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THE TEAM SCIENCE PERSPECTIVE OF SCIENCE COMMUNICATION

Power in science communication collaborations

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Abstract

In this comment, we focus on the ways power impacts science communication collaborations. Following Fischhoff's suggestion of focusing on internal consultation within science communication activities, we examine the ways such consultation is complicated by existing power structures, which tend to prioritize scientific knowledge over other knowledge forms. This prioritization works in concert with funding structures and with existing cultural and social hierarchies to shape science communication in troubling ways. We discuss several strategies to address problematic power structures. These strategies may reveal and thus mitigate problems in individual collaborations, but these collaborations exist within a larger infrastructure in need of systemic change.

Keywords

Professionalism, professional development and training in science communication; Public engagement with science and technology; Social inclusion

DOI

https://doi.org/10.22323/2.19040302

Submitted: 14th July 2020
Accepted: 15th July 2020
Published: 1st September 2020

Introduction

One striking feature of these unprecedented times is the increased reliance on science communication by people who might not have had much time for it before. People around the world hang on news about coronavirus and COVID-19, since it affects their professional lives, their personal lives, and potentially, their very lives. Responsible communication about something that is so clearly in the global public interest requires appreciation for the range of relevant expertise, including expertise in various research disciplines (e.g., virology, epidemiology, microbiology, genetics, public health) as well as expertise in communication, journalism, and policy. Further, the complexity of the problem underscores the need for experts in these different domains to collaborate in producing the science and policy to be communicated, as well as the modes and methods of its communication. As Baruch Fischhoff observes, "communicating science effectively can require . . . collaboration among experts from professional communities with different norms and practices"

[Fischhoff, 2019, p. 7670]. In other words, science communication isn't just the transmission of scientific information from the scientist's mouth to the public's ear.

In general, then, if the expertise responsible for science communication constitutes a more robust and complex ecosystem, it is imperative that contributors to the communication process communicate effectively among themselves. Fischhoff acknowledges this, arguing that one part of a "theory of change for science communication" (p. 7671) concerns consultation among members of the communication team — i.e.., those experts who contribute to shaping the ways scientists and policymakers engage with audiences. As Fischhoff notes, this is complicated by the fact that experts are trained to bound problems differently, i.e., they are trained to regard different things as salient, and as a result may not even agree that they are engaging with the same communication problem [cf. O'Rourke and Crowley, 2013].

Because interdisciplinary, interprofessional communication among science communication experts constitutes an "unnatural act" (p. 7670), it can be helpful to facilitate internal consultation by localizing the different perspectives represented by members of the communication team [Crowley et al., 2010]. The value of assessing and improving communication among team members illuminates the relevance to science communication of small group research, the science of teams, industrial/organizational psychology, and the science of team science. Recent work in the science of team science in particular has focused on *enhancing* the effectiveness of team science [e.g. National Research Council, 2015], which includes close attention to internal communication processes within science teams that are quite similar to Fischhoff's communication teams.

We agree that it takes a system of experts to communicate about science, and that attention to the internal communication dynamic of the system is crucial. In this paper, we emphasize one specific aspect of this dynamic that has not received the attention it deserves, viz., power differences among collaborators in a given science communication endeavor. In the next section we describe and illustrate how power can inflect the interaction between members of science communication collaborations. We then connect this discussion to more general issues of power in interdisciplinary contexts before focusing in the final section on the advantages and drawbacks of several approaches to facilitating team communication that acknowledge and manage power differences so that they do not undermine team functionality.

Conceptualizing power differentials in science communication collaborations

Science communication is rife with challenges, both in terms of the ways communicators engage with publics and in the ways various collaborators engage with each other to develop communication projects. While scholars and practitioners have made strides in understanding relationships between science communicators and audiences, less attention has been paid to the various relationships between and among those who collaborate to communicate science. There are rich areas of study concerned more generally with interdisciplinary collaboration, especially among the sciences, but these often focus on research teams. The collaborations that take place to develop science communication fall somewhere between these two areas of research — one where there is a relatively clear distinction between presenter and audience and the other in which there is a

relatively clear team of scientists and scholars. Science communication is composed of loosely defined communities of practice that work together to develop science communication and public engagement endeavors. These communities include scientists, practitioners, and other specialists who have expertise in a range of scholarly and practical areas. These communities tend to face the challenges of interdisciplinary teams and the challenges of public communication and engagement. Power permeates all types of collaboration concerned with science communication, and though these different science communication collaborations experience power dynamics differently, the privilege granted to the sciences, both epistemologically and materially, shapes each encounter.

The ways power is brought to bear in science communication vary widely. Power manifests differently in different kinds of groups, so there is no homogenous understanding of power. Some science communication endeavors are developed by a clearly defined team, such as a new exhibition at a science museum that involves a team of curators, educators, researchers, designers, and others working together; in other cases, no clear team can be defined, even though collaboration is still necessary. In public health cases, like the example of COVID-19 discussed above, the scientists, public health officials, and journalists involved in communicating information about the pandemic might sometimes collaborate, but their patterns of interaction resemble a science communication ecosystem rather than a team. To accommodate the range of collaborative combination, we refrain from using 'team' and use 'collaboration' instead.

Wenger [2000] might call science communication collaborations *communities of practice*; Strauss [1978] or Becker [1980] may call them *social worlds*. Both define these groups as loosely knit, but working toward shared goals, and often sharing resources. These communities face challenges similar to those encountered by interdisciplinary teams, such as managing differing vocabularies, epistemologies, and expectations. But there are also unique challenges to these different arrangements, such as managing differing sets of priorities, knowledges and skills, as well as a lack of formal structures by which expectations can be clarified. In other words, these arrangements don't always provide collaborators with opportunities to clearly communicate their needs or aims.

No matter whether or not a well-defined, clear team exists, the shared and individual goals present in the ecosystem or even in a team-driven project are deeply impacted by how power subtly shapes all collaborative encounters. Though individual goals may vary in interdisciplinary research teams, the ultimate goal is the generation and dissemination of new knowledge. In science communication ecosystems, goals may be unclear even to participants, they may be poorly articulated, they may differ, or even be at odds with one another. Scientists who may want to share new information about their research will often collaborate with journalists who are pursuing stories not about the scientists' research, but about its implications for a relevant current issue. Scientists working with educators to develop informal science learning programming may want audiences to understand specific scientific principles or theories, whereas educators may have goals related to skills or experiences. In many situations, these disparate goals remain unspoken and unacknowledged.

These compound factors — the broad scope of communication teams and communities and the wide-ranging aims of individuals and sub-groups within them — are indications of how widely varied and fraught collaboration can be for science communication. Generalized principles or best practices may not make sense here. Even if we narrow the focus of this comment to more well-defined teams, like those developing exhibitions or working with university extension to develop engagement processes, the map of expertise, skills, aims, and agendas for any given project will be unwieldy. At the heart of this challenge lies the issue of power. The epistemological differences among collaborators and hierarchical ordering of expertise and knowledge make for problematic power arrangements within these groups.

Science and technology studies can help us think about how and why epistemological differences can underwrite power differentials. Gieryn [1983; 1999], noting that science is ideologically positioned as a "preferred truth in descriptions of natural and social reality" [1983, p. 783], discusses the use of boundary work to demarcate science from nonscience. He uses a geographical metaphor to suggest that in order to maintain autonomy or expand authority into new territory, those working in the sciences often engage in the work of delineating boundaries between what is and is not science. The same is true for other fields or disciplines as well. Though the resources marshalled to establish the boundaries may vary, in the arts, for example, delineations between professional artists and amateurs are constantly being drawn and redrawn in new contexts. In the disciplinarily diverse spaces of science communication, which often include researchers from a range of disciplines as well practitioners with different specializations, boundaries may fluctuate wildly, they may be unclear, and they may well be in dispute. But, in most of these situations, the work has already been done to establish scientific authority at the center of the endeavor.

The very existence of this epistemological authority leads to asymmetrical processes in the development of science communication. Science, and scientists, set the terms not only for their interactions with audiences, but also for their interactions with science communicators. This authority manifests in a variety of ways. Science enjoys immense amounts of funding compared to other disciplines. This means much of the funding for science communication endeavors gets parceled out from larger research grants. Even when soliciting funds for science communication projects, the funding is predicated on science-centric ideas about what should be communicated.

These funding structures, and the infrastructures within which they exist, shape the practice of science communication in informal learning environments. In her exploration of a collaborative art-science project, Halpern [Forthcoming] describes the ways epistemological authority and infrastructure shaped the collaborative process. The project, a performance called *Dance of Scales*, was primarily developed by a choreographer and a physicist who wanted to create a project integrating their work. The collaborators were committed to creating something that was an integration of their work, rather than an effort to develop a novel way to explain the scientist's research using dance.[1] Early attempts to secure funding through

[1]See Halpern and Rogers [Forthcoming] chapter in the Third Edition of the *Handbook of Public Communication of Science and Technology* for a discussion of this kind of instrumentalization of art in service of science.

science agencies indelibly marked the development of the project as an effort to communicate scientific knowledge to new audiences. In addition, moments of friction in the process brought to the surface key tensions between the perceived importance of scientific explanation and the goal of art-science integration. Though communication among the creators was open and the relationship between them was collegial, key assumptions about the value of different kinds of knowledge permeated the process.

There are other ways power manifests in science communication ecosystems. Because it often requires cooperation from groups of people who are not necessarily on the same team, science communication may not involve close-knit collaboration, and the power dynamics may also look drastically different from those on more cohesive teams. For example, journalists may not have the epistemic authority of the sciences behind them, but they do have autonomy over their work, causing discomfort for many scientists. While the epistemological roots of objectivity as an idea and an ideal grow from the sciences, journalism also embraces objectivity, but in ways that might seem unfamiliar to scientists. Because journalists are usually not also scientists, they are generally ill-equipped to judge the truth claims presented by scientists. Thus they may present multiple truth claims, leaving the reader to judge for themselves the accuracy of a specific claim [Dunwoody, 2014].

Along with these manifestations of power, science communication collaborations are riddled with power differentials grounded in dynamics that arise in most diverse teams, such as implicit and explicit bias, and the hierarchical arrangements of education and employment in academia. These variations in power present barriers to the kind of collaboration Fischhoff describes. In many cases expert and lay knowledge are dismissed or ignored. When particular arrangements of power and knowledge are assumed, collaborators may see no need to articulate goals or aims. This can result in mismatched goals or a lack of focus or cohesion for a project. Unvalued or undervalued expertise, whether it comes from bias or from some other power arrangement, can damage the process and can also be devastating for individuals involved, especially those in more vulnerable positions. Finally, problematic manifestations of power can weaken the final product of the collaboration. More often than not, in science communication, communication researchers and practitioners have access to knowledge that scientists do not. If their knowledge is not sufficiently valued, the effort may be fatally flawed.

Generalizing over these examples of power differentials within science communication ecosystems, we can think of *power* as conferring on the one who holds it the ability to influence a certain range of events (e.g., decisions, actions) to a greater extent than those without power [Turner, 2005; MacMynowski, 2007]. This is highlighted in the boundary work mentioned above, which is often done to protect or expand the influence of a particular position or field. Power is grounded in differential access to resources and grounds a kind of authority that creates dependencies in those without power on those with power; conversely, dependency relationships can create differences in power. In a situation where communication about science is warranted, there will typically be various dependencies that induce power differentials. Those on whom others in a communication team depend will hold power relative to that specific relationship, and if it is fundamental enough, their power within the team may be more extensive. For example, in many collaborations it might seem apparent that the

scientists' work is the powerful center around which all of the other work to be done must revolve. When new scientific research has urgent implications, such as research on the transmission of COVID-19, it might seem that team members are more dependent on scientists' research. In this case, such an assumption may be a result of the epistemological power differential. Though scientific research is necessary to begin to think about the intervention, decisions about safety, policies, and guidelines must take much more than science into account. As messages and interventions are generated, the epistemological power afforded science may obscure some of the other kinds of expertise needed.

Because there is a network of dependency in a science communication ecosystem, there will always be power differentials. Internal consultation among collaborators will need to proceed in a way that is mindful of power, since failure to identify and manage power dynamics could result in damage to the project [Bennett, Gadlin and Marchand, 2018]. Fischhoff does not discuss how a communication team might discover and negotiate power differentials that exist among its members; rather, he focuses on communication required for knowledge integration across different members of the communication team. It isn't enough, though, to just "specify which members must talk with one another" (p. 7673) — failure to appreciate power differentials that exist among members of a team can create situations in which people with knowledge but without power go unheard [Dotson, 2011].

Addressing power differentials in science communication collaborations

Power differentials are found in all science communication collaborations; however, there are strategies for mitigating the negative effects they can have on individual projects. In this section, we describe work we've contributed to that can both illuminate how power manifests within science communication collaborations and support collaborations in establishing productive and thoughtful approaches to handling power differentials. Much of this work centers on practices for more well-established teams, but the principles can apply more broadly to trainings and workshops for more diffuse collaboration within science communication. Although there are advantages to these approaches, they are not panaceas, a point we develop in concluding this article.

3.1 The Toolbox dialogue method

One step toward making sure power differentials do not adversely affect a science communication collaboration is to bring them into the open and talk about them. Dialogue can help here, as it encourages practices that can help reduce the potential of power discussions to result in conflict, such as deep listening and co-construction of meaning [Traxler, 2012; O'Rourke, Hall and Laursen, 2020]. Dialogue can be structured with *dialogue methods* that are designed to foreground specific considerations, e.g., methodological practices, ways of knowing, values and priorities, and power differentials [McDonald, Deane and Bammer, 2009].

One example of a dialogue method that has been used to address power differentials in teams is the Toolbox dialogue method [Hubbs, O'Rourke and Orzack, 2020]. Developed by the Toolbox Dialogue Initiative (TDI), this method uses philosophically structured dialogue in a workshop setting — a "Toolbox workshop" — to facilitate knowledge sharing and coordination among

interdisciplinary collaborators. The Toolbox dialogue method aims primarily at increasing mutual understanding among collaborators about their implicit beliefs and values, especially those that concern their common project [O'Rourke and Crowley, 2013; Looney et al., 2014]. Workshop participants dialogue about project-relevant themes expressed in the form of prompts that articulate fundamental beliefs or values with which they might agree or disagree, disclosing unacknowledged commitments and thereby increasing mutual understanding.

Of the more than 330 Toolbox workshops to date, a number have focused explicitly on power. TDI has worked with interdisciplinary groups involving academic researchers and transdisciplinary groups that include non-academic partners, and in some of these cases power was deemed an important topic for consideration. Using prompts such as "Our team must manage our power dynamics to be successful" and "Our management plan adequately addresses power dynamics," we have facilitated dialogue among groups that makes the issue of power explicit and provides them with an opportunity to discuss it. This type of dialogue could be an invaluable part of the process in a science communication collaboration — communication is the focus, but rarely is internal consultation among collaborators focused explicitly on the issue of power dynamics.

3.2 Cultural probes

Cultural probes, or what might be called collaborative probes, were inspired by the work of Bill Gaver and colleagues [1999; 2004] in interactive design. Gaver's original probes were "designed objects, physical packets containing open-ended, provocative and oblique tasks to support early participant engagement with the design process" [Boehner et al., 2007, p. 1077]. Halpern drew on this methodology to develop probes for art-science collaborations. These probes differed from the originals: they were completed cooperatively by the artists and scientists involved in the project, and the researcher was present for the probe activities, as part of the participant observation process. Halpern [2012] provide details about the activities within the probes and about the projects the collaborators created together.

Analysis of both observations and of the artifacts generated by the problems revealed that the activities, which were unusual and unfamiliar to both the artists and scientists, fostered discussions in which the pairs found or created boundary objects [Star and Griesemer, 1989] to help them find common ground. For example, one pair created a circular visualization to represent the cyclical process of observation, interpretation, and sharing. They noted that though they worked in radically different fields (dance and physics) they both followed this cycle in their work. This kind of productive boundary work differs from the kind Gieryn observed because it encourages participants to chart their shared territory. Though the probes did not necessarily lead to direct discussions of power between participants, they created opportunities for recognition of the value of other kinds of knowledge. In many interdisciplinary collaborations, the assumed epistemic authority of scientific knowledge goes unexamined, but when that form knowledge production is placed in conversation with other forms of knowledge production, like artistic practice, these forms are afforded authority, and thus, power, in the collaborative process.

3.3 Communication and collaboration trainings

Toolbox dialogues and cultural probes are both methods of facilitating productive, thoughtful, and respectful conversations. Neither of these methods shy away from conversations about power; rather, they invite frank discussions about the resources team members have at their disposal, their respective knowledge and expertise, and the ways these overlap, clash, or coincide within the project. Scientists, communicators, and other experts working together throughout the science communication ecosystem will not always have the opportunity to do the kind of meaningful group work required of teams, but the principles upon which these two methods have been developed can be adapted for individuals seeking to engage more thoughtfully with others.

Organizations like AAAS, the Alda Center for Communicating Science, and COMPASS provide trainings for scientists hoping to improve communication either with members of the public or with journalists. These trainings often emphasize knowing the audience, relating to them in on their terms, and sharing personal experiences, rather than simply conveying facts. The most successful of these will teach empathy — the perspective taking that is a cornerstone of TDI [Rinkus and O'Rourke, 2020]. There is room for additions to these existing trainings and for new interventions to promote better communication with collaborators. By drawing on some of the same tools used to facilitate better relationships with members of the public, organizers can facilitate better relationships with extended networks of collaborators. Though there is no simple way to navigate the power dynamics present in the science communication ecosystem (or in any social system), these interventions suggest that when there are structured opportunities that facilitate open discussions, there is room for developing shared visions. These practices are far from perfect or fool proof, but they are vital for the kind of connections Fischhoff suggests.

The promise and pitfalls of intervention

Explicitly addressing issues related to power in a science communication collaboration, when done thoughtfully, can offer collaborators a tremendous opportunity for improvement. It encourages collaborators to reflect collectively on who among them has access to resources, whether or not collective decision-making is transparent, and who is dependent on whom. In addition to reflexivity, this sort of communication is well-known for encouraging perspective-taking behavior, i.e., adopting the perspective of one's interlocutors and using it to re-evaluate their common project [Salazar et al., 2019]. Perspective-taking behavior can reveal what is different and what is similar across the collaboration, helping collaborators redraw the boundaries of their project and reconsider their contributions.

For collaborators who are independently inclined to collaborate, reflexivity and perspective taking can encourage empathetic simulation of project events, which generates understanding and appreciation for others' circumstances and perspectives [Rinkus and O'Rourke, 2020]. Toolbox dialogue and cultural probes can further enhance this simulation by encouraging "we"-thinking within the group [cf. Tuomela, 2007], thereby helping collaborators recognize common ground or shared territory, even though they might be quite different from one another. They can also reveal the boundaries of shared territory and where there is

uncommon ground, allowing for appreciation of differences. More to the point for our purposes, though, they can help collaborators collectively consider the distribution of power and the effects of this distribution on project function. What were previously taken to be fixed features of project structure can be reimagined in dialogue in ways that distribute power differently and more effectively across collaborators.

Though these tools can offer transformative experiences for some, they are offered within larger systems that are always at work. They expose and potentially mitigate, but do not erase, problematic power structures. Collaborations and individuals are still likely to encounter many barriers to productive collaboration. Some participants may not fully embrace the need for dialogue and reflection, and their participation may cause further harm. In these instances, deeply rooted beliefs and biases may not come to the surface, or they may be too deeply entrenched for perspective taking. Frank discussions about expertise and authority, if not carefully facilitated, can reinforce existing power dynamics. When collaborators are diffuse and are constantly changing, these problems are magnified and a host of new problems, like lack of trust, differing understandings of expertise, and radically different perceptions of goals can hinder or obstruct the most earnest attempts to communicate science.

In this paper we've assumed, along with Fischhoff, that a system-level understanding of collaboration in science communication can improve communication endeavors. But it would be a mistake not to expand the view of the field much further, and to recognize that all science communication is created within large infrastructures in which power has not always been examined. The larger landscape in which science communication collaborations might seek to find shared territory is deeply damaged by the ways power has been wielded. The resulting injustice and oppression are part and parcel of the system. It is within this landscape that individual ideals and perceptions develop, and within this landscape that collaborations are formed. Mistrust both among collaborators and between science and members of the public is often well founded. The work of revealing and naming power in science communication is vital to its future, and this work starts with individual collaborations, but it does not end there. These practices are key to examining, and transforming, the large-scale systems that shape how all of us experience science.

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How to cite

Halpern, M. K. and O'Rourke, M. (2020). 'Power in science communication collaborations'. *JCOM* 19 (04), C02. https://doi.org/10.22323/2.19040302.

ISSN 1824-2049. Published by SISSA Medialab. jcom.sissa.it