“It’s [*not* just] the [media] economy, stupid”

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It is my pleasure and honor to contribute details of my research to the series, “Sharing UW-Madison Postdoctoral Scholarly Research with Non-Science Audiences,” and especially to work with its sponsor, the Wisconsin Initiative for Science Literacy (WISL). WISL’s mission to connect scientific research with the broader public resonates deeply with me, and I am thrilled to be participating in it with this series. Many thanks to WISL’s team, including Cayce Osborne, Elizabeth Reynolds, and Professor Bassam Shakhashiri, for making this initiative and narrative series possible! I have been a member of Drs. Dominique Brossard and Dietram Scheufele’s Science Communication Incubator (SCI) Lab at the Morgridge Institute for Research and UW-Madison’s Department of Life Sciences Communication since July 2024. In this capacity, I’m a researcher on several projects—one of which I proposed and am carrying out with the assistance of Drs. Brossard and Scheufele and lab members Yijia Erika Zhu, Lindsey Middleton, and Julianne Renner. That project is the subject of the following piece.

“And we get many of our cocoa beans from a company called Ivory Coast,” a fellow first-year announced, concluding her presentation with a confident flourish. Silence greeted her words for several heartbeats, then someone sheepishly made the correction: “Um… Ivory Coast’s a *country*.” *What is wrong with our education system,* I wondered, *if someone arrives at*

college without a basic knowledge of geography? Little did I know, the thought belied a rather glaring blind spot of my own. I was falling for the alluring, intuitive—but ultimately too simplistic—notion that if only the public is given access to scientific information, we can bridge the gap between scientists' understanding and the general public's, ushering in a utopia of widespread science literacy. Alas, it's not that simple. I should've known: nothing worth studying ever is.

I didn't yet know it, but my assumption—known in science communication circles as the "knowledge-deficit hypothesis"—had already fallen out of favor among those in the know: the scholars who had been studying science literacy (and its lack) for many years (Priest, 2018). It turns out that even highly science-literate members of the public are quite capable of denying, disbelieving, or ignoring the sciences they dislike. Indeed, if one's group identity depends on it, it is the only logical approach: group belonging is more important than having accurate beliefs. Furthermore, some groups have valid historical reasons to collectively view science with skepticism—there's a reason "Tuskegee" is so frequently followed up with "syphilis study," to cite an infamous chapter in the history of science. So it is very often not a lack of knowledge, but psychological quirks like motivated reasoning, partisan echo chambers, and lack of trust that accounts for the gap between scientists' understandings and the public's.

At the time, I was double majoring in writing and environmental studies, and on the lookout for a way to blend the two fields into a feasible career. So it was that I set out to remedy the public's knowledge deficits. The already defunct hypothesis was the starting point for my foray into research—ultimately incorrect hypotheses often are. That fact, as it happens, is the crux of my research interest. Though little bandied about around dinner tables and cocktail parties, uncertainty is integral to science (Gustafson & Rice, 2020; Kitcher, 1982). We may be

accustomed to thinking of science as synonymous with answers, but every answer starts with at least one question—and the complexity of the world (and especially of human beings) means many (perhaps most) of the answers must be provisional (Popper, 1959; Kitcher, 1982). That's why the scientific process depends on uncertainty—if we already *knew* the answer, there'd be no value in testing the hypothesis. There'd be no need for science.

Part of what makes this a hard pill to swallow is that uncertainty is inherently uncomfortable. Studies have shown that uncertainty heightens people's expectation that something unpleasant will occur. It also makes the ill feeling worse than if it was broadcast beforehand. Fearsome or disgusting images have a lesser effect if you know they're coming than if you're told they *might* be (Grupe & Nitschke, 2011). In terms of human adaptability, this also makes logical sense. Being able to quickly identify—and be wary of—ambiguities in a perilous environment puts one at an advantage to prepare for the future, exercise some control in the present, and understand past experiences (Grupe & Nitschke, 2011). Uncertainty intolerance might lead us astray when it delays acceptance of scientific recommendations until the findings are "certain," or spurs paralyzing fear when confronted with unavoidable uncertainties, but—for better or worse—it's adaptively engrained in us.

To make it worse, unscrupulous actors have enthusiastically taken advantage of this engrained discomfort. They've aggressively marketed uncertainty as equivalent to untrustworthiness (Oreskes & Conway, 2010). Decades of research show how motivated bad apples in various industries turned science's inherent uncertainties against it—with alarming success (Proctor, 1995; Oreskes & Conway, 2010). The tobacco industry sold smoking on the premise that science wasn't *sure* it caused lung cancer. The fossil fuel industry took a page from the same book, trumpeting that the "science isn't settled" for decades. This strategy was

responsible for agonizing delays in public acceptance of the dangers of smoking, pollution, and climate change. Science's intrinsic uncertainties were cast as reasons to drag our feet (or on those cigarettes, as the case may be) for years past the point when the risks of delayed action were evident.

Now the widespread notion that science is meant to be certain—and, perversely, is untrustworthy when uncertain—has complicated the task of communicating uncertainty without arousing suspicion and casting doubt on inescapably complicated science. It's not about knowledge deficits. Vast stores of information, after all, are readily available in nearly every North American's pocket. It's about a *selective* lack of knowledge; it's about a lack of trust; it's about intentional weaponization of uncertainty; it's about complexity and nuance that can no longer be presented candidly without raising perceived red flags. It's a real, complicated, wicked (Churchman, 1967) problem.

I'm delving into one small facet of this problem in my current work as a Rita Allen Foundation Civic Science Fellow at the Morgridge Institute for Research and UW-Madison Department of Life Sciences Communication. Given the backdrop of relentless uncertainty weaponization, I've lately begun to wonder—and worry—about whether an overemphasis on settled sciences might be causing collateral damage to people's perceptions of cutting-edge, uncertainty-filled ones. Are we playing into the uncertainty-shunning frenzy every time we talk about scientific consensus on climate change? It's a misconception that certainty is what makes science trustworthy; are we science communicators perpetuating the misunderstanding by emphasizing certainty as a reason to act on scientific findings? Could pointing out unopposed agreement on lead toxicity prime people to consider certainty the gold standard—and

consequently cast doubt on emerging, uncertainty-filled findings about, for instance, pesticide toxicity?

As a practitioner and scholar of science communication, one of the last things I want to do is reinforce the misperception that uncertainty is unwelcome in science. I've got a foot in the scholarly realm of studying science communication—and one in the journalistic realm of communicating science. I have a vested interest in bridging the gap between science and the public or I'll find myself doing the splits (metaphorically speaking). This isn't just a "me problem" though: It's in both the public's and science's interest to get chummier too. We in the public rely on science for countless second-nature activities—we owe thanks to science for refrigeration, pasteurization, and transporting produce around the world without spoilage, so we don't even get past the day's first cup of coffee without a heavy lift from scientists past and present. At the same time, science depends on the public to continue advancing technologies and understanding of the world. Taxpayer support funds an enormous amount of research, and I'd wager we're a lot more inclined to support scientific endeavors if we understand where they're coming from and what they're aiming to discover.

More than many realize, of course, these endeavors—whether in medicine, environmental science, or anything else—share a common thread. Whatever experiments and findings they're about, they are also, inescapably, about uncertainty. People might not want to hear it, but the gap between science and the public can't help but widen if people expect science to be something it's not: certain.

So, I'm conducting a study to investigate whether grafting a little extra perspective into messages about consensus science can prevent them casting shade on less certain—but no less valuable—science. My study builds on one conducted by the lab in 2023, which first established

the hypothesis I'm testing: the collateral damage hypothesis. That study found COVID-19 vaccine safety messages telling readers the vaccines didn't contain live viruses inadvertently caused collateral damage to people's perceptions of vaccines that do. However, presenting a message that both debunked the false information—that COVID-19 vaccines contain live viruses—and pointed out that many vaccines do safely employ live viruses eliminated the collateral damage to live virus vaccine perceptions.

My current study asks: what if consensus messages are having a similar collateral effect on people's perceptions of cutting-edge scientific research for which consensus is unmeasured or unestablished? If this is the case, I'm further asking, could a message about the nature of science forestall this effect? What if every consensus message included a disclaimer? "97% of climate scientists agree that climate change is real and human caused. *However,* in many branches of science, lack of consensus doesn't invalidate findings—it's a natural part of the scientific process." Would such a message help bring public perceptions of uncertainty's role in science more in line with scientists'?

With this question in hand, I and colleagues in the SCI Lab designed a social science experiment. We asked nearly 3,000 people from across the country to take a survey we'd designed. We enlisted the help of the survey panel provider, Forthright, to recruit participants from their vast pool of participants across the country—making sure that a third of recruited participants were Democrats, a third were Republicans, and a third were Independents. As these participants began our survey, they read a brief article about a matter of scientific consensus (such as climate change) that had either a statement explaining that there is considerable—on the level of 97%—agreement among scientists that this phenomenon is real, a disclaimer with this detail *plus* an emphasis on how disagreement among scientists is a normal part of the scientific

process that doesn't invalidate results, or neither statement. After reading their assigned topic (with or without an additional statement), participants read a similar article emphasizing the scientific indeterminacy on another topic (such as the degree of risk posed by pesticide exposures or long-term antibiotics use).

We then asked questions to gauge their perceptions of science's credibility, risks posed by the consensus and non-consensus phenomena, and support for taking action on science-recommended actions to address both phenomena. Participants were asked, for example, their level of agreement with statements like: "people trust scientists a lot more than they should," "people don't realize just how flawed a lot of scientific research really is," and "sometimes I think we put too much faith in science." We asked how much people believed the consensus and non-consensus risks would harm "you personally," "people in the United States," and "future generations of people." Having read what we showed them about scientists' assessment of the risks of climate change (for a consensus example) and then pesticide exposures (for a non-consensus one), they were asked to rate their degree of opposition or support to government policies (like carbon taxes in the climate change scenario and fines for excessive pesticide releases in the pesticide exposure one), incentives (like tax breaks for climate-friendly home improvements or funding for water filtration systems in areas of high pesticide exposure), and individual actions (like recycling or wearing PPE when handling pesticides). By comparing individuals' responses to these questions regarding risks there's consensus about and those there isn't, we could see if the implied certainty of the former caused comparatively lukewarm assessments of the credibility, risk assessments, and proposed actions around the latter.

Ultimately, we were asking: would exposure to a consensus science message result in readers regarding a *non-consensus* one with greater wariness? Would this dynamic suggest to

people that the non-consensus topic poses fewer risks to the public—and is therefore less worth taking action to address—than the consensus one? Happily, it doesn't appear so—at least from this one study; so take it with a grain of salt!

We found that the consensus message was effective at decreasing participants' belief that the topic is hotly contested among scientists: it succeeded in the intended persuasion. However, it did not appear to additionally introduce collateral damage to perceptions of less certain science. That is, between the people reading about consensus and those reading about consensus *plus* the normalcy of disagreement in science, there weren't differences in perceptions of science's credibility, risks, or willingness to take action to avert those risks. It's (cautiously) good news for science communicators who prefer to hammer home the point of science's trustworthiness by highlighting consensus (in those fields where it's been established, that is). I say "cautiously," because this finding is nearly as uncertain as they come—based, as it is, on just one study of a little under 3,000 Americans. There's a lot more work to be done to see if this holds in different populations (such as those in other countries), for different consensus and non-consensus topics (we only looked at four of the former and two of the latter), and in cases where a stronger connection between consensus and trustworthiness is implied (perhaps we didn't induce collateral damage because our messages didn't "successfully" equate trustworthiness and consensus—as we fear some communications in the real world might). So… do consensus messages inadvertently undermine trust in sciences without (measured) consensus behind them? *Perhaps* not, though we'd like to investigate further.

As for what further investigation might look like: we divided participants among four different consensus topics and two different non-consensus ones, in hopes of keeping factors like political ideology (rather than the factor we were really interested in, namely, differences in

perceptions of consensus and non-consensus messages) from determining responses. This is easier said than done, however. It's difficult to find topics that are free of partisan polarization, even within "objective" science, so while we included topics polarized toward the political right's preferences (the deleterious effects of pandemic-era school closures) *and* the left (the deleterious effects of fossil fuel emissions)—as well as a supposedly neutral one (the deleterious effects of childhood lead exposure), even the latter isn't accepted as universally across the political aisle as we would expect (and hope). Consequently, we can't be sure the (non)effect we saw was because people were unbothered by non-consensus or because political preferences for or disapprovals of the messages themselves accounted for the survey responses (with liberal-leaning participants' answers "cancelling out" the opposing effects of conservative-leaning participants' ones). In future, we'd like to see if tweaks like including different topics and/or emphasizing the *trustworthiness* of consensus (a tempting communicative tactic, if inadvertently disingenuous about uncertainty's centrality to science) induces collateral damage not evident in this first exploration.

Science is about answers and exciting discoveries (and boring discoveries); it's about learning and increasing understanding and pushing the boundaries of what had been known. But it's also about human behavior, which means it's about questions and ambiguities and devilish complexity; it's about error bars and puzzles, curiosity and frustration and—of this I'm nearly certain—uncertainty. Isn't it marvelous? Now please excuse me as I dismount this soapbox and get back to the lab: I have a few questions to (potentially, provisionally) answer.

Sources

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