# Mass support for global climate agreements depends on institutional design

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**Effective climate mitigation requires international cooperation, and these global efforts need broad public support to be sustainable over the long run. We provide estimates of public support for different types of climate agreements in France, Germany, the United Kingdom, and the United States. Using data from a large-scale experimental survey, we explore how three key dimensions of global climate cooperation—costs and distribution, participation, and enforcement—affect individuals' willingness to support these international efforts. We find that design features have significant effects on public support. Specifically, our results indicate that support is higher for global climate agreements that involve lower costs, distribute costs according to prominent fairness principles, encompass more countries, and include a small sanction if a country fails to meet its emissions reduction targets. In contrast to well-documented baseline differences in public support for climate mitigation efforts, opinion responds similarly to changes in climate policy design in all four countries. We also find that the effects of institutional design features can bring about decisive changes in the level of public support for a global climate agreement. Moreover, the results appear consistent with the view that the sensitivity of public support to design features reflects underlying norms of reciprocity and individuals' beliefs about the potential effectiveness of specific agreements.**

international institutions | environmental cooperation | global warming | international relations | public opinion

Scientists largely agree that anthropogenic emissions of greenhouse gases contribute to global warming, with serious environmental, economic, and social consequences. To provide policymakers with knowledge to help them design international climate policy, the scientific community has intensely examined alternative structures, cost scenarios, and reduction targets of an effective global climate policy architecture (1–5) and has generated informative survey evidence on individuals' general attitudes and beliefs about climate change (6–9). Although these previous studies provide important knowledge, any global climate policy aimed at effectively reducing global warming requires broad public support to be sustainable over the long run. So far, however, we know very little about which types of climate agreements the population prefers and whether the public is sensitive to the specific features of different international climate policy architectures. Improving our knowledge about how mass support for global climate policy depends on its specific design is important not only to assess the political feasibility of alternative climate policy choices, but also because effective and sustainable climate cooperation ultimately relies on individuals' willingness to change their consumption patterns.

To explore how three key dimensions of the design of climate agreements—costs and distribution, participation, and enforcement—affect individual preferences for global climate cooperation, we embedded an experimental conjoint analysis (10, 11) in large-scale Internet surveys on representative samples of the adult population in France, Germany, the United Kingdom, and the United States (12–14). The sample size was 2,000 respondents for France, Germany, and the United Kingdom and 2,500 respondents for the United States. The surveys were carried out by YouGov in summer 2012. The marginal distributions of the sociodemographics in the population and the raw sample are closely comparable. Weighting the sample eliminates the few minor remaining imbalances on observed characteristics (*SI Appendix* provides sampling details and a comparison of the distribution of sociodemographics in the population, the raw sample, and the weighted sample).

The core of our analysis draws on respondent choices between alternative global climate agreements presented within an experimental conjoint framework (15, 16). Conjoint analysis involves having respondents rank or rate two or more hypothetical choices that have multiple attributes with the objective of estimating the influence of each attribute on respondents' choices or ratings. In the conjoint part of the survey, we showed each respondent two hypothetical international climate agreements in comparison and asked them to choose between them. In addition, we asked respondents to rate each agreement individually in terms of how likely they would vote in favor of or against it in a referendum. Fig. 1 shows an image of the conjoint experimental instructions (see *SI Appendix* for details about the explanation and presentation of the conjoint experiment). Each respondent was shown four such binary comparisons. Therefore, across all four countries, 8,500 respondents rated two agreements in four conjoint comparisons, which gives a total of 68,000 rated agreements.

For each agreement that a given respondent considered, we constructed the variable *Agreement Support* and coded it 1 if an individual chose that agreement and 0 if not. Although individuals had to rank and rate hypothetical treaties, we designed the instructions and the conjoint in such a way that respondents would consider the agreements carefully before making a choice. We also performed a series of attention and consistency tests (*SI Appendix*). These tests suggest that most respondents carefully processed the available information. Also, the results remain unchanged once reestimated for different groups of respondents that vary in their levels of attention or consistency.

Table 1 shows the dimensions and values used in the conjoint experiment. For each agreement alternative presented to a respondent, we randomly assigned the values for each dimension. The randomization ensures that the treatment groups are comparable with respect to observable and unobservable confounding variables. For example, respondents might interpret some of the information we provided differently, which might affect the extent to which their support for a climate agreement depends on its specific design features. However, because of the randomization applied to our large sample, any potentially confounding variables will be distributed uniformly across treatment groups. Therefore, these groups will remain comparable, which means our estimates of how institutional design features affect public support for a

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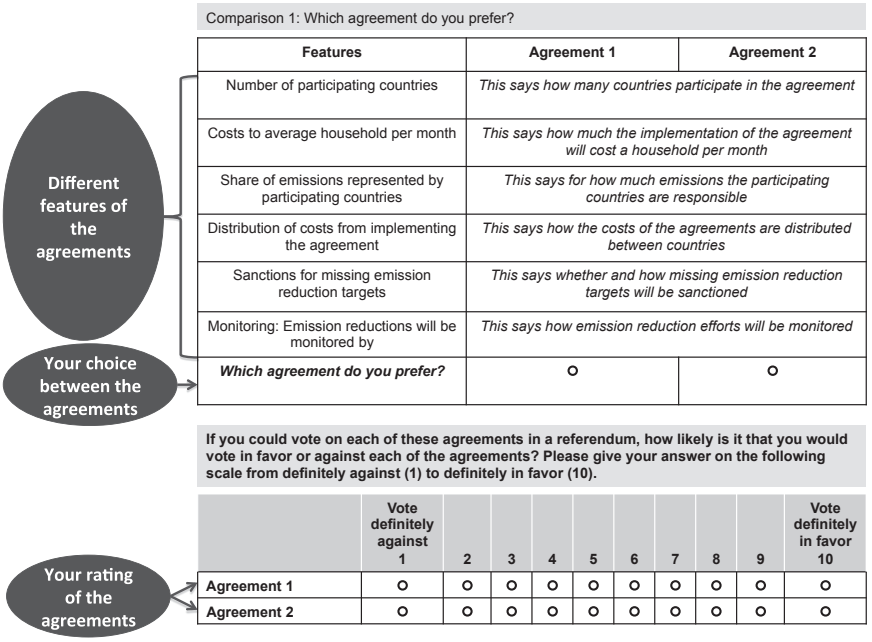


**Fig. 1.** Conjoint experimental instructions. See *SI Appendix* for more details about the directions for the conjoint experiment.

climate agreement remain valid even in the presence of differences in respondents' subjective interpretation or beliefs.

The values for the costs to average households directly mirror the different cost scenarios discussed in the public and scientific debate (17–19). According to the initial version of the Stern report (18) and others (17, 20), stabilizing $CO_2$ concentration at 550 particles per million—a level thought to be consistent with limiting future average temperature increases to 2 °C over preindustrial levels—will require abatement costs on the order of 2% of gross domestic product (GDP) in industrialized countries. However, these costs may vary depending on differences and uncertainties in available cost scenarios, but also as a function of countries' levels of ambition (21), targeted pollutants (22), and efficiency of mitigation policies (4, 23). To incorporate variation in agreement costs, we compute monthly abatement costs to the average household for five different cost scenarios, ranging from 0.5% to 2.5% of a country's GDP in steps of 0.5 percentage points.

Our choice of international allocation principles draws on the scholarly literature on distributional aspects in global climate policy (24, 25) and prominent social conceptions of fairness. In particular, we include the "polluter-pays" principle ("proportional to current emissions" and "proportional to the history of emissions"), as well as the "ability-to-pay" principle ("only rich countries pay" and "rich countries pay more than poor countries"). This set of allocation rules allows us to test which fairness principles citizens prefer when having to decide how the costs of emissions reductions should be distributed among countries (26).

For participation, we vary the number of countries participating from 20 to 80 to 160 of 192 and the percent of emissions accounted for by participating countries from 40% to 60% to 80% of current emissions. We focus on two aspects of enforcement: monitoring and sanctions. For monitoring, respondents considered agreements that would monitor obligations by national governments, the United Nations, an independent commission, or Greenpeace. For sanctions, we again normalize the size of sanctions for a country missing its emission reduction targets to the average household, distinguishing between no sanction and a low, medium, and high sanction. For each country, the low, medium, and high sanction values correspond to 5%, 15%, and 20% of the monthly household costs for the 2% of GDP scenario.

Our research design fully randomizes the attributes of the climate agreements under consideration. Because we are interested in the features' marginal effects, we can use a linear probability model to estimate these elasticities. Specifically, we regress the variable *Agreement Support* on dummy variables for values of the agreement dimensions to nonparametrically estimate the effect of variation in any given attribute of an agreement on support for an agreement (16). We also reestimated the effects using a probit model, and the results remain unchanged (*SI Appendix*).

## Results

Fig. 2 shows our estimates of the influence of the costs, participation, and enforcement characteristics of global climate change agreements on public support if we pool our data across all four countries (we report results by country below). The dots represent the estimated effect of a given value for each characteristic of a climate agreement on the probability of supporting an agreement. The bars indicate 95% confidence intervals, and the points without bars indicate the reference category for a given agreement dimension. The interpretation of each estimate is relative to the reference category for that dimension.

Costs are the major drivers of support for global climate agreements. We estimate that an increase of average household costs from 0.5% to 1% of gross domestic product decreases public support for an agreement by 10 percentage points. This effect represents a decrease of 20% over the baseline level of support (which is 0.5). An agreement expected to cost 2% of GDP, which corresponds to €113 in France, €154 in Germany, £60 in the United Kingdom, and $213 in the United States per household and month, decreases support among citizens by 25 percentage points on average if compared with an agreement that costs only 0.5% of GDP. The strong sensitivity to costs is consistent with the view that manageable greenhouse gases are a global public good that individuals would like to consume, but their demand for it is sensitive to its price.

The strong sensitivity of mass support to costs does not appear to be a result of the fact that this dimension is particularly simple to understand. When we break down the results by education, we find that the effects are almost identical for respondents with high and low levels of education (*SI Appendix*). The high degree of sensitivity to price sets a noteworthy qualification to the common characterization in the public opinion literature that there is strong public support for addressing climate change. Although we also find broad

**Table 1. Policy dimensions and values for the global climate agreement experiment**

| Dimension | Values* |
|---|---|
| Costs and distribution | |
| Costs to average household, per month | €28, €39, £15, $53<br>€56, €77, £30, $107<br>€113, €154, £60, $213<br>€141, €193, £75, $267 |
| Distribution of costs | Only rich countries pay<br>Proportional to current emissions<br>Proportional to history of emissions<br>Rich countries pay more than poor countries |
| Participation | |
| No. of participating countries out of 192 | 20<br>80<br>160 |
| Emissions represented, % of current emissions | 40<br>60<br>80 |
| Enforcement | |
| Monitoring | Own government<br>Independent commission<br>United Nations<br>Greenpeace |
| Sanctions to average household, per month | No sanction<br>€6, €8, £3, $11<br>€17, €23, £9, $32<br>€23, €31, £12, $43 |

*For average costs and sanctions, the values are given in order for France, Germany, the United Kingdom, and the United States.

support for climate change cooperation, that support depends substantially on its expected costs.

Although costs play a central role, the results clearly indicate that the extent to which an agreement resonates with different fairness principles also matters for public support. One way in which the importance of fairness norms is evident is in the sensitivity of opinion to the principles of the distribution of costs across countries. Distributing the costs of emissions reductions proportional to current emissions increases support by about six percentage points compared with an agreement in which only rich countries pay. This effect may suggest that perceptions of agreement fairness are determined most powerfully by a polluter-pays principle as opposed to a strong version of the ability-to-pay principle.

This conclusion is bolstered by the fact that the effect of an agreement that distributes costs proportional to the history of emissions roughly equals the effect of the proportional-to-current-emissions alternative. This comparison is especially telling because practically there is little difference in the contribution of developing countries if a climate agreement distributes costs proportional to historical emissions or if rich countries pay everything. That said, we interpret this result with some caution because the weaker ability-to-pay principle of rich countries pay more than poor countries also has a similar effect on agreement support relative to the only-rich-countries-pay baseline. Presumably, both distributive principles influence agreement support, but for an agreement to be viewed as fair, developing countries have to contribute something to achieving emission reductions.

We also find that mass support depends on how encompassing a global climate agreement is: Increasing the number of countries that participate in an agreement from 20 of 192 to 80 of 192 increases support for an agreement by about 15 percentage points. We find a similar, yet less pronounced, pattern when conceptualizing participation in terms of emissions represented by the countries joining an agreement. Below, we further explore the mechanisms that underlie these sensitivities.

Notably, we find that the public prefers a small sanction over an agreement that involves no sanction for failing to meet emission reduction targets. If sanctions increase to medium or high levels, individuals generally are less supportive of this agreement. Here, we note an important difference between countries: low sanctions significantly increase support for a climate agreement in France and Germany but have no significant effect in the United Kingdom and the United States (although the coefficient on the low sanctions treatment has a positive sign in all four countries).

Finally, the enforcement structure of potential climate agreements influences public support. Across all four countries, having an agreement monitored by an independent commission—that is, a new international institution—increases the probability of supporting an agreement over the alternative that national governments monitor themselves. The magnitude of the effect is 5–10 percentage points or a 10–20% increase over the baseline.

**Levels of Support for Specific Climate Agreements.** So far, we have examined how public support responds to changes in the design of a global climate agreement. However, do these changes lead to decisive shifts in public support for a climate treaty? To answer this question, we compare the levels of support for two hypothetical agreements. The first scenario roughly corresponds to the agreement that currently is being discussed in ongoing international efforts, and the second scenario generally maximizes support given the results of this study. (See *SI Appendix* for exact specifications.) We compute levels of support for each of these hypothetical agreements based on country-specific simulations using the results of our ratings analyses for which respondents indicated the likelihood that they would vote for an agreement in a referendum. (See *SI Appendix* for a full description of simulation methods and results.)

We find that changes in the specific design of a global climate agreement may lead to noteworthy shifts in public support (*SI Appendix*). In three of the four countries we study, the change in agreement design features suffices to turn an agreement that a majority rejects into a treaty supported by the majority of voters. For example, in Germany, public support for an agreement increases from about 37% to slightly over 60% if that agreement incorporates design features individuals value. In the United States, however, the shift in support in response to changing the features of the currently discussed agreement to the most popular agreement does not marshal a majority. However, this design change still raises support from 29% to 47%, an increase that seems significant enough to likely have an important substantive impact on the politics of climate change cooperation in the United States.

**Robustness.** We carry out a large set of additional tests to assess the robustness of our results. First, we explore the consistency of our main results across countries. Fig. 3 reports the results by country. We find that individuals in all four countries largely agree on which dimensions are important and to what extent. This is a noteworthy and unexpected result. Our survey instrument replicates—using a standard question before the conjoint experiment—the cross-country differences in levels of support for international climate change efforts found in previous studies (support is highest in Germany and lowest in the United States). Nonetheless, our study shows that the sensitivity of mass support for global climate cooperation depends on institutional design in similar ways across each country. Second, we analyze the subgroup of respondents that showed attentiveness in filling out the survey, as measured by an attentiveness check embedded in the survey (*SI Appendix* provides results plots for this and all subsequent robustness tests reported here). Third, we break out the results by two different measures of political knowledge to evaluate the possibility of differences by the political sophistication of respondents. Fourth, we construct the variable *Vote for Agreement*, which measures how likely respondents think it is that

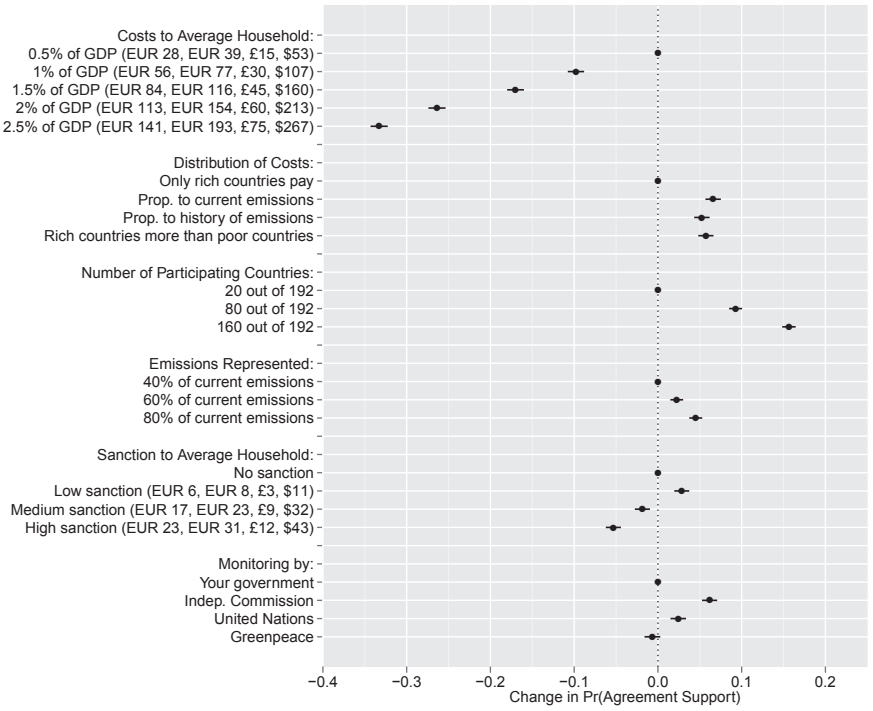


**Fig. 2.** Effect of agreement dimensions on public support for global climate change cooperation in France, Germany, the United Kingdom, and the United States (pooled data). This plot shows estimates of the effect of randomly assigned agreement features on the probability of supporting an agreement ($n$ = 68,000 agreements). Estimates are based on the regression of *Agreement Support* on dummy variables for values of the agreement dimensions, with SEs clustered by respondent. The bars indicate 95% confidence intervals based on robust SEs clustered by respondent, and the points without bars indicate the reference category for a given agreement dimension.

they would vote for their country joining a given agreement in a referendum on a scale from 1 (vote definitely against) to 10 (vote definitely in favor). This allows us to see whether absolute levels of support are affected similarly by the different agreement dimensions as the relative levels of support elicited in the main forced-choice results. Fifth, we reestimate the conjoint analysis using only the observations for which respondent choices are consistent with their referendum evaluations. Sixth, to address the potential concern that the first set of alternatives may have influenced their subsequent choices, we reanalyzed the data using only the first pair of agreements considered. All these and other tests yielded results that were very similar to our main reported findings.

**Effectiveness.** Our results indicate that the public generally prefers global climate agreements in which many countries participate. Is this interest in more encompassing climate policy driven, at least in part, by the expectation of such agreements being more effective? To address this question, we examine our results by subgroups, distinguishing between individuals with high and

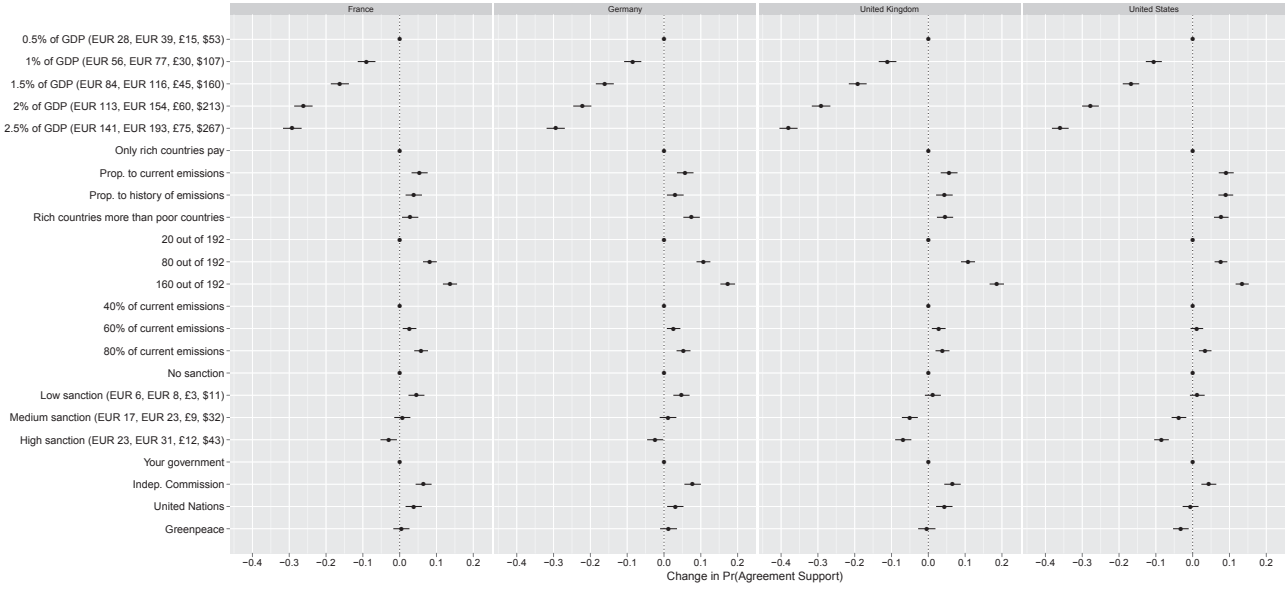


**Fig. 3.** Effect of agreement dimensions on public support for global climate change cooperation by country. This plot shows estimates of the effect of randomly assigned agreement features on the probability of supporting an agreement ($n$ = 68,000 agreements). Estimates are based on the regression of *Agreement Support* on dummy variables for values of the agreement dimensions, with SEs clustered by respondent. The bars indicate 95% confidence intervals based on robust SEs clustered by respondent, and the points without bars indicate the reference category for a given agreement dimension.

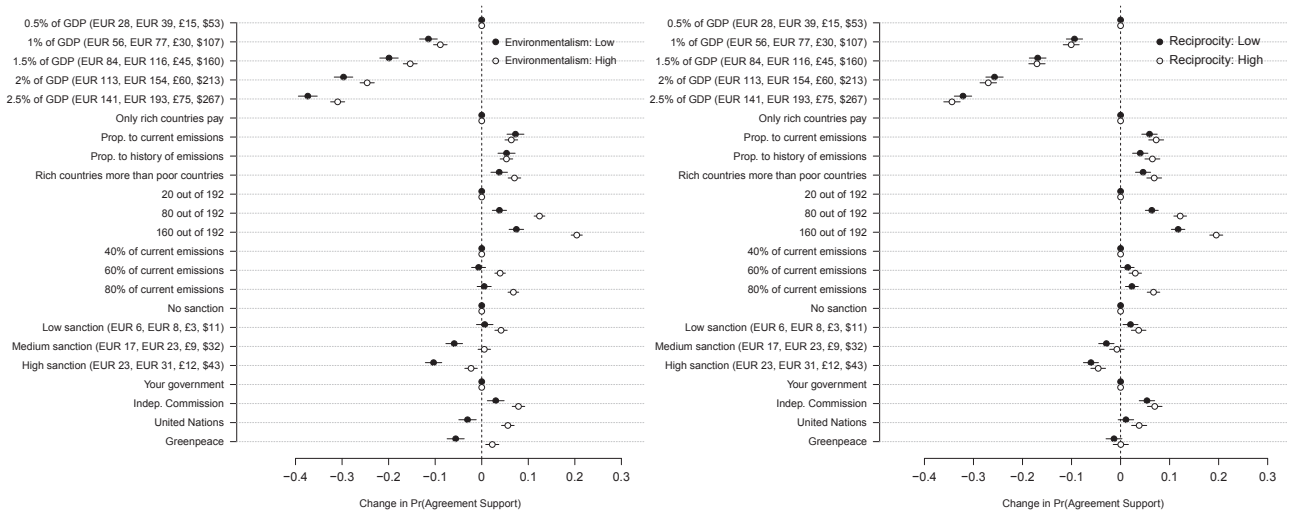


**Fig. 4.** Effect of agreement dimensions on public support for global climate change cooperation in France, Germany, the United Kingdom, and the United States by level of environmentalism and reciprocity. The plots show estimates of the effect of randomly assigned agreement features on the probability of supporting an agreement. Estimates are based on the regression of *Agreement Support* on dummy variables for values of the agreement dimensions, with SEs clustered by respondent. The bars indicate 95% confidence intervals, and the points without bars indicate that that value is the reference category for a given agreement dimension. (*Left*) Breakdown of results by level of environmentalism. Environmentalism is measured by asking individuals about how much they support or oppose international climate change cooperation in general (pretreatment): "As you probably know, many experts say that countries have to reduce their greenhouse gas emissions to address global warming. Generally speaking, how strongly do you support or oppose international cooperation to reduce greenhouse gas emissions even if this involves significant costs?" Respondents could answer that they strongly oppose, somewhat oppose, neither oppose nor support, somewhat support, or strongly support cooperation. The answers were converted into an indicator variable that equals 1 for those who support or strongly support international climate cooperation and is zero otherwise. (*Right*) Breakdown of results by level of reciprocity. Reciprocity is measured using the strategy method (see *Results, Reciprocity* for details). Reciprocity is coded as high if a respondent exhibits more reciprocal behavior than the median respondent.

low levels of environmentalism. We measured environmentalism pretreatment by asking individuals about how much they approve or disapprove of international climate change cooperation in general.* Fig. 4, *Left* plots the results. Individuals who support climate change cooperation—those who presumably have a high demand for providing the global public good—care much more about the number of countries participating in a climate agreement. Similarly, individuals who support climate change cooperation also are more sensitive to the proportion of emissions represented in an agreement in choosing between alternatives than individuals with low climate policy support. [We also reestimated the models using alternative measures of environmentalism. The results remain unchanged (*SI Appendix*).] Individuals' levels of environmentalism also seem to play a role when it comes to costs. Fig. 4, *Left* shows that environmentalists are less cost-averse and more strongly support climate change cooperation that involves a small sanction than an agreement without sanctions. One possible interpretation of these results, most particularly the differences in sensitivities to the participation dimension by individuals with high and low levels of environmentalism, is that individuals who value an effective agreement have a higher demand for these institutional design features. We note, however, that many of the effects of agreement features on individual support remain statistically significant and sizable, even for the group of respondents with low levels of environmentalism. This suggests that the right combination of climate agreement features may improve support, even among those who generally oppose international climate cooperation.

That said, this set of results remains open to alternative interpretations. For example, a rival explanation for these differences in respondents' sensitivities to agreement design features might be that environmentalists tend to be more ideologically left than nonenvironmentalists. In this case, we would expect to find a similar pattern of differences in the effects of agreement design when replacing our environmentalism indicator variable with a variable that measures respondents' ideology. The patterns should be similar, particularly with respect to the participation dimension.

To empirically explore whether a left–right divide underlies the differences in treatment effects, we estimated two additional regressions. In the first regression, we modeled agreement support as a function of agreement feature indicator variables and a full set of interactions between these treatment variables and the environmentalism indicator. In the second model, we included all treatment indicators along with a full set of interactions between the treatment variables and a variable that indicates a respondents' ideology distinguishing between left and right. This allows us to more formally test whether systematic differences exist in the treatment effects across different groups. Taken together, the results based on a comparison of interaction patterns suggest that the high/low environmentalism divide captures a cleavage that is distinct from the ideological left–right divide. (The full results along with a detailed discussion may be found in *SI Appendix*.) Differences in effectiveness concerns seem to help explain why public support for climate agreements is sensitive to particular design features, such as participation, but alternative interpretations remain possible.

**Reciprocity.** The sensitivity of respondents to the participation dimension also may reflect a general norm of reciprocity. To explore this possibility, we use a behavioral measure of reciprocity that relies on a payoff-relevant, two-player linear public good game (27) that we included in the survey. Specifically, respondents were told that individuals completing the survey had

*The exact text of the pretreatment question is "As you probably know, many experts say that countries have to reduce their greenhouse gas emissions to address global warming. Generally speaking, how strongly do you support or oppose international cooperation to reduce greenhouse gas emissions even if this involves significant costs?" Respondents might answer that they "strongly oppose," "somewhat oppose," "neither oppose nor support," "somewhat support," or "strongly support" cooperation. The answers were converted into an indicator variable that equals 1 for those who support or strongly support international climate cooperation and is zero otherwise.

a chance to win one of two €100/$100/£100 Amazon gift cards but that the final amount of the gift card would depend on their decision about whether to give some amount of the gift card to another winner and the analogous decision made by that winning respondent. Any amount given to another respondent would be subtracted from the individual's winnings and doubled before it was distributed to the other winner.[‖]

Following the strategy method (28, 29), we asked individuals how much they would like to give the other winner if they knew that respondent's gift to them. Individuals are coded as conditional cooperators—high reciprocity—if their gift amount is relatively sensitive to the gift of the other winner. Specifically, we estimated an auxiliary regression for each respondent in which we regressed her/his contribution on a variable that indicated the amount given by the other person (0, 25, 50, 75, and 100). The regression coefficient captures a respondent's level of conditional cooperation. We converted this reciprocity measure into a binary indicator that scores one for respondents that exhibited more reciprocal behavior than the median respondent and is zero otherwise.

Fig. 4, *Right* breaks down our results by levels of reciprocity. Individuals who pretreatment exhibit reciprocal behavior in our Amazon lottery game are almost twice as sensitive to both the number of countries participating and the proportion of emissions represented than individuals who do not. This finding supports the view that reciprocity and the extent that an agreement resonates with social norms play a noteworthy role in building support for international cooperation.

## Discussion

International efforts to set up a global climate architecture require broad public support to be politically sustainable and effective in the long run. We find that individual support for climate agreements responds similarly to variation in key features of potential agreements in all four countries included in our study. Among these common agreement features influencing opinion, the cost of climate change mitigation is the most important driver of support for international cooperation. Our estimates suggest that increasing average household costs associated with an agreement from 1% to 2% of GDP decreases support for an agreement by about 20 percentage points. Although public concern about global warming and support for policies to address the issue have been well documented across many countries, our findings highlight the common sensitivity of this support to the costs of mitigation policies across countries and the relative importance of costs compared with other agreement characteristics.

At the same time, our findings suggest that more costly agreements actually may find public support if they have specific design features that make cooperation more effective in reducing emissions and that resolve distributional conflicts in a way that resonates with fairness norms. Specifically, citizens are more likely to support agreements that include a higher number of participating countries, are monitored by an independent third party, and include a low sanction for countries failing to meet their emission reduction targets.

We believe these results not only add to our knowledge about the political feasibility of global climate policies but also improve our understanding of the behavioral foundations of international cooperation. Moreover, future research may extend this methodology productively to estimate the demand for climate cooperation in developing countries, evaluate the impact of variation in policy instruments, and assess the sensitivity of the estimates to changing economic and political environments.

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[‖]After having completed the fieldwork, two winners were randomly drawn from each country sample, and their actual contribution behavior was used to determine the value of the gift card they received.

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