

# Climate justice beliefs related to climate action and policy support around the world

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Climate justice is increasingly prominent in climate change communication and advocacy but little is known about public understanding of the concept or how widely it resonates with different groups. In our global survey of 5,627 adults in 11 countries spanning the global north and south, most participants (66.2%) had never heard of climate justice. Nonetheless, endorsement of climate justice beliefs was widespread (for example, acknowledging the disproportionate impact of climate change on poor people and the underpinning roles of capitalism and colonialism in the climate crisis). Climate justice beliefs were also associated with various indices of climate action and policy support. These associations tended to be stronger in countries with high GHG emissions and where social inequality is also more politically salient. The results highlight the value of climate justice as a motive for climate action across diverse geographical contexts.

Indigenous peoples, women, low-income earners, racialized minorities and other marginalized groups face the greatest risks from climate change<sup>1–3</sup>. Ill-considered climate policies can worsen the disproportionate burden on such groups<sup>4</sup>. Policy responses to climate change must therefore recognize the unequal distribution of causal responsibility, impacts and coping capacities across different groups and place emphasis on promoting fair and equitable outcomes<sup>5,6</sup>. Against this backdrop, climate justice has become a prominent frame in climate change messaging and advocacy.

Little is known about public understanding of climate justice or how widely the concept resonates with diverse groups. Perceptions of justice and fairness have been shown to underlie pro-environmental intentions<sup>7</sup> and public attitudes toward various policies<sup>8</sup>. Therefore, knowledge of public opinion about climate justice can benefit efforts to promote climate action and widen support for just climate policies.

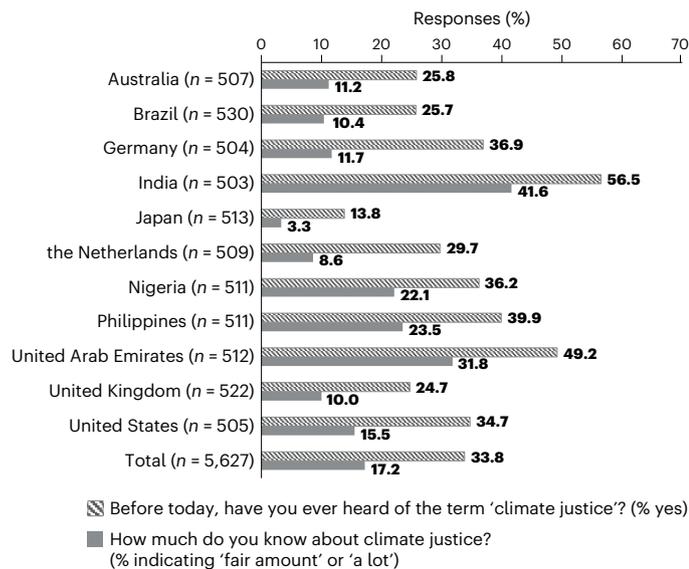
## Defining climate justice

Climate justice has its roots in the anticolonial struggles of Indigenous communities of the global south<sup>9</sup>. It is also linked to the US environmental justice movement which emerged in response to the disproportionate exposure of communities of colour to harmful environmental pollution<sup>10</sup>. Popular usage of the term reflects a fusion of ecological and social justice concerns<sup>11,12</sup>, whereby disproportionate impacts on marginalized communities are highlighted and priority is accorded to protecting the rights of vulnerable groups<sup>13</sup>.

Multiple definitions of climate justice are presented in the academic literature. All reflect a consensus that climate justice encompasses, amongst other elements, notions of the distributional, procedural and recognitional (in)justices associated with climate change impacts and societal responses<sup>14,15</sup>. Distributional injustice refers to the uneven distribution of climate change vulnerability

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**Fig. 1 | Distribution of climate justice awareness and knowledge by country.** Climate justice awareness and knowledge by country.

and adaptive capacity across different social groups. This is broadly linked to histories of colonization; racial, economic and political oppression<sup>13,16</sup>; and the unequal distribution of wealth and power between and within societies<sup>17</sup>. Procedural injustice captures the under-representation of frontline communities in the selection and implementation of responses to climate change. Finally, recognitional injustice describes a failure to recognize the rights and interests of marginalized groups as legitimate in climate change-related policy-making<sup>14</sup>. Misrecognized groups may be further disenfranchised by climate change adaptation and mitigation efforts<sup>18</sup>. Climate justice offers a framework for identifying and tackling the myriad ways in which the climate crisis aligns with long-standing and interconnected patterns of social injustice.

### Public understanding of climate justice

In a 2023 study, roughly two-thirds of Americans (65%) had never heard of climate justice, even though more than half (53%) were supportive of the concept after it was explained to them<sup>19</sup>. In the United Kingdom, the Framing Climate Justice project found that many people recognized the unequal distribution of climate change vulnerability between high- and low-income countries but few understood how climate change relates to racial and class inequalities<sup>20</sup>.

Despite endorsing related facts such as the disproportionate burden of climate change on those who are least responsible, most participants were unable to define climate justice in a study of 6,000 young people aged 18 to 35 years in six European countries (Czechia, Germany, Italy, Romania, Spain and the United Kingdom)<sup>21</sup>. Many of these Europeans were unaware of the interconnections between climate change and issues such as gender or racial inequalities<sup>21</sup>. Similar patterns emerged in US research where there is greater recognition of the economic dimensions of climate justice than the racial dimensions among the public<sup>19,22</sup>.

Previous research offered insight into public understanding of climate justice in Europe and North America but little indication of how widely the findings generalize around the world.

### Linking climate justice beliefs to action and policy support

Justice perceptions can serve as a bridge or barrier to cooperation<sup>23</sup>. For example, environmental justice beliefs and perceived fairness are linked to greater acceptance of climate policies<sup>8</sup>. Moral concerns

**Table 1 | Climate justice beliefs index**

	Responses (%)		
	Agree	Disagree	Do not know
1. People living in poverty suffer worse effects from climate change.	78.2	14.9	6.9
2. Around the world, people who are least responsible for causing climate change suffer the most severe climate change impacts.	71.5	19.6	8.9
3. Climate change affects women worse than men around the world.	41.2	42.0	16.8
4. Climate change will worsen existing oppressions and inequalities (for example, the gap between rich and poor countries).	71.6	19.1	9.2
5. The negative impacts of climate change are worse for Indigenous people and people of colour (for example, Black, Asian and Middle Eastern) around the world.	57.2	30.5	12.4
6. Solving climate change requires redistributing resources from the wealthy to those who have less.	67.3	22.3	10.4
7. People from communities most affected by climate change should have more of a say in decisions about solutions to climate change than they currently do.	77.6	14.7	7.7
8. Climate change is driven by exploitative systems like capitalism.	69.9	18.9	11.2
9. Colonization and historical practices of forced extraction of resources from colonized territories has played a significant role in driving climate change.	70.1	18.1	11.9
Total n	5,627		

(such as concern about negative impacts on future generations) predict greater climate policy support<sup>24</sup>. Climate activists also commonly report justice-seeking as their motivation<sup>25</sup>.

In contrast, justice considerations may prompt counterproductive responses. When players in an economic game received information about historical carbon emissions, successors of high emitters offered to pay more to mitigate climate change while successors of low emitters offered to pay less<sup>26</sup>. Climate narratives focusing on social justice polarized a UK audience along political lines; eliciting strong acceptance among politically left-leaning individuals and reactance among those who were right-leaning<sup>27</sup>. Furthermore, a US study revealed that climate justice proved too complex a concept in a climate advocacy workshop; leaving some participants unmotivated to act despite learning about ongoing climate injustices in their local area<sup>28</sup>.

Intuitively, awareness of climate (in)justices is unlikely to motivate action among groups that benefit from the underlying structural inequalities and may inhibit willingness to act among disadvantaged groups<sup>23,29</sup>. Tolerance of inequality in society and a desire to be socially dominant are generally associated with low pro-environmental motivation and a greater inclination towards unsustainable exploitation of the environment<sup>30,31</sup>. Climate justice is therefore also unlikely to resonate with people who have a dispositional preference for social inequality. Beyond mapping public understanding of climate justice, it is important to determine how climate justice beliefs relate to climate action and policy support among different groups.

### Research design

Here, we present findings from a global survey of climate justice awareness and knowledge. Data were gathered in 2022 with an online survey of adults aged 18+ years (n = 5,627) in 11 countries (Australia, Brazil, Germany, India, Japan, the Netherlands, Nigeria, Philippines,

**Table 2 | Agreement with CJBI by country**

	Agree (%)										
	AUS	BRA	GER	IND	JPN	NED	NGR	PHL	UAE	UK	US
1. People living in poverty suffer worse effects from climate change.	68.6	89.5	76.8	85.1	73.3	78.9	79.3	83.7	82.6	76.5	64.6
2. Around the world, people who are least responsible for causing climate change suffer the most severe climate change impacts.	60.1	78.3	73.4	79.5	67.6	77.4	66.8	76.7	73.4	69.6	63.3
3. Climate change affects women worse than men around the world.	34.5	31.1	32.1	68.2	27.3	37.2	40.9	44.2	56.8	42.9	38.8
4. Climate change will worsen existing oppressions and inequalities (for example, the gap between rich and poor countries).	59.8	81.7	79.4	76.9	66.8	75.4	67.6	75.5	74.0	71.5	59.6
5. The negative impacts of climate change are worse for Indigenous people and people of colour (for example, Black, Asian and Middle Eastern) around the world.	38.7	62.0	61.5	74.1	58.5	59.5	56.6	53.0	62.9	54.6	46.9
6. Solving climate change requires redistributing resources from the wealthy to those who have less.	54.2	65.6	71.0	82.9	55.7	73.4	63.2	74.7	74.2	66.6	59.0
7. People from communities most affected by climate change should have more of a say in decisions about solutions to climate change than they currently do.	70.6	88.3	77.6	83.1	70.5	73.5	83.9	80.6	81.5	75.9	67.8
8. Climate change is driven by exploitative systems like capitalism.	61.3	79.2	72.8	82.9	53.6	71.3	70.8	78.1	71.9	67.3	58.8
9. Colonization and historical practices of forced extraction of resources from colonized territories has played a significant role in driving climate change.	59.7	83.0	69.6	82.5	57.1	65.9	73.5	79.1	76.6	62.8	60.2
<i>n</i>	507	530	504	503	513	509	511	511	512	522	505

AUS, Australia; BRA, Brazil; GER, Germany; IND, India; JPN, Japan; NED, the Netherlands; NGR, Nigeria; PHL, Philippines; UAE, United Arab Emirates; UK, the United Kingdom; US, the United States.

United Arab Emirates, the United Kingdom and the United States). We examined how climate justice beliefs relate to climate action and policy support using a robust psychometric instrument designed to assess public endorsement of climate justice-related beliefs. See Supplementary Table 1 for country-wise demographic profiles of the study participants.

### Climate justice awareness and knowledge

Across all 11 countries, two-thirds of respondents (66.2%) indicated that they had never heard of climate justice before participating in this study (Fig. 1). Furthermore, less than one-fifth of respondents (17.2%) felt that they have 'a fair amount' or 'a lot' of knowledge about climate justice (Fig. 1). Levels of climate justice awareness were highest in India, where more than half of the sample (56.5%) reported that they had heard of climate justice, and lowest in Japan (13.8%).

### Endorsement of climate justice beliefs

A climate justice beliefs index (CJBI) was developed to capture public endorsement of beliefs about the disproportionate impacts of climate change on women, the poor and people of colour; the need for greater representation of frontline communities in climate change-related decision-making; the need to redistribute resources from the rich to the poor; and the connection of climate change with colonization and capitalism (Table 1; see Methods and Supplementary Tables 2, 3 and 6 for details of CJBI factorial analysis and invariance testing).

The CJBI provided insight into public endorsement of key ideas commonly associated with climate justice (Tables 1 and 2). The belief that poorer people suffer worse impacts from climate change (78% agreement) and that people from the worst-affected communities should have more of a say in decisions concerning climate change (78% agreement) were most widely endorsed. The lowest levels of endorsement were recorded for items capturing the gender and racial dimensions of climate (in)justice. Roughly equal proportions of respondents agreed (41%) or disagreed (42%) that climate change affects women

worse than men around the world and just over half of all respondents (57%) agreed that Indigenous people and people of colour are worse affected. In line with scholarly perspectives on climate coloniality<sup>13</sup>, recognition of capitalism and colonialism as underpinning elements of the climate crisis (70% agreement) was prevalent across countries (Tables 1 and 2).

Cross-national variance in CJBI scores was low (4%). The aggregated (mean) scores across the nine CJBI statements indicate that the notions of climate justice captured by the scale are generally supported in all countries (Supplementary Table 2). The CJBI scores showed small to moderate positive correlations with climate justice awareness and knowledge in all countries except Germany and Japan. This suggests that people who are aware of climate justice also tend to endorse ideas commonly associated with the concept.

### Predicting climate justice awareness, knowledge and beliefs

Multilevel linear modelling was used to assess how climate justice awareness, knowledge and beliefs relate to sociodemographic (age, gender, education and political orientation), psychological (climate change awareness and experience) and informational (access to information via television, radio, newspapers, Facebook, Twitter, YouTube, books, scientific journals, family and friends) predictors.

Age was inversely related to climate justice awareness. Respondents aged 25–34 years reported the highest frequencies of climate justice awareness, closely followed by the 18–24 years age group (Table 3 and Supplementary Table 4). However, the 18–24 years group reported the lowest self-ratings of their climate justice knowledge and showed lower endorsement of the climate justice beliefs than all but the oldest age cohorts (45–54, 55+ years). There were no significant gender differences in climate justice awareness and endorsement of climate justice beliefs. Education (attaining a college degree or higher) showed positive associations with climate justice awareness, knowledge and CJBI score. Political orientation was positively related

**Table 3 | Predictors of climate justice awareness, knowledge and beliefs**

	DV: Climate justice awareness			DV: Climate justice knowledge			DV: CJBI		
	Odds ratio	95% CI	P value	Estimate	95% CI	P value	Estimate	95% CI	P value
Intercept	0.36	0.28, 0.45	<0.001	1.70	1.61, 1.79	<0.001	2.71	2.64, 2.78	<0.001
<b>Demographics</b>									
Age	0.98	0.97, 0.98	<0.001	0	-0.01, 0	<0.001	0	0, 0	0.001
Gender (woman)	1.13	0.99, 1.29	0.063	0.05	0.01, 0.08	0.010	0.03	-0.02, 0.07	0.232
Education (degree)	1.25	1.09, 1.44	0.002	0.08	0.04, 0.12	<0.001	0.08	0.03, 0.12	0.001
Political orientation (left-right)	1.02	0.99, 1.05	0.116	0.05	0.04, 0.05	<0.001	-0.03	-0.04, -0.02	<0.001
<b>Psychological factors</b>									
CC informed	2.08	1.89, 2.29	<0.001	0.39	0.36, 0.42	<0.001	0.09	0.06, 0.12	<0.001
CC experience	0.99	0.85, 1.16	0.888	0.01	-0.03, 0.05	0.581	0.27	0.22, 0.32	<0.001
<b>Information sources</b>									
Television	0.93	0.89, 0.98	0.003	-0.02	-0.04, -0.01	<0.001	0	-0.02, 0.01	0.625
Radio	1.00	0.96, 1.05	0.918	0	-0.01, 0.01	0.977	0.01	-0.02, 0.01	0.606
Newspapers	1.06	1.01, 1.10	0.012	0.01	0, 0.03	0.029	0.01	0, 0.02	0.747
Facebook	1.05	1.00, 1.09	0.028	0.03	0.01, 0.04	<0.001	0.01	0, 0.03	0.065
Twitter	1.12	1.08, 1.16	<0.001	0.05	0.04, 0.07	<0.001	0.01	0, 0.03	0.045
YouTube	1.01	0.97, 1.06	0.510	0.02	0.01, 0.03	0.003	0.02	0, 0.03	0.019
Books and magazines	1.05	1.00, 1.10	0.043	0.03	0.02, 0.05	<0.001	0.01	0, 0.03	0.158
Science journal/blogs	1.08	1.03, 1.13	0.001	0.02	0, 0.03	0.015	-0.01	-0.03, 0.00	0.069
Family and friends	1.00	0.96, 1.05	0.916	0.01	0, 0.02	0.173	0.03	0.02, 0.05	<0.001
<b>Random effects</b>									
$\sigma^2$	3.29			0.47			0.40		
$\tau_{00}$ nationality	0.09			0.02			0.01		
ICC	0.03			0.04			0.01		
$k$	11			11			11		
$n$	5,599			5,599			3,649		
Marginal $R^2$ /conditional $R^2$	0.30/0.32			0.43/0.45			0.13/0.14		

DV, dependent variable; CC, climate change;  $\tau_{00}$ , random intercept variance across countries.

to climate justice knowledge and negatively related to CJBI score. This means that, on average, politically right-leaning individuals provided higher self-ratings of their climate justice knowledge but indicated lower endorsement of climate justice beliefs.

Respondents who rated themselves as being more informed about climate change were also more likely to have previously heard of climate justice, have greater climate justice knowledge and have higher CJBI scores than those who rated themselves as less informed about climate change (Table 3). However, while perceived personal experience of climate change was positively associated with CJBI scores, it showed no significant relationship with climate justice awareness and knowledge.

Climate justice awareness, knowledge and beliefs showed varying patterns of association with different climate change information sources (Table 3). People who mainly get their information from television reported lower climate justice awareness and knowledge, while those who get their information from newspapers reported higher awareness and knowledge. Facebook and Twitter use were positively associated with climate justice awareness and knowledge, while YouTube use only showed a positive relationship with climate justice knowledge and endorsement of climate justice beliefs. Accessing information from books and magazines or scientific journals and blogs was positively associated with climate justice awareness and knowledge, whereas getting climate change information from friends, family and colleagues was only positively associated with endorsement of climate justice beliefs.

## Climate justice beliefs linked to actions and policy support

We also examined how climate justice beliefs relate to climate action (for example, attending protests), online activism (for example, signing online petitions to promote climate change mitigation), private-sphere pro-environmental behaviours (PEB; for example, saving energy in the household) and support for 'push' climate change mitigation policies (for example, increasing taxes on fossil fuels) in different countries. Descriptive statistics for the behavioural and policy support measures are provided in Supplementary Table 3.

After adjusting for the demographic covariates (age, gender and education), climate justice beliefs positively predicted engagement in climate action, online activism, PEB and support for climate change mitigation policies (Table 4). Notably, there was no significant cross-national variation in the magnitude or direction of the association between climate justice beliefs and engagement in climate action (Fig. 2). However, the relationship between climate justice beliefs and engagement in online activism was weaker in the Philippines than the overall average and stronger in Australia, Brazil and the United States. The relationship between climate justice beliefs and PEB was also weaker than average in Nigeria and the Philippines but stronger in Australia, Japan and the United States. Interestingly, climate justice beliefs showed a weaker association with climate change mitigation policy support in India, the Netherlands, Nigeria and the Philippines than average, while showing a stronger relationship in Australia, Brazil, the United Kingdom and the United States.

**Table 4 | Climate justice beliefs as a predictor of climate action and climate policy support**

	DV: Climate action			DV: Online activism			DV: PEB			DV: Push policies		
	Estimate	95% CI	P value	Estimate	95% CI	P value	Estimate	95% CI	P value	Estimate	95% CI	P value
(Intercept)	0.28	0.22, 0.35	<0.001	2.76	2.51, 3.00	<0.001	3.48	3.32, 3.65	<0.001	2.63	2.54, 2.72	<0.001
Climate justice beliefs	0.12	0.11, 0.14	<0.001	0.70	0.61, 0.80	<0.001	0.49	0.42, 0.55	<0.001	0.60	0.51, 0.69	<0.001
<b>Random effects</b>												
$\sigma^2$	0.08			0.91			0.51			0.39		
$\tau_{00}$ country	0.01			0.16			0.07			0.01		
$\tau_{11}$ country.cjbi				0.02			0.01			0.02		
$\rho_{01}$ country				-0.09			-0.64			-0.34		
ICC	0.11			0.16			0.13			0.04		
k	11			11			11			11		
n	3,649			3,581			3,636			3,649		
Marginal $R^2$ / conditional $R^2$	0.15/0.24			0.51/0.55			0.18/0.28			0.33/0.36		

Cell entries are estimates from multilevel linear regression models relating CJBI scores with the specified DV while adjusting for demographic covariates (age, gender and education). The model predicting climate action includes random intercepts for country only, while the models predicting online activism, PEB and support for climate policies include random intercepts for country and random slopes for CJBI. Adding a random slope for CJBI did not significantly improve the fit of the model predicting climate action (Methods).  $\tau_{11}$  country.cjbi, random slope variance for CJBI across countries;  $\rho_{01}$ , correlation of random intercept and random slope.

## Discussion

Our findings show that public awareness of climate justice as a concept is generally low around the world. India and the United Arab Emirates showed an exception where half or more of respondents reported having previous awareness of climate justice. Notably, the samples from these two countries had the highest frequencies of university-educated respondents, a factor that showed positive associations with climate justice awareness, knowledge and endorsement of climate justice beliefs. Higher education entails greater exposure to information that can foster conceptual awareness of climate justice but it is challenging if the result is that less privileged groups, those who are often most affected, are left out of the discussion.

Despite low levels of climate justice awareness, climate justice beliefs appear to be widely endorsed across countries; especially beliefs about the unequal distribution of climate change impacts, the importance of giving voice to frontline communities, the underpinning roles of colonialism and capitalism in the climate crisis and the need to redistribute resources from the rich to the poor. Furthermore, we observed positive associations between climate justice beliefs, awareness and knowledge, which suggests that climate justice beliefs among the public may be further heightened through awareness-raising campaigns.

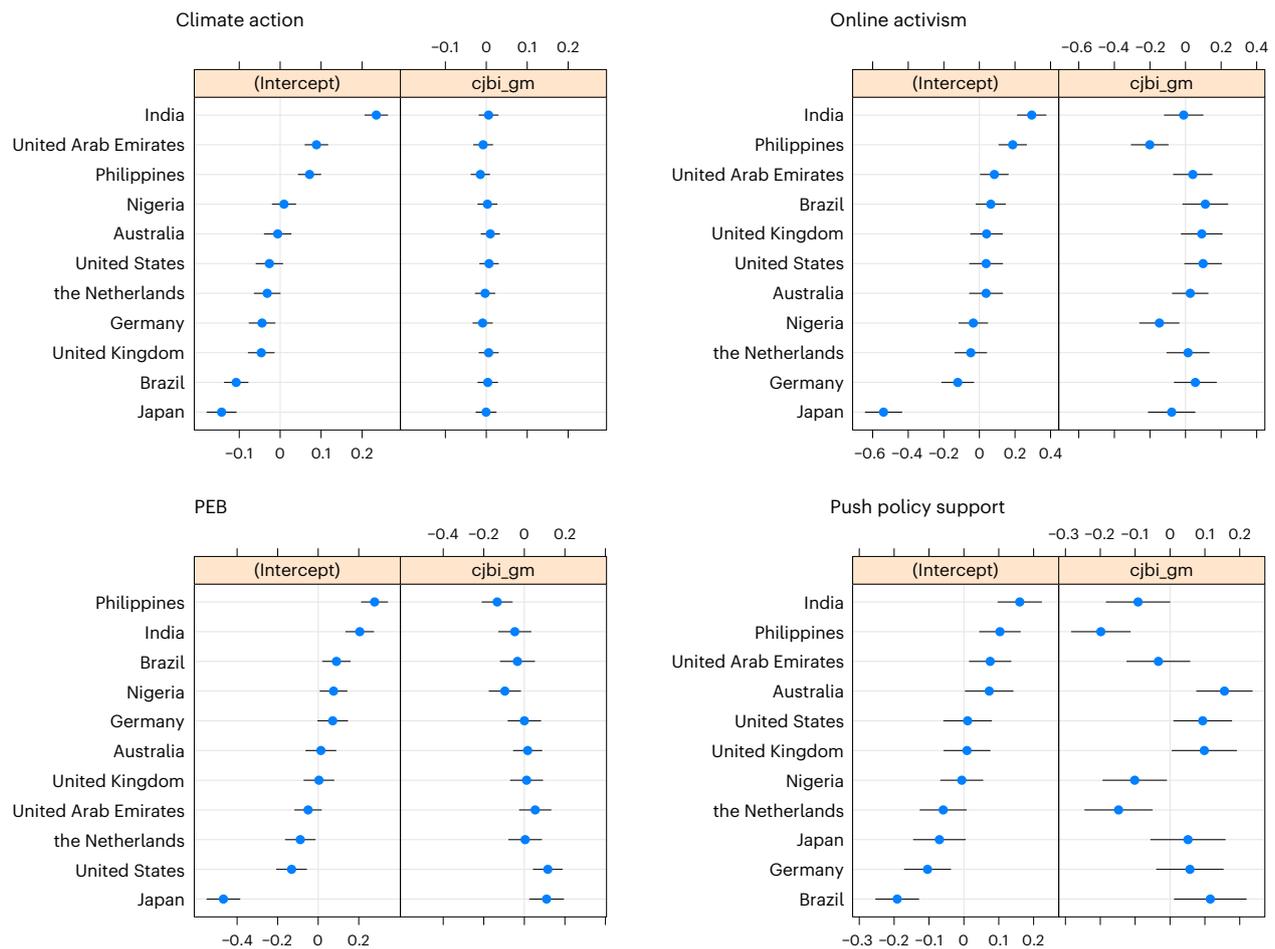
Climate justice beliefs were robustly associated with engaging in climate action, online activism, PEB and showing support for just climate policies. The magnitude of these associations varied across countries, with the strongest associations most frequently observed in Australia, Brazil and the United States. This aligns with previous indications that awareness of historical and present climate inequalities can foster climate change mitigation actions among citizens in developed countries<sup>26</sup>. In contrast, climate justice beliefs showed weaker associations than average with online activism, PEB and mitigation policy support in Nigeria and the Philippines. We propose that climate justice beliefs may be more closely linked to individual climate action and mitigation policy support in countries with greater historical contributions to global GHG emissions and where social inequalities (for example, the disadvantaged status of racialized minorities) are more politically salient. Previous research shows that people in developing countries are less willing to make sacrifices for environmental protection as they tend to believe that wealthier (high-emitting) countries should have a greater share of the responsibility for addressing global environmental degradation<sup>32</sup>. It has been argued on this basis that invoking justice and

fairness considerations could undermine environmental action in such contexts<sup>32,33</sup>. We observed varying levels of climate action, online activism, PEB and climate policy support across countries but these were often higher among people from developing countries (Supplementary Table 3). Our data suggest that people from developing countries are no less motivated to act on climate change, although climate justice beliefs may constitute a smaller part of their motivation.

It is also plausible that climate (in)justice beliefs correspond with different perspectives in different countries whereby people in historically high-emitting countries may be more likely to see themselves as a ‘perpetrator’, ‘beneficiary’ or ‘observer’ of climate injustice, while people in developing countries more commonly see themselves as ‘victims’ of climate injustice. Compared with seeing oneself as a victim of injustice, research suggests that prosocial behaviour is more likely to arise from perceiving oneself as contributing to, passively benefiting from or merely observing injustices<sup>34,35</sup>. Further research is needed to better understand the mechanisms underlying relationships between climate justice beliefs and climate action and policy support in different countries.

Stronger endorsement of climate justice beliefs was associated with climate change awareness and perceived personal experiences of climate change. Collective action by climate activist groups has raised public awareness of climate change in recent years<sup>36</sup>. Personal experiences with intensifying climate change impacts, such as extreme weather, are also changing people’s attitudes and increasing their concern about climate change<sup>37</sup>. These trends can be leveraged to widen public awareness of climate justice. For example, by highlighting social disparities in the impacts of severe weather events and drawing attention to the structural inequalities that underlie these disparities.

Our data reflect similar patterns to the politically polarized responses to social justice framing of climate change observed in previous research<sup>27</sup>. People on the right wing of the political spectrum indicated lower endorsement of climate justice beliefs than those on the left. CJBI items referring to the disproportionate impacts of climate change on women and people of colour received the lowest levels of endorsement. Views on equal rights for historically marginalized groups are ‘culture war’ issues that commonly divide political conservatives and progressives<sup>38,39</sup>. These topics may more likely prompt reactance, especially among politically right-leaning individuals. The pattern of low endorsement suggests that the connections of climate change to gender and racial injustices may not be apparent to most people.



**Fig. 2 | Country-wise random effects intercept and random slope estimates for climate action, online activism, PEB and push policy support regressed on climate justice beliefs, controlling for age, gender and education.** Values represent the variance of each country's intercept and slope from the estimated

fixed effects. Error bars are country-wise random intercept and slope variance estimates  $\pm 1$  s.d. Note: *cjbi\_gm* = grand mean-centred CJBI scores. Analytical sample sizes:  $n = 3,649$  (climate action),  $n = 3,581$  (online activism),  $n = 3,636$  (PEB),  $n = 3,649$  (push climate policy support).

Media sources, especially social media use and discussing climate change with family, friends and colleagues showed significant associations with endorsement of climate justice beliefs. Social media is a key channel of communication and mobilization for climate activist groups<sup>40,41</sup>. This may explain the link between climate justice beliefs and the use of Twitter or YouTube. Discussing climate change with friends and family has previously been shown to increase acceptance of climate science facts and to reinforce climate change worry<sup>42</sup>. Our data suggest that this effect also extends to climate justice-related beliefs.

A limitation of the current study is that we used samples of individuals with digital access which limits the representation of less privileged groups or people potentially at greatest risk of facing climate injustices. More inclusive data-gathering approaches are needed in future research to better represent climate justice perceptions among the most climate-vulnerable groups. We are also unable to establish causal relationships between climate justice beliefs and climate action and policy support given the cross-sectional research design. Experimental and longitudinal research approaches are needed to extend this research. Finally, climate justice issues have varying histories, manifestations and discourses across different spatial and geographical contexts<sup>43–47</sup>. Research should explore if, and how, varying foci of climate justice beliefs (for example, focusing on local versus global issues) shape action tendencies and policy support.

Our study provides a robust assessment of public understanding of climate justice around the world and the implications for climate action and policy support. We found that basic recognition of the social,

historical and economic injustices that characterize climate change is common among the public, even if people do not consciously draw connections across these injustices using a conceptual framework of climate justice. Importantly, endorsement of climate justice beliefs is associated with engagement in climate actions and showing support for just climate policies.

## Online content

Any methods, additional references, Nature Portfolio reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at <https://doi.org/10.1038/s41558-024-02168-y>.

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## Methods

### Data collection

We contracted a commercial partner (Qualtrics Research Services) to recruit samples of adults aged 18+ years from the general population of Australia, Brazil, Germany, India, Japan, the Netherlands, Nigeria, the Philippines, the United Arab Emirates, the United Kingdom and the United States to complete an online survey. The countries were selected to reflect populations with a diverse range of cultures, income, climate change vulnerabilities and responsibilities for global GHG emissions. Sampling was stratified by age and gender. A target of 500 complete responses was set for each location on the basis of the available budget. The survey was fielded from 26 May to 30 June 2022.

The survey included an attention check and respondents who failed this were screened out of the study. We also screened out respondents who completed the survey in less than half the median completion time. Respondents who provided poor-quality responses (for example, irrelevant answers and straight-lining) were scrubbed and replaced by the survey company. Summaries of the country-wise effective samples and demographic breakdown are provided in Supplementary Table 1. Importantly, while online samples provide good quality data, are considered appropriate for preliminary research and are common in the academic literature<sup>48</sup>, readers should be mindful that the respondent samples recruited for this study are not fully representative of the general population of the countries from which they were drawn.

Our questionnaire was developed in English and translated into Arabic, Brazilian Portuguese, Dutch, German and Japanese by the project team working in pairs including at least one fluent bilingual speaker. The translation was completed using the translate-back translate method<sup>49</sup>. The questionnaire was hosted on the Qualtrics online platform and presented to respondents in their local language through automatic detection of the respondents' browser settings. Respondents could also select their preferred language from a pull-down menu presented on the first page of the questionnaire.

Respondents were given information about the nature, purpose and possible risks associated with participating in the study before being asked for consent to participate. Those who did not give consent were redirected to the end of the study. Respondents were further allowed to terminate their participation at any point and at the end were provided with a debrief that included a description of the purpose of the study as well as links to websites where they could get further information about climate change and climate justice.

### Outcome measures

We developed three measures to capture public attitudes about climate justice in this study: climate justice awareness, self-rated climate justice knowledge and the CJBI. In addition, we used measures aimed at capturing behavioural responses to climate change and climate policy support, particularly real-world climate actions, online climate activism, private-sphere PEB and support for radical climate change policies designed to curb high-carbon emission behaviours.

The climate justice awareness measure was a single question: 'Before today, have you ever heard the term climate justice?' Responses were indicated as a 'no' or 'yes', which were coded for analysis as '0' or '1', respectively. Self-rated climate justice knowledge was also measured with a single question: 'How much do you know about climate justice?' Responses were indicated on a four-point scale: 'nothing at all', 'a little', 'a fair amount' and 'a lot', which were coded as '0', '1', '2' and '3', respectively.

The CJBI comprised nine items listed below and responses were recorded on a four-point response scale (1, strongly disagree; 2, tend to disagree; 3, tend to agree; 4, strongly agree) and a 'don't know' option which was coded as missing. Responses to all nine items were averaged to form an aggregate CJBI score for each respondent.

- (1) People living in poverty suffer worse effects from climate change.

- (2) Around the world, people who are least responsible for causing climate change suffer the most severe climate change impacts.
- (3) Climate change affects women worse than men around the world.
- (4) Climate change will worsen existing oppressions and inequalities (for example, the gap between rich and poor countries).
- (5) The negative impacts of climate change are worse for Indigenous people and people of colour (for example, Black, Asian and Middle Eastern) around the world.
- (6) Solving climate change requires redistributing resources from the wealthy to those who have less.
- (7) People from communities most affected by climate change should have more of a say in decisions about solutions to climate change than they currently do.
- (8) Climate change is driven by exploitative systems like capitalism.
- (9) Colonization and historical practices of forced extraction of resources from colonized territories have played a significant role in driving climate change.

These items were determined to be suitable indicators of climate justice beliefs based on a review of communications by climate change and climate justice activists around the topic<sup>50–52</sup>. The Framing Climate Justice project<sup>20</sup> was a key reference for developing the CJBI.

Our climate action scale comprised six items with a yes/no response format. Respondents were asked if they had engaged in the following activities in the past year:

- (1) Attended a climate protest.
- (2) Donated money to an organization tackling climate issues.
- (3) Volunteered in an organization tackling climate issues.
- (4) Signed a petition or contacted a politician about climate change.
- (5) Attended a public lecture, seminar or workshop about climate change.
- (6) Are active members of a group that addresses climate change.

The responses were coded as yes (1) and no (0). Responses across all six items were averaged to form an aggregate climate action score for each respondent.

The online activism scale comprised four items with a five-point response format (1, almost never; 5, almost always). Selection of a 'don't know' response was coded as missing. Respondents were asked to indicate how often they do the following:

- (1) Follow Facebook, links, webpages and/or Twitter accounts addressing climate change.
- (2) Express support of efforts to address climate change on social media (Facebook, Twitter, blogs).
- (3) Sign online petitions to support climate change mitigation.
- (4) Join groups online to support climate change mitigation.

Responses to these scale items were averaged to form one aggregate online activism score per respondent.

The PEB scale was adapted from ref. 53. The scale comprised six items with a five-point response format (1, almost never; 5, almost always). Selection of a 'don't know' response was coded as missing. Respondents were asked to indicate how often they do the following:

- (1) Cycle or walk instead of driving or being driven in a car.
- (2) Buy second-hand or used items instead of buying new things.
- (3) Try to influence family members and friends to act in a climate-friendly way.
- (4) Save energy in the household.
- (5) Take public transportation instead of the car.
- (6) Avoid food waste.

Responses to these scale items were averaged to form one aggregate PEB score per respondent.

The climate change mitigation (push) policy support scale was designed to capture support for radical policies intended to reduce demand for, or push consumers away from, high-carbon behaviours and practices. Respondents were asked about the extent to which they support or oppose the following policies:

- (1) Increasing taxes on fossil fuels (for example, coal, oil, diesel, petrol and gas).
- (2) A ban on production of new cars that are powered by an internal combustion engine or fossil fuels (for example, petrol, diesel and gas) by 2030.
- (3) Increasing taxes on carbon-intensive foods such as meat and dairy (milk products).
- (4) Additional charges for people who fly more than twice a year (a 'frequent flyer' levy).

Responses to these items were recorded on a four-point scale (strongly oppose, 1; tend to oppose, 2; tend to support, 3; strongly support, 4). Responses to these scale items were averaged to form one aggregate push policy support score per respondent.

### Predictor measures and covariates

We identified potential predictors of climate justice awareness, knowledge and beliefs on the basis of three domains shown to be important determinants of climate perceptions in previous research: demographic factors (age, gender and education), identity and ideology (political orientation), knowledge (self-rated climate change information and information sources) and experience<sup>54,55</sup>. The demographic factors were also included as covariates when assessing how climate justice beliefs relate to climate action and policy support.

Respondents were asked to report their age in years. They were also asked to indicate if they identify as: 'woman', 'man', 'other (specify)' or 'prefer not to say'. Responses were recoded for analysis whereby those who identify as 'woman' were coded as '1' and all other responses were coded as '0'. We also asked respondents to indicate their highest level of educational attainment by selecting one of six categories (no formal education, primary school, secondary school or vocational equivalent; community college, trade school or vocational equivalent; university degree or higher or other). The 'university degree or higher' response was coded as '1' and other responses were coded as '0'.

Political orientation was measured with a single question: 'In politics, people often talk about the 'left wing' and the 'right wing', Below is a scale where 0 represents those who are on the far left while 10 represents those who are on the far right. Where would you place yourself on such a scale?'<sup>56</sup>

Respondents' self-rated level of information about climate change was measured with a question: 'How informed would you say you are about climate change?' Response options were 'not at all informed', 'a little informed', 'well informed' and 'extremely well informed'. These were coded as '1', '2', '3' and '4', respectively.

Perceived personal experience of climate change was measured with a question: 'Have you experienced any direct or indirect effects of climate change in your lifetime?' Response options were 'no' and 'yes' which were coded as '0' and '1', respectively.

Finally, respondents were asked to report the frequency at which they access climate change-related information from a range of sources encompassing both traditional (television, radio, newspapers, books and magazines) and social media (Facebook, Twitter and YouTube), as well as scientific journals or blogs and family and friends. Responses were recorded on a nine-point scale ranging from 'never' to 'more than ten times per day'.

### Psychometric analysis

**Reliability.** Descriptive statistics and indices of reliability (Cronbach's alpha) for the CJBI are presented in Table 3. The scale showed high

reliability across all countries. It was positively correlated with climate justice awareness and self-reported climate justice knowledge in most countries except Germany and Japan. The other multi-item scales—climate action, online activism, PEB and push policy support also showed high levels of reliability (Supplementary Table 2) as well as significant positive correlations with CJBI (Supplementary Table 4).

**Factor analysis.** *CJBI.* Using a 'hold-out' sample of 549 cases randomly selected from the full cross-national dataset, we conducted an exploratory factor analysis with principal axis factoring to assess the factor structure of the CJBI. This hold-out sample corresponds to ~10% of the total sample. The results indicate that the sampling was adequate for factor analysis of the CJBI (Kaiser-Meyer-Olkin (KMO) = 0.93,  $\chi^2_{(36)} = 1,386.03$ ,  $P < 0.001$ ). A single latent factor was found to underlie the nine items of the CJBI, which explained 49.09% of the variance. All scale items showed high loadings (>0.60) on to this latent factor.

Subsequently, we conducted multigroup confirmatory factor analysis (CFA) to determine if the single latent factor structure is supported in all 11 countries represented in the study. The results of the multigroup CFA showed a good fit, which indicates that the model has equivalent form or configural invariance across all countries ( $\chi^2_{(297)} = 177.09$ ,  $P = 1.000$ , CFI = 0.95, root mean square error of approximation (RMSEA) = 0.054, standardised root mean square residual (SRMR) = 0.035). The scale also showed metric invariance, which suggests that the scale items are interpreted in a similar fashion in all countries (see Supplementary Table 5 for metric invariance fit indices).

*Climate action scale.* We also used the hold-out sample ( $n = 549$ ) to conduct an initial exploratory factor analysis of the climate action scale. The results indicated that the sampling was adequate for factor analysis of this scale (KMO = 0.85,  $\chi^2_{(15)} = 1,023.14$ ,  $P < 0.001$ ). A single latent factor was observed and this explained 43.9% of the variance across the six items comprising the scale. All items showed moderate to strong loadings on this latent factor (>0.50).

Next, we conducted a multigroup CFA to determine if the single latent factor structure was supported in all 11 countries. The results of the multigroup CFA indicate that the model has configural invariance across all countries ( $\chi^2_{(99)} = 146.17$ ,  $P < 0.001$ , CFI = 0.97, RMSEA = 0.051, SRMR = 0.034). The scale also showed metric invariance across countries (Supplementary Table 5).

*Online activism scale.* The results of an exploratory factor analysis indicated adequate sampling (KMO = 0.84,  $\chi^2(6) = 1,209.52$ ,  $P < 0.001$ ) and a single latent factor which explained 71.8% of the variance across the items comprising the scale. All items loaded strongly onto this latent factor (>0.70).

We also conducted a multigroup CFA to determine if the single latent factor structure was supported across the 11 countries. The results showed an acceptable fit with the data ( $\chi^2(22) = 13.87$ ,  $P = 0.906$ , CFI = 0.99, RMSEA = 0, SRMR = 0.014). Therefore, we concluded that the scale has configural invariance. The scale also showed metric invariance (Supplementary Table 5).

*PEB scale.* Exploratory factor analysis with the hold-out sample revealed that the sampling level was slightly lower than the conventional threshold (KMO  $\geq 0.80$ ) of sampling adequacy (KMO = 0.77,  $\chi^2_{(15)} = 762.78$ ,  $P < 0.001$ ). Further, two latent factors were identified within the scale, which together explained 49.8% of the variance across all six items. The items measuring 'use of public transportation instead of car', 'cycle or walk instead of driving or being driven', 'try to influence friends and family to act in climate-friendly way' and 'buy second-hand items instead of new ones' loaded on to the first factor—PEB1. The items

measuring ‘avoid food waste’ and ‘save energy in the household’ loaded onto the second factor—PEB2.

Multigroup CFA on the full dataset revealed that the two-factor structure of the scale had a good fit with the data and was supported in all 11 countries ( $\chi^2_{(88)} = 221.50, P < 0.001, CFI = 0.98, RMSEA = 0.059, SRMR = 0.044$ ). The scale also showed metric invariance (Supplementary Table 4).

*Climate change mitigation (push) policy support.* Exploratory analysis with our hold-out sample showed adequate sampling ( $KMO = 0.80, \chi^2_{(6)} = 743.14, P < 0.001$ ) and a single latent factor that explained 71.8% of the variance across the scale items. All items loaded strongly onto this latent factor ( $>0.65$ ).

Multigroup factor analysis revealed that the single factor structure was supported across all 11 countries ( $\chi^2_{(22)} = 9.95, P = 0.987, CFI = 1.00, RMSEA = 0, SRMR = 0.012$ ). The scale also showed metric invariance (Supplementary Table 5).

### Analytic strategy

Preparation of the data for analysis was done using SPSS v.27. We investigated predictors of climate justice awareness, self-rated knowledge and beliefs, as well as relationships between climate change justice beliefs and the behavioural and policy support outcomes with hierarchical linear models using the R package lme4 for mixed effects models<sup>57</sup>.

In an initial round of analysis, we estimated the intraclass coefficients (ICC) for all outcome variables to determine the magnitude of clustering effects present in the data. We found that country explained 8% of the variance in climate justice awareness, 14% of the variance of the variance in self-rated climate justice knowledge and 4% of the variance in climate justice beliefs. We also found that country explained 18% of the variance in climate action, 22% of the variance in online climate activism, 16% of variance in PEB and 6% of the variance in push policy support. Although, the ICC estimates vary across the different variables, the data show moderate to strong clustering effects on average. Therefore, the use of a multilevel modelling approach is justified.

For the models predicting climate justice, self-rated knowledge and beliefs, we estimated the linear fixed effects of the predictors and random intercepts for the grouping variable—country. For models assessing how climate justice beliefs relate to the behavioural and policy support outcomes, we were also interested in determining if the effects of climate justice beliefs vary across countries. Therefore, we added a random slope for CJBI, alongside fixed effects for the demographic covariates and random intercepts for country. We compared this model with a simpler model without random slopes for CJBI using a likelihood ratio test to determine if the slopes for CJBI vary significantly across countries for each outcome variable. These comparisons showed that adding a random slope for CJBI to the model predicting climate action did not differ significantly from the simpler model containing only a fixed effect of CJBI ( $\chi^2(2) = 0.72, P = 0.698$ ). In other words, the relationship between climate justice beliefs and climate action does not vary significantly across countries. In contrast, the random slopes of CJBI were significant in the models predicting online activism ( $\chi^2(2) = 21.01, P < 0.001$ ), PEB ( $\chi^2(2) = 20.43, P < 0.001$ ) and push policy support ( $\chi^2(2) = 64.11, P < 0.001$ ), suggesting that the relationship between climate justice beliefs and these outcome variables varies significantly across countries.

### Data transformation and missing data

For the multilevel models, all predictor variables were grand mean-centred before analysis. ‘Don’t know’ responses were treated as missing data and listwise deletion was used to address missing responses across all of the statistical analyses.

### Ethics statement

Ethical approval for this study was granted by the University of Nottingham School of Psychology Research Ethics Committee (ref. F1344). All participants provided informed consent before completing the study.

### Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

### Data availability

The data underlying the results reported here are freely available online at the Open Science Framework (<https://osf.io/36zqr/>)<sup>58</sup>.

### Code availability

R scripts for replicating the results presented in the figures, tables and Supplementary Information are available online at the Open Science Framework (<https://osf.io/36zqr/>)<sup>58</sup>.

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### Author contributions

Conceptualization: C.A.O. Methodology and Investigation: C.A.O., R.D., A.H.A., J.P., A.U., K.L.v.d.B., J.G., S.D.A., S.L., J.J.B.R.A., M.E.S.R., A.Z. and S.C. Data curation: C.A.O. Formal analysis: C.A.O. Funding acquisition: C.A.O., R.D., A.H.A., J.P., A.U., K.L.v.d.B., A.Z. and S.C. Writing—original draft: C.A.O. Writing—review & editing: C.A.O., R.D., A.H.A., J.P., A.U., K.L.v.d.B., J.G., S.D.A., J.J.B.R.A., M.E.S.R., A.Z. and S.C.

### Competing interests

The authors declare no competing interests.

### Additional information

**Supplementary information** The online version contains supplementary material available at <https://doi.org/10.1038/s41558-024-02168-y>.

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- A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- For null hypothesis testing, the test statistic (e.g.  $F$ ,  $t$ ,  $r$ ) with confidence intervals, effect sizes, degrees of freedom and  $P$  value noted  
*Give  $P$  values as exact values whenever suitable.*
- For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- Estimates of effect sizes (e.g. Cohen's  $d$ , Pearson's  $r$ ), indicating how they were calculated

*Our web collection on [statistics for biologists](#) contains articles on many of the points above.*

### Software and code

Policy information about [availability of computer code](#)

Data collection | Data were gathered with an online questionnaire administered using the Qualtrics platform.

Data analysis | Data analysis were conducted with R software version 4.0.3 and SPSS version 27. The multilevel analysis was conducted with the R-package "lme4" version 1.1.27.1. Multigroup Confirmatory Factorial Analysis and equivalence testing was conducted with "lavaan" version 0.6.9 and "semTools" version 0.5.5. The analysis script is available on the project OSF repository: <https://osf.io/36zqr/>

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

### Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

Data underlying the results presented in this paper are available at the Open Science Framework (OSF; <https://osf.io/36zqr/>).

## Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender	Gender was included as a covariate in the analyses reported in this study. We measured gender identity by asking people to self-identify through a question in the survey. The wording of the question was: "What is your gender?" Response options were: "Woman", "Man", "Other (please specify)" and "Prefer not to say". In our analysis, the gender variable was recoded as a dichotomous factor with "Woman" being the indicator category, and other options aggregated to create the reference group.
Population characteristics	See below
Recruitment	Participants were recruited by Qualtrics Research services, under a commercial contract, from a series of double opt-in aggregated panels. The study was advertised as a survey of climate change perceptions meaning that people with a particular interest in the topic of climate change may have been more likely to participate. Self-selection into the study by people with a high interest in climate change may potentially cause an inflation in the rates of climate justice awareness and knowledge in the sample relative to the general population. This does not however compromise the validity of our conclusions regarding the significance of climate justice beliefs for climate action and policy support.
Ethics oversight	Ethics approval for the study was granted by the University of Nottingham School of Psychology Research Ethics Committee (Ref F1344).

Note that full information on the approval of the study protocol must also be provided in the manuscript.

## Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

Life sciences  Behavioural & social sciences  Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

## Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	Quantitative questionnaire-based international study
Research sample	A quota sample of adults aged 18 years or over in Australia, Brazil, Germany, India, Japan, Netherlands, Nigeria, Philippines, United Arab Emirates, United Kingdom and the United States. The countries were selected to reflect populations with a diverse range of cultures, income, climate change vulnerabilities, and responsibilities for global greenhouse gas emissions. Sampling was stratified by age and gender. A minimum target of 500 complete responses was set for each location based on the available budget. Being online samples, the samples recruited for this study are considered appropriate for preliminary academic research but cannot be considered to be fully representative of the general population of the countries from which they were drawn.
Sampling strategy	Sampling was stratified by age and gender to ensure a match with the distribution of those characteristics in the population. Age quotas were relaxed in Nigeria and UAE during data collection due to difficulty with recruiting sufficient numbers of males aged 55 years+. The target sample size was ultimately determined by available budget but we aimed to recruit within each country an adequate number of participants to allow detection of associations between climate justice beliefs and the behavioural/policy support outcomes, even if these associations might be of a small effect size ( $r \leq .20$ ). Using the SPSS power analysis module, we estimated that a minimum sample of 462 cases is required to detect a small effect ( $r = .15$ ) using a Pearson correlation analysis with a power of .90. Therefore, the country-wise samples recruited in this study were sufficient for the purpose of the research.
Data collection	Data were collected online with a questionnaire hosted on the Qualtrics platform. Participants were recruited by Qualtrics Research services, under a commercial contract, from a series of double opt-in aggregated panels. Participants completed the online survey remotely at a time and location of their choosing. We are unable to determine if participants were alone or in the company of others when completing the questionnaire. Furthermore as this was an exploratory study, we had no specific hypotheses about the relationship between climate justice beliefs and the outcomes variables.
Timing	Data collection began on 26 May 2022 and ended on 30 June 2022
Data exclusions	The survey included an attention check and respondents who failed this were automatically screened out of the study. We also screened out respondents who completed the survey in less than half the median completion time. Respondents who provided poor-quality responses (e.g., irrelevant answers, straight-lining, etc) were scrubbed and replaced by the survey company. We do not have an exact estimate of how many respondents were screened from the study as this process takes place automatically once the survey software was programmed with these criteria. Screened responses do not appear on the final dataset received at the end of data collection.

Non-participation

There were no participant dropouts

Randomization

Our analysis controlled for age, gender, education, political orientation, self-rated climate change knowledge, perceived personal experience with climate change, and information sources when assessing the association of climate justice with the behavioural and climate policy support indices.

## Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

### Materials & experimental systems

- | n/a                                 | Included in the study                                  |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Antibodies                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Eukaryotic cell lines         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Palaeontology and archaeology |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Animals and other organisms   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Clinical data                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Dual use research of concern  |

### Methods

- | n/a                                 | Included in the study                           |
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| <input checked="" type="checkbox"/> | <input type="checkbox"/> ChIP-seq               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Flow cytometry         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> MRI-based neuroimaging |