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The Science of Science Communication

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How can research in the social sciences contribute to effective public science communication? That theme framed the 2012 Sackler Colloquium, presented by the National Academy of Sciences in its restored historic home in Washington, D.C. In addition to a wide range of academic researchers drawn from the social sciences, presenters included Nobel laureate Daniel Kahneman, AAAS President Alan Leshner, *New York Times* columnist and NOVA host David Pogue, John Holdren, and three former Presidential science advisors. Colloquium speakers shared empirical research and insights that inform communication by scientific experts to the public.

Rather than attempt to summarize each of the more than 25 presentations, the following section identifies key issues, findings, and recommendations most relevant to the informal learning field. The Appendix contains the program and agenda; further information and videos of the sessions are available online.[1]

Speaker Observations

Biology defines the possibilities of what can be effectively communicated. Working memory is limited, distractions are many, and attention is scarce. To address these limitations, communication should be "close" to the audience; concrete; immediate; relevant, and perhaps useful in solving a problem. Its intended outcome should be possible to achieve. Because values are as important, or more important, than knowledge in making decisions and reaching conclusions, the communication should speak to core values.

Credibility is critical but cannot be taken for granted. It gets bestowed by the audience based on its perception of the communicator. The speaker or source must have a perceived common interest and shared values. Most importantly, we believe people whom we like and trust. Interestingly, when a scientist also advocates for a particular position in addition to communicating science, credibility decreases.

Not surprisingly, audience research is essential. In that regard, evaluation is required for creating effective communication. It is needed to determine audience needs and interests, to test communication approaches, and to evaluate impact. In addition to being evidence-based, scientific communication should be strategic, as illustrated by a guide recently published by the U.S. Food and Drug Administration for communicating risks and benefits (Fischoff *et al*. 2011).

Our two complementary modes of thinking have implications for communication. The brain's "system 1" is automatic, fast, associative, emotional, and generates internal stories that make sense; it provides our "expert intuition." On the other hand, "system 2" is "lazy," slow, provides more detailed and specific processing, and acts as "spokesperson" for system 1 (Kahneman 2011). Based on this model, communication is most effective when it tells stories that speak to system 1.

Stories and messages should be simple (as simple as possible, but no simpler) and coherent, repeated often by trusted sources. What to say should be guided by audience research. The notion of "gist"

offers a strategy for generating insightful scientific intuitions by communicating essential meanings, rather than facts that require knowledge-based interpretation (Reyna 2012). Developing effective communication ultimately requires an interdisciplinary team that includes content experts, social science and decision-making experts, and communication experts.

The media play a key role in agenda setting and framing issues for the public. Typically, issues go through cycles of attention, with "spikes" of interest related to precipitating events. As part of that dynamic, dramatic claims often become the public focus (Nisbet and Scheufele 2009).

The NAS Science and Entertainment Exchange is attempting an innovative strategy to embed authentic science into television and movies. So far, it has provided more than 400 "consults" between top scientists and engineers with writers, directors, and producers, as well as scientist "salons" held in the homes of entertainment industry executives.

There is an active science audience online. The most frequent means to access new media are through search, blogs, and social media for sharing, such as YouTube. An example demonstrating the communication potential of online media is a laboratory-recorded video[2] that went "viral," attracting more than six million views, along with some 40,000 "likes." Google "suggestions" may limit searches and in fact create a self-reinforcing information spiral. Data from the Pew Research Center demonstrate continuing growth in online media use, as well as increased exposure to partisan media sources. Factors that influence media exposure include socio-economic status, ideology, and motivation.

Efforts to communicate global climate change face particular challenges, in part because the changes are gradual, abstract, and seemingly remote. Instead of highlighting distant effects on glaciers and polar bears, for example, communication should bring attention to how people may be affected by placing greater emphasis on public health and projected local impacts (Maibach *et al*. 2011). In addition, views on climate change are guided both by personal values and cultural group norms.

Conclusions

This two-day Colloquium highlighted a diverse range of empirical research drawn from mass communication, risk communication, and health communication, along with psychology, decision science, political science, sociology, and related areas. The convening was designed to foster the emerging field of "science of science communications." That term may be somewhat limiting, however, since "science communication" can carry the connotation of one-way direction--from the expert to the public. It was encouraging to hear social science researchers repeatedly counsel scientists to understand their audience, but it is of concern that such advice still is necessary.

Although aspects were introduced by two speakers (Paula Apsell and Martin Storksdieck), relatively little attention was given to informal learning institutions or to informal learning in general. The emerging field would benefit from giving greater consideration to the role of informal learning organizations as mediators, translators, and providers of professional development for scientists and engineers, as well as build on their experience in engaging public audiences. Discourse should be broadened to include these areas, along with the learning sciences, perhaps leading to a shared research agenda.

Conversely, research from the social sciences in general, as with the learning sciences, is needed for developing effective informal learning experiences. Utilizing that knowledge base is essential to the continued professionalization of the informal learning field. That is especially the case when seeking to

change attitudes and behavior, or when addressing value-laden topics, such as climate change, evolution, stem cell research, and biotechnology.

However well-intentioned, efforts that ignore social science research may in fact prove counterproductive. A provocative climate change study (Kahan *et al.* 2011) was presented that found greater cultural polarization with increasing scientific literacy and numeracy, rather than the decrease that might be predicted by standard models of public understanding. Rather than change beliefs, enhanced scientific knowledge and technical ability better enabled those on each side to believe even more firmly in the evidence that supported their values (e.g., hierarchy, individualism) and the perspective of their cultural community.

The informal learning field has started reaching out to social scientists in a variety of ways. For example, the Nanoscale Informal Science Network has partnered with social scientists at Arizona State University. In addition to serving as lead for NISE Net, the Museum of Science, Boston has been working with social scientists on other projects involving public engagement and societal implications. Additional examples include the AAAS Conference on Promoting Climate Literacy Through Informal Science and development of the Exploratorium's "Science of Sharing" exhibition.

This Colloquium represented an important first step in bringing together social scientists from diverse disciplines to share their research on how the public comes to understand and make decisions about science, technology, and health. Based on the high level of interest generated (the Colloquium was oversubscribed), it is likely that further efforts will build on this initiative. Continued interaction among social scientists and STEM researchers should be encouraged, along with greater involvement of informal learning professionals.

Notes

[1] National Academy of Sciences. "Arthur M. Sackler Colloquia." Accessed June 1, 2012. http://www.nasonline.org/programs/sackler-colloquia; TV Worldwide, Inc. "The Science of Science Communication." Accessed June 1, 2012. http://events.tvworldwide.com/Events/NAS120521.aspx.

[2] YouTube. "A Swarm of Nano Quadrotors." Accessed June 1, 2012. http://www.youtube.com/watch?v=YQIMGV5vtd4.

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Appendix:
Program and Agenda
The Science of Science Communication

Monday, May 21, 2012

8:30 a.m. **Welcome**
Barbara Schaal, Vice President, National Academy of Sciences

8:45 a.m **The Science of Science Communication: Overviews**
The Micro View: Individual Responses in Science Communication, Baruch Fischhoff, Carnegie Mellon University
The Macro View: Social Dynamics in Science Communication, Dietram A. Scheufele, University of Wisconsin, Madison

9:45 a.m. **Science in our Daily Life: Emerging Technologies and Their Likely Impacts on Lay Publics**
Moderator and Respondent: Miles O'Brien, Science Correspondent, PBS NewsHour
Nuclear Power, Eric P. Loewen, General Electric-Hitachi Nuclear Energy
Agricultural Biotechnology, David Fischhoff, Monsanto Company
Nanotechnology, Vicki L. Colvin, Rice University
Geoengineering, David Keith, Harvard University

12:45 p.m**.** **Lunch Speaker**
Introduction: Alan Leshner, Chief Executive Officer, American Association for the Advancement of Science
Why We Can't Trust Our Intuitions: Communication as a Science, Arthur Lupia, University of Michigan

1:15 p.m. **The Science of Science Communication I: What Do People Need to Know About Science?**
The Content of Scientific Communication: Identifying the Scientific Knowledge that Is

Most Relevant to Personal and Policy Decisions, Detlof von Winterfeldt, University of Southern California

Developing Scientific Communication: How to Find Out What People Need to Know, Wändi Bruine de Bruin, Carnegie Mellon University

Trust in Scientists, Controversy Among Scientists, and American Public Opinion on Climate Change: How Attitude Formation and Change Unfolds, Jon A. Krosnick, Stanford University

3:15 p.m. **The Science of Science Communication II: Developing Strategies for Effective and Trustworthy Communication**

Generating the Science Needed for Relevant Communication: How Can Social, Behavioral, and Decision Research Extract the Information that the Public Needs Most from the Wealth of Scientific Knowledge?, Lisa Schwartz and Steven Woloshin, Dartmouth Medical School

What Do We Mean?: On the Importance of Not Abandoning Scientific Rigor When Talking about Science Education, David Klahr, Carnegie Mellon University

The Science of Citizen Participation: What Are the Best Ways to Engage in Two-Way Communication with Those Concerned About Science-Related Issues?, Thomas Dietz, Michigan State University

6:00 p.m. **12th Annual Sackler Lecture**

Introduction: Ralph Cicerone, President, National Academy of Sciences

Thinking That We Know, Daniel Kahneman, Princeton University

<u>Tuesday, May 22, 2012</u>

8:30 a.m. **Welcome**

Ralph Cicerone, President, National Academy of Sciences

8:45 a.m. **The Science of Science Communication III: How Science Is Presented and Understood in Modern Mass Cultures**

Effects of Mass Media on the Political Process: How Do Mass Media Shape the Nature of Public Debates About Science?, Matthew C. Nisbet, American University

Effects of Mass Media on Knowledge and Beliefs: How Do Mass Media (Across Different Channels and Content) Influence the Public?, William P. Eveland, Jr., Ohio State University

New Media Landscapes: Where Do People Go for Information About Science and How Do They Evaluate What They Find?, Dominique Brossard, University of Wisconsin, Madison

10:15 a.m. **Science and Politics: Forum of Presidential Science Advisors**

Moderator: Ralph Cicerone

John H. Gibbons, Assistant to the President for Science and Technology, and Director, Office of Science and Technology Policy, 1993-1998

John P. Holdren, Assistant to the President for Science and Technology, and Director, Office of Science and Technology Policy, 2008-present

Neal F. Lane, Assistant to the President for Science and Technology, and Director, Office of Science and Technology Policy, 1998-2000

Frank Press, Assistant to the President for Science and Technology, and Director, Office of Science and Technology Policy, 1977-1980

12:45 p.m. **Lunch Speaker**

Introduction: Alan Leshner, Chief Executive Officer, American Association for the Advancement of

Science

Lost in Translation? Journalists as Conduits Between Science and the Public , David Pogue, New York Times/NOVA scienceNOW

1:15 p.m. **The Science of Science Communication IV: Developing Organizational Infrastructures for Evidence-Based Communication about Science**

Institutional Constraints and Incentives: What Factors Determine When Scientists Act as Communicators and How They Succeed?, Hans-Peter Peters, Research Center Jülich

Building Organizational Infrastructures for Effective Communication: What Have We Learned from Experiences in the Corporate, Governmental, and Academic Worlds?, Edward Maibach, George Mason University

Communication as an Empirical Endeavor: Why Is Systematic Evaluation So Rare and How Can We Make It the Norm?, Martin Storksdieck, National Research Council

3:15 p.m. **Bold Proposals: Harnessing Communication Science**

Moderator: Alan Leshner, American Association for the Advancement of Science

Respondents: Michael M. Crow, Arizona State University, and Paula S. Apsell, PBS/NOVA

The Science & Entertainment Exchange: Fast Forward, Barbara Kline Pope, National Academy of Sciences

The National Partnership for Climate Communication, Anthony Leiserowitz, Yale University

Risk Communication and Risky Decision Making: From Viruses to Vaccines, Valerie Reyna, Cornell University

Science Communication as the "New Political Science" for Democracy, Dan M. Kahan, Yale Law School

4:50 p.m. **General Discussion**

5:20 p.m. **Concluding Remarks**

Alan Leshner, American Association for the Advancement of Science

5:30 p.m. **Adjourn**

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