

Your opinion on climate change might not be as common as you think

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Political and media debate on the existence and causes of climate change has become increasingly factious in several western countries, often resting on claims and counter-claims about what most citizens really think. There are several well-established phenomena in psychology about how people perceive the prevalence of opinions, including the false consensus effect¹ (a tendency to overestimate how common one's 'own' opinion is) and pluralistic ignorance² (where most people privately reject an opinion, but assume incorrectly that most others accept it). We investigated these biases in people's opinions about the existence and causes of climate change. In two surveys conducted 12 months apart in Australia ($n = 5,036$; $n = 5,030$), respondents were asked their own opinion about the nature of climate change, and then asked to estimate levels of opinion among the general population. We demonstrate that opinions about climate change are subject to strong false consensus effects, that people grossly overestimate the numbers of people who reject the existence of climate change in the broader community, and that people with high false consensus bias are less likely to change their opinions.

Our opinions about the existence and drivers of climate change influence our environmental behaviours and support for climate-change mitigation and adaptation policy^{3–6}. There are many determinants of these opinions: they may reflect social identity needs⁷, cultural values⁸, political identity and allegiances⁹, or desires to maintain prevailing social systems and institutions¹⁰. These in turn may shape our opinions of what others in our community think: our consensus estimates reflect our own thinking on the matter. However, our perception of what the broader community thinks is a dynamic process: these perceptions can reinforce our own patterns of thinking, or convince us to think differently¹¹. The contested nature of climate change in political and public media spheres underscores the importance of understanding whether and how errors in estimating others' thoughts operate and perpetuate in the context of climate change, both at individual and societal levels.

A false consensus effect operates when estimates of consensus with one's position exceed estimates of those holding other positions^{1,12}. The effect crosses domains, from death penalty and gun regulation¹³, to water conservation¹⁴. The effect is highly reliable and of moderate magnitude¹⁵. False consensus may occur for several reasons: we tend to socialize with like-minded people, and their opinions are more readily accessible when we are asked to estimate what people in our community are thinking; and it may serve our need for social support, particularly when we hold opinions or beliefs that are unpopular, unpalatable or that we are uncertain about¹⁶. False consensus effects influence behaviour¹⁷, so it is important also to assess whether fluctuating opinions about

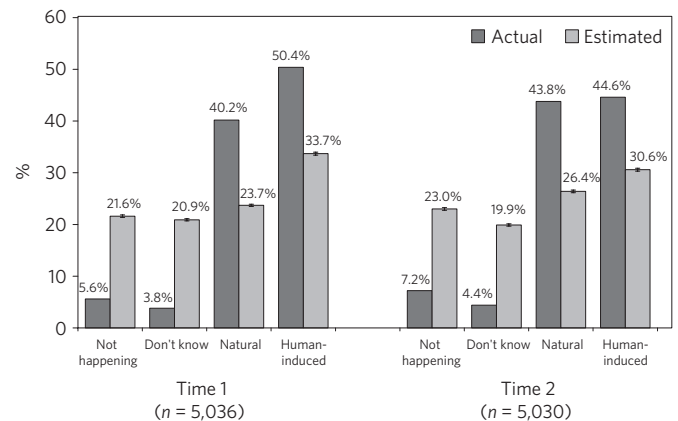


Figure 1 | Actual and estimated percentages of community-wide agreement with each statement. Observe that in each case the error bars, denoting s.e.m., do not overlap with the actual percentage, indicating that each averaged estimated percentage was significantly different from the actual percentage.

climate change are linked to false consensus. High levels of false consensus may mean that opinions are more resistant to change, although this has yet to be empirically tested.

A concept that is different from, although related to, false consensus is pluralistic ignorance, in which most group members privately reject an opinion but assume incorrectly that most others accept it. This in turn provides support for an opinion or a norm that may be actually disliked or disavowed by most people. Each individual errs in judging the sentiments of the plurality². Studies of pluralistic ignorance are typically limited to cases where a minority position is misperceived as being the majority position—a form of absolute pluralistic ignorance. A more subtle form, relative pluralistic ignorance, exists where there is a marked misperception of opinion distribution, although not to the point of misconstruing the mode¹¹. As with false consensus, pluralistic ignorance arises from cognitive and motivational biases in information processing, but social and cultural processes are also critical. Social and political groups, economic structure, cultural values and especially the media provide indicators on which to base estimates of public sentiment. However, these information sources can also provide misleading or false information cues, compounding individual cognitive bias¹¹. For instance, systematic biases in media reporting can lead to collective distortions about the popularity of certain opinions¹⁸.

We tested for the following hypotheses: the perceived prevalence of opinions about climate change will be subject to false consensus

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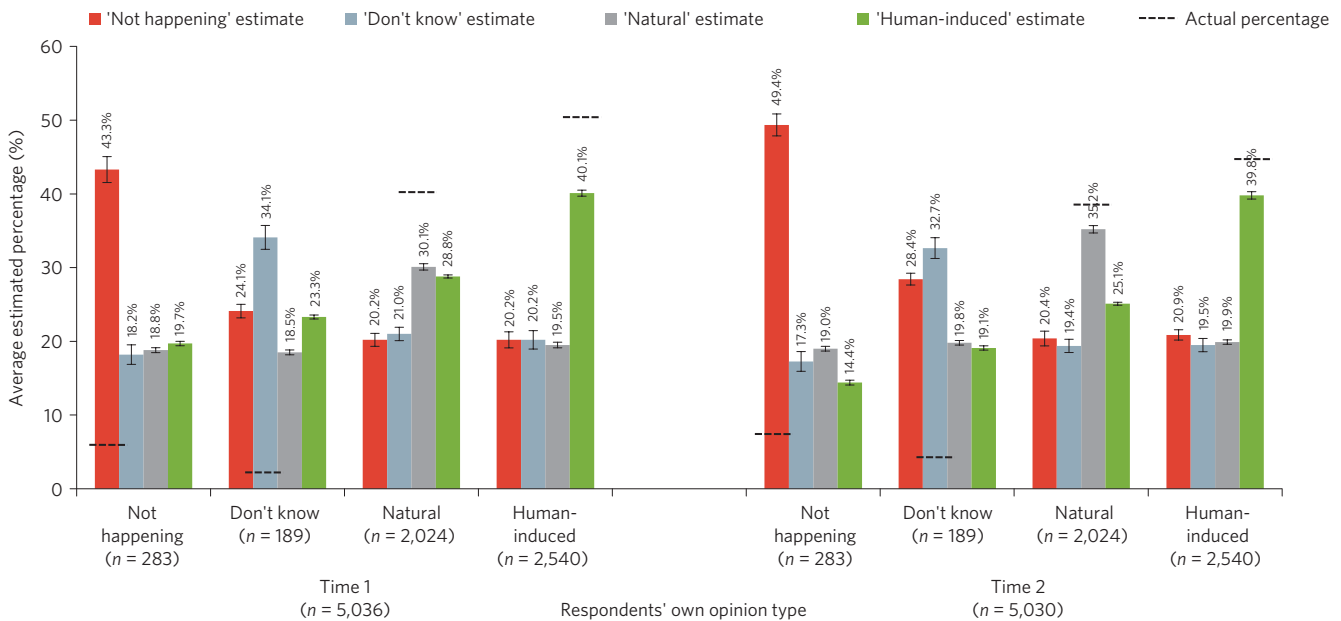


Figure 2 | Estimated percentages of community-wide agreement with each statement broken down by each opinion type. Each opinion type, on average, estimated community consensus with their own opinion significantly higher than did other groups. At T1, moderate effect sizes were found for the ‘not happening’: $t(5, 034) = 23.03, p < 0.001, \eta^2 = 0.10$; ‘natural’: $t(5, 034) = 25.07, p < 0.001, \eta^2 = 0.11$; and ‘human-induced’ opinion types: $t(5, 034) = 23.46, p < 0.001, \eta^2 = 0.10$. A small effect was found for the ‘don’t know’ opinion type: $t(5, 034) = 12.65, p < 0.001, \eta^2 = 0.03$. At T2, there were large effects for the ‘not happening’: $t(5, 028) = 30.80, p < 0.001, \eta^2 = 0.16$; ‘natural’: $t(5, 028) = 32.27, p < 0.001, \eta^2 = 0.17$; and ‘human-induced’ opinion types: $t(5, 028) = 31.93, p < 0.001, \eta^2 = 0.17$. A small effect was found for the ‘don’t know’ opinion type: $t(5, 028) = 13.47, p < 0.001, \eta^2 = 0.03$. Error bars denote s.e.m.

effects (that is, on average, people will overestimate the community prevalence of their own opinion); the perceived prevalence of those rejecting the existence of climate change will be subject to pluralistic ignorance effects (that is, on average, people will overestimate the prevalence of climate-change rejection in the broader community); and those with high false consensus in the first survey will be less likely to change their opinion than others in a follow-up survey.

Figure 1 reveals that actual percentages of climate-change opinions differed markedly from estimated percentages. On average, people overestimated the proportion of people who were of the opinion that climate change was ‘not happening’ or ‘didn’t know’, and underestimated the proportion of people who believed climate change was either ‘natural’ or ‘human-induced’. The effect was significant and evident in both surveys.

Actual and estimated levels of opinion were analysed by each opinion type (Fig. 2). Here, the horizontal axis shows the actual opinion type of the respondents. The bars indicate the average in-group estimates of how prevalent they thought each opinion was. In the Time 1 (T1) survey, the ‘not happening’ group estimated (on average) that 43% of the rest of the community agree with their opinion, but estimated that only 20% of the community agree that climate change is ‘human-induced’. Every group exhibited the false consensus effect. That is, each group’s average estimate of its own opinion type exceeded the estimation made by other groups. Furthermore, each group estimated its own opinion as ‘the most’ prevalent opinion in the community (refer to Fig. 2 caption). These findings were replicated in the Time 2 (T2) survey, with even stronger effects.

We tested the accuracy and direction of estimated consensus for each opinion type by comparing mean estimated percentages of own opinion with actual percentages (results are based on T2 survey data; results for T1 survey data are included in Supplementary Information). Those holding minority opinions: ‘not happening’ ($M = +42.16\%$, $s.d. = 28.48$) and ‘don’t know’ ($M = +28.25\%$, $s.d. = 20.92$), overestimated the amount of actual agreement with

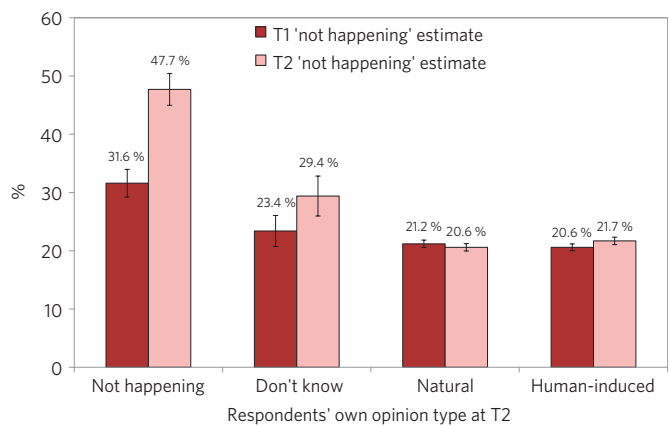


Figure 3 | Estimated levels of community doubt in climate change at T1 and T2 based on respondents' own opinion type at T2 (n = 1,355). Error bars denote s.e.m.

their own opinion. In contrast, those whose opinions together formed the majority: ‘natural’ ($M = -8.65\%$, $s.d. = 21.25$), and ‘human-induced’ ($M = -4.83\%$, $s.d. = 21.17$), underestimated levels of agreement with their own opinion. The overestimation of minority opinions was greater than the underestimation of majority opinions ($F(3, 5026) = 719.48, p < 0.001, \eta^2 = 0.30$), suggesting the pattern of over- and underestimation was not simply a product of a tendency for individuals to regress to the mean in their ratings.

To test for pluralistic ignorance effects we calculated the deviation of estimated levels of the ‘not happening’ opinion, for each opinion type, with the actual percentage of people selecting this opinion (7.2%; results are based on T2 survey data; results for T1 survey data are included in Supplementary Table S1). Deviation of estimated levels of ‘not happening’ from actual levels indicates that ‘all’ groups overestimated the proportion of

Table 1 | False consensus and stability of opinions for all respondents ($n = 1,355$), and for those who initially thought climate change was not happening ($n = 68$).

	All respondents		'Not happening' opinion type	
	Low false consensus	High false consensus	Low false consensus	High false consensus
Consistent opinion	$n = 278$ 48.5%* 66.0%†	$n = 295$ 51.5% 78.9%	$n = 9$ 29.0% 32.1%	$n = 22$ 71.0% 55.0%
Inconsistent opinion	$n = 143$ 64.4% 34.0%	$n = 79$ 35.6% 21.1%	$n = 19$ 51.4% 67.9%	$n = 18$ 48.6% 45.0%

*Within consistency type. †Within consensus type.

people who think climate change is not happening. Respondents who themselves nominated the 'not happening' opinion most grossly overestimated ($M = +42.16\%$, $s.d. = 28.48$), followed by 'don't know' ($M = +21.24\%$, $s.d. = 19.81$). Those of the 'natural' ($M = +13.18\%$, $s.d. = 15.15$) and 'human-induced' ($M = +13.37\%$, $s.d. = 15.53$) opinion types had lower levels of overestimation, $F(3, 5026) = 334.20$, $p < 0.001$, $\eta^2 = 0.17$.

Separate analyses were conducted on the 1,355 respondents who took part in both T1 and T2 surveys. Their overestimation and underestimation patterns were stable across the two surveys, with slight changes in actual opinion closely mirrored by slight changes in the estimated prevalence of opinions (see Supplementary Fig. S1). However, when changes in estimated levels of those who think climate change is 'not happening' were broken down by one's own opinion type (Fig. 3) we see a sharp increase in estimated levels of the 'not happening' opinion by those who themselves chose the 'not happening' opinion type at T2 (column 1).

Finally, to test for the effect of false consensus on the stability of people's opinions, a quartile split was performed to identify two groups: respondents with 'high' levels of initial false consensus (same-opinion estimate of greater than 50% for the T1 survey, $n = 374$); and respondents with 'low' levels of initial false consensus (same-opinion estimate of less than 20% for the T1 survey, $n = 421$). High false consensus respondents were significantly more likely to have the same opinion in the T2 survey than were low consensus respondents: $\chi^2(1, n = 795) = 16.2$, $p < 0.001$, $\phi = -0.14$ (Table 1). The analysis was repeated using false consensus as a continuous variable. On average, the initial same-opinion estimate of those who did not change their opinion ($M = 36.77$; $s.d. = 20.94$) was higher than those who shifted their opinion ($M = 33.27$; $s.d. = 21.80$; $t(1, 353) = 2.69$; $p < 0.01$).

For only those respondents who initially thought climate change was 'not happening', those with 'high' levels of false consensus were significantly 'less' likely to change their opinion in the T2 survey than were those with initially 'low' levels of false consensus: $\chi^2(1, n = 68) = 3.47$, $p = 0.05$, $\phi = -0.23$ (Table 1).

Our study implies: people estimate their 'own' opinion about climate change to be more common than other people estimate it to be; regardless of their own opinion, people generally and grossly overestimate doubt among the community that climate change is occurring; and those with high initial levels of false consensus are less likely to change their opinions about the causes of climate change than those with low false consensus. The projected prevalence of people who reject climate change deviates far from actual estimates, suggesting that false consensus functions as a social support mechanism for those holding minority and/or unpopular views about the causes of climate change. This social support interpretation is consistent with recent findings that those with sceptical views towards climate change have less attitudinal certainty about their position¹⁹. Furthermore, although privately

most people think the climate is changing, people of 'all' opinions overestimated the prevalence of those rejecting climate change, suggesting that a form of pluralistic ignorance is operating (note that this is relative rather than absolute pluralistic ignorance—for the latter to occur estimates would have to exceed 50%). This general overestimation of levels of climate-change rejection persisted over time, and 'increased' in the case of those who themselves reject climate change.

Media research suggests that the journalistic tradition of giving equal weight to both sides of a story, and the influence of big-industry opinion, have led the community to overestimate the number of people who doubt climate change is occurring, and have undermined the scientific consensus surrounding climate change^{20–23}. Media bias can also predict community attitudes towards contentious issues, in turn enhancing and entrenching false consensus effects²⁴. We note however that Australian media coverage of climate change is in many ways atypical²⁵. Testing the patterns found in this study in other countries would provide insight into the universality of consensus biases, and help assess the relative influences of psychological and cultural determinants. Notwithstanding, our results highlight the importance of presenting people with accurate information about 'actual' levels of consensus, not just with regards to the scientific community, but throughout the broader community itself. Leaving perceived estimates of doubt about climate change unchallenged risks perpetuating the myth of widespread scepticism, entrenching sceptical orientations and undermining adaptive responses to climate change.

Methods

Respondents consisted of a nationally representative sample of 5,036 Australian citizens in 2010 (Time 1 survey), and 5,030 Australian citizens in 2011 (Time 2 survey). A cohort of 1,355 respondents completed both surveys. Respondents completed online surveys through The Online Research Unit (ORU) (<http://www.theoru.com/>). The ORU is a research-only Internet panel provider with an active database of 300,000 respondents located throughout Australia and New Zealand. The ORU has QSOAP Gold Standard and Global ISO 26362 standard accreditations. Its recruitment and sampling methods are designed to capture a demographically representative sample of the Australian population (see Supplementary Information for details of the sample's demographics and representativeness).

Opinions about the causes of climate change were assessed with the question 'Which of the following statements best describes your thoughts on climate change?' Respondents selected one of the following four statements: 'I don't think that climate change is happening'; 'I have no idea whether climate change is happening or not'; 'I think that climate change is happening, but it's just a natural fluctuation in Earth's temperatures'; 'I think that climate change is happening, and I think that humans are largely causing it'. These last two statements distinguished between different perceived causes of climate change: natural (that is, non-human-induced) climate change, and human-induced, or anthropogenic, climate change. For ease of reporting, these statements are referred to as 'not happening', 'don't know, natural' and 'human-induced'.

Estimates of community opinions were measured by asking respondents to estimate the percentage of Australians they thought would agree with each of the belief statements. The four estimates were required to total 100% before

respondents were able to proceed to the next section of the survey. Following the method of ref. 26, the average estimated prevalence of own belief type was used as a proxy for the actual belief level.

Conventionally, consensus effects are measured dichotomously; whether it is a behaviour (engage versus not engage), or an attitude or belief (capital punishment versus anti-capital punishment). However, the case of opinions about climate change is not so straightforward. Simply asking whether one believes in climate change or not risks conflating an opinion that fails to accept climate change as a phenomenon, with an opinion that accepts climate change is happening but attributes it to natural fluctuations. Our findings suggest that people supporting these two views differ significantly from one another: those that think it is happening but natural engage in more pro-environmental behaviours, think the impacts of climate change will be more severe and feel a greater moral obligation to respond than do those who think climate change is not happening at all²⁷. Capturing the wide range of community views about climate change also had to be balanced against having so many response categories that the measure becomes unwieldy and uninterpretable. Hence, we used a categorical measure to distinguish between the not happening, don't know, natural and human-induced views. Further experimental testing suggests that this measure has strong predictive and criterion validity²⁸, and is strongly associated with political preferences²⁹, making biases and social influences in consensus estimates for these opinions relevant.

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Author contributions

Z.L. designed the studies, coordinated data collection, analysed the data and wrote the paper. I.W. contributed to all aspects of the paper, including project planning, study design, statistical analysis, and writing and revisions. S.M. contributed to the writing and revisions of this paper.

Additional information

Supplementary information is available in the online version of the paper. Reprints and permissions information is available online at www.nature.com/reprints. Correspondence and requests for materials should be addressed to Z.L.

Competing financial interests

The authors declare no competing financial interests.