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The Problem of Effective Communication in Science

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July 19, 2017

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On April 22, 2017, hundreds of coordinated rallies occurred in cities worldwide, creating a collective March for Science. On the Facebook group's page[1] dedicated to organizing the marches, scientists and activists argued. They argued about the effectiveness of the March and whether it further politicized the work of scientists. Most notably, they argued about how to effectively communicate the worth of their ideas and research to the public. Some thought simple messages were more accessible, while others contended that oversimplifying scientific concepts was patronizing. Suggested poster captions were rejected for being too elitist, simplistic, off-topic, esoteric, or any of several other contradictory descriptors. Nevertheless, the marches happened, and attendees carried whatever placards they saw fit. Yet, the issue of effective communication in science remains.

The challenges of communicating science have long been a stumbling block for scientists. Universities offer courses to teach their science students how to present their ideas more clearly.[2] Scientific journals and academic institutions issue guides on science communication. [3,4] Despite these efforts, the National Opinion Research Center at the University of Chicago reported in their General Social Survey that only about 40% of the general American public has "a great deal" of confidence in the scientific community.[5] Effective science communication can fix public perception of scientific research and increase the value of scientific research.

By examining the difficulties researchers encounter in communicating with both collaborators and with the public, as well as how these communication shortcomings compound each other, researchers, project managers, and other key stakeholders can collaboratively mitigate the risks that arise from miscommunication. Mitigating these risks through continued education, partnering with project managers, and direct engagement with the public will improve support for their research and increase scientific applications.

As was discussed in E3 Federal Solutions' *The Need for Project Management in Science*,[6] funding cuts and the prioritization of interdisciplinary research require many scientists to collaborate outside their fields, making effective communication a crucial part of successful research. However, a

[1] March for Science. (n.d.). Facebook. Retrieved from https://www.facebook.com/groups/marchforscience/

[2] Durant, J. and Venkataraman, B. *STS.034 Science Communication: A Practical Guide.* Fall 2011. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.

[3] Cooke, S.J. et al. (2017). Consideration for effective science communication. *Facets* 2, 233-248.

[4] Brown University Science Center. (May 2014). Quick Guide to Science Communication. Retrieved from https://www.brown.edu/academics/science-center/sites/brown.edu.academics.science-center/files/uploads/Quick_Guide_to_Science_Communication_0.pdf

[5] NORC at the University of Chicago (2017). Confidence in science community. GSS Data Explorer. Retrieved from https://gssdataexplorer.norc.org/trends/Politics?measure=consci

[6] Beins, K. (2017, May 17). *The Need for Project Management in Science*. E3 Federal Solutions. Retrieved from http://www.e3federal.com/sites/default/files/White%20Papers_The%20Need%20for%20Project%20Management%20in%20Science_E3%20Federal%20Solution.pdf

combination of academic exclusivity and highly specific training may hinder such collaboration. In order to focus on their research, academics prioritize their areas of focus, sometimes at the expense of other topics. For environmental scientists, this may mean that they concentrate on a certain solution or dataset without incorporating perspectives from other disciplines. Though it often depends on the field of study, research has shown that scientists often focus on depth rather than on breadth of knowledge.[7] Although this approach works well for poster presentations and symposia, it limits environmental scientists' ability to work with those outside their field.

Even more concerning than failed communication with collaborators is the failure of many researchers to communicate their work to the general public. Much of scientific research is funded at the federal and state level, often through Congressional budgeting to federal scientific organizations or state funding of universities and research groups.[8,9] Consequently, science is not only accountable to the public, but also funding for scientific research often depends on public support. If the scientific community does not learn to effectively communicate the purpose of their research, scientists risk losing public support and could face budget cuts. This lack of funding will limit scientists' ability to conduct comprehensive experiments, potentially leading to more errors and limited conclusions. Decreased funding and inconclusive results arising from ineffective science communication thereby further undermine scientific integrity and effectiveness.[10]

Due to the severe implications of ineffective science communication, it is important to identify the issues scientists encounter when trying to communicate with the public. There are three main contributing factors: a disjointed educational system, field-specific frameworks, and public rejection of scientific research. First, as acknowledged by Virginia Tech researcher Benjamin R. Cohen, the educational system often presents science as the antithesis of humanities.[11] The two courses of study are thought to teach different skills and attract different students. Professionals in one field are often assumed to be lacking in the other. The implication for scientists is that they are not trained to communicate clearly or to simplify scientific topics to make them more accessible to the public; instead, they are taught to focus on the minutia of complex topics. By communicating mainly with others in their field, scientists fail to develop a communication style that is comprehensible to non-scientists.[12] Beginning with the separation in the education system, scientists often fail to learn effective communication skills and encounter significant challenges disseminating their research to a diverse audience outside their own fields.

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[7] Bateman T.S. and Hess, A.M. (2015). Different personal propensities among scientists relate to deeper vs. broader knowledge contributions. *PNAS* 112 (12), 3653-3658.

[8] Berkeley Understanding Science. (n.d.). *Who pays for science?* University of California, Berkeley. Retrieved from http://undsci.berkeley.edu/article/who_pays

[9] American Association for the Advancement of Science. (n.d.). Where to Search for Funding. *Science*. Retrieved from http://www.sciencemag.org/careers/where-search-funding

[10] Jahnke, A. (2015, April 6). Who Picks Up the Tab for Science? *BU Today*. Retrieved from http://www.bu.edu/today/2015/funding-for-scientific-research/

[11] Cohen, B.R. (2001). Science and humanities: across two cultures and into science studies. *Endeavour* 25 (1), 8-12.

[12] Wu, K. (2017, May 24). Why Can't Scientists Talk Like Regular Humans? *Scientific American*. Retrieved from https://blogs.scientificamerican.com/observations/why-cant-scientists-talk-like-regular-humans/

In addition to the effects of the divisions in the education system, scientific communication is often difficult because of the precise ways in which scientists frame their research. As a discipline, science is based on specific paradigms, or shared knowledge frameworks, that are key to understanding scientific research. Since these frameworks help teach scientists how to think methodically about their work, scientists are frequently unable to operate outside of them. Therefore, communicating with those outside the scientific paradigms becomes increasingly difficult.[13] Similarly, the tools scientists use to analyze their data may not be familiar to non-scientists, further distancing scientists from those with whom they should be communicating. For example, the results of statistical analysis must be presented in a certain way. Scientists must explain their uncertainties, usually pointing only to association rather than causation. To the general public, this may seem questionable or confusing, but to scientists, it is how they follow the rules of their discipline. These communication issues, in conjunction with the prevalent attitude of "publish or perish," lead many scientists to focus inward, continuing to rehash their research with their colleagues instead of attempting to communicate it to the public.

Finally, though most scientists face these issues with communication, environmental scientists face some communication challenges that are unique to their field. Environmental research is often more visible to the public than other forms of science. The water crisis in Flint, Michigan, public debates about climate change, and registration of Superfund sites all occur on a national and even international stage. The accessibility of environmental science means that the public may have more opinions on environmental research than on less visible types of scientific research such as neurology or molecular biology. Therefore, environmental science may come under more scrutiny, meaning that environmental scientists must both effectively communicate their research and overcome any potential oppositions or disbelief from the public.

Although addressing the challenges in science communication requires sustained effort, education, effective collaboration, and transparency with the public will all ease the process. On a systematic level, science education must incorporate communication experience. University professors should value good writing and public speaking skills and teach their students how to digest and translate their specific knowledge for general audiences. For example, at Georgetown University, undergraduate students are encouraged to take a course on communicating science. This course focuses both on communication within the scientific field and communication with general audiences.[14] In recommending this course for their students, the Georgetown University Department of Biology demonstrates the importance of effective communication and prepares its students to make an impact with their research outside the scientific community.

[13] Aines, R. (2016, April 6). Why Can't Scientists Communicate Outside Our Field? Because We are Trained that Way. Championing Science. Retrieved from http://championingscience.com/cant-scientists-communicate-outside-field-trained-way/

[14] Armbruster, P. and Rolfes, R. (2017). *BIOL-191 Biology Gateway*. Georgetown University Course Catalog. Retrieved from http://courses.georgetown.edu/index.cfm?Action=View&CourseID=BIOL-191

In addition to changing the way budding scientists are educated, it is important that established scientists commit to engaging with the public. In order to dispel the notion of scientists being members of a distant and unapproachable elite, scientists should try to foster a social media presence, doing their best to condense their research into accessible ideas. Neil deGrasse Tyson's Twitter account,[15] the American Chemical Society's YouTube account,[16] and Jane Goodall's Facebook page[17] all work to transform complex research into interesting information that is accessible and readily available to the public.

Nevertheless, while changes in the education system and direct contact with the public will increase the effectiveness of scientific communication, this issue will likely continue to affect the academic community and hinder research. We also recognize that partnerships between scientists and project managers present an opportunity for smoother interdisciplinary collaborations, as well as more effective dissemination of scientific research. Project managers focus on outcomes and deliverables, key components of research that are more visible to the public and play an important role in funding decisions. Project managers, such as the team at E3 Federal Solutions, use effective communication strategies as well as detailed project plans to help federal science organizations streamline their processes and increase their research outputs.

In short, whether scientists learn to communicate more effectively or project managers begin to facilitate more effective communication of science, the goal of effective communication is more direct engagement with the public. Increasing the accessibility of scientific research through improved communication allows for the effective application of science and the progress that it brings.

[15] Tyson, N.D.(2009, January). [Twitter account]. Retrieved from https://twitter.com/neiltyson?ref_src=twsrc%5Egoogle%7Ctwcamp%5Eserp%7Ctwgr%5Eauthor

[16] American Chemical Society. (2009, February 6). [YouTube account]. Retrieved from https://www.youtube.com/user/AmerChemSoc

[17] Goodall, J. (n.d.). *Dr. Jane Goodall*. [Facebook account]. Retrieved from https://www.facebook.com/janegoodall/