Title
Science, Values, and Science Communication: Competencies for Pushing Beyond the Deficit Model

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ABSTRACT:
The deficit (knowledge transmission) model of science communication is widespread and resistant to change, highlighting the limited influence of science communication research on practice. We argue that scholar-practitioner partnerships are key to operationalizing science communication scholarship. To demonstrate, we present a transformative product of one such partnership: a set of ethics and values competencies to foster effective communication with diverse audiences about scientific research and its implications. The ten competencies, focused on acknowledging values, understanding complexities of decision-making, strategies to deal with uncertainty, and diversifying expertise and authority, provide a guiding framework for re-envisioning science communication professional development.

KEYWORDS:
Communication competencies, ethics, values, decision-making, uncertainty, policy.

MAIN TEXT:
Despite decades of criticism, the deficit model of science communication continues to thrive (Wynne, 1989; National Academies, 2017). The deficit model assumes facts speak for themselves and giving citizens information about a scientific issue will “correct” their views and eliminate controversy (National Academies, 2017). In reality, reasoning is complex and attempts at debunking misinformation frequently backfire (Lewandowsky, Ecker, Seifert & Schwarz, 2012). Science communication breaks down not when laypeople fail to understand the scientific facts, but when scientists fail to understand and

speak to the core values of their audiences. Thus, whether scientists aspire to be neutral advisors or to be advocates, the deficit model is especially detrimental at the intersection of science and policy.

Impediments to Change

A reason given for scientists' adherence to the deficit model is lack of formal training in science communication (Simis, Madden, Cacciatore & Yeo, 2016). Alarmingly, most current science communication training, with its focus on imparting specific skills such as simply "distilling the message," is largely based on the deficit model (Besley, Dudo, Yuan & Ghannam, 2016). It is more likely to promulgate the deficit model than to eliminate it. In short, the tenacity of the deficit model reflects the lack of influence, on science communicators and trainers, of the scholarship on the science of science communication (Jamieson, Kahan & Scheufele, 2017). Here we define science of science communication broadly to encompass relevant research from a range of methodological approaches and disciplines, including philosophy, political science, psychology and sociology (Priest, Goodwin & Dahlstrom, 2018).

Transforming scholarship into practice is a challenge in most if not all fields, including the sister field of science education. In science communication, however, features of both the scholarship and the practice create unique impediments. The research that is relevant to the practice of science communication is not a cohesive body of scholarship: It is an interdisciplinary corpus of works that each tend to be written for other scholars in the authors' discipline. Science communication trainers typically come from a journalistic tradition and are not researchers (Besley *et al.,* 2016). Thus given the challenges of the task and the pragmatic limitations on time, it is unrealistic to expect trainers to translate and operationalize the unwieldy body of scholarship on the science of science communication on their own.

Vision and Collaboration

To reduce the scholarship-to-practice barrier, we propose leveraging the unique resources at a research university by bringing scholars who are conducting relevant research together with those who are designing science communication professional development. A recent partnership between two new entities at the University of California San Diego, the Research Communications Program, housed in the Divisions of Biological and Physical Sciences, and the Institute for Practical Ethics, housed in the Division of Arts and Humanities, illustrates this approach to forging a path between scholarship and practice. The Research Communications Program, a grant-funded effort that offers a variety of professional learning opportunities for (chiefly) early-career researchers, began with the vision of changing the aforementioned *status quo* in science communication training. The Institute for Practical Ethics aims to further both the theoretical and pragmatic analysis of ethical problems that relate to policy. Both groups agreed that it would be synergistic with their missions to document the ethics and values competencies that scientists need in order to engage in meaningful dialogue about their research with diverse audiences. In our focus on attentiveness to publics and their values, our work contributes to emerging efforts to create a more ethical practice of science communication (Priest, Goodwin & Dahlstrom, 2018)

Emergent Themes

Values. Four themes emerging from science communication scholarship framed our work. The first theme relates to how communication breakdowns may result from a clash of values. The most dramatic failure of the deficit model occurs when information is framed in such a way that it conflicts with an individual's worldview or identity (Lewandowsky *et al.,* 2012). Political affiliation, social networks, religious beliefs and other cultural influences all shape opinions on controversial issues, from childhood vaccines to global climate change to genetic engineering of food (The Public Face of Science Initiative, 2018). Contrary to what scientists may believe, however, while there are demographic groups that are more critical of scientists, almost none are opposed to science writ-large (The Public Face of Science Initiative, 2018). Scientists may have other misconceptions about certain groups, for example the notion that the conflict between religion and science is mostly about knowledge versus ignorance, when in reality it is chiefly a conflict over values (Evans, 2018). Furthermore, scientists have their own implicit values that may not be shared by publics, resulting in disputes over competing visions of the good (Gere, 2017). Downplaying or denying the role of values may shift the conflict, not eliminate it, and inadvertently instigate a battle over the perceived integrity of the scientific evidence (Nisbet, 2009).

Decision-making. The second theme follows directly from the first and relates to how values underlie decision-making about socio-scientific issues. Although public debates about these issues may be depicted by the media, as well as by scientists, as being dichotomous, nuance is the norm. For example, vaccination debates are often presented as a pro-science/anti-science conflict. Yet, policy decisions, such as whether to introduce a new vaccine, are not simply reflective of a "pro-science" position. They involve a multitude of tradeoffs and complex assessments of risk, such as vaccine morbidity, disease morbidity, vaccine efficacy, pathogen contagiousness and exposure risk (Seethaler, 2016). Tradeoffs of socio-scientific issues also include individual versus collective rights, economic factors, and costs and benefits for current versus future generations. Clearly, by its very nature, the act of prioritizing tradeoffs can never be values neutral. Furthermore, assessments of risk and decisions about what risks are acceptable for what gain are crucial aspects of making tradeoffs. Again, by its very nature, this process of assessment is driven by values (Thompson, 2018). A case in point is how different versions of the precautionary principle have shaped international trade decisions about genetically engineered food (Ahteensuu & Sandin, 2012).

Uncertainty. The third theme, uncertainty, is crosscutting in the science of science communication literature. Tidied-up textbook histories of discoveries lead to widespread misconceptions about the scientific process and frustration with the degree of uncertainty surrounding current scientific issues. Furthermore, people often reason about uncertainty in non-intuitive ways. Communicating about uncertainty is therefore one of the greatest challenges in science communication, one that raises ethical issues including, but not constrained to, finding a middle ground in prognostication between false assurances and doomsday scenarios. In response to the ethical concerns of communicating under uncertainty, others have proposed five communicative norms: 1) honesty, 2) precision, 3) audience relevance, 4) process transparency and 5) specification of uncertainty about conclusions (Keohane, Lane & Oppenheimer, 2014). Application of these principles is a matter of compromise because the details required to be fully precise, transparent or to specify uncertainty may be at odds with audience relevance (Keohane *et al.*, 2014) Despite these challenges, a nuanced approach to communication about uncertainty is sorely needed: In communication about climate change, the effort to focus on the scientific consensus at the expense of openness about uncertainty, especially with respect to climate impacts at the local level, may actually have intensified political polarization (Pearce, Brown, Nerlich & Koteyko, 2015).

Diverse Voices. The fourth and final theme that emerges from the literature has to do with who has a voice in a decision-making process. Sheila Jasanoff, a Professor of Science and Technology Studies at the Harvard Kennedy School of Government, has advocated for what she calls "technologies of humility," defined as "methods, or better yet institutionalized habits of thought, that try to come to grips with the ragged fringes of human understanding—the unknown, the uncertain, the ambiguous, and the uncontrollable" (Jasanoff, 2009, p. 32). She advocates for new forms of engagement between experts, decision-makers and the public, ones in which citizens are encouraged to bring their knowledge and skills to the governance process. The argument for incorporating diverse expertise in the policy process is in part a matter of equity and social justice, especially when risks and benefits will be unevenly distributed (Pierce, 2013). It is also a matter of avoiding scientific gaffes, like the ones made after radioactive fallout from Chernobyl contaminated sheepfarming areas in the Cumbrian

Hills of England. Failing to draw on the sheepfarmers' craft knowledge about farming and local vegetation and geological conditions, scientists handling the crisis made a series of flawed predictions and recommendations, followed by retractions and revisions that undermined their credibility and led to a breakdown in trust (Wynne, 1989).

Ethics Competencies for Research Communication

The four themes that emerge from scholarship are echoed in the ten competencies generated by the Research Communications Program—Institute for Practical Ethics partnership (Table 1). The four coauthors on this paper, who among them have backgrounds in the sciences, science communication, science education, science studies, philosophy and sociology, drafted the competencies using the modified Delphi method, an iterative process to reach consensus through both written responses and face-to-face deliberations (Engleberg *et al*., 2017). Our team began with a face-to-face meeting to collectively set the scope of the work: Proposed competencies had to be relevant to researchers' communication about science with publics (defined as anyone outside the researchers' field), and thus would be distinct from research ethics or a journalism code of ethics. Each team member then independently generated a list of proposed competencies. These were shared electronically before a face-to-face meeting that began several cycles of synthesis and analysis, conducted both synchronously and asynchronously, in which proposed competencies were grouped, emerging themes were identified, and overlap was discussed. When collective agreement had been reached on what core ideas were present in the differently worded proposed competencies, one member of the team took the lead on crafting the language of the draft competencies, which were then finalized by the team through additional rounds of face-to-face and written feedback.

Each resulting competency has a knowledge component and a communication skills component; the latter states how the knowledge component should influence communication. To illustrate, the following is the full text of the Tradeoffs in Applications of Science competency:

Researchers know that possible conflicts related to the applications of their scientific research include: i) Technology improving lives versus exacerbating disparities; ii) Emerging versus traditional values; iii) Regulation versus individual rights; iv) Economic priorities versus environmental sustainability; v) Short-term versus long-term costs and benefits.

Researchers seek opportunities to learn how diverse publics view and deliberate about tradeoffs and strive to be transparent about how to weigh these concerns when making decisions about the direction of their work, its applications or policy recommendations.

Any effort to use the science of science communication to inform practice must avoid the pitfall of trainers themselves (or trainers of the trainers) falling into deficit model thinking. The science of science communication challenges widely held beliefs about what is effective communication, and the ethical aspects in particular ask scientists to reflect deeply on implicit assumptions and values that may be a core part of their identity and their work. For many researchers, while reflection on the ethical conduct of their research is the norm, reflection on the societal-level implications of their work is rare (Kahlor, Dudo, Liang, Lazard & AbiGhannam, 2016). The vision for the competencies, therefore, is not that they are a set of points to make at a workshop, but rather they are a framework to inform the goal-driven design of a research communications curriculum. We are hopeful that their influence will ultimately extend to core science courses and other aspects of researchers' professional preparation.

The example activities listed in **Table 1** illustrate how a competencies-driven science communication curriculum would differ from more traditional offerings. Guided discussion and activities introduce the need for the individual competencies and provide the opportunity to practice the core skills component. Lesson scenarios, tailored to meet local needs, could draw from relevant projects, such as the Center for Nanotechnology in Society at Arizona State University and the American Association for the Advancement of Science's Dialogue on Science, Ethics, and Religion.

The Research Communications Program has begun applying the competencies in its professional development offerings and the response from our workshop participants has been positive. This is not surprising given that scientists are under increasing pressure, in Broader Impacts statements for National Science Foundation grant proposals and elsewhere, to be able to communicate about the implications of their work. Even communicating basic scientific findings can raise unanticipated ethical questions. One of our physicists, reflecting on the decisions his team made in the public communication of their results, wrote, "To think a scientist can intuit ethical laws is as wishful as expecting that quantum mechanics can be acquired by osmosis" (Keating, 2018, p. 246). Also tellingly, as we embarked upon this work, one trainer stated he could not believe that, despite years of offering science communication workshops, he had never thought to integrate an ethics component. In our view, these kinds of aha moments, reduplicated in science communication training programs across the country, can drive the deficit model into obsolescence.

Centers like the Institute for Practical Ethics are hubs of expertise and typically have missions that extend beyond the production of scholarship. These two features make them ideal collaborators for science communication training programs. Given that the science of science communication spans many disciplines, partnerships with a plethora of centers, such as those with a mission focused on education, political science or psychology, could be similarly fruitful. Not only is dialogue between scholars and practitioners a conduit from scholarship to practice, it has the potential to encourage scholars to take a fresh perspective on their work and better articulate its implications. The science of science communication itself tells us why decades of criticism of the deficit model have not had the desired impact: Changing minds requires dialogue. Now is the time to begin the conversation.

REFERENCES:

Ahteensuu, M., & Sandin, P. (2012). The precautionary principle. In *Handbook of Risk Theory* (pp. 961-978). Dordrecht: Springer.

Besley, J. C., Dudo, A. D., Yuan, S., & Abi Ghannam, N. (2016). Qualitative interviews with science communication trainers about communication objectives and goals. *Science Communication*, *38*(3), 356-381.

Engleberg, I. N., Ward, S. M., Disbrow, L. M., Katt, J. A., Myers, S. A., & O'Keefe, P. (2017). The development of a set of core communication competencies for introductory communication courses. *Communication Education*, *66*(1), 1-18.

Evans, J. H. (2018). *Morals Not Knowledge*. Oakland, CA: University of California Press.

Gere, C. (2017). *Pain, Pleasure, and the Greater Good: From the Panopticon to the Skinner Box and Beyond*. Chicago: University of Chicago Press.

Keating, B. (2018). *Losing the Nobel Prize: A Story of Cosmology, Ambition, and the Perils of Science's Highest Honor*. New York: WW Norton & Company.

Jamieson, K. H., Kahan, D., & Scheufele, D. A. (Eds.). (2017). *The Oxford Handbook of the Science of Science Communication*. New York: Oxford University Press.

Jasanoff, S. (2009). Technologies of humility: citizen participation in governing science. In *Communicating Biological Sciences: Ethical and Metaphorical Dimensions* (pp. 45-64). New York: Routledge.

Kahlor, L. A., Dudo, A., Liang, M. C., Lazard, A. J., & AbiGhannam, N. (2016). Ethics information seeking and sharing among scientists: the case of nanotechnology. *Science Communication*, *38*(1), 74-98.

Keohane, R. O., Lane, M., & Oppenheimer, M. (2014). The ethics of scientific communication under uncertainty. *Politics, Philosophy & Economics*, *13*(4), 343-368.

Lewandowsky, S., Ecker, U. K., Seifert, C. M., Schwarz, N., & Cook, J. (2012). Misinformation and its correction: Continued influence and successful debiasing. *Psychological Science in the Public Interest*, *13*(3), 106-131.

National Academies of Sciences, Engineering, and Medicine. (2017). *Communicating Science Effectively: A Research Agenda*. Washington, DC: National Academies Press.

Nisbet, M. C. (2009). The ethics of framing science. In *Communicating Biological Sciences: Ethical and Metaphorical Dimensions* (pp. 51-73). New York: Routledge.

Pearce, W., Brown, B., Nerlich, B., & Koteyko, N. (2015). Communicating climate change: conduits, content, and consensus. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(6), 613-626.

Pierce, R. (2013). A role for social justice in science communication? In Jean Goodwin, Michael F. Dahlstrom & Susanna Priest (Eds.), *Ethical Issues in Science Communication: A Theory-Based Approach* (pp. 195-206). Charleston, SC: CreateSpace.

Priest, S., Goodwin, J., & Dahlstrom, M. F. (Eds.) (2018). *Ethics and practice in science communication*. Chicago: University of Chicago Press.

Seethaler, S. L. (2016). Shades of grey in vaccination decision making: Tradeoffs, heuristics, and implications. *Science Communication*, *38*(2), 261-271.

Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016). The lure of rationality: Why does the deficit model persist in science communication?. *Public Understanding of Science*, *25*(4), 400-414.

The Public Face of Science Initiative. (2018). *Perceptions of Science in America.* Cambridge, MA: American Academy of Arts and Sciences.

Thompson, P. (2018). Communicating science-based information about risk: How ethics can help. In Priest, S., Goodwin, J., & Dahlstrom, M. F. (Eds.). *Ethics and practice in science communication* (pp. 34-54). Chicago: University of Chicago Press.

Wynne, B. (1989). Sheepfarming after Chernobyl: A case study in communicating scientific information. *Environment: Science and Policy for Sustainable Development*, *31*(2), 10-39.

TABLE 1:

Competency Themes, Titles and Corresponding Example Workshop Activity

THEME	COMPETENCY TITLE	EXAMPLE SKILL-BUILDING ACTIVITY
1. Intrinsic Ethics, Identities and Connecting with Audiences	Humanistic Principles Intrinsic to Science	Develop a first-person narrative to highlight the sources of inspiration behind one's research.
	Implicit Ethics and Value-Ladenness of Science	Identify ethical assumptions embedded in one's views of the social impacts of science and technology.
	Identity, Worldviews and the Deficit Model	Explore examples of how cultural influences can affect people's reasoning.
2. Acknowledging the Role of Values in Decision Making	Tradeoffs in Applications of Science	Present and discuss a risk-costs-benefits analysis of an application of one's research.
	Assessments and Perceptions of Risk	Formulate intelligible ways of expressing and contextualizing data about risk.
3. Challenges of Communication under Conditions of Uncertainty	Open-endedness and Non-linearity of Scientific Discovery	Use multimedia tools of choice to realistically portray an episode in one's research process.
	Uncertainty in Forecasting and Extrapolating	Practice communicating the sources and magnitude of uncertainty in one's research.
	Unanticipated Consequences of Research	Role play in a tricky interview about the possible side effects of research in one's lab or discipline.
4. Social Divides in Science Governance	Social Inequalities and Power Differentials	Hold a citizen forum to gain input about the possible rollout of a new technology or policy.
	Diversifying Expertise and Authority	Discuss a scenario in which the absence of local or craft expertise led to a science policy failure.

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