Journal of Scientific Temper
Vol 6(1-2), Jan-Jun 2018, pp. 85-96

BOOK EXCERPT

Title: Communicating Science Effectively: A Research Agenda

Publisher: The National Academies Press, Washinton DC, 2017

152 pages | 6 x 9

ISBNs:

Paperback: 978-0-309-45102-4

Ebook: 978-0-309-45105-5

DOI: https://doi.org/10.17226/23674

SUMMARY

Science and technology are embedded in virtually every aspect of modern life. As a result, people face an increasing need to integrate information from science with their personal values and other considerations as they make important life decisions about vaccinating their children and other medical care, the safety of foods, what to do about climate change, and many other issues. Communicating science effectively, however, is a complex task and an acquired skill. Moreover, the approaches to communicating science that will be most effective for specific audiences and circumstances often are not obvious. Fortunately, an expanding science base from diverse disciplines can support science communicators in making these determinations.

The purpose of this report is to offer a research agenda for science communicators and researchers seeking to apply this research and fill gaps in knowledge about how to communicate effectively about science, with a particular focus on issues that are contentious in the public sphere. Examples include climate change, stem cells, nanotechnology, vaccines, hydraulic fracturing, genetically modified organisms, nuclear energy, obesity, education policy, and the teaching of evolution and climate change in K-12 schools. To inform the research agenda, the study committee sought to identify important influences—

psychological, economic, political, social, cultural, and media-related—on how science associated with such issues is understood, perceived, and used. For the purposes of this report, "science communication" is defined as the exchange of information and viewpoints about science to achieve a goal or objective such as fostering greater understanding of science and scientific methods or gaining greater insight into diverse public views and concerns about the science related to a contentious issue.

CROSS-CUTTING ISSUES

Although each societal concern entails unique issues that need to be considered if science is to be communicated effectively, some issues cut across all of science communication.

Aligning Goals with the Right Communication Approach

The most effective approach for communicating science will depend on the communicator's goal. The committee identified five such goals for communicating science, each of which places quite different demands on the knowledge and skills of science communicators and their audiences and calls for its own distinct approach:

- Simply to share the findings and excitement of science.
- To increase appreciation for science as a useful way of understanding and navigating the modern world. This goal assumes that people who have more knowledge about and are more comfortable with science will be more willing and able to use knowledge from science in their everyday lives. This assumption has not yet been fully tested.
- To increase knowledge and understanding of the science related to a specific issue. In this case, communicators may seek to inform or educate people about the relevant facts from science and their meaning for the issue.
- To influence people's opinions, behavior, and policy preferences.This goal becomes salient when the weight of evidence clearly shows that some choices or policies have more positive consequences for public health, public safety, or some other societal concern.

- To engage with diverse groups so that their perspectives about science related to important social issues can be considered in seeking solutions to societal problems that affect everyone. Meeting this goal requires understanding the concerns of each group and working together to find acceptable solutions by, for example, identifying important research questions that scientists should be exploring further.

Given this diversity of goals, a major research effort is needed to help science communicators select approaches that best match their particular goals. It is important to emphasize, moreover, that science communication often is undertaken to achieve a larger end that goes beyond discussion of the science itself—for example, to affect health behaviors or to encourage a particular policy choice. In these cases, it is possible that means other than simply communicating the science may be more effective at accomplishing such goals. In such a context, two important questions arise: How much does science communication matter to the achievement of end goals relative to everything else that matters? and How do various ways of communicating scientific information[1] augment or alter how science is weighted or used in making decisions?

Moving Beyond the "Deficit Model" of Science Communication

A second overall issue is that the most widely held, and simplest, model of what audiences need from science communication—what is known as the "deficit model"—is wrong. A common assumption is that a lack of information or understanding of science fully explains why more people do not appear to accept scientific claims or engage in behaviors or support policies that are consistent with scientific evidence. The research on science communication, however, shows that audiences may already understand what scientists know but, for diverse reasons, do not agree or act consistently with that science. People rarely make decisions based only on scientific information; they typically also take into account their own goals and needs, knowledge and skills, and values and beliefs. A related widespread assumption in both the scientific and science communication communities is that if only science communication were done "better," people

would make choices consistent with scientific evidence. This assumption has not been fully tested in diverse situations. And although people may need to have more information or to have information presented more clearly, a focus on knowledge alone often is insufficient for achieving communication goals.

The Ethics of Science Communication

Choices about what scientific evidence to communicate when, how, and to whom can be a reflection of the communicator's values. This fact becomes especially salient when the science pertains to an individual decision or policy choice that is contentious. One important ethical question is how far science communicators should go beyond simply communicating scientific facts and theories in an effort to influence decisions. Individual science communicators have differing perspectives on their roles as advocates, and this issue will continue to be debated. Yet that debate, while important, is beyond the scope of this study. The focus of this report is on science communication that conveys scientific information and helps people assess how that information may apply to a particular situation. In exploring these topics, the report draws on research on other types of communication, such as public health campaigns, that may be designed to persuade people to change their behaviors but may or may not include underlying scientific information.

Major Challenges for Research and Practice in Science Communication

Research and practice in science communication face a number of challenges. Some of these challenges are common to all communication, but others are unique to science communication. These challenges include the converging influences on science communication; challenges of engaging formally with the public about science; the special complexities of communicating science when it is part of a public controversy (science-related controversy); and the complex, dynamic and competitive communication media environment.

Converging Influences on Science Communication

A number of factors contribute to the complexity of communicating science, regardless of whether the science is part of a public controversy. These factors relate to

- the complex nature of scientific information;
- the ways in which people process such information; and
- social influences, such as social networks, norms, group memberships, and loyalties.

Further study is needed to determine the importance of these diverse factors to communicating with specific audiences and how these factors interact in various contexts to affect the ability of science communicators to achieve specific goals.

In addition, many of the decisions to be made about societal issues occur in the realm of policy. Information about the actual impact of science communication on policy decisions, however, is sparse. Several important questions in this area need to be addressed. For example,

- How is scientific information accessed, encountered, understood, shared, or discussed by policy makers in formal policy processes?
- How can science communication affect these processes? and
- How are these policy processes affected by science communication when science is involved in public controversy?

Think tanks, scientific associations, evidence-based clearinghouses, government agencies, and nonprofit organizations all play an organized role in interpreting scientific information for use by policy makers, the media, and the broader public. Research is needed on the conditions for success—such as affecting the quality or outcomes of policy discussions—in the efforts of diverse types of organizations to communicate science.

Challenges of Engaging Formally with the Public about Science

The purpose of formal public engagement is to facilitate the exchange of information, knowledge, perspectives, and

preferences among groups that differ in expertise, power, and values (National Academies of Sciences, Engineering, and Medicine, 2016b) and help them find common ground. Elected officials, government agencies, and other public- and private-sector organizations often seek to engage the general public in discussions with scientists about important science-related issues. Effective public participation is difficult, although some principles for success can be gleaned from the environmental policy and assessment literatures.

As formal public engagement is undertaken on such diverse issues as gene editing, biomedical research, and health policy, important questions for research arise, such as

- What are the particular structures and processes for public engagement that best enable science to be communicated effectively? and
- To what degree do these approaches generalize or need to be tailored according to the diversity of the participants, the decisions to be made, and the nature of the topic?

The Special Complexities of Communicating Science in the Face of Controversy

The involvement of science in public controversy makes the already complex task of science communication even more so. Science-related controversies take different forms and arise for diverse reasons, and they occur in particular historical and cultural circumstances. Better understanding of the origins and dynamics of such controversies will be necessary if science communication is to be more effective. In addition, science-related controversies have three key features about which more needs to be known.

First, science-related controversies typically involve conflicts over beliefs, values, and interests that are central to the debate rather than simply a need for knowledge from science. Research is needed to determine how science can be communicated effectively in these conditions.

- Additional research is needed to determine how much of an effect science communication can have in these circumstances, for whom, and in what contexts.

- Given the importance of audience perceptions about the trustworthiness and credibility of the communicator, research needs to examine the effects on audiences when science communicators are open about their own values and preferences.
- The best strategies for communicating science about contentious social issues if there is distrust of the science or of the scientific community need to be investigated.
- Commonly considered best practices in public engagement suggest the importance of engaging with those concerned with an issue early on, but research is needed to determine to what extent and in what ways communicating science during public engagement processes can be effective once an issue has already become controversial.
- Research needs to explore the structures and processes for communicating science effectively across a range of social issues and types of science-related controversies.

Second, the public often perceives uncertainty either in the science itself or its implications or as a result of various communicators conveying different, and sometimes contradictory, messages. In some science-related controversies, uncertainty can be mischaracterized, exploited, or exaggerated to serve particular interests.

- Effective ways of communicating scientific consensus, as well as degrees or types of uncertainty, need to be identified.

Research is needed to develop detailed approaches to understanding audiences' responses to uncertainties about science in cases of science-related controversy that can be implemented on a large scale.

Finally, in science-related controversy, the voices of organized interests and influential individuals are amplified in public discourse and can impede clear communication about the state of the scientific evidence. High stakes, conflicting interests, uncertainty, and concerns about risk and its consequences all can expand the number and diversity of people and organizations that are attempting to communicate about as well as to use science.

In this context, misinformation can make it difficult for authoritative voices from science to be heard.

- Research is needed to identify effective strategies for correcting misinformation and to determine the role of different communicators, such as opinion leaders, in affecting people's awareness and understanding of accurate scientific information.
- Research needs to investigate effective ways of framing or reframing an issue, how much framing matters, and when is it best done.

The Complex, Dynamic, and Competitive Communication Media Environment

Science communication today takes place in a complex and rapidly changing media environment, and new ways of communicating are constantly emerging. These changes present both opportunities and challenges for communicators of science, regardless of whether the science is involved in public controversy. The ways in which complex and evolving media affect people's engagement with scientific information is a relatively new area of research. For the future, it will be important to determine how individuals and decision-making bodies derive and evaluate information from various sources. Future research also will need to keep pace with changes in the media landscape as they occur and devise more comprehensive models for science communication. More needs to be known in particular about the following:

- How can accurate information about the state of the science be heard among many competing messages and sources of information?
- How can science communicators reach audiences that face barriers to accessing and using scientific information, such as those with lower levels of education and income or those with strongly held views?
- Are some forms of media better than others in promoting awareness or understanding or informing public opinion about scientific information or science, and if so, for whom?
- Despite the growing impact of new media, much of the scientific information that Americans receive through media originates from traditional journalism. It is important to

understand and track over time how science is covered in the media to determine how the media are affecting people's perceptions, understanding, and use of science in a dynamic communication environment.

- People's social networks are known to affect their beliefs, attitudes, and behaviors, and social media and blogs also are increasingly being used to spread both accurate and inaccurate scientific information. Research is needed to determine roles and effective approaches for communicating science through social media platforms and blogs.
- Better understanding is needed of the effects of changes in media on how people understand and perceive science through social media and other social networks. The use of tools such as social network analysis could be explored to document the flow of information and sentiments in social networks and to assess their effects.

General Conceptual and Methodological Issues

Several conceptual and methodological considerations relate to all research on science communication. These include the use of a systems approach to guide the research, the need to determine which communication approaches work best under which circumstances, and the importance of building a coherent science communication research enterprise.

Use of a Systems Approach to Guide the Research

Science communication occurs in a complex context whose elements include the content to be communicated, the communicator, the audience, the channels of communication, the other diverse organizations and individuals that are also communicating science, and the many other sources from which audiences may obtain additional and perhaps conflicting or inaccurate information about science. Moreover, people's understandings and opinions about science in general and its relevance to specific issues change over time. Advances in science communication will require a robust understanding of each of these interacting elements and their dynamics both individually and collectively—what is often called a systems

approach. Such an approach, which has been applied in many other fields, could help researchers and science communicators consider the interactions among the various elements involved in science communication and its context as they occur in the real world.

The Need to Determine Which Communication Approaches Work Best under Which Circumstances

Substantially more research is needed to help science communicators determine which approaches to communicating are effective for whom and under what conditions for achieving specific communication goals. Research focused in the following ways would be especially informative:

- randomized controlled field experiments to assess the impact of a particular approach to communicating science on changes in people's understanding, perception, or use of science;
- research that, to the extent possible, simulates the conditions of real-world communication environments; and
- analyses of large datasets, such as those derived from social media and other emerging online communication platforms, to assess changes in people's responses to science communication.

Efforts are needed, perhaps in the form of registries such as those that exist in the health sciences, to aggregate and share information from effectiveness studies so an evidence base can be built. These efforts could catalog evaluation studies according to key dimensions to identify factors that affect science communication and the elements of various approaches to communicating that may generalize across topics or be specific to certain circumstances. Such efforts also are needed to help researchers address the challenge of accessing and utilizing research relevant to science communication across disciplines.

The Importance of Building a Coherent Science Communication Research Enterprise

To achieve real progress in understanding what makes for effective science communication, it will be necessary to direct

particular attention to four key aspects of a coherent science communication research enterprise.

First, researchers and practitioners of science communication need to form partnerships to translate what is learned through research into practice and to develop detailed research agendas for testing hypotheses about how to communicate science that are realistic and pragmatic. Researchers need to be actively engaged with the various professionals and organizations that communicate science and take into account their particular motivations for communicating and the context in which they work. Researchers and diverse science communicators need to have opportunities and mechanisms for the regular exchange and synthesis of information and ideas, and to work together to study science communication in real-life contexts, where it occurs.

Second, the diverse disciplines that study aspects of science communication and science-related controversies are similarly disconnected. Researchers in these various disciplines need opportunities and mechanisms for working together to develop more unified theories, concepts, and definitions of the factors that matter to communicating science. New or refocused journals for science communication research and professional meetings and other forums would support interdisciplinary and practice-driven research collaborations.

Third, given the complex individual and social phenomena involved, more scientists need to be recruited to this field from neighboring disciplines, particularly the social and behavioral sciences. Science communication researchers at all career levels may need additional training to carry out the research agenda proposed in this report, or may need to be encouraged to work in teams that include partners with the necessary expertise.

Fourth, having mechanisms for the rapid review and funding of certain science communication research is important. The need for such mechanisms becomes clear when such issues as the Zika virus emerge suddenly, and important messages from science need to be communicated. To this end, it would be necessary to address policies that can make timely research difficult.

A Final Word

Many studies reviewed by the committee are compelling and suggest ideas for practice. It is important, however, not to over generalize from the research conducted to date. In many cases, studies need to be replicated and extended to provide greater certainty about their results and to determine whether they apply to diverse audiences. This work ideally would begin with in-depth, comprehensive reviews of existing research related to science communication. Just as important, research on science communication, which tends to focus on detailed questions, needs to be aggregated and integrated into a more coherent enterprise. Simple solutions are unlikely; needed instead is a nuanced understanding of how best to communicate science for the benefit of society across different settings, issues, and audiences.

The committee hopes the research agenda outlined in this report will be pursued not only by researchers in academic settings but also by those embedded in the various types of organizations that communicate science. Progress will require the collective expertise of science communicators and scientists. Two National Academy of Sciences Arthur M. Sackler Colloquia on the Science of Science Communication, as well as the convening of this committee, point to the readiness of science communicators and researchers from diverse fields to address this need and work toward science-informed approaches to science communication.

"Summary." National Academies of Sciences, Engineering, and Medicine. 2017. *Communicating Science Effectively: A Research Agenda*. Washington, DC: The National Academies Press. doi: 10.17226/23674.