

Chapter 2

Turning Climate Misinformation into an Educational Opportunity ()*

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Introduction

“Education is a better safeguard of liberty than a standing army.”

Edward Everett

Misinformation is information that is initially presented as true but later found to be false (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). Misinformation can prevent the public from learning correct facts, which in turn can lead to public preferences different to those if they were accurately informed (Kuklinski, Quirk, Jerit, Schwieder, & Rich, 2000). Such outcomes can have significant consequences for democracy, which requires a well-informed populace to properly function.

Misinformation as a societal issue has become particularly prevalent in recent years. In 2014, online misinformation was named one of the top ten global trends of concern (World Economic Forum, 2014). Oxford Dictionary named “post-truth” the word of the year in 2016 (Flood, 2016). The 2016 U.S. election marked an elevation in the salience of misinformation and fake news. Politifact assessed that 68% of Donald Trump’s statements were false although this low performance did not prevent his electoral victory (Politifact, 2017). One analysis found that President Donald Trump made 492 false or misleading claims in the first 100 days of his presidency (Washington Post, 2017).

Misinformation associated with the 2016 election also originated from a range of sources beyond the Presidential candidate. Bessi and Ferrara (2016) found that one-fifth of online conversation during the U.S. election was generated by automatic social media bots, with 75% of the bots supportive of Donald Trump. Bots were retweeted as often as humans, indicating that users have trouble distinguishing between bots and humans (or don’t care). Consistent with these results, Kollanyi, Howard, and Woolley (2016) found that Pro-Trump bots were around four times more prolific than pro-Clinton bots.

Misinformation is also highly relevant to the issue of climate change. An analysis of social media activity in 2016 found that the most shared article about climate change was an article claiming that climate change was a hoax (Readfearn, 2016). Boussalis and Coan (2016) found that in recent years, misinformation targeting climate science has been on the increase relative to arguments targeting climate policy. In posing the question “is the era of climate denial over?”, the authors conclude unfortunately not.

However, the presence of climate misinformation dates back to the early 1990s and has had significant influence on public discussion, public levels of climate literacy and climate policy for decades (McCright & Dunlap, 2000). Correspondingly, a large body of research has examined the phenomenon of climate science denial, analyzed the structure and techniques of misinformation, and experimentally tested interventions designed to neutralize its influence.

Research into misinformation is more relevant than ever in this current post-truth era. It can help us understand the various psychological impacts of misinformation and offer insights into evidence-based responses that can potentially reduce the influence of

misinformation. Crucially, it points to ways that misinformation can be used for educational purposes, by increasing climate literacy and critical thinking skills.

Understanding climate misinformation

Misconceptions about climate change are numerous, which is to be expected given the complexity of our climate. Students hold a number of misconceptions about causes of climate change and the greenhouse effect (Chang & Pascua, 2015; Gautier, Deutsch, & Rebich, 2006). Nearly half of U.S. teenagers believe that stopping rockets from punching holes in the ozone layer would reduce global warming (Leiserowitz, Smith, & Marlon, 2011). An international survey of adults found that one third of adults think the Earth would be warmer with no greenhouse gases (Thompson, 2017). These misunderstandings are particularly consequential given the important role that understanding the greenhouse mechanism plays in acceptance of human-caused global warming (Ranney & Clark, 2016).

An especially damaging misconception is the lack of awareness of the high level of agreement among climate scientists that humans are causing global warming. Despite the fact that between 90 to 100% of climate scientists agree that humans are causing global warming (Cook et al., 2016), with a number of studies converging on 97% agreement (Anderegg, Prall, Harold, & Schneider, 2010; Cook et al., 2013; Doran & Zimmerman, 2009; Carlton, Perry-Hill, Huber, & Prokopy, 2015), only 12% of Americans think that the scientific consensus is above 90% (Leiserowitz, Maibach, Roser-Renouf, Rosenthal, & Cutler, 2017). The discrepancy between public perception and the overwhelming scientific agreement is known as the “consensus gap”. This gap varies across political ideology, with liberals showing higher perceived consensus relative to conservatives, indicating a strong influence of political ideology on climate perceptions.

In a meta-analysis of 25 polls and 171 academic studies across 56 nations, Hornsey, Harris, Bain, and Fielding (2016) found that the strongest predictors of climate beliefs were political affiliation and political ideology. One way that political ideology influences attitudes regarding climate change is through aversion to climate solutions. For example, when climate change information was presented with two different solutions to climate change (regulation of pollution or nuclear energy), political conservatives responded positively to the nuclear energy message but negatively to the regulation message (Campbell & Kay, 2014). Climate change information that was perceived to conflict with a person’s ideology resulted in reduced acceptance of climate change.

In the case of Donald Trump, the underlying dynamic of economic beliefs driving scientific views is made explicit: the subtext becomes text. In a New York Times interview, Trump indicated his views on humanity’s role in driving climate change was based to some degree on whether climate policy was economically viable (New York Times, 2016):

*...I think there is some connectivity [between climate change and human activities].
[...] It depends on how much. It also depends on how much it’s going to cost our companies. (par 85)*

While the consensus gap may be greater for conservatives, it still exists at the liberal end of the political spectrum. This indicates that misinformation as well as a lack of awareness also plays a part in public misconceptions about climate change. The misinformation campaign against climate change began to take form in the early 1990s, created by

conservative think-tanks whose goal was to undermine the Kyoto Protocol (McCright & Dunlap, 2000). Rather than advocate alternative policies to mitigate climate change, the think-tanks began to cast doubt on the scientific evidence that necessitated mitigation policies. These efforts turned a bipartisan issue, with George H. W. Bush pledging to “fight the greenhouse effect with the White House effect” (Peterson, 1989, p. A1), into a polarized public debate. The fossil fuel industry was an ally and funder of the conservative misinformation campaign (Jacques, Dunlap, & Freeman, 2008; Farrell, 2015). From 2003 to 2010, 91 organizations known to disseminate climate misinformation received corporate funding totaling over \$900 million per year (Brulle, 2014).

Misinformation is disseminated in a number of ways. Conservative think-tanks have been prolific in publishing a number of environmentally-skeptical books, most since 1992 (Jacques, Dunlap, & Freeman, 2008). Accompanying this strategy has been the exploitation of the journalistic norm of balanced media coverage of political issues. This has resulted in false-balance coverage of climate change (Painter & Ashe, 2012), which has been observed to reduce public perception of scientific consensus, thus widening the consensus gap (Cook, Lewandowsky, & Ecker, 2017).

The internet and social media is particularly effective in indiscriminately facilitating the spread of misinformation. Qiu, Oliveira, Shirazi, Flammini, and Menczer (2017) found that low quality information received just as many Facebook shares as high-quality information. Similarly, Weng, Flammini, Vespignani, and Menczer (2012) found that content quality was not a requisite for tweets to go viral. Social media has also led to the development of echo-chambers, accelerating the polarization of views on climate change (Jasny, Waggle, & Fisher, 2015). One danger of echo-chambers is the perception among climate science denialists that their views are widely shared, which renders them particularly resistant to changing their beliefs (Leviston et al., 2013).

The fracturing of the media landscape has also made it possible for politicians to target core constituents in a way that facilitates strategic political extremism (Glaeser, Ponzetto, & Shapiro, 2005). The interface between misinformation and political elites is a crucially important component in understanding the mechanisms by which misinformation influences the general public. From 1993 to 2003, the semantic similarity between climate misinformation, news media coverage, and U.S. Presidential statements increased, indicating a growing influence of climate misinformation (Farrell, 2016). Meta-analysis of public surveys found that cues from political elites are one of the most important drivers of public concern over global climate change (Carmichael & Brulle, 2017). Further, Mildemberger and Leiserowitz (2017) found that changes in political elite cues drove a reduction in acceptance of climate change in the late 2000s, rather than changes in economic conditions. This means that events such as Republican senators unanimously voting that humans aren't causing global warming (Kollipara, 2015) have real influence on Republican voters' views on climate change.

Political elites also influence climate policy in more direct ways. Other national leaders who were skeptical about human-caused global warming, such as President George W. Bush, Prime Minister Tony Abbott in Australia and Prime Minister Steve Harper in Canada, employed a number of strategies to delay climate change policies (De Pryck & Gemenne, 2017). These included appointing climate science denialists at the head of scientific agencies, abolishing advisory panels and scientific programs, cutting funding to environment portfolios, reorienting research towards more industry-relevant

research, and censorship of federal scientists. Similar activities have been observed in the early stages of the Trump administration.

This body of research shows that climate misinformation has significant consequences on public attitudes and policy outcomes. In order to counter the negative impact of climate misinformation, a better understanding of the structure of climate misinformation as well as its psychological impact is required.

The five climate disbeliefs

Psychologists have identified five key beliefs regarding climate change (Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011): global warming is real, human activity is the primary cause, the impacts are bad, the experts agree on these first three points, and there's hope that we can avoid the worst impacts of climate change. A number of studies have examined different aspects of contrarian claims that argue against the mainstream positions of climate science. All contrarian arguments about climate change can be grouped under five denialist categories: it's not real, it's not us, it's not bad, the experts are unreliable, and there's no hope (i.e., climate solutions won't work). Mirroring the five climate beliefs, these denialist categories can be characterized the five climate disbeliefs.

An overview of analyses categorizing climate misinformation illustrates how individual studies tends to cover subsets of the five climate disbeliefs. Capstick and Pidgeon (2014) categorized two types of climate skepticism: epistemic (related to climate science) and response (related to climate solutions). Restricting his analysis to epistemic skepticism, Rahmstorf (2004) divided skeptic arguments into three categories: trend (it's not real), attribution (it's not us) and impact (it's not bad). Measuring people's beliefs in Rahmstorf's three types of skepticism, Poortinga et al. (2011) found that people who were skeptical about one aspect of climate change (e.g., whether humans were causing climate change) were more likely to be skeptical about other aspects of climate change (e.g., whether climate impacts would be serious). Akter, Bennett, and Ward (2012) found that skepticism about the human contribution to global warming was at the core of climate change skepticism, being a common source of impact and mitigation skepticism.

Mazo (2013) listed four stages of climate change denial encompassing both epistemic and response skepticism: it's not happening, it's not us, it's not bad, and it's too hard to fix. In addition to scientific or policy related claims, a fifth category focuses on attacking the integrity of climate science. An analysis of early conservative think-tank publications by McCright and Dunlap (2000) found that in addition to casting doubt on climate impacts and the efficacy of climate policies, a third key counter-claim questioned the strength of the scientific evidence for global warming. Machine learning analysis of conservative think-tank articles found that as well as policy and science arguments, a major theme was attacks on scientific integrity (Boussalis & Coan, 2016). Religious metaphors have been used in order to frame climate science as an unfounded belief (Nerlich, 2010; Woods, Fernandez, & Coen, 2010).

In summation, a number of studies have examined specific subsets of climate misinformation. An overarching framework encompassing all these studies finds that climate skepticism or denial can be summarized by five key disbeliefs. Since 2011, Donald Trump has expressed views on climate change spanning the five climate disbeliefs, mostly in the form of tweets (Matthews, 2017). Most of his utterances fall under the category that global warming isn't happening, typically in response to a cold weather

event (Trump, 2013b). While people's views on the reality of global warming are subconsciously influenced by local temperature variations (Joireman, Truelove, & Duell, 2010; Li, Johnson, & Zaval, 2011), Trump's knee-jerk reaction to cold weather events are another stark example of subtext becoming text.

Further, Trump has argued that humans are not causing global warming (Trump, 2014a) and minimized the impacts (Trump, 2014b). On climate solutions, Trump has argued against renewable power (Trump, 2012a) and climate policy (Trump, 2013a). In casting doubt on the integrity of climate science, Trump famously characterized climate change as a conspiratorial hoax (Trump, 2012b).

Whether it be in tweets, public statements, media coverage or other mediums, misinformation about climate change influences people's views in a number of ways. Understanding the psychological mechanisms by which different types of misinformation does damage is key to developing interventions that neutralize its influence.

How misinformation does damage

Cook, Lewandowsky, and Ecker (2017) tested two types of misinformation: explicit and implicit. Explicit misinformation states outright falsehoods. The immediate impact of explicit misinformation is causing people to believe in false information. For example, exposing people to misinformation about the scientific consensus on climate change lowers perceived consensus (Cook et al., 2017; van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017). Similarly, Ranney and Clark (2016) found that a few misleading statistics can reduce acceptance of climate change. Misinformation about climate change (both implicit and explicit) has also been found to disproportionately influence political conservatives (Cook et al., 2017; van der Linden et al., 2017). This means that climate misinformation has a polarizing effect, widening the gap between liberals and conservatives.

Implicit misinformation differs from explicit information in that it contains a mix of facts and falsehoods. A common form of implicit misinformation is false-balance media coverage, where climate scientists are given equal weight with contrarian voices. This has a more insidious influence than explicit misinformation but still has the result of significantly lowering perceived consensus (Cook et al., 2017). Other studies have found that false-balance presentations are effective in cancelling out the impact of accurate scientific information (McCright, Charters, Dentzman, & Dietz, 2016; van der Linden et al., 2017). Given the damaging impact of false-balance media coverage, it was of particular concern that the Trump administration at one time planned to conduct red versus blue team debates on climate science (Davidson & McNutt, 2017).

This research into implicit misinformation underscores the insidious danger of misinformation and fake news: it does not need to be coherent, evidence-based, or even believable. Without needing to convince people, misinformation can reduce belief in facts. When people are unable to resolve conflicting pieces of information, they disengage and choose to not believe the facts. For example, people underestimate the influence that conspiracy theories have on their own beliefs (Douglas & Sutton, 2008). Even fringe conspiracy theories that fail to convince people can nevertheless have negative effects such as reducing intent to reduce one's carbon footprint (Jolley & Douglas, 2014), decreasing trust in government (Einstein & Glick, 2014), and lowering support for climate action (van der Linden, 2015). The subversive nature of fake news was highlighted in a

radio interview when Trump supporter and CNN political commentator Scottie Nell Hughes declared “there’s no such thing, unfortunately, anymore [as] facts” (Rehm, 2016, par 45).

Different types of misinformation require different responses. Cook et al. (2017) found that informing people of the 97% consensus was effective in countering the negative influence of false-balance media coverage. However, explicit misinformation about the scientific consensus cancels out the positive effect of consensus information (van der Linden et al., 2017). This means that simply communicating the facts is insufficient to overcome explicit misinformation. As a consequence, inoculating interventions that explain the techniques used to distort facts are required to neutralize explicit misinformation.

Responding to climate misinformation

Given the dire impact of misinformation, how can we respond? Commonly, we look to undo the damage by refuting (or debunking) the misinformation. There exist a number of reviews of psychological research into debunking (Lewandowsky et al., 2012; Swire & Ecker, 2018), with a concise set of guidelines summarized in Cook and Lewandowsky (2011).

A refutation of misinformation compels people to update their mental model of how the world works, removing the false piece of information. This creates a gap in their mental model and if the gap is left unfilled, the misinformation continues to influence (Seifert, 2002). However, people are less likely to rely on the misinformation if a factual alternative is supplied that fills the gap left by the vacated misinformation (Ecker, Lewandowsky, Cheung, & Maybery, 2015). The replacement fact should ideally be more plausible and easy-to-understand than the original misinformation (Baadte & Dutke, 2012). This dynamic is best summarized by the maxim: “fight sticky myths with stickier facts” (Heath & Heath, 2007).

The structure of a debunking determines its effectiveness. When debunking material places undue emphasis on the myth or introduces misinformation before flagging it as false, it increases the risk that the myth is mistakenly recalled as true (Peter & Koch, 2016; Skurnik, Yoon, Park, & Schwarz, 2005). There are several techniques that minimize this risk. First, providing a warning before mentioning the myth places people on cognitive alert and reduces their reliance on misinformation (Ecker, Lewandowsky, & Tang, 2010). Second, communicators should place more emphasis on the replacement fact designed to fill the gap left by the refuted misinformation.

While refuting misinformation is a necessary and often unavoidable activity, research points to a more optimal approach whenever available. Pre-emptively refuting misinformation before it is received (otherwise known as prebunking, Cook, 2016) is more effective at reducing the influence of misinformation than attempting to undo the damage after misinformation has been received (Bolsen & Druckman, 2015).

Prebunking is the new debunking

Inoculation theory offers a framework for effectively prebunking misinformation (McGuire & Papageorgis, 1961). This borrows the concept of inoculating against disease and applies it to knowledge, finding that exposing people to a “weak form of misinformation” is effective in helping people build immunity against the influence of misinformation. An

inoculating text consists of two elements: a warning of the threat of being misinformed and counter-arguments that refute the misinformation.

Inoculation has other benefits besides reducing the influence of misinformation. Ivanov et al. (2015) found that people exposed to an inoculating text were more likely to talk about the target issue. This indicates that inoculation carries the added bonus of helping break “climate silence”, the phenomenon that people are reluctant to talk even with friends and family about climate change. Geiger and Swim (2016) found that even people who were concerned about climate change refrained from talking about the issue with their social networks.

Two studies into inoculating against climate misinformation have employed different forms of inoculation, offering a variety of approaches for communicators. Van der Linden et al. (2017) found that inoculations that refuted denialist arguments found in a specific piece of misinformation was effective in partially neutralizing the misinformation. Cook et al. (2017) found that explaining the techniques of misinformation in general terms, without specifically mentioning the misinformation, was effective in neutralizing a specific piece of misinformation. This indicates that it is possible to neutralize multiple instances of misinformation with a single inoculation framed in general terms.

Further, Cook et al. (2017) tested ways to inoculate against both implicit and explicit forms of misinformation. While inoculation text was useful against both forms of misinformation, communicating the 97% consensus was also effective against implicit misinformation. This has been replicated in another study that tested the influence of a John Oliver comedy video about false-balance media coverage of climate change (Brewer & McKnight, 2017). Watching the John Oliver video increased viewers’ belief in global warming, as well as perceptions that most scientists believe in global warming. The video had the greatest effect on people with low interest in climate.

These studies indicate that raising critical thinking skills is an effective way to build immunity to misinformation. One useful framework for explaining the argumentative techniques of misinformation are the five characteristics of science denial. These were first conceived by Hoofnagle (2007) and fleshed out further by Diethelm and McKee (2009). They are fake experts, logical fallacies, impossible expectations, cherry picking and conspiracy theories (summarized with the acronym FLICC, Cook et al., 2015).

Inoculating against misinformation by fostering critical thinking is an approach going back millennia. Aristotle argued that understanding the reasoning flaws of false arguments provided a more universal safeguard against faulty persuasion (Compton, 2005). Critical thinking is a powerful tool likened to “having x-ray vision into thinking” (van Gelder, 2005, p. 44). However, acquiring expertise in critical thinking is also difficult as it is a contrived, high-order skill requiring deliberate practice. Van Gelder equates mastering critical thinking to learning a second language. One way to facilitate this type of deeper learning is through educational programs.

Misconception-based learning

Misconception-based learning offers a practical and powerful way to inoculate people against misinformation (McCuin, Hayhoe, & Hayhoe, 2014). This is also known as agnotology-based learning (Bedford, 2010) or refutational teaching (Tippett, 2010). This teaching approach involves explicitly introducing misconceptions at the same time as communicating factual information.

Misconception-based learning has been shown to have a number of benefits relative to standard lessons that teach accurate information without mentioning misconceptions. A meta-analysis found that refutation text is the most useful form of educational text among elementary, high school and adult learners (Guzzetti, 2000). It has been shown to result in greater learning gains (McCuin et al., 2014; Muller, Bewes, Sharma, & Reimann, 2008) with longer effects than standard lessons (Guzzetti, 2000; McCuin et al., 2014). This teaching approach increases students' argumentative skills (Kuhn & Crowell, 2011) and fosters critical thinking skills (Berland & Reiser, 2008). Students also show more interest in refutational texts compared to traditional textbooks (Mason, Gava, & Boldrin, 2008).

Consequently, Frankie (2014) recommended that teachers would benefit from climate science courses that targeted climate change misconceptions. Further, Guzzo and Dall'Alba (2017) argued that educators should motivate their students to think critically, helping them to develop a better understanding of the world and be protected against misinformation. However, there is a current dearth of misconception-based learning material available to educators (Tippett 2010).

Nevertheless, misconception-based learning is being applied in various contexts. Bedford (2010) describes how a college class on climate change drew on misinformation texts to reinforce climate concepts taught earlier in the course. Cook, Bedford, and Mandia (2014) expand this work further, looking at efforts of misconception-based learning in educational and public communication contexts. Lambert and Bleicher (2017) instructed preservice teachers to research and rebut denialist claims and found that this was effective in increasing their understanding and perceptions about climate change. Lovitt and Shuyler (2016) had students evaluate the credibility and source of various climate science misconceptions and found students were able to distinguish between popular and scholarly literature, retaining their newly acquired information literacy skills after a four-week delay. Some teachers have re-purposed "teach the controversy" frames as a way to neutralize the controversy and introduced climate change topics in the classroom where it might not otherwise be included (Colston & Vadjunec, 2015). An online course, Making Sense of Climate Science Denial, adopted the approach of misconception-based learning, reaching over 26,000 students from 166 countries and providing video resources for teachers who enrolled in the course (Cook et al., 2015).

Educational efforts afford arguably the greatest opportunity to produce deeper, long-lasting reductions in the spread and influence of misinformation. However, short-term communication efforts are also required, when newly generated misinformation disseminated to the public requires an immediate response.

Fact checking and "technocognition"

Fact-checking is a necessary tool in countering and neutralizing misinformation. When political elites are made aware of the political consequences they might face from fact-checking, they become less likely to make false statements (Nyhan & Reifler, 2013). This is significant given the important role that political elites have on public opinions about climate change.

However, there are limitations to fact-checking. The quip, "a lie will go round the world while truth is pulling its boots on", underscores the unequal playing field between facts and misinformation. Accurately researching and publishing fact-based responses

takes time, during which misinformation can disseminate quickly and influence a large number of people. Fact-checking, even if deployed successfully can also have minimal impact in some contexts. Swire, Berinsky, Lewandowsky, and Ecker (2017) found that even when Trump supporters read and accepted a refutation of a Trump statement, their intention to vote for him was unchanged.

Fact-checkers can also have unintended counterproductive effects. Levin (2017) found that when Facebook labelled a specific article as possible “fake news”, it led to a number of conservative groups sharing the article, causing a surge in traffic. Similarly, an analysis of Facebook activity found that conspiratorial users increased their engagement with conspiracy posts after interacting with debunking posts (Zollo et al., 2017).

One way to maximize the effectiveness of fact-checking, while avoiding counterproductive outcomes, is a multi-disciplinary approach described as “technocognition” (Lewandowsky, Ecker, & Cook, 2017). This involves applying the insights of cognitive science in technological solutions. For example, online fact-checkers should adopt the recommendations of psychological research into debunking in order to minimize the risk of potential backfire effects where the debunking reinforces rather than reduces misperceptions.

Automatic detection of new misinformation is an emerging technology that can greatly enhance the effectiveness of online fact-checking efforts. Developing an automatic platform that can detect and assess the accuracy of new information is thought of as the “Holy Grail” of fact-checking (Hassan et al., 2015). Such a platform would need to monitor online information sources, spot claims, assess their reliability, and publish responses (Babaker & Moy, 2016).

Some automatic fact-checking solutions already exist. One Chrome browser extension tags the veracity of Facebook links based on the source’s credibility and consistency with other news stories (Itkowitz, 2016). Using a knowledge representation derived from Wikipedia, Ciampaglia et al. (2015) was able to reliably assess truth value to statements. Ott, Choi, Cardie, and Hancock (2011) found that a combination of text categorization, classifiers and psycholinguistic deception allowed them to detect deceptive text more accurately than most human judges.

While delivering fact-checking content is a necessary service, users are also encouraged to develop their own fact-checking, critical thinking skills. FactCheck.org published a set of practical steps to encourage closer reading and critical thinking (Kiely & Robertson, 2016), adopting key strategies such as checking sources, authors and consulting experts. Walton and Hepworth (2011) found that teaching information literacy through online social network learning was successful in conveying the ability to evaluate source material. Developing information literacy and critical thinking is consistent with the goals of misconception-based learning.

Conclusion

Misinformation is a serious societal issue that has become especially prevalent in recent years, as fake news has achieved mainstream attention. However, this is not a new phenomenon, particular in the area of climate change, and a large body of research can help us understand the structure and impact of misinformation. A key finding is that misinformation can cancel out the effect of accurate information, a result that has significant communication implications. It means that communicating the science is

necessary but insufficient for communicators and educators looking to increase public levels of climate literacy. Further, the psychological research into debunking finds that undoing the impact of misinformation is difficult, and poorly designed attempts to debunk misinformation can be ineffective or counterproductive. Therefore, adopting an evidence-based communication approach that adopts the best-practices recommended by psychological research is essential.

To insulate our science communication efforts from misinformation, we need to accompany our science messages or lessons with inoculating text that explain the techniques used to distort the science. Inoculating text equips people with the critical thinking tools required to discern the truth when presented with conflicting pieces of information. Indeed, educational research has found that misconception-based learning is one of the most powerful and engaging ways to teach science. Not only does it more effectively increase science literacy levels, it also increases critical thinking skills that neutralize the influence of misinformation. Consequently, our current predicament of fake news, while dire, also presents opportunities for communicators and educators. Misconception-based learning, if deployed widely enough in classrooms, could potentially eradicate climate science denial in the same way that vaccination eradicated polio.

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