

ARTICLE OPEN



Exposure to and learning from the IPCC special report on 1.5 °C global warming, and public support for climate protests and mitigation policies

Rouven Doran^{1✉}, Charles A. Ogunbode^{1,2}, Gisela Böhm^{1,3} and Thea Gregersen^{1,4,5}

Based on national survey data from Norway, this study assesses if exposure to the IPCC special report on global warming of 1.5 °C can be associated with support for climate protests and mitigation policies. Respondents were asked if they had heard about the report (closed-ended question) and what they had learned from or about the report (open-ended question). Analyses of the closed-ended question showed that those who had heard about the report were also more likely to express their support for, as well as to plan on engaging in, protest for increased action by the government against climate change. A similar pattern was observed with respect to support for policy changes that can assist in mitigating climate change. Complementary analyses of the open-ended question revealed that evaluative statements formed the largest category of responses. This category included both references to the seriousness of the evolving climate crisis and comments questioning the credibility of the presented information, with the former being the most frequent response. The findings from this study are discussed in the context of public engagement with climate change, with a particular scope on the potential impacts of making the insights from scientific reports known to the general public.

npj Climate Action (2023)2:11 | <https://doi.org/10.1038/s44168-023-00042-9>

INTRODUCTION

Anthropogenic greenhouse gas (GHG) emissions from fossil fuel consumption, deforestation and agriculture are driving unprecedented changes in the climatic system; raising global temperatures and threatening the ecological systems that support life on earth. Scientific discourse concerning solutions to address these changes highlights key roles for political, social and technological interventions to facilitate the global transition to a low-carbon economy¹. This is partly mirrored in the public sphere by the international expansion of activist groups demanding increased government action on climate change^{2,3}. The current study addresses support for activism and policy changes that are targeted at reducing anthropogenic GHG emissions, especially those that entail substantial individual effort and sacrifice. This was done against the background of the Intergovernmental Panel on Climate Change (IPCC) special report on global warming of 1.5 °C, which described mitigation scenarios that would be (in) consistent with keeping the emission reduction targets outlined by the Paris Agreement¹.

In 2019, the youth-led school strikes around the world have helped elevate the threat of climate change into the mainstream public debate. Not only coincided these and other forms of climate protests with intensified media coverage about the topics of 'global warming' and 'climate change', but there was also a notable increase in internet searches that employed the terms 'climate crisis' or 'climate emergency'⁴. In this context, many of the protesters articulated their demand that political leaders acknowledge the available science on climate change^{5,6}. Now, the pressure on governments to adhere to internationally agreed emission reduction targets must be sustained into the future to secure lasting changes in climate-relevant policies and practices.

An analysis of narratives that are shared amongst contemporary climate movements suggests that science may serve different purposes. This included materials (webpages, press statements, and media coverage) from Fridays For Future, Extinction Rebellion, and the Sunrise Movement; for more details, see ref. ⁷. Whereas science has been employed to gain a sense of legitimacy and public recognition, especially in the initiating stages, the supporters of these movements also tend to proclaim their role as communicators that share knowledge about the projected consequences of failing to comply with the 1.5 °C target with the public⁷.

The IPCC special report on global warming of 1.5 °C generated considerable news coverage after its release in October 2018⁸. References to this and other reports have been common among activists attempting to galvanize public support for, and further involvement in, the school strikes and other forms of protest. A key observation is that the IPCC tends to be viewed as an authoritative source of information with respect to what needs to be done to prevent a major climate crisis^{9–11}. While activists have been characterized as displaying low trust in governments to take measures against climate change, they also tend to show high trust in scientists to supply them with accurate information¹². Also, there is evidence from Germany and the US suggesting that large parts of the public are not opposed to scientists getting more involved in the political discourse on climate change, such as by advocating for specific mitigation policies¹³.

Research investigating the use of scientific knowledge by activists has highlighted its function as a moral resource used to legitimize their demands and actions¹⁴. When it comes to the question of whether exposure to information affects how people construe and respond to climate change, the empirical evidence

¹Department of Psychosocial Science, University of Bergen, Bergen, Norway. ²School of Psychology, University of Nottingham, Nottingham, United Kingdom. ³Department of Psychology, Inland Norway University of Applied Sciences, Lillehammer, Norway. ⁴Centre for Climate and Energy Transformation (CET), University of Bergen, Bergen, Norway. ⁵Norwegian Research Centre (NORCE), Bergen, Norway. ✉email: rouven.doran@uib.no

on the subject has been mixed. This resonates with some broader criticism of the information deficit model in terms of it providing a simplistic understanding of public engagement with climate change¹⁵. For example, media usage has been associated with intentions to engage in climate change mitigation actions at the household level¹⁶, but other research suggests that sharing information about the seriousness of global warming may not uniformly make people more receptive to calls for behavior change^{17,18}. Similarly, while newspaper coverage of global warming has been shown to correlate positively with public concern in Japan¹⁹, evidence for the effects of exposure to climate-related information via the media has been inconclusive in other contexts^{20,21}.

News covering the IPCC special report on global warming of 1.5°C (hereafter only referred to as the IPCC special report) spotlighted its pronouncements on the consequences of failure to reduce global GHG emissions radically by 2030⁸. While core messages from the report were widely quoted by prominent figures of the climate movement, exemplified by Greta Thunberg's address at the World Economic Forum in Davos, January 25 2019, relatively little is known about the extent to which this coverage might have had relevance for public views about the urgency of climate action. One study from Norway analyzed longitudinal panel data to show that exposure to the IPCC special report increased worry about climate change among large parts of the public. An important finding was that the magnitude of these changes varied based on political orientation; with those locating themselves on the right of the political spectrum appearing to be less affected²². Exposure to the report also happened predominantly via media, particularly newspapers and television, and only a small fraction of the participants had read parts of the actual report or the summary for policymakers²².

AIMS

In the following, we report findings from a study that employed a combination of open-ended and closed-ended questions to scrutinize the role of the IPCC special report for public engagement with climate change in Norway. We were particularly interested in assessing variations in what people claim to have learned from or about the report, along with an exploration of whether exposure to the report shows any significant associations with supporting climate protests and mitigation policies. The latter included policy changes with mitigation potential in areas like energy, transportation, and food. Aside from political orientation, we accounted for the extent to which people already altered their lifestyles due to climate change. There have been findings suggesting that topic-related media exposure may reinforce pre-existing views among those taking extreme positions toward climate change (dis)engagement²³.

METHOD

Sample

This study uses data from the Norwegian Citizen Panel (NCP), which is an online survey that addresses public views on issues with social and political relevance among residents in Norway. All questions included are presented in Norwegian, and the only eligibility criteria for being considered as a panelist is to be at least 18 years of age and resident in Norway. The panelists are randomly selected from the National Population Registry, maintained by the Norwegian Tax Administration. The NCP has several waves of data collection each year, where the first wave is used to update information on core questions that are unlikely to fluctuate throughout a year, such as for instance political orientation. These core questions are meant to be combined with data from subsequent rounds to reduce the length of each survey. The

Table 1. Demographic profile of the sample.

	<i>n</i>	%
Gender		
Male	646	49.1
Female	671	50.9
Age (birth cohort)		
1959 or earlier	607	46.1
1960–1989	614	46.6
1990 or later	96	7.3
Education (highest completed)		
No education/Elementary school	96	7.3
Upper secondary education	356	27.0
University/University College	816	62.0
Not answered	49	3.7
Total	1317	

Table shows unweighted data.

NCP currently consists of more than 10,000 active participants. While the core questions are asked to the full panel, participants are randomly divided into sub-samples for the remaining waves. In this study, we analyzed items that were included in NCP Wave 14 (January–February 2019) and NCP Wave 15 (May–June 2019). Response rates for these two waves were 76.3% and 74.4%, respectively; for more information on the sampling and recruitment procedures, see refs. ^{24,25}. A detailed description of the demographic profile from the respondents that received questions inquiring about their exposure to, and possibly learning from, the IPCC special report in NCP Wave 15 is reported in Table 1.

Measures

Items that entered the analyses are shown in Tables 2 and 3. These items were included either in NCP Wave 14 (i.e., political orientation) or in NCP Wave 15 (i.e., climate protests, climate change mitigation policies, exposure to the report, learning from or about the report, lifestyle changes, demographics).

Two items measured support for, and self-reported likelihood of engaging in, climate protests. Three items measured support for a selection of different climate change mitigation policies, ranging from public investment in renewable energy to the imposition of taxes on frequent air travel or on high-carbon foods. To assess exposure to and learning from the IPCC special report, respondents were first asked whether they had heard about the report (closed-ended question), and if this was affirmed, they were then asked what they have learned from or about the report (open-ended question). Aside from an item measuring political orientation, the analyses included one item that asked the respondents about the extent to which they have changed their lifestyles because of climate change. We included this item as an indicator for prior climate change (dis)engagement. For a linguistic analysis of self-reported motivations for adopting changes to one's lifestyle, see ref. ²⁶.

Answers to the open-ended question were subject to content analysis²⁷, for which purpose a multilevel coding scheme was developed. First, answers were screened independently by two individuals, one researcher involved in the study and one research assistant, each of which suggested a system for categorization. Second, these suggestions were integrated into a coding scheme after a joint discussion, accompanied by desk research. The final coding scheme comprised a range of superordinate categories, which in turn could include several more subordinate categories to reflect different levels of specificity; for details, see

Table 2. Descriptive statistics and item wording for the dependent variables.

Variables	Responses	
<i>Climate protests</i>		
In many parts of the world, groups of citizens have been engaging in various forms of civil disobedience and protest with the aim of pressuring their governments and leaders to take more drastic measures against climate change and carbon emissions.	<i>M</i>	<i>SD</i>
To what extent do you support or oppose people engaging in non-violent civil disobedience and protests to pressure government representatives to act against climate change? ^a	4.98	1.51
How likely would you be, over the next 12 months, to participate in a protest for increased action by the government against climate change? ^b	2.10	1.00
<i>Climate change mitigation policies</i>		
Various policies might be used to reduce climate change or deal with its effects. To what extent do you support or oppose the following policies in Norway?	<i>M</i>	<i>SD</i>
Using public money to extend renewable energy, such as wind and solar power. ^a	5.53	1.42
A law requiring additional charges on people who fly more than twice a year (a 'frequent flyer levy'). ^a	3.81	1.97
A carbon tax on food items with high emissions, such as beef and dairy products. ^a	3.39	1.88
Means and standard deviations exclude respondents who did not answer the item in NCP Wave 15 ($n = 8$ for protest support, $n = 6$ for protest likelihood, $n = 12$ for renewable energy, $n = 10$ for frequent flying, $n = 10$ for food items). Table shows unweighted data.		
^a Seven-point scale (1 = Strongly oppose, 7 = Strongly support).		
^b Five-point scale (1 = Not likely at all, 5 = Very likely).		

supplementary material. Answers were to be coded at the most specific category available, but it was possible to assign one answer into multiple categories where applicable.

The superordinate categories can broadly be described as learned content regarding (i) perceived impacts of climate change (e.g., impacts on human life, the ecosystem, and/or on biodiversity), (ii) responses to climate change (e.g., actions, activities, and solutions implemented to mitigate or adapt to climate change), (iii) responsibility for climate actions (e.g., individual, collective, and political responsibility), (iv) evaluations of the IPCC special report and climate change (e.g., credibility of the information), (v) no learning (e.g., response indicates that the participant has learned only little [if anything at all] from the report), and (vi) remnant responses that do not fit into any of the aforementioned categories. Two research assistants coded the answers. Based on their initial independent coding, the research assistants reached the same conclusion in 95.9% of the cases. Some differences could be resolved by discussion between the research assistants who would then assign a mutual code (0 = category not mentioned, 1 = category mentioned). As for the remaining differences in which no such agreement could be reached, the respective category was treated as if it had not been mentioned.

Gender (1 = Male, 2 = Female), age (1 = 1959 or earlier, 2 = 1960–1989, 3 = 1990 or later), and education (1 = No education/Elementary school, 2 = Upper secondary education, 3 = University/University College) were included as covariates. This was informed by evidence showing that certain demographics tend to be overrepresented in climate protests, including a disproportionately large number of young, female, and well-educated participants^{28,29}.

Analyses

First, we screened responses for whether the respondents had heard about the report, which was followed up by mapping responses based on what they had learned from or about the report. Second, we ran a series of regressions with exposure (to the report) as the independent variable, political orientation and lifestyle changes as moderating variables, and the above-mentioned demographics as covariates. This procedure was repeated with measures on climate protests (i.e., protest support, protest participation) and climate change mitigation policies (i.e., energy, transportation, food) as dependent variables.

RESULTS

Exposure to and learning from the IPCC special report

Most respondents (74.6%) had heard about the IPCC special report, which was followed up by the open-ended question. When asked specifically about what they had learned from or about this report, the respondents mentioned a range of topics that could further be differentiated based on their level of specificity. Table 4 summarizes the distribution of these responses, excluding those who either had not heard about the report or who had heard about the report but failed to provide an answer to the open-ended question. While it could be speculated that leaving the text field empty means that the respondents did not learn anything from the report, they consider worth mentioning, the exact reasons cannot be inferred from the current data.

The largest category comprised an evaluation of the information presented in the report (57.8%). In addition to some more general (unspecific) evaluative statements, a significant proportion of the respondents made explicit references addressing the seriousness of the climate crisis (e.g., "The report is a serious reminder of the problem"; 36.1%), followed by references to the credibility of the facts and data presented by the report as a whole (e.g., "UN is not independent and has little credibility"; 12.4%).

The second largest category includes potential impacts from climate change (29.2%), of which the ecosystem (e.g., "If we are unable to reduce global warming, we will have a more unpredictable weather. ..."; 15.4%) was more frequently mentioned than impacts on human life (e.g., "Areas can become uninhabitable"; 9.3%) or on biodiversity (e.g., "... human activity can have significant and sometimes unpredictable negative consequences for the living conditions of living organisms on our planet. ..."; 5.9%).

The third largest category included comments that can be described as measures that could be taken in response to climate change (20.9%). This included references to individual actions (e.g., "Do something 'different' than driving an electric car"; 4.2%), societal actions (e.g., "Use of taxes/regulation"; 4.7%), and technological solutions (e.g., "More renewable energy"; 2.4%).

The remaining categories comprised statements indicating that the respondents learned little or nothing at all from the report (e.g., "Not much"; 16.1%), as well as ascriptions of responsibility for action on climate change (13.5%). These ascriptions tended to focus on collective (e.g., "All must act", 8.8%) rather than political (e.g., "Politicians must act. Politicians have an extra large

Table 3. Descriptive statistics and item wording for the independent variables.

Variables	Responses	
<i>Exposure (to the report)</i>		
The UN Intergovernmental Panel on Climate Change, IPCC is an international working group of scientists who regularly publish reports to summarize scientific assessment on climate change. In October 2018, they published a special report on the impact of global warming exceeding 1.5 degrees.		
Have you heard about this report?	<i>N</i>	<i>%</i>
Yes	982	74.6
No	327	24.8
Not answered	8	0.6
<i>Learning (from or about the report)</i>		
What have you learned from or about this report? All replies would be welcome, preferably a couple of sentences, or just a few words if you prefer. ^a		
	<i>N</i>	<i>%</i>
Answered	623	63.4
Not answered	359	36.6
<i>Lifestyle changes</i>		
In previous surveys, we have seen that many Norwegian citizens are willing to change their way of life to limit harmful climate change. Have you changed your way of life to help limit harmful climate change?		
	<i>N</i>	<i>%</i>
Yes, a lot	114	8.7
Yes, a little	955	72.5
No	242	18.4
Not answered	6	0.5
<i>Political orientation</i>		
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 politically, while 10 represents those who are on the far right. Where would you place yourself on such a scale? ^b		
	<i>M</i>	<i>SD</i>
	5.92	2.30
Mean and standard deviation excludes respondents who did not answer the item in NCP Wave 14 (<i>n</i> = 184 for political orientation). Table shows unweighted data.		
^a Contingent upon responding 'yes' to the previous item.		
^b Eleven-point scale (0 = Left, 10 = Right).		

responsibility"; 2.9%) or individual (e.g., "That we need to become more conscious about reducing CO₂ emissions - and internalize this awareness in our daily routines"; 1.0%) responsibility in taking action against climate change.

There were a few responses that could not be allocated clearly to one of the above-mentioned categories (e.g., "I have heard about the UN's climate panel but I have not read it"; 2.9%). These responses were subsumed under a remnant category.

Explaining support for climate protests and mitigation policies with exposure to the IPCC report

Table 5 summarizes responses to items measuring support for climate protests and climate change mitigation policies. Respondents showed greater support, on average, for using public funds to extend renewable energy than for imposing additional costs on frequent air travel or high-carbon foods. Further, though many expressed their support for engagement in civil disobedience or protests (see Table 5), only a small proportion indicated they were likely to participate themselves (see Fig. 1).

Exposure to the IPCC special report was positively associated with support for non-violent forms of civil disobedience and with

a greater self-reported likelihood of personally engaging in these forms of protest (see Table 6). Support and engagement showed in addition positive associations with the extent to which the respondents had already changed their individual lifestyles due to climate change. This was contrasted by a negative association with political orientation; the more people positioned themselves to the right of the political spectrum, the less likely they were to support and/or engage in protests. Further, there was a significant interaction between exposure to the report and political orientation in explaining support for non-violent forms of civil disobedience to pressure governments to act on climate change; the strength of the association was greatest among people who placed themselves to the left of the political spectrum. Education showed a positive association with likelihood of participating in protests, and gender predicted both support for and likelihood of engagement.

Likewise, exposure to the IPCC special report predicted support for each climate change mitigation policy: extending renewable energy, taxing frequent fliers, and taxing high-carbon foods (see Table 6). Again, exposure to the report explained unique variance alongside lifestyle changes (positive association with policy support) and political orientation (negative association with policy support). There was no significant interaction of exposure to the report with political orientation or lifestyle changes. The only demographic variable that showed a significant association with policy support was education, which predicted support for extending renewable energy and for imposing taxes on high-carbon foods policies, but not for imposing charges on frequent flying.

DISCUSSION

It is evident that limiting global warming to no more than 1.5 °C above pre-industrial levels requires reducing global GHG emissions at an unprecedented scale¹. Increased public engagement has the potential to facilitate these reductions, as public support remains integral to the successful implementation of climate policies. This is evidenced by research linking public attitudes toward environmental protection with national commitments to climate change mitigation strategies^{30,31}. Consistent with the interpretation that the IPCC special report could have made the public more receptive to calls for mitigation action, exposure was stably associated with support for policies directed at the transition to a low-carbon economy. A similar pattern was observed regarding support for, and enhanced likelihood of, engaging in civil disobedience and protests to put pressure on governmental representatives. These associations were insensitive to whether people have already changed their lifestyles because of climate change, herein strengthening the conclusion that scientific reports could have a part in shaping public acceptance of increased effort and sacrifice to tackle climate change.

Along with evidence for the biased assimilation of information when people confront climate-related news reporting^{32,33}, exposure to the IPCC special report was shown to have more pronounced effects on climate concern among those locating themselves on the left of the political spectrum²². In the current study, however, we did not find a similar pattern with respect to support for climate change mitigation policies. A more nuanced picture was obtained for climate protests, where the strength of the association varied as a function of political orientation for one of the item measures. While the analyses failed to suggest an interaction effect for protest participation, the association with protest support was relatively weaker among respondents positioning themselves to the right of the political spectrum. This only partially supports prior studies where the public response to the IPCC special report differed across the political spectrum. Note that the latter remained a consistent predictor for supporting climate protests and policy, which aligns with literature

Table 4. Distribution of the mentioned content across the categories of the coding scheme.

Label	Codes			Categories	Percentages		
	Level 1	Level 2	Level 3		Level 1	Level 2	Level 3
R1	1			Impacts	29.2		
R1.0		10		<i>No specification</i>		8.5	
R1.1		11		Impacts on human life		9.3	
R1.1.0			110	<i>No specification</i>			4.3
R1.1.1			111	Migration			3.2
R1.1.2			112	Food supply			1.6
R1.1.3			113	Water supply			0.6
R1.1.4			114	Generational injustice			0.5
R1.1.5			115	Geographical injustice			0.6
R1.2		12		Impacts on the ecosystem		15.4	
R1.2.0			120	<i>No specification</i>			1.9
R1.2.1			121	Sea level rise			6.7
R1.2.2			122	Ice melting			4.8
R1.2.3			123	Extreme weather			6.1
R1.2.4			124	Temperature rise			5.1
R1.3		13		Impacts on biodiversity		5.9	
R1.3.0			130	<i>No specification</i>			3.2
R1.3.1			131	Animals			2.6
R1.3.2			132	Plants and vegetation			1.0
R2	2			Responses	20.9		
R2.0		20		<i>No specification</i>		12.0	
R2.1		21		Individual actions in response to climate change		4.2	
R2.2		22		Societal activities in response to climate change		4.7	
R2.3		23		Technological solutions to handle climate change		2.4	
R3	3			Responsibility	13.5		
R3.0		30		<i>No specification</i>		2.2	
R3.1		31		Individual responsibility to take action on climate change		1.0	
R3.2		32		Collective responsibility to take action on climate change		8.8	
R3.2.0			320	<i>No specification</i>			5.1
R3.2.1			331	Collective local responsibility			0.2
R3.2.2			332	Collective global responsibility			3.5
R3.3		33		Political responsibility to take action on climate change		2.9	
R4	4			Evaluations	57.8		
R4.0		40		<i>No specification</i>		11.7	
R4.1		41		Information credibility		12.4	
R4.1.0			410	<i>No specification</i>			5.3
R4.1.1			411	Skepticism towards the scientific community			2.6
R4.1.2			412	Skepticism towards the scientific consensus			2.7
R4.1.3			413	Belief in hidden agenda underlying the report			1.3
R4.1.4			414	Belief in anthropogenic causes of climate change			2.1
R4.1.5			415	Belief in natural causes of climate change			1.0
R4.2		42		Information severity		36.1	
R4.2.0			420	<i>No specification</i>			18.5
R4.2.1			421	Optimism towards the future			0.8
R4.2.2			422	Pessimism towards the future			1.9
R4.2.3			423	Affective evaluation of the present situation			4.2
R4.2.4			424	Cognitive evaluation of the present situation			11.9
R5	5			Little (or no) learning	16.1		
R6	6			Remnant	2.9		

Percentages are based on valid responses ($n = 623$); excludes respondents who heard about the report without making any statement about what they learned from or about this report ($n = 359$). Level 1 categories are in boldface. Responses were coded as specific as possible but could be assigned to more than one category. Table shows unweighted data.

highlighting the role of political affiliation and ideology as predictors of climate change engagement^{34,35}.

More than half of the respondents who answered the open-ended question included some sort of evaluative statement, such as highlighting the gravity of the evolving climate crisis. The second most frequently mentioned category consisted of statements comprising an assessment of anticipated impacts of continuous global warming, like disruptions in the ecosystem. Such statements were more frequent than suggestions for concrete measures that could be taken to address climate change and more frequent than comments about the responsibility of different societal actors. The predominance of evaluative statements in respondents' recollections about what they have learned, in addition to describing possible impacts, perhaps reflects shared narratives in news coverage. It has been recognized that the public discourse on climate change evolves at least partly from agenda setting in the media³⁶, which in the case of the IPCC special report, was often reflected in news outlets portraying

possible doomsday scenarios unless there will be rapid and far-reaching socio-economic transformations⁸.

It has been documented that people are more likely to respond to messages that depict threats posed by climate change if these are paired with cues about how these threats can be countered^{37–39}. A fair proportion of respondents in this study mentioned the severity of the emerging climate crisis, which could mean that the IPCC special report elevated public awareness about the consequences of not meeting the 1.5 °C target. In the meantime, however, there were comparatively fewer statements that focused on specific mitigation options that could be implemented in response to climate change. The apparent overweight of threat appraisals may not be surprising when considering results from research subjecting the summary for policymakers of the 5th IPCC assessment to content analysis⁴⁰. This research found that threat-related content (e.g., projected increase in extreme weather events) was emphasized more frequently than efficacy-related content (e.g., possible measures to reduce global GHG emissions). For a further discussion on when and where communications employing references to assessments and reports by the IPCC could benefit from a greater focus on efficacy appeals, see ref. ⁴¹.

It remains open for discussion whether the content that respondents reported to have learned from the report reflects their prior knowledge on the subject. An analysis of media coverage of the 5th IPCC assessment report suggests that frequent exposure to related news coverage in the (print) media may have supported the acquisition of knowledge about climate change consequences⁴². However, these effects were shown to be rather small when accounting for the extent to which people already possess corresponding knowledge from before the report was publicized⁴². The current study included education as a covariate, yet there was no separate assessment for any knowledge that respondents possessed prior to being exposed to the report in the media or elsewhere. An empirical juxtaposition of prior versus acquired knowledge, and their integration in explaining self-reported learning after exposure to scientific reports, would make a useful addition in future studies that choose to employ a similar research design.

Table 5. Distribution of responses to items measuring support for climate protests and climate change mitigation policies.

Answer options	Engaging in non-violent civil disobedience and protests		Funding of renewable energy extensions		Imposing extra charges on frequent flying		Taxing high-carbon foods	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Strongly oppose	37	2.8	40	3.1	206	15.8	258	19.7
Oppose	62	4.7	37	2.8	248	19.0	288	22.0
Somewhat oppose	105	8.0	49	3.8	129	9.9	169	12.9
Neither support nor oppose	248	18.9	82	6.3	182	13.9	170	13.0
Somewhat support	291	22.2	258	19.8	221	16.9	199	15.2
Support	364	27.8	531	40.7	194	14.8	147	11.2
Strongly support	202	15.4	308	23.6	127	9.7	76	5.8
Not answered	8		12		10		10	

Percentages are based on valid responses; excludes respondents who did not answer the item in NCP Wave 15. Table shows unweighted data.

LIMITATIONS

One limitation is the time delay between the initial release of the IPCC special report (October 2018) and the point at which

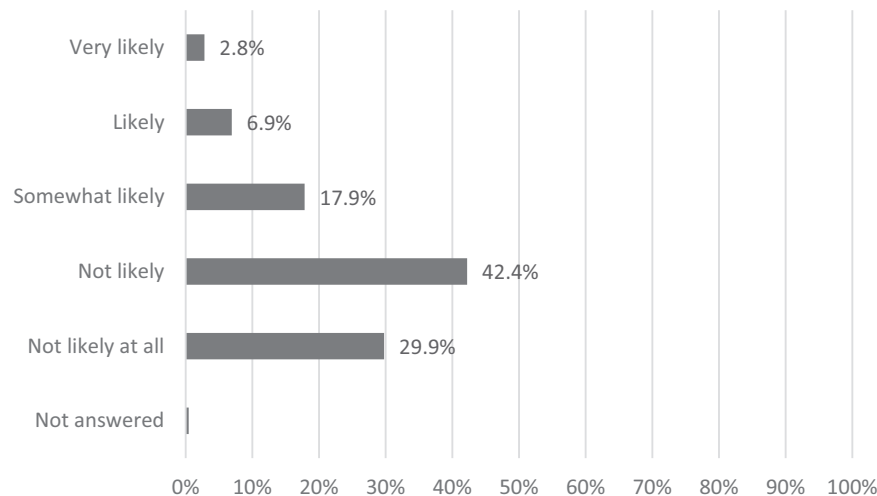


Fig. 1 Distribution of responses to the item measuring likelihood of participating in a protest for increased action against climate change by the government. Percentages are based on valid responses ($n = 1311$); excludes respondents who did not answer the item in NCP Wave 15 ($n = 6$). Figure shows unweighted data.

Table 6. Explaining support for climate change mitigation policies and climate protests.

	Climate change mitigation policies			Climate protests	
	Funding of renewable energy extensions	Imposing extra charges on frequent flying	Taxing high-carbon foods	Protest support	Protest participation
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Constant	4.57 (0.23)***	3.16 (0.31)***	1.79 (0.29)***	4.27 (0.23)***	1.58 (0.15)***
Exposure (to the report)	0.28 (0.10)**	0.47 (0.14)**	0.48 (0.13)***	0.26 (0.10)**	0.39 (0.06)***
Political orientation	−0.10 (0.02)***	−0.27 (0.02)***	−0.22 (0.02)***	−0.23 (0.02)***	−0.16 (0.01)***
Lifestyle changes	0.46 (0.08)***	0.72 (0.11)***	0.72 (0.10)***	0.51 (0.08)***	0.48 (0.05)***
Exposure × Political orientation	−0.04 (0.05)	−0.10 (0.06)	−0.05 (0.06)	−0.10 (0.05)*	−0.04 (0.03)
Exposure × Lifestyle changes	0.29 (0.19)	−0.21 (0.25)	0.35 (0.24)	0.36 (0.19)	0.23 (0.12)
Demographics					
Gender	0.05 (0.09)	0.19 (0.11)	0.20 (0.11)	0.25 (0.08)**	0.18 (0.05)**
Age (birth cohort)	0.08 (0.07)	0.00 (0.09)	0.15 (0.08)	0.09 (0.07)	0.01 (0.04)
Education (highest completed)	0.29 (0.07)***	0.15 (0.09)	0.41 (0.08)***	0.08 (0.07)	0.09 (0.04)*
R ²	0.11	0.18	0.19	0.22	0.30
df	(8, 1081)	(8, 1082)	(8, 1082)	(8, 1085)	(8, 1085)
F	15.96***	30.45***	32.58***	38.84***	57.64***

Parallel moderation model (Model 2⁵⁰) based on 5000 bootstrap samples and 95% percentile bootstrap confidence intervals, variables that define products were mean-centered. Demographics were included as covariates.

B unstandardized regression coefficient, SE standard error.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

respondents answered the items analyzed in this study (May–June 2019). This could have made it more difficult for the respondents to recall specific content from the report. The topic of global warming has been prevailing in the media before and after the report was published, yet news coverage of the report was greatest immediately after its initial release date⁸. Another limitation was that exposure to the IPCC special report was assessed by using a dichotomous variable, which precludes testing whether repeat exposure plays a role in eliciting an attitudinal response. Including measures on how often people attend to sources mentioning the IPCC special report could have provided a more nuanced picture of the role of information exposure in this context. Finally, this study did not explore if the source for exposure has any bearing on the type of content that was learned from the report. An analysis of online articles on the 2015 climate summit in Paris yielded some notable variation in terms of which themes (e.g., civil societal protests) became spotlighted as part of the coverage, as well as in terms of the number of articles that were published in relation to the event⁴³.

FUTURE DIRECTIONS

More research is needed to contrast the relative importance of exposure to scientific reports with other factors that were not accounted for by this study. First, group processes such as social identification can be crucial for mobilizing and maintaining individual participation in climate protests^{44,45}, possibly more so than appraising anthropogenic climate change as a serious threat that is insufficiently addressed by current policies⁴⁶. Accounting for these processes could help clarify the circumstances under which exposure to scientific reports can make a difference, and if certain groups are more receptive than others. Second, there is reason to assume that worldviews (e.g., individualism, egalitarianism) can affect the remembering and retelling of climate change narratives. This has been shown, for instance, in the context of people debating solutions for dealing with problems associated

with global warming⁴⁷. It could be that worldviews influence what aspects of scientific reports receive the most attention, and by extension, the extent to which individuals express their support for climate change mitigation policies.

CONCLUSION

Drawing upon national survey data from Norway, the present study addressed the role of the IPCC special report on global warming of 1.5 °C in understanding the landscape of public engagement with climate change. While the employed research design warrants caution in making causal inferences from these data alone, the findings provide some novel insights into the possible role of scientific reports in shaping support towards climate protests and mitigation policies. Future research focusing on individual encounters with these reports, particularly those produced by the IPCC, may consider the influence of group processes and individual differences in worldviews. Addressing these factors would yield further insights into when and how sharing information on global warming may shape motivations for climate action and support for climate policies among the public.

DATA AVAILABILITY

Data will be made available on reasonable request.

Received: 22 July 2022; Accepted: 23 March 2023;

Published online: 31 May 2023

REFERENCES

1. IPCC. Summary for policymakers. In *Global Warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and*

- efforts to eradicate poverty (eds. Masson-Delmotte, V. et al.) (World Meteorological Organization, 2018).
2. O'Brien, K., Selboe, E., & Hayward, B. M. Exploring youth activism on climate change: dutiful, disruptive, and dangerous dissent. *Ecol. Soc.* **23**, 42 (2018).
 3. Thomas, A., Cretney, R. & Hayward, B. Student Strike 4 Climate: justice, emergency and citizenship. *N. Z. Geogr.* **75**, 96–100 (2019).
 4. Thackeray, S. J. et al. Civil disobedience movements such as School Strike for the Climate are raising public awareness of the climate change emergency. *Global Change Biol.* **26**, 1042–1044 (2020).
 5. Evensen, D. The rhetorical limitations of the #FridaysForFuture movement. *Nat. Clim. Change* **9**, 428–430 (2019).
 6. Marquardt, J. Fridays for Future's disruptive potential: an inconvenient youth between moderate and radical ideas. *Front. Commun.* **5**, 48 (2020).
 7. Rödder, S. & Pavenstädt, C. N. 'Unite behind the Science!' Climate movements' use of scientific evidence in narratives on socio-ecological futures. *Sci. Public Policy* **50**, 30–41 (2023).
 8. Boykoff, M. & Pearman, O. Now or never: how media coverage of the IPCC Special Report on 1.5 °C shaped climate-action deadlines. *One Earth* **1**, 285–288 (2019).
 9. Eide, E., & Kunelius, R. Voices of a generation the communicative power of youth activism. *Clim. Change*, **169**, 6 (2021).
 10. Han, H. & Ahn, S. W. Youth mobilization to stop global climate change: narratives and impact. *Sustainability* **12**, 4127 (2020).
 11. Martiskainen, M. et al. Contextualizing climate justice activism: knowledge, emotions, motivations, and actions among climate strikers in six cities. *Global Environ. Change* **65**, 102180 (2020).
 12. Cologna, V., Hoogendoorn, G. & Brick, C. To strike or not to strike? An investigation of the determinants of strike participation at the Fridays for Future climate strikes in Switzerland. *PLOS One* **16**, e0257296 (2021).
 13. Cologna, V., Knutti, R., Oreskes, N. & Siegrist, M. Majority of German citizens, US citizens and climate scientists support policy advocacy by climate researchers and expect greater political engagement. *Environ. Res. Lett.* **16**, 024011 (2021).
 14. Soßdorf, A., & Burgi, V. "Listen to the science!"—The role of scientific knowledge for the Fridays for Future movement. *Front. Commun.* **7**, 983929 (2022).
 15. Suldovsky, B. The information deficit model and climate change communication. In *Oxford Research Encyclopedia of Climate Science* (Oxford University Press, 2017).
 16. Arlt, D., Hoppe, I. & Wolling, J. Climate change and media usage: effects on problem awareness and behavioural intentions. *Int. Commun. Gaz.* **73**, 45–63 (2011).
 17. Kellstedt, P. M., Zahran, S. & Vedlitz, A. Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. *Risk Anal.* **28**, 113–126 (2008).
 18. Staats, H. J., Wit, A. P. & Midden, C. Y. H. Communicating the greenhouse effect to the public: evaluation of a mass media campaign from a social dilemma perspective. *J. Environ. Manag.* **46**, 189–203 (1996).
 19. Sampei, Y. & Aoyagi-Utsui, M. Mass-media coverage, its influence on public awareness of climate-change issues, and implications for Japan's national campaign to reduce greenhouse gas emissions. *Global Environ. Change* **19**, 203–212 (2009).
 20. Fernández-Llamazares, Á. et al. Links between media communication and local perceptions of climate change in an indigenous society. *Clim. Change* **131**, 307–320 (2015).
 21. Thaker, J., Zhao, X. & Leiserowitz, A. Media use and public perceptions of global warming in India. *Environ. Commun.* **11**, 353–369 (2017).
 22. Ogunbode, C. A., Doran, R. & Böhm, G. Exposure to the IPCC special report on 1.5 °C global warming is linked to perceived threat and increased concern about climate change. *Clim. Change* **158**, 361–375 (2020).
 23. Wonneberger, A., Meijers, M. H. C. & Schuck, A. R. T. Shifting public engagement: how media coverage of climate change conferences affects climate change audience segments. *Public Underst. Sci.* **29**, 176–193 (2020).
 24. Skjervheim, Ø., Høgestøl, A., & Bjørnebekk, O. *Norwegian Citizen Panel methodology report, wave 14 [Produced by Ideas2Evidence]*, <https://www.nsd.no/data/individ/publikasjoner/NSD2689/NCP%20Documentation%20Report%20Wave%2014.pdf> (2019a).
 25. Skjervheim, Ø., Høgestøl, A., & Bjørnebekk, O. *Norwegian Citizen Panel methodology report, wave 15 [Produced by Ideas2Evidence]*, <https://www.nsd.no/data/individ/publikasjoner/NSD2743/NCP%20Documentation%20Report%20Wave%2015.pdf> (2019b).
 26. Fløttum, K., Gjerstad, Ø. & Skiple, J. K. Climate change and lifestyle: people's expressed motivations to adopt or not adopt a climate-friendly way of life. *ASP* **79**, 75–94 (2021).
 27. Bos, W. & Tarnai, C. Content analysis in empirical social research. *Int. J. Educ. Res.* **31**, 659–671 (1999).
 28. De Moor, J., Uba, K., Wahlström, M., Wennerhag, M. & De Vydt, M. *Protest for a future II: Composition, mobilization and motives of the participants in Fridays for Future climate protests on 20-27 September, 2019, in 19 cities around the world.* <https://doi.org/10.17605/OSF.IO/ASRUW> (2020).
 29. Wahlström, M., Wennerhag, M. & De Vydt, M. *Protest for a future: Composition, mobilization and motives of the participants in Fridays For Future climate protests on 15 March, 2019, in 13 European cities.* <https://doi.org/10.17605/OSF.IO/XCNZH> (2019).
 30. Anderson, B., Böhmelt, T. & Ward, H. Public opinion and environmental policy output: a cross-national analysis of energy policies in Europe. *Environ. Res. Lett.* **12**, 114011 (2017).
 31. Drummond, A., Hall, L. C., Sauer, J. D. & Palmer, M. A. Is public awareness and perceived threat of climate change associated with governmental mitigation targets. *Clim. Change* **149**, 159–171 (2018).
 32. Corner, A., Whitmarsh, L. & Xenias, D. Uncertainty, scepticism and attitudes towards climate change: biased assimilation and attitude polarisation. *Clim. Change* **114**, 463–478 (2012).
 33. Hamilton, L. C. Did the arctic ice recover? Demographics of true and false climate facts. *Weather Clim. Soc.* **4**, 236–249 (2012).
 34. Hornsey, M. J., Harris, E. A., Bain, P. G. & Fielding, K. S. Meta-analyses of the determinants and outcomes of belief in climate change. *Nat. Clim. Change* **6**, 622–626 (2016).
 35. Marquardt-Pyatt, S. T., McCright, A. M., Dietz, T. & Dunlap, R. E. Politics eclipses climate extremes for climate change perceptions. *Global Environ. Change* **29**, 246–257 (2014).
 36. Boykoff, M. *Who speaks for the climate? Making sense of mass media reporting on climate change* (Cambridge University Press, 2011).
 37. Hart, P. S. & Feldman, L. The influence of climate change efficacy messages and efficacy beliefs on intended political participation. *PLOS One* **11**, e0157658 (2016).
 38. Kotcher, J., Feldman, L., Luong, K. T., Wyatt, J. & Maibach, E. Advocacy messages about climate and health are more effective when they include information about risks, solutions, and a normative appeal: evidence from a conjoint experiment. *J. Clim. Change Health* **3**, 100030 (2021).
 39. Xue, W. et al. Combining threat and efficacy messaging to increase public engagement with climate change in Beijing, China. *Clim. Change* **137**, 43–55 (2016).
 40. Poortvliet, P. M. et al. Communicating climate change risk: a content analysis of ipcc's summary for policymakers. *Sustainability* **12**, 4861 (2020).
 41. McLoughlin, N. Communicating efficacy: how the IPCC, scientists, and other communicators can facilitate adaptive responses to climate change without compromising on policy neutrality. *Clim. Change* **169**, 1–14 (2021).
 42. Oschatz, C., Maurer, M. & Haßler, J. Learning from the news about the consequences of climate change: an amendment of the cognitive mediation model. *J. Sci. Commun.* **18**, A07 (2019).
 43. Painter, J., Kristiansen, S. & Schäfer, M. S. How 'Digital-born' media cover climate change in comparison to legacy media: a case study of the COP 21 summit in Paris. *Global Environ. Change* **48**, 1–10 (2018).
 44. Furlong, C. & Vignoles, V. L. Social identification in collective climate activism: predicting participation in the environmental movement, Extinction Rebellion. *Identity* **21**, 20–35 (2021).
 45. Haugestad, C. A. P., Skauge, A. D., Kunst, J. R. & Power, S. A. Why do youth participate in climate activism? A mixed-methods investigation of the #FridaysForFuture climate protests. *J. Environ. Psychol.* **76**, 101647 (2021).
 46. Wallis, H. & Loy, L. S. What drives pro-environmental activism of young people? A survey study on the Fridays For Future movement. *J. Environ. Psychol.* **74**, 101581 (2021).
 47. Böhm, G., Pfister, H. R., Salway, A., & Fløttum, K. Remembering and communicating climate change narratives - The influence of world views on selective recollection. *Front. Psychol.* **10**, 1026 (2019).
 48. Ivarsflaten, E. et al. *Norwegian Citizen Panel Round 14, 2019 [Data set]*. Sikt - Norwegian Agency for Shared Services in Education and Research, <https://doi.org/10.18712/NSD-NSD2689-V3> (2022).
 49. Ivarsflaten, E. et al. *Norwegian Citizen Panel Round 15, 2019 [Data set]*. Sikt - Norwegian Agency for Shared Services in Education and Research, <https://doi.org/10.18712/NSD-NSD2743-V3> (2022).
 50. Hayes, A. F. *Introduction to mediation, moderation, and conditional process analysis* (3rd ed.) (Guilford Press, 2022).

ACKNOWLEDGEMENTS

We thank Petter Risholm and Max Korbacher for their help in coding the responses to the open-ended question. Preliminary results were presented at two conferences (Beyond Oil conference, Bergen, Norway, October 20-21, 2021; 5th Conference on Environmental Psychology, Lillehammer, Norway, November 18-19, 2021). The data applied in the analysis are based on NCP Wave 14⁴⁸ and NCP Wave 15⁴⁹. The survey was financed by the University of Bergen (UiB). The data are provided by UiB, prepared and made available by Ideas2Evidence, and distributed by the Norwegian

Centre for Research Data (NSD). Neither UiB nor NSD is responsible for the analyses/interpretation of the data presented here.

AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by RD, CO, GB, and TG. The first draft of the manuscript was written by RD, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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/s44168-023-00042-9>.

Correspondence and requests for materials should be addressed to Rouven Doran.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2023