growing uncertainty about the stability of the West Antarctic Ice Sheet in the research community. A linear increase in yearly rate of contribution to SLR is assumed and integrated over the twenty-first century to arrive at the total ice-sheet contribution to SLR. These 95th percentile results are comparable to earlier semi-empirical models[13], but are larger than the 13.3 cm projected by the base case of Little *et al.*[3]. Comparisons are complicated by the fact that their base case assumes constant accumulation[3], and does not consider the possibility of ice-sheet collapse.

Comparing the methods is no less interesting than comparing the results. It's fair to say that Bamber and Aspinall[5] leave more of the modelling assumptions in the heads of the experts than Little *et al.*[3]. In consequence, results like those in Fig. 1 are directly interpretable without further assumptions. On the other hand, with SEJ, insight into the sources of uncertainty must come from the experts' rationales, so expert-informed modelling yields more quantitative insight. Is structured expert judgment science? Well, experts' performances are measured with standard statistical tools of hypothesis testing, based on their assessments of variables from their field to which answers are known *post hoc*. In this very real sense, the results of an SEJ are falsifiable, and are sometimes falsified. But the alternative approach means ignoring effects we cannot competently model, is this better science? SEJ is for quantifying uncertainty, not removing it. For that we must take measurements. ❐

Roger M. Cooke is at Resources for the Future, 1616 P Street NW, Washington DC 20036-1400, USA.
e-mail: cooke@rff.org

References
1. IPCC *Climate Change 2007: Synthesis Report* (eds Pachauri, K. & Reisinger, A.) 45 (Cambridge Univ. Press, 2007).
2. Krinner, G. & Durand, G. *Nature Clim. Change* **2,** 396–397 (2012).
3. Little, C. M., Oppenheimer, M. & Urban, N. M. *Nature Clim. Change* http://dx.doi.org/10.1038/nclimate1845 (2013).
4. Little, C. M., Urban, N. M. & Oppenheimer, M. *Proc. Natl Acad. Sci. USA* **110,** 3264–3269 (2013).
5. Bamber, J. L. & Aspinall, W. P. *Nature Clim. Change* **3,** 424–427 (2013).
6. Cooke, R. M. *Experts in Uncertainty* (Oxford Univ. Press, 1991).
7. Aspinall, W. P. A route to more tractable expert advice. *Nature* **463,** 294–295 (2010).
8. Goossens, L. H. J. & Kelly, G. N. (eds) *Radiation Protection and Dosimetry* **90** (special issue) 293–381 (2000).
9. Tuomisto, J. T., Wilson, A., Cooke, R. M., Tainio, M. & Evans, J. S. *Epidemiology* **16**, S74–S75 (September 2005).
10. Tyshenko, M. G. *et al. Int. J. Risk Assess. Manage.* **16,** 48–77 (2012).
11. Rothlisberger, J. D., Finnoff, D. C., Cooke, R. M. & Lodge, D. M. *Ecosystems* **15,** 462–476 (2012).
12. Martin, T. G. *et al. Conserv. Biol.* **26,** 29–38 (2011)
13. Schaeffer, M., Hare, W., Rahmstorf, S. & Vermeer, M. *Nature Clim. Change* **2,** 867–870 (2012).

PSYCHOLOGY

Seeing is believing

Or do we see something, because we believe it? Evidence suggests that personal experience is more likely to influence Americans with no strong beliefs about climate change than those with firm beliefs.

Elke U. Weber

Most people will start suspecting that a coin is not fair if it overwhelmingly comes up 'heads' in toss after toss. The fact that the public in the USA or UK is less likely to believe in a changing climate than climate scientists has been attributed to the abstract statistical nature of climate change, making it a phenomenon difficult to 'see'[1]. This would suggest that belief, together with willingness to mitigate, will increase if and when the public personally experiences the manifestations of climate change — a prediction that has received some support[2]. Alternative explanations of such results turn the connection between personal experience and climate change belief around, suggesting that stronger beliefs in climate change may make it more likely that people will look for — and thus see — evidence supporting it. Writing in this issue of *Nature Climate Change*, Teresa Myers and colleagues[3] find evidence supporting both of these processes, albeit in different segments of the public.

Beliefs do and should change with disconfirming evidence, quickly when initial beliefs are weak and more slowly when beliefs are deeply held[4]. Physical evidence should bring about convergence in conflicting beliefs on scientific issues, but when it comes to the public's belief in climate change, polling results show a divergence rather than convergence in beliefs over time[5]. This suggests that a basic assumption of belief-updating models — that evidence presents itself to everyone identically, regardless of beliefs, and that it is interpreted identically by everyone — may not hold.

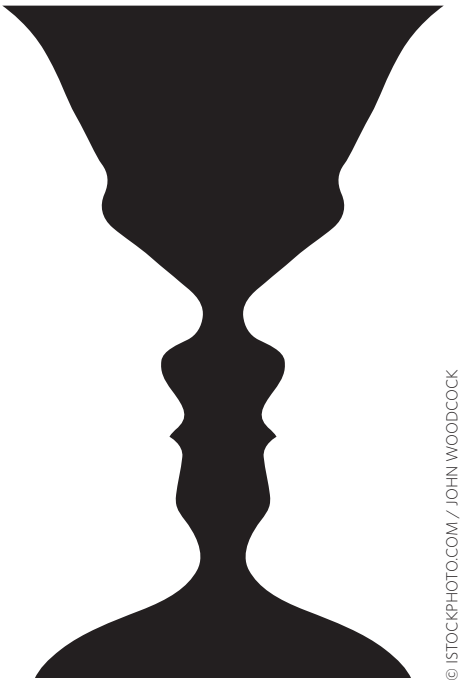
What seems to happen instead is that people are motivated by their beliefs to selectively seek out evidence and to process it in a manner favourable to their existing beliefs. Myers *et al.*[3] provide several examples of such 'motivated cognition', where political ideology was a stronger predictor of climate change beliefs than detectable temperature variations. Weber and Sonka[6] showed that prior beliefs not only lead to biased predictions about the future, but also to biased memories of past events, in this case memories by Illinois farmers about temperature and rainfall patterns in previous years.

In a world where available information and evidence far exceeds the finite processing capacity of decision-makers who are thus only 'boundedly rational'[7], attention is a scarce resource that needs to be carefully allocated. Although logic argues for a focus on evidence that may change existing beliefs, the need for confidence and assurance argues for looking at evidence that confirms our beliefs.

Myers and colleagues[3] provide evidence for both of these processes, using a longitudinal data set to help them distinguish between evidence-based belief revision and belief-motivated perception. Previous reports that personal experience of climate change impacts seems to increase people's belief in climate change have been based on correlations between self-reports of personal experience and of belief certainty, typically collected in the same survey. Correlations do not imply causation, making it equally likely that: (1) personal experience with climate change manifestations (in the form of droughts, floods or other extreme events attributed in their increased frequency

or intensity to climate change) gave rise to increased belief certainty, or (2) greater belief certainty made reports of personal experience with climate change more likely. Myers *et al.* refer to this as the chicken-or-egg question (which one came first?) and address it by collecting data about both personal experience and belief certainty at two different points in time, about 20 months apart, from the same set of American respondents. Causation involves a temporal order where the cause precedes the effect. Their lagged model allows them to test whether personal experience at Time 1 was the cause of belief certainty at Time 2 (evidence-based belief revision) or whether belief certainty at Time 1 was the cause of personal experience reports at Time 2 (belief-motivated perception). The full population of respondents to the survey yielded evidence for both.

In their article the authors refer to the Global Warming's Six Americas[8], an audience segmentation analysis that clustered the public into: Alarmed, Concerned, Cautious, Disengaged, Doubtful and Dismissive about climate change. Based on answers to different questions, they group their respondents into two broad categories: (1) those 'highly engaged' with the issue of climate change, falling either into the Alarmed or the Dismissive group, each strongly convinced of their belief or disbelief in climate change (showing belief-motivated perceptions); and (2) those falling into any of the intermediate groups — the Concerned, Cautious, Disengaged, and Doubtful — who are 'less engaged' with the issue and less committed to their belief or disbelief in climate change (showing evidence-based belief revision). This is an important result, though I would argue that the strength of pre-existing beliefs or disbeliefs in climate change is a more important difference than the levelof engagement to distinguish the two groups when it comes to the relationship between perception and beliefs. Experience-based learning is a larger threat to those with strong beliefs, so we would expect motivated cognition



© ISTOCKPHOTO.COM / JOHN WOODCOCK

Expectations guide our perception. People looking for a candlestick in the image above will find it, as will people looking for two faces in profile.

(that is, belief-consistent distortion of perception) among this group, but belief revision in line with personal experience in the group with less certain beliefs. This is precisely what the authors find.

These results are important because they direct climate change education efforts towards their most receptive audience, namely members of the public whose mind is not yet fully made up, who are still actively searching for evidence that will help them form a firm opinion on the issue. Although educators may be tempted to convince those with extreme opinions (climate change deniers or alarmists) to moderate their views, such efforts may be wasted or even counter-productive. Beliefs (at both ends of the spectrum) that are held with high confidence and strongly associated with political ideology and worldviews become hard to assail with empirical evidence, as belief holders selectively seek (or avoid) information and interpret it in belief-consistent ways.

On the other hand, for those not yet fully committed to a position on climate change, personal experience is a powerful teacher, in part because such lessons are vivid and memorable[9] and also because people look for highly trusted sources of information in ideologically-charged controversies[10]. As the adage that forms the title above suggests, we see ourselves and our own eyes as trusted sources, making it important to translate scientific insights about the occurrence and speed of climate change into local lessons that are accessible to and involve our five senses.

The work by Myers and colleagues[3] provides a compelling explanation for why climate change beliefs held by the public have become more polarized over time, rather than converging to the scientific level of evidence-based belief. At the same time, the researchers find support for the effect of personal experience, thus sustaining place-based local education efforts. ❐

Elke U. Weber is at Columbia University, 3022 Broadway, 716 Uris Hall, New York 10027, USA.
e-mail: euw2@columbia.edu

References

1. Weber, E. U. *Climatic Change* **70,** 103–120 (2006).
2. Spence, A., Poortinga, W., Butler, C. & Pidgeon, N. *Nature Clim. Change* **1,** 1–4 (2011).
3. Myers, T. A., Maibach, E. W., Roser-Renouf, C., Akerlof, K. & Leiserowitz, A. A. *Nature Clim. Change* **3,** 343–347 (2013).
4. Bayes, T. & Price, R. *Phil. Trans. R. Soc. London* **53,** 370–418 (1763).
5. Weber, E. U. & Stern, P. C. *Am. Psychol.* **66,** 315–328 (2011).
6. Weber, E. U. & Sonka, S. in *Farmers' Decision Making: A Descriptive Approach* (eds Jacobsen, B. H., Pedersen, D. E., Christensen, J. & Rasmussen, S.) 201–218 (European Association of Agricultural Economists, 1994).
7. Simon, H. in *Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting* 241–260 (Wiley, 1957).
8. Leiserowitz, A., Maibach, E. & Roser-Renouf, C. *Global Warming's "Six Americas": An Audience Segmentation* (Yale School of Forestry & Environmental Studies, 2008).
9. Marx, S. M. *et al. Glob. Environ. Change* **17,** 47–58 (2007).
10. Moser, S. C. *WIREs Clim. Change* **1,** 31–53 (2010).