Perspective

The role of language in expressing the life sciences in a polarized age

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This Perspective is based on the keynote plenary lecture delivered at the Annual Conference of the Association for Politics and the Life Sciences (APLS), held on October 23, 2015, at the University of Wisconsin–Madison.

In these comments, I adopt a rhetorical perspective in order to consider the role of language in clarifying or confusing the public and public debates on a number of consequential polarized topics in the life sciences. My analysis is predicated on Samuel Taylor Coleridge's notion that "language itself does, as it were, think for us."[1] Literary critic Kenneth Burke advanced the same concept in humorous fashion when he suggested that a toast I was slated to deliver in his honor state simply, "Language can do our thinking for us but language cannot do our drinking for us."

From that premise, I will advance three sober arguments: Custodians of knowledge tell us what science knows and how it knows it. Their language can enhance or cloud public understanding of the underlying science. Because language plays these roles, we need to be aware of the ways in which audiences hear the language that is used to conceptualize scientific concepts. When, advertently or not, linguistic choices miscommunicate the underlying science, the policy debate becomes muddied and the credibility of the science is more susceptible to polarizing challenge.

The role of custodians of knowledge

Although the scientific community generates and communicates knowledge, the official custodians of scientific knowledge serve an additional synthesizing and certifying function. Custodians such as the Royal Society in the United Kingdom; the U.S. National Academies of Sciences, Engineering, and Medicine; the Centers for Disease Control and Prevention (CDC); and the Food and Drug Administration (FDA) tell us what science knows and how it knows it. These entities are invested with the status of custodians of knowledge by a process of rhetorical construction, sometimes through certification by other authorities (e.g., the National Academy of Sciences was created by Congress to advise it on scientific matters relevant to policymaking); sometimes, as is the case with the American Association for the Advancement of Science, by simply reliably summarizing science and being treated deferentially by those who already have public trust; sometimes because their word carries impact backed by the legitimacy of other entities (e.g., statements by the FDA, the U.S. Department of Agriculture [USDA], and the Environmental Protection Agency [EPA] carry regulatory authority derived from congressional authorization or the constitutional prerogatives of the executive branch); and sometimes because they have generated credible practical science and scientific achievements (e.g., the National Institutes of Health [NIH] and the National Aeronautics and Space Administration).

By treating them as credible sources of scientific information, the press bolsters these custodians' capacity to serve their function authoritatively. When their credibility is challenged by their own actions (e.g., the mistaken conclusion of the Intergovernmental Panel on Climate Change [IPCC] about the imminent disappearance of Himalayan glaciers) or by real or supposed scandals (e.g., the IPCC's "Climategate"), their capacity to ground discourse can be eroded, an argument that I make elsewhere.[2]

When confidence in a custodian of knowledge drops, its ability to translate what it knows into public belief does as well. The CDC risked that outcome when those speaking for it provided mistaken assurances about U.S.

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hospitals' preparedness to deal with the Ebola virus. Surveys taken at the time show a short-term drop in confidence in that agency that coincides with that misstep.

Sowing doubts about the scientific consensus

An institution that functions as a custodian of knowledge can speak in the form of a consensus report, and often those who head or have headed such a custodial organization also speak. Throughout the Zika outbreak in Florida in 2016, for instance, CDC head Thomas Frieden summarized the emerging Zika science for the press and public.

Not all such communication is as unproblematic as Frieden's. Spokespersons can undercut as well as clarify our understanding of the science. So, for example, when a former director of the NIH legitimized the false inference that there may be a link between autism and the measles, mumps, and rubella (MMR) vaccine, she provided fodder for those perpetuating that misconception. The following exchange occurred in a nationally aired interview in 2008 with former NIH head, Dr. Bernadine Healy:

> Interviewer: It sounds like you don't think the hypothesis of the link between vaccine and autism is completely irrational.
>
> Bernadine Healy: When I first heard that there was a link between autism and vaccines, I thought, 'Well that's silly.' Really, I tended to dismiss it on the superficial kind of reading or reading what was in the paper. No offense to the media. So when I first heard about it, I thought, 'that doesn't make sense to me.' The more you delve into it, you look at the basic science, if you look at the research that has been done, animals, if you also look at some of these individual cases and you look at the evidence that there is no link, what I come away with is the question has not been answered.[3]

Scholars have tried to explain why, even in the face of persistent correction, some in the public insist that there is an MMR vaccine association with autism. Our standard narrative says that in the absence of a scientifically justified explanation for the cause of autism, the temporal association between receiving the MMR and likely onset of autism's symptoms leads to a post hoc, ergo propter hoc inference, which then seems to be validated by a bogus "scholarly" article that was not promptly retracted.

However, there may be other factors at work as well. Dr. Healy's statement on national television certainly did not help correction efforts, not simply because she is a doctor but also because she headed an institution that is a custodian of health-related knowledge.

Sometimes I suspect that when we look at the people who question or reject a matter on which a scientific consensus exists, our analysis is too narrow. Cues inside the scientific community can reinforce a narrative that runs contrary to the consensus science position. When those cues originate with someone who carries the authority of an institution that is a custodian of knowledge, their credibility rises. In the example just noted, Dr. Healy did that.

For a related instance in another life sciences domain, a statement by a former U.S. secretary of agriculture relevant to the debate over the safety of genetically modified organisms (GMOs) on the market in the United States is illustrative. Three agencies have regulatory authority over GMOs: the FDA, USDA, and EPA. All three assert, in one fashion or another, that GMO products on the market are as safe to eat as the conventionally grown equivalents.

However on October 31, 2013, Dan Glickman, former secretary of agriculture (1995–2001), said in an interview with the *Washington Post,* "You know, my own feeling is there is no scientific reason to label these crops. But, ultimately, the consumers have to be the ones who decide if they want it labeled or not."[4]

He went on to say, "I haven't advocated mandatory labeling by the government. *We don't really have modern testing equipment out there. We can't really determine the thresholds to grade precision.* So it's too premature to require mandatory labeling. But I predict that, within five years or so, these things will all be labeled" (emphasis added).[5]

Note his logic. There is no scientific reason to label. He has not advocated labeling. So far, so good. But the next sentence seems to imply a relationship to the preceding one saying that he has not advocated labeling. Under that reading, he has not advocated labeling because of the absence of modern testing equipment. And the sentence "So it's too premature to require mandatory labeling" is consistent with that interpretation of his intended meaning. His statements raise the question: if the equipment is imprecise, how confident can we be that the USDA is correct in saying GMOs on the market are as safe as the conventionally grown equivalents? And how confident can we be that "there is no scientific reason to label"?

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Both Healy and Glickman have special standing because each once spoke for an agency that is a custodian of knowledge. Each, in an extemporaneous utterance — responding to a question in an interview — is entering assumptions into a contentious debate that can be used, whether fairly or not, to suggest that the scientific consensus is suspect, in the first case on the safety of the MMR vaccine and, in the second, on the comparative safety of GMOs on the market in the United States.

Doubts invited by inconsistent uses of language by custodians of knowledge

Custodians of knowledge also increase confusion and open the credibility of governmental custodians of knowledge to attack when their articulation of what science knows seems inconsistent. An example of this can be seen in what the governmental agencies that regulate GMOs tell us about their relative safety.

The backdrop for this analysis is a "substantial equivalence standard" used by the federal agencies to determine whether a GMO should be allowed on the market. When we hear "as safe as," we are hearing the language of substantial equivalence. The website of the FDA acknowledges that the substantial equivalence standard is a reference point for it. Specifically, the FDA says,

> The scientific concepts described in this guidance section are *consistent with the concepts of substantial equivalence* of new foods discussed in a document under development by the Group of National Experts on Safety in Biotechnology of the Organization for Economic Cooperation and Development (OECD). (emphasis added)[6]

The "substantial equivalence" standard is a reminder that GMO crops are not identical to the conventionally grown equivalents. At the same time, it sets up an explanation for the difference in language on three websites: two from regulatory agencies, the FDA and USDA, and one from the Law Library of Congress, a synthesizer of what is known.

> FDA: "Using a science-based approach, the Food and Drug Administration (FDA) regulates foods and ingredients made from genetically engineered plants to help ensure that they are safe to eat."[7] The important part of this statement is that it's determining *that they are safe to eat*.
>
> USDA: "the United States Department of the United States Department of Agriculture (USDA), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA) work to ensure that crops produced through genetic engineering for commercial use are properly tested and studied to make sure they pose no significant risk to consumers or the environment."[8]

The important part says, "They pose no significant risk." Note, by the way, the care that both agencies take to remind us that they are not "ensuring" that GMOs are safe to eat but rather "help ensure" (FDA) and "work to ensure" (USDA).

Interestingly, it is the Law Library of Congress and not the FDA or USDA that explicitly includes language capturing the "substantial equivalence" standard. Specifically, "Several scientific organizations in the US have issued studies or statements regarding the safety of GMOs indicating that there is no evidence that GMOs present unique safety risks compared to conventionally bred products."[9] The central language of interest: *there is no evidence that GMOs present unique safety risks compared to conventionally bred products*.

> FDA: ". . . that they are safe to eat."
>
> USDA: ". . . they pose no significant risk . . ."
>
> The Law Library of Congress: ". . . there is no evidence that GMOs present unique safety risks compared to conventionally bred products . . ."

As a wary literalist, I am uncomfortable with a categorical statement that any product is "safe to eat." For whom? Under what conditions? Absolutely safe or contains a level of small but acceptable risk? And, importantly, based on what tests? (This is from *Nature*: "Substantial equivalence is a pseudo-scientific concept because its commercial and political judgment masquerading as if it were scientific. It was created primarily to provide an excuse for not requiring biochemical or toxicological tests. It therefore serves to discourage and inhibit potentially informative scientific research."[10])

Of the three formulations, I prefer the third because the words "unique" and "compared to conventionally bred products" are more scientifically accurate and because the statements about safety and risk offered by the FDA and USDA are backed by science that draws its safety and risk conclusions from a comparison to the conventional equivalents.

In the context of the debate about whether crops produced with genetic engineering (GE) should be labeled

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as such, a second difference in the three formulations is of note. Whereas the frame in the FDA statement is a safety frame, the USDA and the Law Library of Congress offer a risk one.

If there is no scientific justification for mandating labeling GE or GMO products in the grocery aisle, a safety frame is the preferred one. But that framing leaves us with at least two questions. If "GM products on the market in the US are safe to eat" is not the most scientifically accurate way to express what science knows, should a custodian of knowledge agency use that formulation? Can we fashion statements that accurately digest what science knows without providing ammunition to those who see advantage in opposing a scientific consensus in order to achieve unrelated ends of their own?

By indicating how we know what we know, I believe we can. Although the words "per se" and "breeding technologies" require translation, the European Commission went a long way toward accurately digesting the science when it said,

> The main conclusion to be drawn from the efforts of more than a hundred and thirty research projects covering a period of more than 25 years of research and involving more than five hundred independent research groups, is that biotechnology and, in particular, GMOs are not per se more risky than conventional breeding technologies.[11]

The statement's virtues are many. "Main conclusion" allows for the occasional exception or outlier. And "not more risky than" allows that there may be risk in consuming conventionally grown crops as well while also framing the question of safety or risk as comparative. In the process, it tells the reader "safer or riskier than what."

Language that is unjustified by the available science is problematic

When a custodian of knowledge or a person speaking with the authority of a custodian of knowledge gives the public a categorical assertion of safety that turns out to be false, the language of safety and scientific credibility in making such claims can take a hit.

Historically, in 1995, a person in Great Britain became the first to die from variant Creutzfeldt-Jakob disease (vCJD), which is the form that bovine spongiform encephalopathy (BSE), commonly known as "mad cow" disease, takes in humans. By the end of 2012, 176 Britons had died of the same disease.

This unfortunate state of affairs invited not only the question famously asked by White House lawyer John Dean in the U.S. Watergate Committee hearings, "What did they know and when did they know it?," but also, "What assurances had the custodians of health knowledge given the British people?" The answers resided in news clips retrieved and replayed as a governmental investigation in the United Kingdom uncovered answers to such questions.

From a May 1990 news report on the BSE outbreak in the United Kingdom:

> News anchor: "The agriculture minister, John Gummer, today enrolled his daughter, Cordelia, in his campaign to persuade people that eating beef is safe. It was a little hot for her, but later he munched it himself to prove to the world that he at least is confident there is nothing to worry about." [child is shown being offered a hamburger by her father]
>
> John Gummer, British Agriculture Minister: "When you have got the clear support of the scientists who deal with these matters, the clear support of the Department of Health, the clear action of the government, there is no need for people to be worried. I can say perfectly honestly that I should go on eating beef, my children will go on eating beef. There is no need to be worried. Now, you can't do anything more than that."
>
> News anchor: "The government's chief medical officer lent his support to official efforts to restore confidence in beef."
>
> Donald Acheson, British Chief Medical Officer: "There is no risk associated with eating British beef and that everyone — children, adults, patients in hospitals — can be quite confident that it is safe to eat beef."[12]

The governmental investigation that followed the vCJD deaths in the United Kingdom prompted questioning of institutional spokespersons who had vouched for the safety of British beef. In the process, news accounts revealed,

> Sir Kenneth [Calman] yesterday also said that official advice during the early 1990s that British beef was "safe" to eat, had not meant, imposed no possible risk to human health. As Chief Medical

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> Officer for England from 1991 until he stepped down last month, and before that Chief Medical Officer for Scotland, Sir Kenneth had repeatedly assured the public that British beef was safe to eat.[13]

Now, if "safe to eat" does not signal the absence of risk, what is a reasonable lay person supposed to conclude that it means? Indeed, what is one to surmise when a father who is also a custodian of knowledge goes on national television to offer his daughter a hamburger?

Donald Acheson, the British chief medical officer during the outbreak of vCJD, noted that "in retrospect, it would have been preferable to introduce an element of uncertainty due to incomplete knowledge about BSE and the risk to humans."[14] No kidding. He added, "It was several years after the events that I became aware that for some people, the word *safe* without qualification means zero risk."[15]

When custodians of knowledge make claims that are proved false, subsequent assurances of safety in other domains are contaminated. People remember the earlier use of the word "safe." And instead of saying, "Do you mean 'as safe as,'" some ask, "What are you hiding and am I going to die from engaging in this supposedly safe activity?"

Unsurprisingly, then, the false assurances about the safety of British beef not only infected the GMO debate in Britain but also affected the press frame and public opinion there. Here is an indication that it affected the press frame:

> It is impossible to exaggerate the significance of the regulatory failure associated with BSE on the attitude of the European public toward GM foods. This was especially true in Britain, where unfavorable press coverage of agrobiotechnology increased substantially following the BSE crisis: between 1996 and 1998 the percentage of those strongly opposing genetically modified foods rose from 29 percent to 40 percent.[16]

Memories that past assurances had proved false helped mobilize the campaign against GMOs in Britain. "The anti-GMO movement could capitalize on the issue salience of the mad cow crisis because it was able to effectively mobilize at each of these levels and to some extent mobilize one against the other," noted a team of scholars who studied the issue.[17] "The B.S.E. scandal has been used by such lobbies as a means to gaining political weight within the European regulatory process,"[18] wrote Matteo Ferrari.

The lesson? False assurance by a custodian of knowledge can contaminate the discourse environment. Recollections of earlier betrayals of trust are available for retrieval and use in subsequent debates. In Britain, the logic went, "Governmental custodians of knowledge were wrong about beef. They may be wrong about GMOs as well." Different body of science. Different scientists offering the conclusions. But, because both involve human consumption of food, there is a lay logic that says, it may be wise to distrust this custodian of knowledge when it is offering safety claims.

Language can confuse or clarify

Just as language can cloud and confuse, mislead and misdirect, it can also clarify. The literature on the power of linguistic framing illustrates this idea. Cast the tax imposed when assets are transferred from a decedent to an heir as an "estate tax" and support increases but, alternatively, characterize it as a "death tax" and approval drops.[19] When affirmative action is characterized as additional efforts to ensure "equal" treatment rather than as a process providing "preferential" treatment, acceptance among whites in the United States increases.[20] Approval of so-called partial birth abortion varies depending on whether the news articles to which one is exposed use the word "baby" or "fetus."[21]

To illustrate the ways in which language can misdirect or clarify, let me turn to the ways in which the science community informs the public about the transmissibility of viruses. My focus is on two concepts: herd immunity versus community immunity.

Herd immunity versus community immunity

Experts routinely tell us that when 90% to 94% or 95%, depending on the microbe, of the total population is immunized, we achieve so-called population or herd immunity. That explanation is problematic on at least two grounds. Even at 95% immunization, the population as a whole is not protected from transmission of a highly contagious disease such as measles. And, analogizing us to herd animals is not the best way to suggest that those of us who speak in words not "moos" and "baas" should take specific action to protect ourselves and others.

If each person in the population is equally likely to interact with each other person, then the 95% threshold works well. But the concept underlying population or herd immunity falters when we have enclaves

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of unimmunized individuals who have regular contact with those who cannot be immunized. Predictably vulnerable locations include pediatric practices open to families who refuse to vaccinate and schools without mandatory vaccination as a condition of attendance.

Because those under 12 months of age should not be vaccinated, there are infants in doctors' offices for their checkups who could be exposed to an unvaccinated child. So, too, in schools and among the homeschooled in communities with higher proportions of parents opposed to vaccination. Those who map vaccination rates identify clusters with lower vaccination levels.[22,23] Unvaccinated and undervaccinated individuals within each cluster are more vulnerable. So, too, are those who cannot be vaccinated who unknowingly come into contact with a measles-infected individual who may even be contagious but not yet symptomatic. That is what occurred with a baby in San Diego who had to be hospitalized when he was exposed at 10 months to an unvaccinated child who did not yet have the characteristic measles rash when he passed briefly through the pediatric room in which the unvaccinated baby and his mother were awaiting the child's 10-month checkup. [24]

The label "community immunity" is preferable to "herd immunity" because the former invites a relevant question: whose community? The answer is all communities, including those in which individuals with measles or some other highly transmissible disease come in contact with those who are unimmunized. The pediatric office. The school. Disneyland. Or any anti-vaxxer enclave.

We need language that invites questions whose answer is sound science. Neither "population" nor "herd immunity" gives us an explanatory frame for why an area with 95% immunization can still be vulnerable to a measles outbreak. "Community immunity" does. The word "community" invites the questions whose answer is the science explaining why everyone who can be vaccinated should be vaccinated. Yet a Google Scholar search for "population immunity" yields 6,340 results; the same search for "herd immunity yields 30,400; and a search for "community immunity" locates 1,010.

The relevance to policy is clear. Because schools are vulnerable spaces in which the unvaccinated can be exposed to measles, government should, as California just did, require vaccination as a condition of school attendance. We do not want people to say, when a community gets to 95% vaccination, "That's really terrific, now I don't have to vaccinate my child because the risk that she has and poses is gone," when it isn't.

Conclusion

In summary, I have drawn together a number of examples from across the life sciences to make three points. Custodians of knowledge tell us what science knows and how it knows it. Their language can enhance or cloud public understanding of the underlying science. Because language plays these roles, we need to be aware of the ways audiences hears the language that is used to conceptualize and explain scientific concepts.

Custodians of knowledge and those empowered to speak in their name complicate the communication environment when they adopt a safety rather than relative safety frame, overstate their level of certainty about what is known and how it is known, seem to question the scientific conclusions promulgated by their own institutions or agencies, or neglect to disclose the scientific justification for their recommendations. When the language of custodians of knowledge miscommunicates or misframes the underlying science, the policy debate becomes muddied and the credibility of the science itself is more likely to be subject to polarizing challenge.

By contrast, when the language of the custodians of scientific knowledge carefully hews to what is known and is comprehensible, parents deciding whether to vaccinate their children should be better able to understand the need, and lay audiences should be more likely to realize that science is making a comparative claim about GMOs not one about absolute safety or risk. If so, those speaking about what science knows about vaccination and genetically engineered crops should be more likely to survive scrutiny with their credibility intact.

A final note: even if language cannot do our drinking for us, when carefully chosen and calibrated, it can increase the likelihood that our audiences will understand the characteristics and probable impact of the fluid in the glass being raised as part of the toast.

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