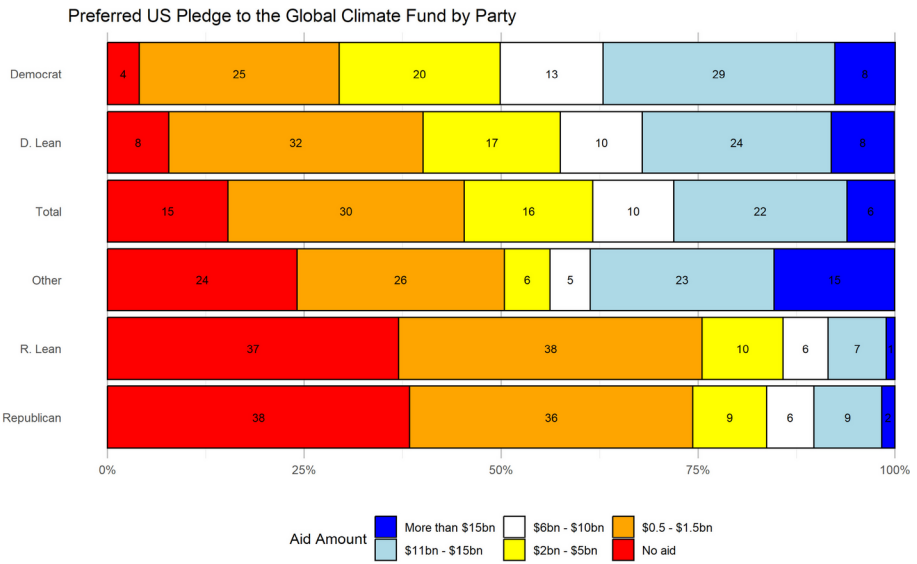**Fig. 2** Support for climate aid by party identification

Preferred US Pledge to the Global Climate Fund by Party

Party	No aid	$0.5 - $1.5bn	$2bn - $5bn	$6bn - $10bn	$11bn - $15bn	More than $15bn
Democrat	4	25	20	13	29	9
D. Lean	8	32	17	10	24	8
Total	15	30	16	10	22	6
Other	24	26	6 (5)		23	15
R. Lean	37	38	10	6	7	
Republican	38	36	9	6	9	

Aid Amount — More than $15bn | $6bn - $10bn | $0.5 - $1.5bn | $11bn - $15bn | $2bn - $5bn | No aid

Fig. 3 Support for presidential climate package by party identification

Individual Donations to Charity Fighting Climate Change by Party

Party	$0	$10	$20	$30	$40	$50	$60	$70	$80	$90	$100
Democrat	19	20	17	8	6	15	2	3	2		8
D. Lean	24	22	14	8	3	17	2	2	1		8
Total	29	20	14	7	4	14	2	2	2		7
Other	34	18	12	8	3	15	2	2	2		5
R. Lean	48	22	10	4	3	8	1	2	1		4
Republican	49	16	8	4	3	10	2	2	1		4

Donation Amount — $100 | $70 | $40 | $10 | $90 | $60 | $30 | $0 | $80 | $50 | $20
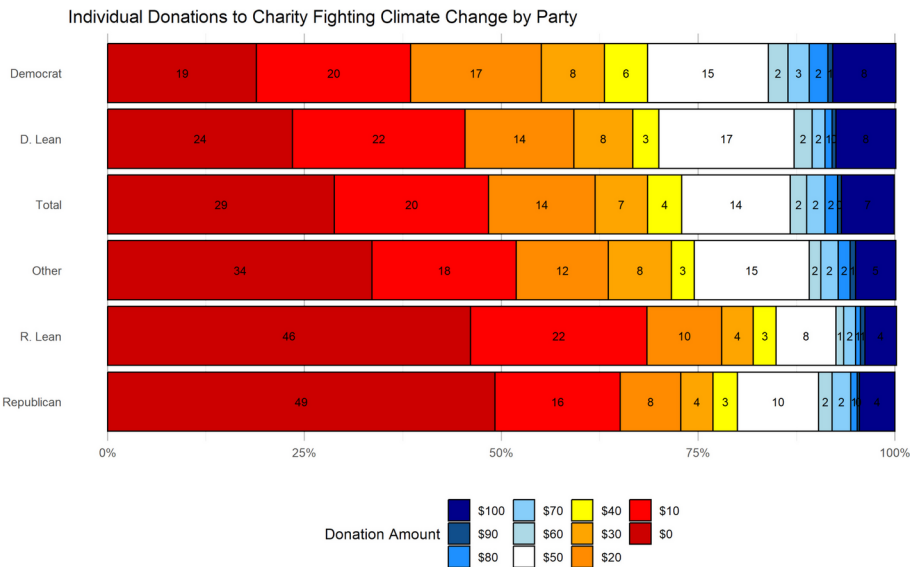
Fig. 4 Willingness to make hypothetical donation for foreign climate adaptation by party identification

dition, on our primary outcome, the index of support for climate-related foreign aid.[8] The points indicate point estimates and lines indicate 95% confidence intervals (CI) for each comparison for the indicated samples. The figure demonstrates that the climate justice frame

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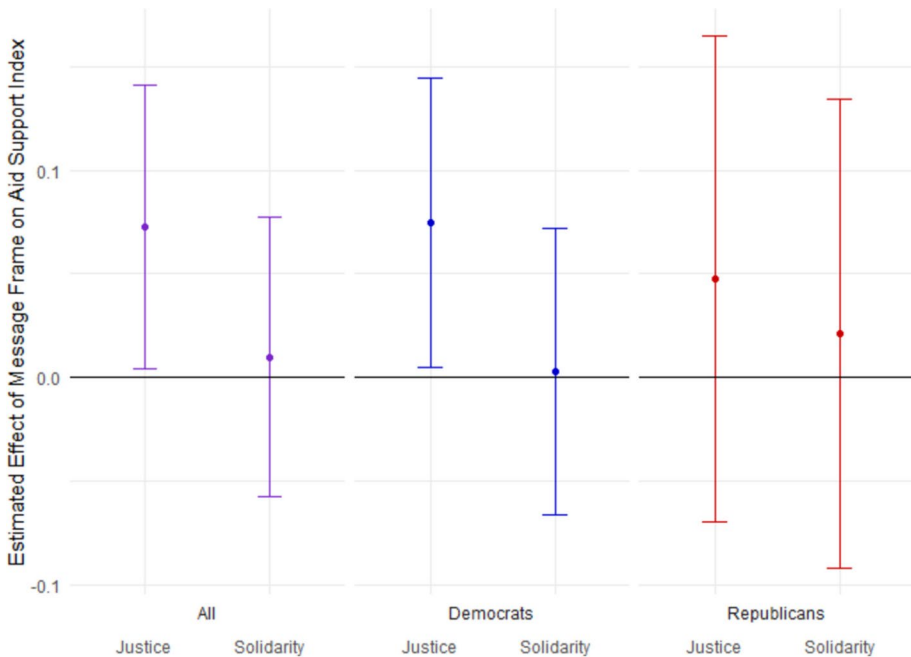[8] We present full regression estimates for figures in the Appendix.

Fig. 5 Estimated effects of message frames on support for climate-related aid. Note: Treatment effects, measured in terms of standard deviations of the outcome variable, are estimated relative to the control condition. Error bars depict 95-percent confidence intervals calculated with HC2 standard errors. X-axis labels indicate the sample and messaging frame in the treatment condition

indeed has a statistically significant and positive Average Treatment Effect (ATE) on support for climate aid, ($\beta=0.07$, 95% CI: 0.00, 0.14), while the effect of the solidarity frame is zero.

Figure 5 also presents estimates of treatment effects separately for supporters of the two major political parties. Among Democrats, again, we find a moderate and statistically significant treatment effect for the climate justice frame ($\beta=0.07$, 95% CI$=0.00$, 0.15), among Republicans, contrary to expectations, the estimated effect is also positive, but the effect size is smaller and statistically indistinguishable from zero. (As reported in Appendix Table 2.3, when we include covariates, the estimated effect of the climate justice treatment increases among Democrats, and decreases among Republicans.) For both parties, the solidarity frame has essentially no effect.[9]

The results are similar when we looked at the two components of the Aid Support Index separately. As shown in Appendix Section 8, the climate justice frame has a positive and statistically significant effect on support for US governmental aid to climate adaptation in poor countries (component 1) as well as on the support for the Presidential Pledge to the Global Climate Fund (component 2), both in the full sample and among Democrats, but not among Republicans.

In Fig. 6, we present results for our supplementary outcome, private donations, which is only weakly correlated with support for governmental aid ($R=0.42$). We observe no statisti-

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[9] We analyze results separately by party as indicated in our pre-analysis plan. In the Appendix, we present results of a pooled analysis with an interaction term for Republican*climate justice. The interaction term for party and climate justice is negative, but not statistically significant.

cally significant treatment effects for this outcome. However, we note that the point estimate for climate justice among Republicans is negative, consistent with hypothesis 4 ($\beta=-0.08$, 95% CI: −0.19, 0.03). Null results for this outcome could signal that although (some) Americans are willing to accept their government's responsibility for assisting the developing world when faced with facts about the US's disproportionate emissions, they do not see themselves as *personally* responsible– either because of their lower identification with their national ingroup or because they perceive their own contributions to CO_2 emissions to be minimal. Such a divergence between collective and personal guilt has been demonstrated by other researchers in a different empirical context (Branscombe et al. 2004).

Finally, we consider responses to follow-up questions to understand the mechanisms responsible for the positive effect of climate justice framing on support for governmental aid, particularly in the Democratic sub-sample. Given the relatively small effect sizes, formal mediation analysis is implausible as we are statistically underpowered, even with our relatively large sample. Nonetheless, following our pre-analysis plan, we consider the possibility of ancillary attitudinal changes affected by treatment to identify suggestive evidence about mechanisms.

In Fig. 7, we present estimates of our framing treatments on responses to two different questions that were correlated with our index of support for climate, and do so separately for supporters of the Democratic and Republican parties. We had predicted that the climate justice treatment would lead to a greater sense of "collective guilt" but we find no evidence in support of this expectation. We further predicted that the solidarity frame would shrink
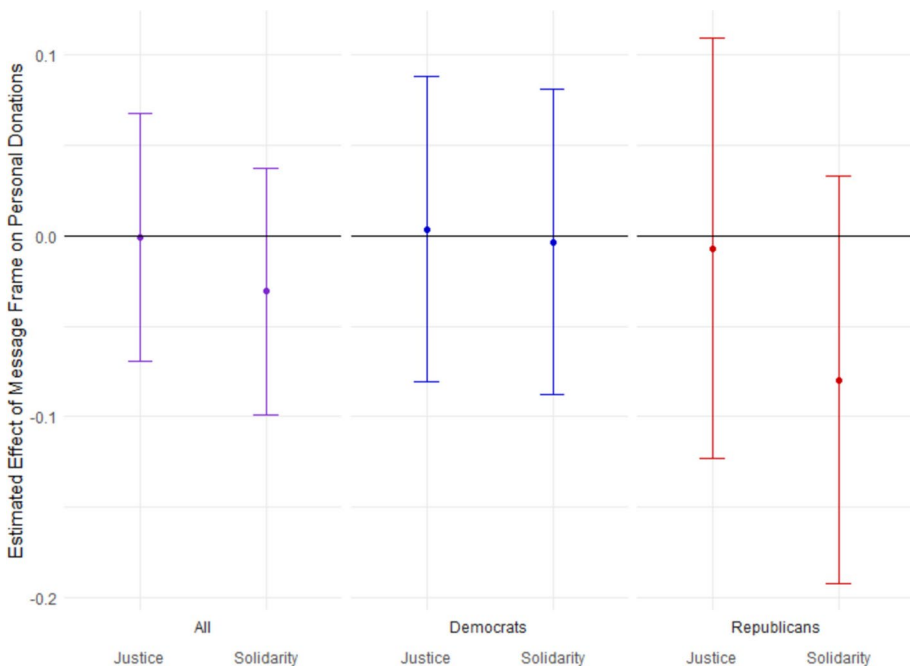

Fig. 6 Estimated effects of message frames on private donation intentions. Note: Treatment effects, measured in terms of standard deviations of the outcome variable, are estimated relative to the control condition. Error bars depict 95-percent confidence intervals calculated with HC2 standard errors. X-axis labels indicate the sample and messaging frame in the treatment condition
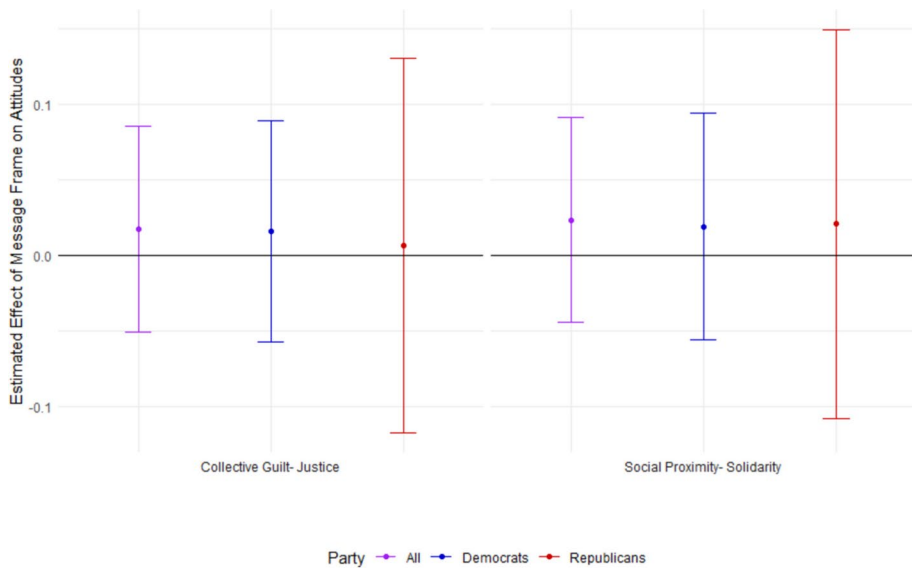
Fig. 7 Estimated effects of messaging on related attitudes. Note: X-axis labels indicate attitudinal outcome and messaging frame indicated in the treatment condition. For collective guilt outcome, we estimate the impact of climate justice treatment relative to control. For the social proximity outcome, we estimate the impact of the global solidarity treatment relative to control. Effect sizes are measured in terms of standard deviations of the outcome variable. Error bars depict 95-percent confidence intervals calculated with HC2 standard errors

the perceived social distance between respondents and citizens of the Global South. We asked respondents whether they agree that "[p]eople in poor countries and Americans are more similar than different." While estimated treatment effects are positive, large standard errors render those estimates statistically indistinguishable from zero.

A possible alternative explanation for greater support for governmental aid in the climate justice condition relative to control is that the frame increases concern about global warming by presenting respondents with a graph of rapidly increasing emissions and triple-digit numbers (expressed in billions), which may appear larger than the single-digit numbers (expressed in trillions) in the global solidarity frame. Conversely, respondents may have correctly interpreted the higher total emissions on the y-axis in the solidarity frame and become more concerned about the fate of their own country, which could reduce their support for sharing resources with the developing world. To address these alternative explanations for our findings, we examine the effects of each frame on respondents' concerns about global warming. As reported in the Appendix Section 6, we find no evidence for this alternative explanation.

Finally, we test the proposition that the solidarity treatment will be more effective among those with more favorable views towards foreigners (50 or above on a 0–100 feeling thermometer), but as detailed in the Appendix Section 3, we find no support for that claim.

5 Discussion

5.1 Main contributions

In this study, we investigated the effects of two different types of climate aid appeals that highlight historic carbon emissions, varying the assignment of responsibility for those emissions as either disproportionately on the shoulders of the United States (an appeal to climate justice) or as shared by "everyone" (an appeal to solidarity). In line with one of our core hypotheses, we find modest, statistically significant positive effects for the climate justice frame on support for US governmental aid for climate adaptation in the developing world. However, contra another of our core hypotheses, we found that the solidarity frame has failed to move respondents' support for assisting poor countries.

Analysis of our survey data confirms that attitudes about climate-related foreign aid– much like about climate policy more generally– are extremely polarized along partisan lines in the United States. Self-described party attachment is far and away the most important predictor of general support for aid, the size of specific proposals for aid, or the willingness to contribute privately. Such findings stand up in models that include a wide range of covariates.

In this context, when we consider the effects of the climate justice frame separately by party, the effects are, as predicted, larger and only statistically significant for the sub-group of Democrats. To be clear, we cannot establish whether one's partisan identity *causes* one to respond differently to messages (Fesenfeld et al 2024), but rather that the effects are simply *different* across the groups. A wide range of factors may account for this difference, including the differential effects of media and elites; and/or other factors not measured in this study.

Perhaps not surprisingly, given the strong associations between party and other individual-level characteristics with virtually all climate-related attitudes, the magnitude of the estimated framing effects is small. This is a pattern observed in other framing studies across contexts (Amsalem and Zoizner 2022). Consistent with Bernauer and McGrath (2016), considerations of international responsibilities and obligations are not as important as more localized factors. For example, the estimated difference between Republicans and Democrats is thirteen times as large as the estimated effect of the climate justice treatment relative to our control condition. This pattern is consistent with Egan and Mullin's (2017) conclusion that partisanship is by far the strongest predictor of attitudes toward climate change more broadly. Egan and Mullin argue that people may be more likely to interpret climate issues through a partisan lens because (1) climate change is a complex scientific issue and (2) because its effects are perceived as geographically and temporally removed.

Our study adds to the body of evidence that communicating the historic responsibility of the largest carbon emitters can help motivate citizens of wealthy, historically-polluting countries to support climate aid to the developing world. We contribute to the external validity and contextualization of prior research by establishing that this framing does not consistently or substantially move the crucial Republican subset of the population. As voters, such citizens are much more likely to support political leaders who either deny climate change altogether or object to climate-related foreign aid. Thus, while the climate communications discussed in this study may "do no harm," in the sense that they do not seem to lead to any *decreases* in support, they also may not be nearly enough to make a difference in a polarized political environment.

5.2 Limitations

Some limitations of the study should be noted. First, as is true with virtually all related studies, we have chosen just one combination of text and graphics to represent each of our experimental frames, and it is possible that our findings would be different with alternative combinations. Second, real-world communications may vary in intensity (e.g. repeated messaging), and in duration between delivery and intended expressions of support. Third, citizens' expressed attitudes on a survey may reflect some social desirability bias (the desire on the part of respondents to provide responses that they think interviewers want to hear) and/or may not well predict relevant climate-related behaviors. For example, respondents were asked to consider how much they would give as a personal donation rather than giving actual money, and the latter likely would have generated different results. Notwithstanding these limitations, we believe the study offers important insights into the drivers of citizens' attitudes about climate change.

5.3 Conclusions and future research

Scholars and climate policy advocates have understandably sought to gain insight into the types of messages and appeals that could boost public support for climate-related policies. As is the case for climate mitigation policies, a challenge in generating support for climate adaptation aid is that it offers few immediate benefits to the citizens of contributing countries. As a result, moving public support on this issue may require the use of normative appeals, such as ones that stress fairness or solidarity considerations.

Our study contributes to a still nascent literature on public opinion about climate-related foreign aid– an outcome of growing substantive concern as poor countries face droughts, rising sea levels, extreme temperatures, and intense storms, all of which increase levels of collective misery in an increasingly unequal world. Political calculations and public opinion will profoundly affect the degree to which such aid is ultimately delivered through government and private channels.

Given the substantive significance of partisanship on actual policy-making in the United States and in other democratic countries, we suggest several areas for future research:

1. Researchers might aim to assess the robustness of these findings with alternative research designs, including field experiments that measure behavioral outcomes. Stronger treatments and delays between treatment assignment and measurement of outcomes would provide better opportunities to study mechanisms. Such studies could more naturally test findings from the more rarefied (online, and involving questions about hypothetical actions) environment of this and similar studies.
2. Scholars should continue to experiment with alternative climate messages to understand a wider range of frames and representations of historic carbon emissions.
3. Researchers should continue to examine the possibly heterogeneous effects of messaging and other initiatives across political parties. Understanding the drivers of Republican opinion may require investigations across sub-groups of Republicans based on likely variation in receptivity to motivational appeals. Mayer and Smith (2023) offer some insights that ought to be considered in conjunction with our findings: They find less resistance to climate change policy among Republicans expressing lower levels of

negative partisanship. Future research should focus on uncovering additional effective strategies for delivering climate-related information and communicating across the partisan divide.

Data and code availability All data and code will be made available at the Harvard Dataverse.

Declarations

Ethics approval and consent to participate On March 27, 2023, the protocol E-4863, American Attitudes Towards Climate-Related Foreign Aid, was determined by the MIT Committee on the Use of Humans as Experimental Subjects (COUHES) to be exempt from full human subjects review because the study involved only a benign behavioral intervention, and involved a low-risk survey.

Consent for publication Yes.

Conflict of interest No conflict of interests.

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