ENVIRONMENTAL RESEARCH
LETTERS

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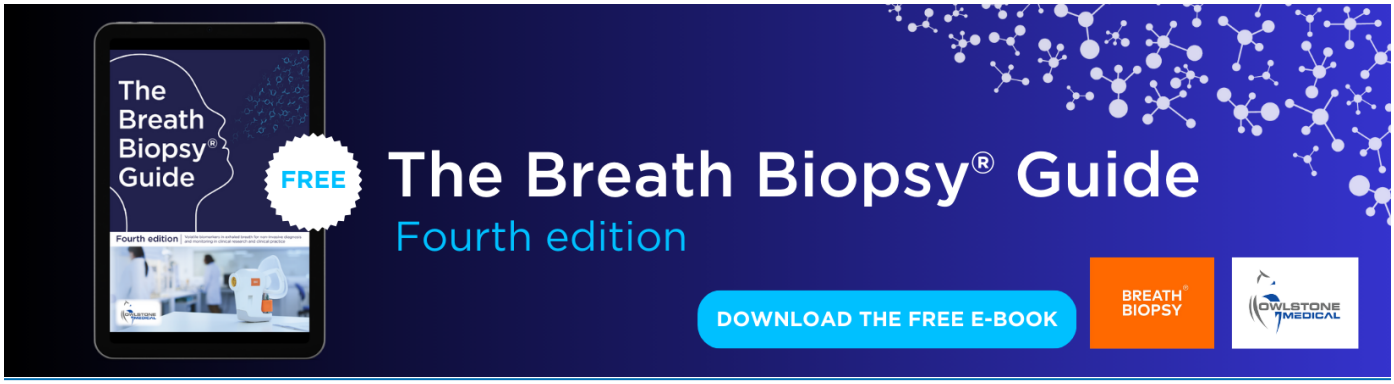
To cite this article: Edward W Maibach and Sander L van der Linden 2016 *Environ. Res. Lett.* **11** 091003



Environmental Research Letters

PERSPECTIVE

The importance of assessing and communicating scientific consensus

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Keywords: scientific consensus, gateway belief model, SLAP, misinformation

PUBLISHED
14 September 2016

Abstract

The spread of influential misinformation, such as conspiracy theories about the existence of a secret, large-scale atmospheric spraying program (SLAP), is contributing to the politicization of science. In an important recent study, Shearer *et al* (2016 *Environ. Res. Lett.* **11** 084011) employ a novel methodology to quantify the expert consensus of popular SLAP assertions. The authors find that 99% (76/77) of surveyed experts have not encountered any evidence that would support the existence of such a program. Here we argue that this finding is important because a growing body of research has shown that the public's perception of expert consensus on key societal issues acts an important 'gateway' to science acceptance. Furthermore, communicating normative agreement among experts, such as the strong scientific consensus against the existence of a SLAP, can help limit the spread of misinformation and promote more effective public decision-making about science and society.

Scientific inquiry seeks to understand, predict, and explain how our physical and social worlds work. Importantly, scientists often aspire to see the fruits of their inquiry used to benefit society. Although there are many exceptions to the rule, societal decision-makers—including public officials, business managers, civic organizations and ordinary citizens alike—are often motivated to seek out the best available scientific evidence to help inform the important decisions they must make. Cancer patients, their doctors, and health insurance companies, for example, are all motivated to know how effective various treatment options are, and for whom. Similarly, parents, school officials, and regulators are all motivated to know what levels of lead in drinking water can be considered safe for children. In turn, experts appreciate the opportunity to share what they know, so that good decisions can be made, and good outcomes are more likely to be achieved.

The ideal situation occurs when the issue at hand has been well-studied over an extend period of time and trusted science organizations have reliably concluded that the weight of evidence is unequivocal. Important current examples of issues for which a strong scientific consensus exists, include human-caused climate change (Anderegg *et al* 2010, Cook *et al* 2016), and the safety of the MMR vaccine (Taylor *et al* 1999, DeStefano and Thompson 2004).

A different—yet all too common—situation occurs when the weight of evidence genuinely is not clear, either because the evidence is limited, uncertain, or has never been quantified. This was the case, until recently, with regard to public concern about the existence of a 'secret large-scale atmospheric program' (SLAP)—a concern shared by as much as 17% of the adult population in Canada, the United Kingdom, and the United States (Mercer *et al* 2011). This public concern arose in response to 'evidence'—posted in various sites on the internet—asserting the existence of SLAP, but none of this evidence has ever been peer-reviewed by scientists.

In an important recent study, Shearer *et al* (2016) decided to put this evidence to a test. They showed the evidence to 77 domain experts (i.e., atmospheric chemists with expertise in condensation trails, and geochemists working on atmospheric deposition of dust

and pollution), and asked about each of the claims made by 'SLAP theorists.' They found near-unanimous consensus (76/77) among the experts that there is no evidence to support the existence of SLAP. Indeed, all SLAP assertions can be explained by other factors (i.e., well known behavior of aircraft contrails and atmospheric aerosols). This research clearly established that the weight of evidence overwhelming disproves common 'SLAP' assertions.

We contend that 'scientific consensus' research of this kind is important for two key reasons; (a) it provides a novel methodology for assessing scientific weight of evidence, and (b) scientific consensus highlights a special form of proof, 'social proof', that is particularly appropriate for conveying the weight of evidence to non-scientists. Traditional scientific explanations convey the evidence—for or against the assertion of concern—often using complicated scientific jargon (e.g., 'atmospheric concentrations per unit mass'), concepts that non-experts often have difficulty comprehending. In contrast, scientific consensus is expressed in the form of a descriptive norm, or the collective judgment of a group of influential individuals (experts). In other words, consensus cues are a form of 'social proof' easily comprehended by lay people and experts alike—i.e., the proportion of relevant experts who are convinced by the evidence (e.g., 76 out of 77, or 99%). People are generally motivated to hold accurate beliefs about the world, and when uncertain, they often look to experts for guidance (Cialdini *et al* 2015). Importantly, as a heuristic, consensus information is often both accurate and appealing because it harnesses the 'wisdom-of-crowds' effect (Surowiecki 2005), which is especially strong and persuasive to people when the 'crowd' consists of 'wise' experts (Mannes *et al* 2014).

Yet, because of a well-established human information processing mechanism called the 'availability bias' (Tversky and Kahneman 1973), people tend to reach conclusions—often erroneously—about the weight of evidence based on simple yet misleading information (whether deliberately misleading, or not). For example, when people see a TV news story featuring two scientists—one who is convinced of X, and one who is not—they tend to believe there is a lot of disagreement among the experts about X. Anecdotal evidence and 'false media balance' have shown to undermine perceived scientific agreement (Koehler 2016). Moreover, although Shearer *et al* (2016) state that; 'our goal is not to sway those already convinced that there is a secret, large-scale spraying program' (p.1), the propagation of conspiracy theories of this kind do in fact undermine the public's perception of a scientific consensus (van der Linden 2015). Therefore, in a very real sense, failure to communicate the expert consensus—when a scientific consensus exists—makes the public vulnerable to harmful misinformation (Maibach 2012).

In fact, our research, and that of several other independent research teams, has shown that this is particularly important because; (a) perceived scientific agreement is a key 'gateway' cognition that acts as an important determinant of public opinion and (b) communicating the scientific consensus about societally contested issues—including climate change and vaccine safety—has a powerful effect on realigning public views of the issue with expert opinions (Ding *et al* 2011, Lewandowsky *et al* 2013, van der Linden *et al* 2014, 2015a, 2015b, Myers *et al* 2015, Hornsey *et al* 2016). We are not suggesting that communicating scientific consensus is a magic bullet, but it is an easily conveyed fact that has shown to be broadly helpful in reducing the 'consensus gap' (Cook and Jacobs 2014), in countering motivated reasoning (Bolsen and Druckman 2015), and in safeguarding the public against influential misinformation.

In conclusion, for us, the implication of the research conducted by Shearer *et al* (2016) is that the scientific community should make an effort to put to rest the public's erroneous concerns about the existence of a large-scale atmospheric spraying program by conveying an intuitive social fact, namely; that 99% of experts agree that there is no evidence of a secret, large-scale atmospheric spraying program (SLAP).

Acknowledgments

The first author receives grant support from the National Science Foundation (DRL-1422431), NASA (NNX11AQ80G) and the Energy Foundation. The second author would like to acknowledge support from the Andlinger Center for Energy and the Environment.

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