

The ‘Scientific Consensus on Climate Change’: Doran and Zimmerman Revisited

*Murray Goot
Macquarie University*

According to a 2008 survey of members of the American Geological Institute human activity contributes significantly to changes in mean global temperatures. A review suggests that the findings derived from the survey are unlikely to be an artefact of the sampling. Nor is it likely that the results would have been substantially different if the question had referred explicitly to global warming or asked not just about whether human activity contributed significantly but also accounted for most of the rise in mean global temperatures.

Introduction

In 2008, Maggie Kendall Zimmerman, a student enrolled in a Master of Science in the Department of Earth and Environmental Sciences at the University of Illinois at Chicago, conducted an online survey designed to gauge the opinions of scientists on issues to do with climate change and global warming. The scientists were members of the American Geological Institute, ‘a nonprofit federation of 44 geoscientific and professional associations’ said to represent ‘more than 100,000 geologists, geophysicists and other earth scientists’ (Zimmerman 2008, 12).

Results

In the paper that emerged from this study, Zimmerman and her supervisor, Peter T. Doran, who devised the original questions on which the survey was based (Zimmerman 2008, 10), reported the results of ‘the two primary questions’ with which their survey had been concerned: ‘When compared with pre-1800s levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?’; and ‘Do you think human activity is a significant contributing factor in changing mean global temperatures?’ No fewer than 90% of respondents said ‘mean global temperatures have generally risen’ while 82% agreed that ‘human activity’ had been ‘a significant contributing factor in changing mean global temperatures’ (Doran and Zimmerman 2009).

Asked what they ‘consider[ed] to be the most compelling argument’ for their position, over 70% of those who thought human activity ‘a significant factor in changing mean global temperatures’ nominated ‘CO₂’. Of the relatively small number who thought human activity not ‘a significant

factor in changing mean global temperatures', over 50% nominated 'natural climate cycles' and nearly 30% said 'increased solar output' (Zimmerman 2008, 27-28).

The greater the respondent's 'expertise in the area of climate change' the greater 'the percentage of participants who thought 'temperatures have risen and that human activity is a significant driving factor' (Zimmerman 2008, 58). Of 'those who listed climate science as their area of expertise' and who had 'published more than 50% of their recent peer-reviewed papers on the subject of climate change', 96% said 'risen' in response to the first question and 97% said 'yes' to the second. 'It seems', the paper concluded, 'that the debate of the authenticity of global warming and the role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes'(Doran and Zimmerman 2009).

Method

Respondents in the survey, which was conducted between April 3 and April 17 2008 (Zimmerman 2008, 12), were drawn from a database said to cover 'all geosciences faculty at reporting academic institutions, along with researchers at state geological surveys associated with local universities, and researchers at US federal research facilities -US Geological survey, NASA, and NOAA (US National Oceanic and Atmospheric Administration) facilities; US Department of Energy National Laboratories; and so forth'. Everyone on the database, a number in excess of 12,000, was approached to participate in a professionally managed online survey designed to take no more than two minutes to complete; brevity, it was hoped, would 'maximise the response rate' (Doran and Zimmerman 2009; Zimmerman 2008, 12-13).

Overwhelmingly, those listed on the database appear to have been scientists working in North America; hardly surprising given its provenance. A breakdown of respondents showed that 90% were from the US, 6% were Canadian, and 4% came from 21 other countries. Concentrated in geochemistry (15.5%), geophysics (12%), and oceanography (10.5%), the survey also netted scientists working in general geology, hydrology/hydrogeology, and palaeontology (each of these areas accounting for 5-7%). Climate scientists accounted for 5% of the respondents, but 8.5% of the respondents had published 50% or more of their peer-reviewed papers in the last five years on climate change. The authors note 'that the survey included participants with well-documented dissenting opinions on global warming theory' (Doran and Zimmerman 2009).

Evaluation

A number of climate sceptics – Bob Carter, John Christy, Richard Lindzen and Patrick Michaels, among them - have disparaged the paper's findings (Anon 2011). Criticism of the paper has focused on the second of the two findings, the claim that '97% of climate scientists' agree that the planet is experiencing anthropogenic climate change; specifically, the criticisms have focused on the nature of the sample, the number of respondents in the sample regarded as most expert in

the area, and especially on the wording of the questions. The first of the two findings that showed 90% agreeing that ‘compared with pre-1800s levels’ the ‘mean global temperatures have generally risen’ rather than ‘fallen, or remained relatively constant’ is relatively uncontroversial; protagonists on both sides of the debate on anthropogenic global warming can readily agree to that.

Sampling

The main criticism of the sampling – a criticism that could be used to undermine responses to both questions not just the second - was not that the respondents were overwhelmingly North American, as they were; not that the sample was dominated by people not wholly or even mainly engaged in climate science, which is equally true; but that the respondents ‘self-selected’.

What does this mean and how might it be a problem? There is a sense in which respondents can always be said to self-select; they self-select by virtue of agreeing to take part in the survey. And of the 10, 257 people approached to take part in this survey, 3,146 or 30.7% chose to participate. But this, presumably, is not what self-selection is meant to signify here; the response rate, which the authors of the study say is ‘typical’ of Web-based surveys, is not what the critics have in mind. Self-selection here more likely refers to the act of getting one’s name on to one of the lists from which the database was constructed. In the ordinary course of events what sample surveys try to do is give everyone in a given population – here, the population of (North American) earth scientists – an equal chance of being approached. The key question, therefore, is what proportion of this population is enumerated in the lists of ‘all geosciences faculty’, etc. from which the respondents were drawn. Doran and Zimmerman don’t address this question, nor do their critics. The best one can say is that the authors, through their silence, might be taken to imply that the lists provide a pretty comprehensive coverage of the population and that their critics don’t come up with anything substantial to challenge this; for example, the critics produce no evidence that self-selection might have biased the sample in favour of believers in global warming. But the extent to which the lists are themselves representative of earth scientists remains an open question.

The number of respondents for the survey as a whole is large; leaving aside the question of response rates, 3,146 is a large sample by almost any measure. And with 82% of respondents as a whole agreeing that ‘human activity is a significant contributing factor in changing mean global temperatures’ we might reasonably conclude that in this survey the proposition in question was overwhelmingly supported. But it is not the overall number on which the critics have focused. Rather, it is the sub-sample of climate scientists – defined as those who had both ‘nominated climate science as their area of expertise’ and ‘published more than 50% of their recent peer-reviewed papers on... climate change’ - that has attracted the attention of the sceptics. Among these respondents, of which there were 79, no fewer than 97% agreed that ‘human activity is a significant contributing factor in changing mean global temperatures’.

Since a sub-group of 79 looks small, a number of points ought to be noted. First, Doran and Zimmerman don't suggest that anyone should take the figure of 97% (more precisely, 97.4%) literally. While they don't say it explicitly, there is nothing in their report to suggest that they regard their figure as anything other than an estimate of the true figure; this holds for any survey figure. Second, they note a pattern in their data that suggests that whatever the true figure might be for those who nominate climate science as their area of expertise and have published more than 50% of their recent peer-reviewed papers on climate change, the figure is likely to be greater than the corresponding figure for any other group. Third, even if the true figure turned out to be not as large as 97%, it is certain to be very large. In a simple random survey the standard error for a sample of 79, assuming a 95% confidence interval, would be eleven percentage points; so we might interpret the result, within this confidence band, as falling somewhere between 86% and 100%. If one thinks that 'consensus' requires something like unanimity (a synonym offered by Merriam-Webster's Dictionary) the difference between 97% and some lower figure might matter. But if one thinks that the term 'consensus' requires some large number even if it is well short of 100% it doesn't. One meaning ascribed to 'consensus' in The Macquarie Dictionary is 'majority of opinion'. In this sense a figure of 86%, or even something a little lower - making allowance for some design effect, like clustering - is very impressive; it's overwhelmingly the majority.

Question wording

This brings us to the wording of the question. According to one critic the question 'Do you think human activity is a significant contributing factor in changing mean global temperatures?' is a question to which 'most climate scientists' would say yes 'even if they aren't concerned about future climate change'. On this view, the question was deficient at every turn. The phrase 'human activity' is much too general: since 'human activity' might refer to 'numerous actions which can affect the climate other than greenhouse gases' someone 'who believes that ANY human activity can change the climate must answer yes to this question'. The phrase 'significant contributing factor' is much too vague: 'What makes something significant? If 5% of recent temperature change is caused by mankind, is that significant? How about 10%?' But the phrase 'changing mean global temperature' is the 'most problematic part ... because there is no indication of how much temperature change is considered worth answering "yes" - '[m]any climate skeptics believe that human activities have increased the temperature of the planet, but not by any significant amount' - and because "changing" should be changed to "increasing"'. In short, 'the phrasing is so poor' that 'the entire study' is 'flawed because of it.' A 'much better question', one that would remedy each of these faults, would be: 'Do you believe that anthropogenic greenhouse gas emissions were the primary factor (50% or more) in the observed mean global temperature increase since the mid-20'th century?' (Anon 2011; emphasis in the original).

Not only is the Doran and Zimmerman phrasing open to question; so, it is said, are their bona fides (Anon 2011). As with most of those involved in establishing the existence of a scientific consensus, Doran and Zimmerman set out with the policy implications of their quest very much in view. As they say in their paper, if one accepts the evidence of a scientific consensus the challenge then becomes ‘how to effectively communicate this fact to policy makers and to a public that continues to mistakenly perceive debate among scientists.’ But if Doran and Zimmerman have an agenda so too do most of their critics for whom the point of showing that there is no consensus is to persuade policy-makers and the public that little if anything needs to be done. The point, however, is not to scrutinise the motives for pursuing certain lines of research, whether in favour or against the consensus; the point, rather, is to establish whether the means adopted are any good and where the pursuit leads.

To get some sense of how damaging the criticisms of their question might be we can compare responses to the Doran and Zimmerman question with responses to similar questions posed in other surveys of climate scientists. In the Bray and von Storch surveys of climate scientists in 1996 (mail; n = 546), 2003 (internet; n = 558) and 2008 (internet; n = 375), respondents were questioned about both global warming and anthropogenic global warming. Asked in 1996 and again in 2003 whether ‘[w]e can say for certain that global warming is a process already underway’ the answer increasingly was that ‘we’ could: 62% agreed in 1996, 82% in 2003 (Bray and von Storch 2007, fig 28). In 2008, no fewer than 93% agreed ‘that climate change, whether natural or anthropogenic, is occurring now’ (Bray and von Storch 2008, fig. 20). That the proportion would have been much lower had the phrase ‘global warming’ been substituted by ‘climate change’ is to be doubted, given the distribution of opinion on ‘global warming’ in 1996 and 2003.

Asked ‘whether climate change is mostly the result of anthropogenic causes’, less than half (40%) of the respondents in 1996 said it was, but more than half (53%) the respondents in 2003 said it was (Bray and von Storch 2007, fig. 30). Moreover, three-quarters of the respondents (74% in 1996, 76% in 2003) agreed that ‘without change in human behavior, global warming will definitely occur sometime in the future’ (Bray and von Storch 2007, fig 31). In 2008, an even greater proportion (84%) was ‘convinced’ that ‘most of recent or near future climate change is, or will be, a result of anthropogenic causes’ (emphasis supplied). Indeed, on a seven-point scale of conviction that ran from one (‘none’) to seven (‘very much’), two-thirds of the respondents opted for either the sixth point on the scale (32%) or the seventh (35%) (Bray and von Storch 2008, fig. 21).

The results of the Zimmerman survey can also be compared to the results of a mail survey of 489 scientists, conducted between March 19 and May 28 2007 in the United States by Harris Interactive for the Statistical Assessment Service (STATS) at George Mason University. Respondents were members of the American Meteorological Society or the American Geophysical Union and the data weighted to correct for respondents whose chances of being included in the survey were greater by being members of both bodies. In this survey 97% agreed

that ‘global average temperatures’ had increased during the past century; 84% said they believed human-induced warming was occurring with only 5% denying it; and 74% agreed that ‘currently available scientific evidence’ substantiates its occurrence (Lichter 2008).

Conclusion

Concerns about the sampling and the number of respondents used in the Doran and Zimmerman study are secondary even when they are not misplaced. The key issue has to do with the wording of the questions. While the questions asked in Bray and von Storch aren’t exactly equivalent to the question ‘Do you believe that anthropogenic greenhouse gas emissions were the primary factor (50% or more) in the observed mean global temperature increase since the mid-20'th century?’ they are sufficiently close – and the distribution of responses are sufficiently clear – to suggest that the results reported by Doran and Zimmerman are unlikely, in any very material sense, to be misleading.

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