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Is public awareness and perceived threat of climate change associated with governmental mitigation targets?

Aaron Drummond[1] · **Lauren C. Hall**[1] · **James D. Sauer**[2] · **Matthew A. Palmer**[2]

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Abstract Social scientists and science communicators are concerned about the apparent discrepancy between the scientific consensus on climate change (Anderegg et al. Proc Natl Acad Sci 107:12107–12109, 2010; Doran and Zimmerman EOS Trans Am Geophys Union 90:22–3, 2009) and the general public's views (Knight Environ Sociol 2:101–113, 2016; Lee et al. Nat Clim Chang 5:1014–1020, 2015). It is reasoned that increased public awareness and perceived threat of climate change may pressure governments to enact policy to counteract climate change (e.g. setting stringent carbon emissions targets). Despite a logical link between public awareness and government-set emissions targets, this relationship remains untested. We examined the relationship between public awareness about and perceived threat of climate change and governmental emissions targets across 71 countries and 1 region. We found a positive association between the proportions of a country's population that are aware of climate change and the unconditional emissions reduction targets set by that country in the Paris Agreement (Rogelj et al. Nature 534:631–639, 2016). However, the proportion of people in a country who perceive climate change as a personal threat was not associated with higher emissions reduction targets. Our results suggest that public awareness may be an important part of garnering the public support required for policies designed to mitigate climate change to succeed.

1 Introduction

Despite consensus amongst climate scientists that climate change is occurring (Anderegg et al. 2010; Doran and Zimmerman 2009), the level of public awareness of the issue is both lower and

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✉ Aaron Drummond
a.drummond@massey.ac.nz

[1] School of Psychology, Massey University, Manawatu, Palmerston North 4424, New Zealand

[2] Psychology, School of Medicine, University of Tasmania, Hobart, Australia

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more varied across countries (Knight 2016; Lee et al. 2015). This discrepancy has prompted interest from psychological, social, and communication scientists and efforts to document patterns and antecedents of public awareness of the facts of climate change (Brulle et al. 2012; Hamilton and Keim 2009; Hornsey et al. 2016; Kahan et al. 2012; Knight 2016; Lee et al. 2015; Lewandowsky et al. 2013b; McCright and Dunlap 2011; O'Connor et al. 1999; Poortinga et al. 2011). A particular focus has been on interventions to reduce the discrepancy between the scientific consensus and the public opinion (Drummond et al. 2016; Feygina et al. 2010; Lewandowsky 2011; Lewandowsky et al. 2013a; Myers et al. 2015; Suhay et al. 2015; van der Linden et al. 2015; Wolsko et al. 2016). Such interventions rest upon the critical, but untested assumption that public awareness about and perceived threat of climate change should prompt governmental attempts to address it. While this may seem logical because democratic and representative forms of government are ostensibly based upon the principle that governments are subject to the will of their people, there are at least two reasons why this relationship may not hold. First, not all countries involved in climate change mitigation operate as full democracies: some are constitutional monarchies or one-party states. Countries with less democratic systems of government have fewer obligations to enact policy based upon the wishes of their people, and hence, public awareness may not be a driver of climate policy in such countries. Second, democracies do not always operate according to the will of the people. For example, in the USA, research shows that congressional voting behaviour is generally not reflective of the majority of citizens' opinions (Gilens and Page 2014).

The assumption that public opinion on the issue of climate change should drive democratic governmental efforts to counteract climate change assumes that such governments are operating as *Majoritarian Electoral Democracies* (Gilens and Page 2014)—a form of democracy in which governmental policies primarily reflect the collective will of the majority of citizens. However, this is not the only manner in which democracies operate. Governments in *Economic-Elite Domination* societies enact policies based primarily on the preferences of wealthy individuals, especially business owners (Gilens and Page 2014). Alternatively, special interest groups may exert considerable influence on public policy, and the views of divergent special interest groups may be considered with equal weighting (*Majoritarian Pluralism*), or the views of special interests representing corporations and business associations may be considered with greater weight than those that represent non-business interests (*Biased Pluralism*; Gilens and Page 2014). While some research suggests that public opinion seems to influence a majority of public policies (Page and Shapiro 1983), evidence from congressional voting patterns suggests that US public policy reflects *Biased Pluralism* or *Economic-Elite Domination* and not a *Majoritarian Electoral Democracy* (Gilens and Page 2014). Although the US political system does not necessarily reflect the wider global community, this finding raises concerns about the efficacy of building widespread awareness of climate change as a tool for increasing governmental efforts to counteract it. Moreover, even if countries are operating as *Majoritarian Electoral Democracies*, this does not guarantee that any given policy issue will be influenced by public opinion. Further, various moderating or suppressing factors may disrupt or eliminate the relationship between public awareness and government-set emissions targets. For example, countries that experience greater effects of climatic change may perceive more potential harm from the effects of climate change than nations who experience fewer climate change related effects, altering the relationship between public perception and action (see, for example, the effects of flooding; Spence et al. 2011).

Although there is a relative paucity of research about the link between awareness of climate change and public policy responses at a national level, data from public policy in a variety of

counties and states offer some support for the link between awareness of climate change and policy implementation to counteract the effects of climate change. Analyses of surveys from several US states suggest that greater awareness of the causes and effects of climate change was generally predictive of increased support for public policy (O'Connor et al. 2002; Dietz et al. 2007). Moreover, the failures of carbon taxation policy in the USA, and federally in Canada, are generally attributed to a lack of public support (Harrison 2012; Rabe and Borick 2012). As such, we expect that there will be a relationship between awareness of climate change and governmentally set emissions reduction targets at a national level.

A second issue is whether increasing public awareness of climate change is enough to drive public policy changes or whether the public must be also convinced that climate change poses a serious personal threat. Psychological distance is the degree to which a person feels that something is removed from their self. Greater psychological distance can be due to the event occurring further into the future, further away or happening to people less similar to oneself (Trope and Liberman 2010). Lower estimation for the probability of an event is also a form of greater psychological distance (Trope and Liberman 2010). Studies suggest that reducing the psychological distance people experience from the effects of climate change generally increases their willingness to take action to counteract it (Milfont et al. 2014; Spence et al. 2012). Thus, one possibility is that the belief that climate change poses a personal threat to oneself may be indicative of reduced psychological distance and thus increase the willingness for people to take, or support government efforts to take, pro-environmental action. However, there are solid theoretical reasons to believe that decreasing psychological distance may only be effective in the absence of intense emotional reactions such as fear (McDonald et al. 2015). Although fear can be an effective persuasion tool (Tannenbaum et al. 2015), message content, prompting strong fear reactions combined with a low degree of personal efficacy for action, can result in defensive responses that undermine message effectiveness (Witte and Allen 2000). Given the relatively low efficacy many individuals feel they have when combating climate change (Gifford 2011), greater public belief that climate change poses a serious threat to themselves or their families may actually reduce motivation to take action (e.g. alter voting behaviour based on the issue) and reduce pressure felt by governments to set stringent emissions targets (McDonald et al. 2015). This may explain why fearful messages draw people's attention to climate change, but prove relatively ineffective at increasing personal engagement (O'Neill and Nicholson-Cole 2009), and why psychologically close representations of climate change are ineffective at increasing intention to act when they draw attention to human suffering caused by its effects (Manning et al. 2018). Thus, a second possibility is that greater belief that climate change poses a personal threat may not be associated (or may be negatively associated) with higher emissions reduction targets if the experience of personal threat includes a strong enough emotional reaction to cause disengagement (McDonald et al. 2015).

2 Method

We empirically examined the relationship between public awareness of climate change, public perception of the threat posed by climate change and government commitment targets to mitigate climate change across 71 countries and 1 region (the EU). Combining data from an international survey of climate change awareness and risk perceptions (Lee et al. 2015) with governmental commitments made to reduce emissions in the Paris Agreement (Rogelj et al.

2016), we examined whether countries with greater public awareness about, or perceived threat of, climate change also committed to higher mitigation targets in the Paris Agreement.

We took survey data on the opinions of the populace about climate change from the publically available dataset used in Lee et al.'s research extrapolated from Gallup's World Poll (Lee et al. 2015). The measures used were taken from the 2007–2008 poll. Although this may initially appear to be a long lag between measures of public opinion and the enactment of policy, we address this concern in detail below. Measures were composites of the proportion of the population of each of the 119 countries involved in the 2007–2008 poll whom (a) were aware of the existence of climate change and (b) considered climate change to be a serious threat to themselves or their family. For the awareness question, participants were asked 'How much do you know about climate change?' Participants were able to respond 'I don't know', 'I have never heard of it', 'I know something about it' or 'I know a great deal about it'. Participants were then classified as having been unaware ('I don't know'; 'I have never heard of it') or aware ('I know something about it'; 'I know a great deal about it').

For the perceptions of threat question, participants who indicated that they were aware of climate change were asked 'How serious of a threat is global warming to you and your family?' Participants responded on a four-point scale ('Not at all serious'; 'Not very serious'; 'Somewhat serious'; 'Very serious'). Participants who responded with 'Not at all serious' or 'Not very serious' were coded as not serious, while participants who chose the other responses were coded as serious. In this way, the analyses reported in the main text represent the proportion of people who were aware of climate change that felt threatened by it. An alternative approach is to multiply the proportion of the population who were aware of the issue by the proportion of the population who felt threatened to produce an absolute proportion of people who felt threatened within the country. Doing so yielded similar results. We discuss these analyses in Section 3.

These data were combined with emissions reduction targets stated in the Paris Agreement and were drawn from Rojelj et al.'s (Rogelj et al. 2016) analysis of the efficacy of the Paris Agreement to keep climate change below 2 °C. Emissions targets were either unconditional (they would be met irrespective of other countries actions) or conditional upon external factors (e.g. financial support from other countries or regions). Countries that pledged only conditional reduction targets were coded as having 0% unconditional reduction targets. Where stated targets were a range (e.g. 20–25%), the midpoint of this range was taken as the indicative emissions reduction target. Due to the fact that not all countries in the Lee et al. (2015) dataset were included in the Rojelj et al. (Rogelj et al. 2016) dataset (and vice-versa), this resulted in a final dataset of 71 countries whom had both declared emissions targets in the Paris Agreements and had data reported by Lee et al. (2015). We also computed an average awareness and perceived threat for the European Union. In combination, this produced a dataset of 71 countries and 1 region. Analyses excluding the EU were qualitatively similar to when the EU was included.

Emissions reduction targets were regressed on awareness and perceived threat scores independently, using 5000 bootstraps to increase the precision of the point estimates (Results were similar when no bootstraps or 10,000 bootstraps were used.).

Additional variables that are included in the models predicting emissions targets included gross domestic product (GDP) per capita in US dollars,[1] CO_2 emissions per capita and the World Governance Indicator. The CO_2 emissions data were drawn from the

[1] Results were virtually identical when the purchasing power parity of GDP per capita was used instead of the GDP per capita in $USD, and, if anything, were slightly stronger.

World Bank, which calculates CO_2 emissions from the burning of fossil fuels and industrial activities. Although such an approach may underestimate emissions from smaller more agrarian economies, they are a valid indicator of the likely influence of a country in generating CO_2 (World Bank 2014). We also included indices of each country's experienced sea level rise, extreme weather events and agricultural productivity reductions. These climate change vulnerability measures were quantified as the estimated number of people per 100,000 who were affected by sea level rise, extreme weather events and agricultural productivity loss according to the Centre for Global Development (Wheeler 2011). The World Governance Indicator is an aggregate measure annually calculated by the World Bank. The indicator is a composite measure of six individual measures. These measures combine individual survey measures and existing data sources to estimate the voice and accountability (*the ability for citizens to participate in selecting their government and freedom of expression, association and media*), political stability, governmental effectiveness, regulatory quality, rule of law and corruption controls of over 200 countries. The resulting measure is a Z score, ranging from approximately − 2.5 to 2.5, with higher scores indicating better governance (e.g. greater governmental accountability, better control of corruption). For an overview of the World Governance Indicators, see the World Bank (2016). All variables were available in Lee et al.'s dataset (Lee et al. 2015).

Although the lag between 2008 public opinion data and the 2016 emissions reduction targets might, at first glance, appear to be a long time frame over which to consider whether public opinion might influence policy, there are several reasons to anticipate that public opinion might have influence over such a period of time. First, investigations of relationships between public opinion and policy in domestic settings show that while a majority of government policy responds to public opinion within a 1-year lag, around one in six policies take longer than 4 years to converge with public opinion (Page and Shapiro 1983). Given the complexity of the Paris agreement, and the fact that it is an international (cf. domestic) policy framework, it is likely that a longer period is necessary for public opinion to translate into public policy. Second, and perhaps more importantly, the Paris Agreement targets represent the final positions of sustained negotiations which ostensibly began in 2009 with the Copenhagen Accord and as such represent policy positions taken by countries during the 2009–2016 Conference of Parties sessions. Importantly, when we examined the small number of countries who explicitly stated emissions targets in the Copenhagen Accord (UNFCCC 2009) for which Awareness data were also available (representing a 1-year lag between opinion and emissions targets), we found qualitatively similar effects (see Section 3 for further details). For these countries, Copenhagen Accord emissions targets were strongly predictive of Paris Accord targets, $B = 0.64$, 95% CI [0.19, 1.23], $r = .63$ [.19, .89], $p = .04$, demonstrating consistency between the 2009 and 2016 emissions targets for countries which were signatories on both agreements. Finally, it is worth noting that research has shown that in aggregate, environmental attitudes appear to be relatively stable across time, with attitudes varying little within many countries across a 17-year time period (Franzen and Vogl 2013).

The indicators for CO_2 emissions per capita, GDP per capita, governance indicators and climate risk were also all drawn from Lee et al. (2015). As such, these measures are also 2007–2008 values. However, when we reanalysed the data with newer CO_2 emissions per capita, GDP per capita and Governance indicators, we obtained almost identical results. We were unable to obtain newer climate risk indicators, though we address this limitation in Section 3.1.

3 Results

The descriptive statistics for each of the variables used in our analyses are presented in Table 1. Note from the values in Table 1 that the average proportion of the population perceiving climate change as a threat is substantially higher than the average proportion of the population aware of climate change. This is due to a sampling issue. Only people who indicated awareness of climate change were asked the question about perceived threat, and therefore, the higher level of perceived threat (cf. awareness) is not surprising. A complete list of each country included in our analyses as well as their proportion of awareness of climate change and emissions reduction targets are reported in Table S1 in the supplementary material available online.

Figure 1 shows the relationship between climate change awareness and emissions reduction targets. As can be seen in the figure, there is a robust positive relationship between the public awareness of climate change and government set CO_2 emissions reduction targets borne out by both the Pearson (r) and Spearman (r_s) correlation coefficients. To pre-empt the results of the regression analyses, the weak negative relationship between the perceived threat of climate change and emissions reduction targets disappears when important variables such as GDP are statistically controlled. Figure S1 in the supplementary material available online shows the correlation between these variables.

To further examine the relationship between public awareness and climate change mitigation targets, we computed several different models. Table 2 shows the results of the regressions for each of the models. The simplest model regressed CO_2 emissions reduction targets on public awareness controlling for only 2007 CO_2 emissions per capita in each country. The most complicated model also controlled for GDP per capita in US dollars, the average World Governance Indicator and each country's vulnerability to climate change (as measured by experienced sea level rise, extreme weather events and reduction in agricultural productivity in Lee et al. 2015).

As can be seen in Table 2, there is a clear relationship between public awareness of climate change and government-set CO_2 emissions reduction targets, even after

Table 1 Descriptive statistics for independent measures, control variables, climate change vulnerability measures and CO_2 emissions reduction targets in 2016

	Number	Mean (SD)	Minimum	Maximum
Independent measures				
Awareness (%)	72	58.86 (21.50)	20.62	98.92
Threat (%)	72	80.33 (15.55)	36.09	98.59
Control variables				
CO_2 emissions per capita (metric tons)	72	3.81 (5.27)	0.02	27.94
GDP per capita ($USD)	72	8350.06 (15,615.57)	127.12	82,294.16
Average World Governance Indicators (aggregate index)	72	− 0.12 (0.40)	− 0.85	0.87
Extreme weather (persons affected per 100,000)	72	1377.78 (8240.40)	0.00	63,260.00
Sea level rise (persons affected per 100,000)	72	1167.63 (3927.80)	0.00	26,390.00
Agricultural productivity loss (persons affected per 100,000)	72	1104.75 (5533.42)	0.00	47,040.00
CO_2 emissions reduction targets				
Unconditional (% reduction)	72	16.88 (15.38)	0.00	65.50
Conditional (% reduction)	54	32.19 (16.97)	10.00	89.00

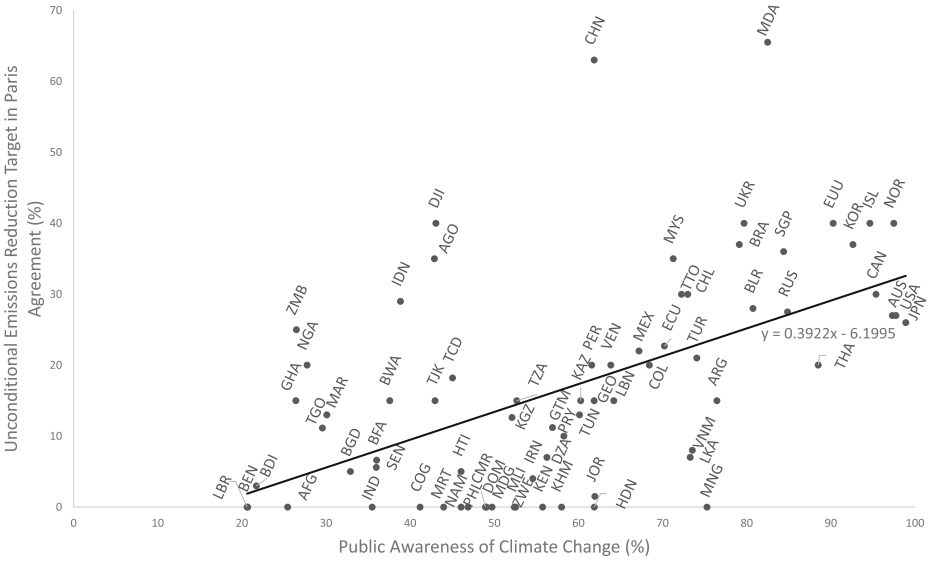

Fig. 1 The relationship between public awareness of climate change and unconditional emissions targets specified in the Paris Agreement, $r = .548$, $r_s = .567$, $ps < .001$

statistically controlling a wide range of relevant variables. Indeed, the relationship remained small-moderate even after controlling for the GDP of each country, as well as governance and climate change vulnerability indicators. It should be noted that the estimates of the variance explained by awareness in Table 2 (r^2 change) are likely conservative estimates of the extent of the relationship, as at least some of the controlled variables contain elements of the likely mechanism for the proposed relationship. For example, controlling for GDP allows for an estimate of the relationship when the wealth of countries is held constant. This is important as rich countries have greater means to combat climate change. However, public education tends to be higher in countries with greater GDP, and one plausible mechanism for the relationship between awareness and climate change mitigation is that public education improves awareness of key issues such as climate change and also of mechanisms by which the public can influence societal change (e.g. by voting patterns, petitions). Similarly, World Governance Indicators include factors such as the voice and accountability of the country's government, which is likely a key mechanism for the public to influence governmental decisions. Thus, we suggest that the figures in Table 2, especially those of models 3 and 4, likely represent the lower bound of the relationship between public awareness and CO_2 emissions reduction targets, while model 1 represents the upper bound of such a relationship. In sum, awareness of climate change likely explains somewhere between 6.0 and 12.4% of the variance in governmental emissions targets. The unstandardized regression coefficients presented in Table 2 suggest that for every one percentage point increase in awareness of climate change, it corresponds to an increase of between 0.262% (model 4) and 0.330% (model 1), on average, in emissions reduction targets.

In contrast, the relationship between the proportions of a country's populace who perceive climate change to be a serious threat to themselves does not appear to be related to emissions reduction targets. Indeed, the proportion of variance explained in model 1 by perceived threat

Table 2 Regression models tested the relationship between public awareness of climate change (2007) and government set CO_2 emissions reduction targets (2016) in the Paris Agreement after controlling for country level variables. Results include both standardised (β) and unstandardized (B) regression coefficients [95% CI's]. Awareness and Perceived Threat were analysed in separate regressions

	Model 1			Model 2			Model 3			Model 4		
	β	B	p	β	B	p	β	B	p	β	B	p
Control variables												
CO_2 emissions per capita	0.432**	1.261** [0.832, 2.274]	.002**	0.241*	0.704* [0.264, 1.906]	.034*	0.226*	0.660* [0.212, 1.855]	.043*	0.181	0.529 [0.097, 1.48]	.059
GDP per capita ($USD)				0.306**	0.001** [0.000, 0.001]	.005**	0.208	0.001 [0.000, 0.001]	.109	0.223	0.001 [0.000, 0.001]	.085
Average World Governance Indicator							0.133	5.069 [− 6.030, 15.023]	.339	0.160	6.079 [− 5.343, 15.679]	.259
Experienced sea level rise										− 0.033	− 0.001 [− 0.001, 0.003]	.473
Extreme weather events										0.422**	0.001** [− 0.024, 0.001]	.007**
Agricultural productivity loss										− 0.283	− 0.001 [− 0.004, 0.008]	.081
Predictor variable												
Awareness	0.461**	0.330** [0.132, 0.531]	.001**	0.401*	0.287* [0.054, 0.520]	.024*	0.393*	0.281* [0.049, 0.531]	.021*	0.366*	0.262* [0.043, 0.544]	.032*
r^2 change		0.124			0.077			0.072			0.060	
Adj r^2		0.291			0.291			0.281			0.392	
Perceived threat	− 0.193	− 0.191 [− 0.432, 0.103]	.181	− 0.129	− 0.128 [− 0.416, 0.193]	.455	− 0.155	− 0.153 [− 0.464, 0.166]	.375	0.010	0.010 [− 0.005, 0.008]	.930
r^2 change		0.035			0.014			0.020			0.001	
Adj r^2		0.199			0.225			0.226			0.325	
n		72			72			72			72	

Dependent variable was unconditional emissions reduction targets. The 72 observations comprised 71 countries and 1 region, the European Union

*$p < .05$; **$p < .01$

Undertaking model 1 with Copenhagen Accord targets for the dependent measure resulted in qualitatively similar results, e.g., for awareness, $B = 0.38$ [0.16, 1.46], r^2 change = .31, $p = .09$. Models with additional controls were not undertaken as the number of countries with Copenhagen targets was quite small, severely limiting the *df* of analyses.

is small and non-significant and declines to virtually 0 when other factors are controlled. Unlike awareness, threat of climate change would seem to bear little relationship to CO_2 emissions reduction targets. Repeating these analyses with reduction targets that were conditional upon other factors (e.g. financial support from other countries) yielded no significant relationships (r^2s < .022, ps > .27).

In a separate analysis, we also examined the relationship between perceived threat and emissions reduction targets using an alternative approach. The proportions of threat used in the primary analyses represented the proportion of people aware of climate change who also felt threatened by it. It is possible to compute instead a proportion of the total population of the country who felt threatened by climate change by multiplying the proportion of people aware of climate change by the proportion of people threatened by climate change. Repeating the analyses with this measure of threat produced results similar to the primary analyses. Specifically, all models remained non-significant for the relationship between threat and emissions reduction targets. We include the analyses using this threat measure in the supplementary materials for completeness (Table S2).

3.1 Robustness checks

To assess the robustness of our results, we undertook a number of supplementary analyses. First, we calculated Cook's D_i for the regression analyses (Cook 1977). We observed no D_i greater than 1 (Cook and Wesberg 1982) or the more conservative value of $n/4$ (0.54; Bollen and Jackman 1990) for models 1–3, indicating a lack of highly influential data points in the analyses. Model 4 yielded two countries with high D_i values—China with a D_i of 293.18 and India with a D_i of 18.96—indicating that they may be highly influential cases. Excluding one or both of these cases from the analyses did not alter the findings and in fact strengthened the findings slightly.

To further investigate the potential for outliers and highly influential cases, we undertook a delete-one jackknife procedure on the data (Wu 1986). This method is a special case of bootstrapping in which the analysis is repeated a number of times equal to the number of cases in the analysis, each time with a different single case removed from the analysis. The jackknifed unstandardized regression coefficients for awareness varied from 0.26 to 0.36 for model 1, 0.19 to 0.32 for model 2, 0.19 to 0.31 for model 3 and 0.16 to 0.29 for model 4, all of which were within the 95% CIs for the unjacknifed models.

We also undertook regression analyses substituting the Purchasing Power Parity (PPP) of GDP per capita as obtained from the St. Louis Federal Reserve Bank (http://fred.stlouisfed.org) for GDP per capita in US dollars. Results for these analyses were almost identical to those reported above and, in fact, were slightly stronger. A summary of these analyses can be found in Table S3 in the supplementary material available online. We also repeated the primary analyses using newer CO_2 emissions per capita data from 2014 , GDP per capita in $USD from 2016 and World Governance Indicators from 2014 as drawn from the World Bank (https://data.worldbank.org/indicator). Results from these analyses were also virtually identical to the analyses reported here. Summaries of these analyses can be found in Table S4 in the supplementary material available online. We were unable to source more recent climate risk indices. While we acknowledge that using newer climate risk data may weaken the results slightly, given the robustness of the reported analyses, we expect that analyses employing such data would be relatively similar to those presented here.

4 Discussion

We investigated the relationship between the proportion of the population whom were aware of, or perceived threat from, climate change within a country and that country's stated CO_2 emissions reduction targets in the Paris Agreement. Analyses show that unconditional climate change reduction targets are positively related to public awareness of the issue. Each percentage point that awareness rises was associated with between 0.262 and 0.330% higher emissions reduction targets. This implies that a hypothetical increase in public awareness of 10% would be associated with a 2.62 to 3.30% average increase in emissions reduction targets. These results, though correlational, are encouraging. Many public awareness campaigns and psychological interventions rest upon the critical assumption that by increasing awareness at the individual level, collective or cumulative action will also increase. Had this relationship been absent, it would all but rule out the effectiveness of such interventions. Although we cannot state that awareness causes governmental action, our data suggests no evidence for a lack of relationship (or worse a negative relationship) between these variables. Certainly, the results suggest that increasing public acceptance of climate change is unlikely to result in unintended backfire effects.

The results from the analysis of public perception of the threat of climate change, however, are more complicated. The results seem to imply that the perceived threat posed by climate change bears little relationship to emissions reduction targets. However, high fear-low efficacy messages can produce defensive psychological responses that undermine message effectiveness (Witte and Allen 2000), and, specifically, research has shown that fearful messages are ineffective at motivating climate change mitigation action (O'Neill and Nicholson-Cole 2009). One reason for the observed lack of a relationship in the present study may be that while perceived threat was measured, self-efficacy to deal with such a threat was not. Previous research has shown self-efficacy to be an important moderator of the effectiveness of fear-based messages. That is, fear-based messages are more effective when recipients perceive that they can take action to respond to a threat (high self-efficacy) than when recipients feel they are powerless to respond to a threat (low self-efficacy; O'Neill and Nicholson-Cole 2009). As the present data only speak to the perceived threat posed by climate change to the participant and their families, it is likely the individuals in the sample possess varying degrees of perceived self-efficacy, which may explain why no systematic relationship was observed. As such, we suggest that further research is needed to understand the relationship between perceptions of threat from climate change and public policy responses, including whether the relationship is moderated by perceived self-efficacy.

Importantly, our results also suggest that the relationship between awareness and mitigation targets is only present for unconditional targets set by countries in the Paris Agreement, while conditional targets bear no relationship to public awareness or perceptions of threat. This may imply that conditional targets primarily reflect external factors (e.g. international pressure) rather than internal, country-level factors such as public awareness of climate change. As unconditional targets are preferable in ensuring that catastrophic climate change is averted (because there is a greater chance they will be met), fostering public awareness of the issue appears to be a worthwhile goal. Perhaps to the extent that governmental mitigation targets are associated with public awareness, these relationships appear to only hold when governments have the required financial and technological resources required to implement effective climate change mitigation policies.

We note that the present study is limited in that self-reported awareness of climate change does not necessarily go hand-in-hand with belief in the issue and, in fact, in the USA, belief may be most divided along socio-political lines amongst those with the greatest scientific literacy (Kahan et al. 2012) or self-reported knowledge of climate change (Stern 2012). If increased division in belief occurs at the highest levels of knowledge, we would expect to see no relationship between awareness and emissions reduction targets. Empirically, this is not borne out in the data. The cultural cognition effect has primarily been established in politically polarised contexts such as the USA, and from a theoretical perspective, the effects of cultural cognition should be more pronounced where culture is more strongly divided (Kahan and Braman 2006). It is therefore possible that the division at higher levels of knowledge may not occur in all countries. While the present data indicate awareness as an important factor associated with climate change action at a governmental level, we suggest that continued efforts to simultaneously foster belief in climate change are also essential.

We addressed a key untested assumption present in the literature: that public awareness of climate change should lead to greater governmental action to mitigate it. Consistent with this assumption, we found that public awareness of climate change is positively related to governments' emissions reduction targets. However, public perception of the personal threat posed by climate change is not associated with higher emissions targets. Science communicators may benefit from focusing on raising public awareness of the issue of climate change.

Data accessibility This study is a reanalysis of data presented in Lee et al. (2015) and Rogelj et al. (2016). The data are available from http://www.nature.com/nclimate/journal/v5/n11/full/nclimate2728.html?foxtrotcallback=true and https://images.nature.com/full/nature-assets/nature/journal/v534/n7609/extref/nature18307-s1.pdf respectively

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