Can education make polarization on scientific topics worse?


In recent years, public opinion polling in the U.S. has revealed startling partisan and ideological divides on topics where scientific consensus is relatively strong. Some of this data has revealed a counterintuitive connection with education level. As a recent example, Gallup data reported in a New York Times article indicates that worry about climate change increases with higher education level among Democrats but decreases with higher education levels among Republicans (see right). This kind of data provokes many questions about what strategies work for building public support for policy solutions that could address problems like climate change. For instance, results like this run counter to the general presumptions that more information or education on a topic will lead to changed behaviors or to greater convergence in belief about scientific topics.

A new study published in The Proceedings of the National Academy of Sciences by Caitlin Drummond (University of Michigan) and Baruch Fischhoff (Carnegie Mellon University)
offers an expanded way to examine this problem using survey data from 2006 and 2010. In their paper titled, “Individuals with greater science literacy and education have more polarized beliefs on controversial science topics,” the authors analyze viewpoints on six controversial scientific topics: stem cell research, the big bang, human evolution, climate change, nanotechnology, and genetically modified (GM) food. The paper is important because it goes beyond public opinion polling on particular topics like climate change that may not be generalizable to other scientific issues. It also captures a wider range of respondent characteristics such as levels of science education and an index-based measurement of science literacy.

The authors find a so-called “funnel” effect is consistently demonstrated in public perception about most other scientific topics, with the exception of genetically modified foods. That is, the effect of increasing education level, science education, and science literacy leads to either greater divergence or persistent gaps in attitudes between respondents with different ideological views. What is perhaps more striking is that this funnel appears not just in general education level but also frequently with the level of science education level and science literacy. In the figure below, higher values on the vertical axis represent viewpoints closer to scientific consensus.

The results from Drummond and Fischhoff lend support to two behavioral science theories for why more knowledge does not necessarily change individual opinions. The first is an idea about motivated reasoning, which suggests that individuals with more knowledge are better able to interpret evidence in support of their preferred
conclusions. As the authors write, “better educated people are more likely to know when political or religious communities have chosen sides on an issue, and hence what they should think (or say) in keeping with their identity.” Another explanation is the miscalibration explanation, which theorizes that when individuals are exposed to new knowledge, their confidence increases faster than their actual knowledge. When we see stronger views expressed by the most ideological position (e.g., climate change), it’s possible we are seeing an interaction between the effects of miscalibration and motivated reasoning.

The authors are careful to point out that these results do not suggest a causal connection between education and polarization, so these should not be interpreted to suggest that education itself is the root of the problem. Indeed, upward sloping trends among all ideological groups occur for nanotechnology, GM foods, the big bang, and human evolution, suggesting education does have some effect on beliefs regarding scientific topics. Yet, the divergence between ideological positions is still striking for all but GM foods where perhaps ideological positions are less well known or consistent. A more appropriate interpretation is that education alone may not be able to overcome the influence of ideological or religious leaders on the most controversial scientific topics. One silver lining in these results is the expectation that as religious and ideological leaders take positions on issues that are in keeping with scientific consensus (such as the Pope Francis’ 2016 encyclical), we can expect beliefs to change and for them to change more strongly with more science literacy and education.

Threading the needle: Pathways to stay below 2°C


Even though most climate science news tends to be dire, one set of researchers intimate with emission trajectories and their effect on climate what it would take to achieve the Paris Agreement’s aspirational goal of limiting warming to 1.5°C. Given the global average surface temperature increase of 0.9°C since pre-industrial time to the present, Millar and colleagues (2017) consider a range of carbon emission budgets that allow for an additional 0.6°C of warming. Their analysis shows that limiting additional CO₂ emissions to about 200 GtC (billion tons of carbon) achieves this goal. If this is combined with aggressive non-CO₂ mitigation, then the remaining allowable budget for CO₂ goes up to about 240 GtC. The authors contend the stringent goal of 1.5 deg C is “not yet a geophysical impossibility”.
As shown in the Millar’s figure 2, the blue line is the standard IPCC RCP 2.6 scenario in all 3 panels which includes major emissions reductions beginning in 2010. Reality has exceeded the RCP2.6 path. This analysis updates the standard RCP2.6 with a start date in 2017 (green line) but otherwise utilizing similar emissions. The seven-year delay results in higher concentration and temperature by 2100 – the difference between the blue and green lines. The result for the 2017 (modified RCP 2.6 referred to by the authors as RCP2.6-2017) is very similar to a straight line reduction in emissions beginning in 2020 and reaching zero in the 2080s, indicated as a dashed purple line. RCP2.6-2017 allows for a mid century peak in temperature with a slight decline by 2100. The brown bar in (a) shows the projected emissions by 2030 if the Nationally Determined Contributions (NDCs) are adhered to. The right panel (c) shows the simple model results for the modified RCP2.6-2017. The median result for the RCP2.6-2017 is peak warming of 1.6°C above pre-industrial and a resulting warming of 1.5°C by 2100.

Millar and colleagues also find promise from what is emerging in China. While China was central to much of the increase in global emissions between 2000 and 2013, the question becomes one of its economic growth rate in the coming years combined with greater energy efficiency measures and deployment of cleaner energy sources. Improvement from China’s efforts coupled with the potential for aggressive mitigation efforts by other countries will set the still unknown timing for peak global emissions. In general, many studies make the point that the sooner peak emissions are reached, the rate of decline following peak becomes a more manageable task. The NDC goals from Paris, while an important step, fall short of the 2°C or better goal. The analysis in this study provides guidance that informs needed updates to the NDCs for global emissions to be consistent with the aspirational goals set at Paris – a remaining budget of 200 to 240 GtC.

A study also in 2017 focuses on new understanding of the Earth’s energy balance with important implications for future warming projections. Brown and Caldeira utilize satellite data to better evaluate climate models identifying ones that produce atmospheric and their radiative properties closer to satellite observations. The result is
shown in the figure below where the red line is showing results from Brown and Caldeira and the dashed blue line is showing the IPCC AR5 results for RCP 2.6, 4.5, 6.0, and 8.5.

The effect becomes more important for the higher emission scenarios where in RCP8.5 the effect is about 0.6°C above what was determined in the IPCC RCP8.5 by 2100 multi-model results. The Brown & Caldeira study also provided information on the equilibrium climate sensitivity (ECS) to a doubling of CO2. The IPCC AR5 estimated ECS range is much as it has been for decades – about 1.5 to 4.5°C. This work indicates that the ECS is likely higher signaling the need for greater emission reductions than previously thought to limit any desired limit to the Earth’s global average temperature above pre-industrial. When taken together the two papers offer better understanding of the climate system and allowable emission paths to achieve the desired Paris goals. Uncertainties in climate sensitivity and in carbon cycle feedbacks as well as better sorting of model results consistent with new findings offer both optimism and caution.