Meaning-Making in Science Communication: A Case for Precision in Word Choice

Anna Nellis B. Smith1 and Bethann Garramon Merkle2

1College of Arts and Sciences, University of Wyoming, 1000 E. University Ave., Laramie, Wyoming 82071 USA
2Department of Zoology and Physiology, University of Wyoming College of Arts and Sciences, 1000 E University Ave Dept. 3166, Laramie, Wyoming 82071-2000 USA

Many advocates for better science communication argue that transparency in science is necessary for the public to contribute to informed decisions about scientific issues, yet transparency is not straightforward (Kahan 2010, Priest 2013, Fischhoff 2019). Particularly when communicating research results, scientists are commonly taught that data should be presented without interpretation and that the meaning of data is self-evident (Nisbet and Scheufele 2009, Wolfe, 2009). Increasingly, and perhaps ironically, evidence indicates this approach is unrealistic (Kahan 2010, Davies et al. 2019, Iyengar and Massey 2019).

Even as we communicate within our own scientific communities, we are constantly shaping and instilling meaning, intentionally or not. Furthermore, our audiences do the same. Renowned environmental writer Barry Lopez articulated this reality over two decades ago:

The kernel of indisputable information is a dot in space; interpretations grow out of the desire to make this point a line, to give it direction. The directions in which it can be sent, the uses to which it can be put by a culturally, professionally, and geographically diverse society are almost without limit (Lopez 1986, p. 190).

In other words, we must understand that political, social, cultural, economic, and ethical concerns impact and are impacted by science communication (Gigante 2018). Anyone interested in communicating science will benefit from a deeper awareness of how meaning is shaped at multiple levels within the communication process, by factors both within and outside our control. We can begin by better understanding how differences in interpretation are influenced at the foundational level of word choice.

Many scientists know, at least theoretically, to avoid jargon in communicating their research to the public (Plain Language Action and Information Network n.d.). Even definitions of the word, jargon, often have negative connotations that instill wariness (“Jargon” n.d.). What is less commonly addressed is how to identify technical jargon when the definitions of widely used words can shift in meaning between the scientific community and the public (e.g., American Geophysical Union n.d.; Somerville and Hassol 2011; Plain Language Action and Information Network n.d.). Though easily overlooked, these differences in meaning can have significant impacts on public interpretation and perception of science (e.g., the Robinson v. Liberty Mutual Insurance Co., [2020] court decision that recently ruled hinged on whether the legal definition of insects should be based on technical or ordinary meanings).
Terms that have different meanings for different audiences present a unique challenge in communicating science. We know from the field of semiotics that words are inherently subjective and cannot convey consistent absolute truths (de Saussure et al., 1966). Instead, meaning is constructed from our cultural contexts and is liable to shift between communities (Berlin 2003, Medin and Bang 2014). Table 1 provides an accessible reference for just how slippery the meaning of some commonly used words can be (Table 1).

In these examples (by no means exhaustive), the divergences in meaning range from subtle to vast. The potential ramifications are similarly variable. A closer examination of three examples from this table illustrates the different degrees of risk embedded in word choice. Not long ago, the word aerosol would present a fairly harmless level of discrepancy between scientific and public meanings. The public meaning of the word is usually used for substances in pressurized containers like hair spray, but to scientists it is a small particle suspended in the atmosphere (“Aerosol” n.d.; Hassol 2008). Assuming that aerosol refers to a spray can might not cause a major rift in public perception of science, but it would likely lead to confusion and a missed opportunity for better understanding of atmospheric science. Today, aerosols are in the news on a regular basis, due to their possible role in transmission of the SARS-CoV-2 which causes COVID-19 (Asadi et al. 2020, Schleunes 2020, World Health Organization 2020), and shared understanding of the word has direct implications for public health.

Broadening the scope now, the word theory is commonly used by the scientific community and the general public. However, the meaning of this word changes profoundly in these two contexts. To someone in the sciences, a theory is our best current understanding of something, but to most people, a theory is merely a conjecture (“Theory” n.d.; Hassol 2008). We can immediately identify the misinterpretations that might arise from this disparity. Not only is the public’s understanding of a particular study at risk here, but also so is their understanding and confidence in scientific knowledge more broadly. We can see from this example why someone who thinks of a theory as speculation might then be skeptical of

| Scientific term | Public meaning | Better choice |
|-----------------|----------------|---------------|
| Enhance         | Improve        | Intensify, increase |
| Aerosol         | Spray can      | Tiny atmospheric particle |
| Positive trend  | Good trend     | Upward trend   |
| Positive feedback | Good response, praise | Vicious cycle, self-reinforcing cycle |
| Theory          | Hunch, speculation | Scientific understanding |
| Uncertainty     | Ignorance      | Range         |
| Error           | Mistake, wrong, incorrect | Difference from exact true number |
| Bias            | Distortion, political motive | Offset from an observer |
| Sign            | Indication, astrological sign | Plus or minus sign |
| Values          | Ethics, monetary value | Numbers, quantity |
| Manipulation    | Illicit tampering | Scientific data processing |
| Scheme          | Devious plot   | Systematic plan |
| Anomaly         | Abnormal occurrence | Change from long-term average |

Note. Reproduced from Somerville and Hassol (2011), with the permission of the American Institute of Physics.
using scientific theory as a basis for decision-making. This is congruent with reports showing that those already familiar with scientific knowledge (and therefore more likely to interpret these terms from a scientific perspective) tend to have higher levels of trust in science than those without a foundational understanding of science (Funk et al. 2019).

The stakes are raised yet again when we look at the word manipulation. Manipulation, as scientific data processing, rearranges data without fundamentally changing it (“Data manipulation” 2013). Yet, the public meaning of manipulation introduces a notion of dishonesty and falsification into this process (Hassol 2008). When manipulation is used, we risk not just misunderstanding or skepticism, but an active distrust in scientists and the scientific process (Weingart and Guenther 2016).

This rift in trust becomes particularly important when we recognize that most efforts to improve science communication focus on content, accessibility, and delivery of information. However, the modern information environment is increasingly complex. Compelling research indicates that an abundance of misinformation, rather than faulty communication, is the root cause for public distrust in the scientific process and knowledge (Iyengar and Massey 2019). Furthermore, recent Pew surveys show that public trust in science is often influenced by familiarity with the work of scientists and by how closely the science aligns with preexisting values and beliefs (Kunda 1990, Scheufele 2013, Funk et al. 2019). Viewed this way, to be effective communicators we must have a deeper appreciation for how language and ideas are reshaped in context. We can no longer rely solely on accurate delivery of information. Nowadays, we must work to build and maintain our credibility as scientists.

To put it bluntly, science cannot be separated from scientists. “Science is socially performed, not mechanically formulated, and scientists are people, not data” (Northcut and Yu 2018, p. 7). Scientists are a part of, not separate from, the social contexts in which we live, and even our use of the word “public” can reinforce a perceived division between scientists and our broader communities (Medin and Bang 2014). By failing to attend to the diversity of cultural contexts and perspectives among our audiences, we risk alienating and distancing ourselves and our science from many members of the public, often including those most jeopardized (Medin and Bang 2014, Davies et al. 2019).

It is well documented that environmental hazards disproportionately impact communities that are already marginalized (McIntyre-Brewer 2019), yet science and scientific discourse continues to be shaped primarily by the dominant culture in which it is embedded (Penrose and Katz 2010, Polk and Diver 2020). In this context, the need for an intersectional approach to science communication is clear. Incorporating environmental justice practices into science communication requires us to become aware of how our perspectives are shaped by our social position: “what [this positionality] allows us to see and what it prevents us from seeing, and how this affects our understanding of environmental policy impacts on marginalized communities” (Polk and Diver 2020, p. 4).

With a more expansive understanding of how meaning is formed through cultural context, we can be more conscious of our and others’ underlying assumptions about the words we use to communicate our work. It should be clarified that broadening our awareness does not replace the need to elevate the voices of leaders within marginalized communities. Increasingly, researchers are advocating for treating science communication as part of a collective meaning-making process within the broader web of culture (Davies et al. 2019, Hettinger et al. 2019). As a collaborative process, meaning-making takes into
account all of the ways groups of people explain the world, including but not limited to scientific ways of knowing (Davies et al. 2019). Centering community leaders and collaborating with them in meaning-making helps to empower the knowledge, authority, and agency of marginalized communities (Polk and Diver 2020). As can be seen from case studies (e.g., Pulido and Peña 1998), expanding scientific discourse to include the insights and concerns of marginalized communities leads to increased social relevance of scientific findings, greater trust in scientific knowledge production, and a more complete understanding of the world (Polk and Diver 2020).

As recent studies indicate, scientists are becoming increasingly aware of the complex rhetorical environments we must navigate (Reid 2018) and the reality that a speaker can “never predict the significance [a] term will have for an audience, since listeners will receive it differently… In short, language has an uncontrollable life of its own” (Berlin 2003, p. 64). This does not mean that we should consider the task of science communication impossible. Indeed, through inaction or by “failing to anticipate common misunderstandings, scientists can inadvertently reinforce them” (Somerville and Hassol 2011, p. 51). Instead, we should strive to learn how to recognize commonly used words in our field that have multiple meanings and connotations. We must ask ourselves what underlying assumptions we are making about these words and what cultural perspectives are being reinforced, privileged, and left out. Then, we must be as thoughtful and precise as possible in the words we use. By drawing from shared language to reduce the risk of misinterpretation, we take an essential step in improving our effective communication of science to broader audiences.

Literature Cited

“Aerosol”. n.d. In Merriam-Webster.com dictionary. Retrieved July 29, 2020, from https://www.merriam-webster.com/dictionary/jargon
American Geophysical Union. n.d. Watch your words! Science vocabulary with dual meanings [Infographic]. sharingscience.agu.org. Retrieved May 24, 2020, from https://www.agu.org/-/media/Files/Share-and-Advocate-for-Science/AGU_Toolkit-Watch-Your-Words.pdf
Asadi, S., N. Bouvier, A. S. Wexler, and W. D. Ristenpart. 2020. The coronavirus pandemic and aerosols: Does COVID-19 transmit via expiratory particles? Aerosol Science and Technology 54:635–638. https://doi.org/10.1080/02786826.2020.1749229
Berlin, J. A. 2003. Rhetoric, poetics, and cultures: reconfiguring college English studies (expanded ed.). Parlor Press, West Lafayette, Indiana, USA.
“Data manipulation”. 2013. In Computer Hope dictionary. Retrieved July 29, 2020, from https://www.computerhope.com/jargon/d/datamani.htm
Davies, S. R., M. Halpern, M. Horst, D. A. Kirby, and B. Lewenstein. 2019. Science stories as culture: experience, identity, narrative and emotion in public communication of science. Journal of Science Communication 18:A01.
Fischhoff, B. 2019. Evaluating science communication. Proceedings of the National Academy of Sciences of the United States of America 116:7670–7675.
Funk, C., M. Heffron, B. Kennedy, and C. Johnson. 2019. Trust and mistrust in Americans’ views of scientific experts. Pew Research Center. https://www.pewresearch.org/science/2019/08/02/trust-and-mistrust-in-americans-views-of-scientific-experts/
Gigante, M. E. 2018. Confronting the objectivity paradigm: a rhetorical approach to teaching science communication. Pages 203–218 in K. M. Northcut and Yu, H., editors. Scientific Communication: Practices, Theories, and Pedagogies. Routledge, New York City, New York, USA.
Hassol, S. J. 2008. Improving how scientists communicate about climate change. Eos, Transactions American Geophysical Union 89:106–107.

Hettinger, A., A. Kumar, T. Eaves, S. Anderson, B. G. Merkle, and S. Bayer. 2019. Extending the Vision: highlighting the Human Dimensions of the Ecological Society of America. The Bulletin of the Ecological Society of America 100:e001595.

Iyengar, S., and D. S. Massey. 2019. Scientific communication in a post-truth society. Proceedings of the National Academy of Sciences of the United States of America 116:7656–7661.

“Jargon”. n.d. In Merriam-Webster.com dictionary. Retrieved July 29, 2020, from https://www.merriam-webster.com/dictionary/jargon

Kahan, D. 2010. Fixing the communications failure. Nature 463:296–297.

Kunda, Z. 1990. The case for motivated reasoning. Psychological Bulletin 108(3):480–498.

Lopez, B. 1986. Arctic dreams. Charles Scribner’s Sons, New York City, New York, USA.

McIntyre-Brewer, M. 2019. Environmental racism throughout the history of economic globalization. AUC Geographica 54:105–113.

Medin, D. L., and M. Bang. 2014. The cultural side of science communication. Proceedings of the National Academy of Sciences of the United States of America 111:13621–13626.

Nisbet, M. C., and D. A. Scheufele. 2009. What’s next for science communication? Promising directions and lingering distractions. American Journal of Botany 96:1767–1778.

Northcut, K. M., and H. Yu, Editors. 2018. High stakes and great responsibility: an introduction to scientific communication. Pages 1–15 in Scientific communication: Practices, theories, and pedagogies. Routledge, New York City, New York, USA.

Penrose, A. M., and K. B. Steven. 2010. Writing in the sciences, Third edition. Pearson Longman, New York, New York, USA.

Plain Language Action and Information Network. n.d. Avoid jargon. Plainlanguage.gov. Retrieved May 24, 2020, from https://plainlanguage.gov/guidelines/words/avoid-jargon/

Polk, E., and S. Diver. 2020. Situating the scientist: creating inclusive science communication through equity framing and environmental justice. Frontiers in Communication 5:1–10.

Priest, S. H. 2013. Critical science literacy: What citizens and journalists need to know to make sense of science. Bulletin of Science, Technology and Society 33:138–145.

Pulido, L., and D. Peña. 1998. Environmentalism and positionality: the early pesticide campaign of the United Farm Workers’ organizing committee, 1965–71. Race Gender Class 6:33–50.

Reid, G. 2018. Compressing, expanding, and attending to scientific meaning: writing the semiotic hybrid of science for professional and citizen scientists. Written Communication 36:68–98.

Robinson v. Liberty Mutual Insurance Co. 2020. No. 19-10940. United States Court of Appeals for the Eleventh Circuit.

de Saussure, F., C. Bally, A. Sechehaye, A. Riedlinger, and W. Baskin. 1966. Course in general linguistics. McGraw-Hill Book Co., New York City, New York, USA.

Scheufele, D. A. 2013. Communicating science in social settings. Proceedings of the National Academy of Sciences of the United States of America 110:14040–14047.

Schleunes, A. 2020. The COVID-19 Coronavirus may travel in aerosols. The Scientist. https://www.the-scientist.com/news-opinion/the-covid-19-coronavirus-may-travel-in-aerosols-67380

Somerville, R. C. J., and S. J. Hassol. 2011. Communicating the science of climate change. Physics Today 64:48–53.

“Theory”. n.d. In Merriam-Webster.com dictionary. Retrieved July 29, 2020, from https://www.merriam-webster.com/dictionary/theory
Weingart, P., and L. Guenther. 2016. Science communication and the issue of trust. Journal of Science Communication 15:C01.

Wolfe, J. 2009. How technical communication textbooks fail engineering students. Technical Communication Quarterly 18:351–375.

World Health Organization. 2020. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. WHO Scientific Brief. Retrieved May 26, 2020, from https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations