The Science of Science Communication II

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A puzzling world confronts scientists today. On the one hand, the fruits of science and technology are everywhere, providing health and prosperity that were unimaginable a century ago. In the United States, federal funding for science is far beyond any reasonable extrapolation of the US $120 million per year proposed by Bush (1) (for the nascent National Research Foundation). International collaboration on a grand scale can be seen in European Center for Nuclear Research, the Intergovernmental Panel on Climate Change, and European Union projects that help to bind the continent.

On the other hand, worrying minorities of the general public reject conclusions that are widely accepted in the scientific community, such as the advisability of childhood immunization, the foundational role of evolution in biology, and the reality of anthropogenic climate change. Whole sciences find themselves in political cross-hairs (e.g., stem cell research in some jurisdictions, social sciences periodically at the National Science Foundation, genetically modified crops in large parts of Europe).

Better science communication is key to reconciling these puzzling trends. Better communication to the public and policy makers can help scientists send clearer signals regarding the accomplishments, promises, and uncertainties of their work. Better communication from the public and policy makers can provide scientists with clearer signals regarding the public's concerns and science's role in addressing them. The result would be a more productive dialogue about the science and the political, social, and moral implications of its application.

Because communication is central to everyday life, people have intuitive theories about how to make themselves understood and how to interpret what others say. However, communications about science can take such generally useful strategies beyond their range of validity. Communications about science often involve unfamiliar audiences, intricate social dynamics, and complex topics, and lack the direct interactions (and feedback) needed to identify and correct problems. When intuition fails, research is needed. The Science of Science Communication Sackler Colloquia have mobilized the sciences of communication to make scientists and the public less puzzling, and more rewarding, to one another.

The first Colloquium was in May 2012 and set the stage by having distinguished practitioners—including four Presidential Science Advisors—describe the challenges that they have faced in communicating science to demanding audiences. Responses followed from three kinds of science: decision science, for identifying the scientific facts that audiences most need to know, from amid all of the facts that it would be nice to know; behavioral science, for describing and enhancing the processes by which individuals express themselves and process information; and social science, for characterizing and improving communications among groups, collectives, and organizations. In the spirit of the Sackler Colloquia, the program also brought together scientists whose disciplines had not fully realized their opportunities for collaboration—hoping to create, and help define, a broader, richer, and more socially useful field of science communication. The full program is available at www.nasonline.org/science-communication. Published papers from the first Colloquium can be found on the PNAS website (www.pnas.org/content/110/Supplement_3). A Digital Reprint Edition is also available (http://onlinedigeditions.com/publication/?i=174803).

The second Colloquium expanded the set of sciences of science communication, while emphasizing the contributions that engagement with the challenges surrounding the communication of science can make to the disciplines themselves. Would their theories and results prove robust in the new, complex contexts of science communication? Would these applications raise new theoretical questions? The full program is available at www.nasonline.org/science-communication-II with a narrative summary at www.nap.edu/catalog.php?record_id=18478, including talks and discussant comments that do not appear here.

Four papers address the controversies that have puzzled many scientists. Scheufele (2) discusses how the central role of science in many social issues makes it inevitably the target of controversy. Even when scientists just report the facts, as honestly and clearly as they can, their message may benefit some political and economic interests while weakening others. As a result, attacking or supporting the science, by any available means, serves political purposes. It can simplify the science for lay audiences that accept the interpretations of pundits, rather than consider the research itself.

Fiske and Dupree (3) challenge the contention that laypeople are necessarily irrational when they question scientists' claim. Rather, they argue, the public poses to science the same questions as arise with any communication: How warm and competent are the people conveying it? Can their intentions be trusted? Can they act effectively? The research suggests ways for scientists to reduce their perceived coldness while preserving their perceived competence.

Jamieson and Hardy (4) analyze the dynamics of political controversies over science with an eye to what scientists can do to ensure a fair hearing for their work. Based on the research, they advocate having scientists vigorously pursue a nonpartisan role. This means presenting their science clearly and defending it against misrepresentation, using what is known from social science to achieve the greatest effect. It also means explicating the expected consequences of alternative policies, without presuming to make political choices among them.

Pidgeon et al. (5) offer a proactive communication approach for achieving as much agreement as possible regarding scientific topics that are fundamentally contentious. Integrating elements from multiple social,

This paper results from the Arthur M. Sackler Colloquium of the National Academy of Sciences, "The Science of Science Communication II," held September 23–25, 2013, at the National Academy of Sciences in Washington, DC. The complete program and video recordings of most presentations are available on the NAS website at www.nasonline.org/science-communication-II.

Author contributions: B.F. and D.A.S. wrote the paper.

The authors declare no conflict of interest.

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behavioral, and decision science disciplines they created a national dialogue in the United Kingdom, regarding the country's future energy policy. It involved diverse citizens in informed, respectful discussion, reaching perhaps surprising degrees of understanding and consensus regarding these complex issues.

Three papers consider the fundamental role of narratives in how people communicate about scientific topics. Dahlstrom (6) discusses how the cognitive and emotional impact of narratives can make them forces for good or evil. Because narratives affect how information is processed, retained, and retrieved, they can facilitate reasoning about scientific topics. However, well-crafted narratives can also confer undue credence on stories lacking a scientific foundation, with the link between vaccines and autism as a case in point.

Medin and Bang (7) draw on basic research in cognitive science to show how lay narratives reflect the intuitive epistemologies of individuals and cultures. They illustrate these principles in research conducted in collaboration with the American Indian Center of Chicago and the Menominee Nation of Wisconsin. Using diverse data sources (interviews, experiments, and content analysis of texts), they identify differences in how people look at the world that must be understood for effective communication with them.

Downs (8) uses narratives research to design an interactive video intervention that communicates the science relevant to the sexual decisions facing late adolescent women. Users of the intervention follow young women (actresses) as they acquire information and integrate it in their life stories. Seeing that information being applied in those narratives gives it meaning and relevance for the users' own stories. Stories also allow communicators to create a desired tone and engaging material.

Five papers address design principles arising from the science. Ratner and Riis (9) draw on cognitive and social psychology to argue for the importance of simple, actionable messages, when communications seek behavior change. They show how simplicity aids each step of the change process: grasping the message, creating an action plan, knowing when the plan is relevant, and activating it when that contingency arises. They illustrate these principles with nutrition guidelines, which must make complex science applicable to diverse people and situations.

Milkman and Berger (10) address the science relevant to predicting when stories about science go viral online, as an indicator of how they catch on in any medium. Echoing basic psychological principles, they find that stories about science, like stories about other topics, have greater staying power when they are interesting, surprising, useful, personal, and emotional. They describe how scientists can add these elements to reports on research that might naturally lack them.

Contractor and DeChurch (11) offer a social-level overview of how information and influence spread through social networks and how they affect individual audience members. Examining the reduction of neonatal mortality in India, they show how macro- and microfactors can combine to change beliefs and behaviors, leading to recommendations for more effective communication.

Wong-Parodi and Strauss (12) describe the collaboration needed between communication scientists and scientists with research to communicate. They show how to apply basic scientific principles to design a website's welcome page and then how to conduct empirical testing to refine its elements. They also show concrete examples of how to address fears (or charges) of bias in presenting information on controversial topics—here, the risks of coastal flooding as exacerbated by climate change (http://sealevel.climatecentral.org).

Fischhoff and Davis (13) ask how communications can deal with the uncertainty that is a part of all science. They distinguish between persuasive communications, intended to motivate behaviors, and nonpersuasive communications, intended to inform independent choices and provide general understanding. For each, they consider the analytical challenges of characterizing uncertainties in useful terms and the behavioral challenges of communicating them, leading to a proposal for a protocol for communicating scientific uncertainty.

Together, these papers offer rich, empirically rigorous resources for improving science communication, along with worked examples for applying that basic research in real-world settings. Individually, these papers show how engaging the challenge of communicating science has advanced the different sciences of communication.

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