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TWENTY YEARS OF SCIENCE COMMUNICATION: LOOKING BACK, LOOKING FORWARD

Science communication: a messy conundrum of practice, research and theory

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Abstract

Theoretical perspectives of science communication were initially driven by practice, which in turn have influenced practice and further science communication scholarship. The practice of science communication includes a variety of quite diverse roles. Likewise, the scholarship of science communication draws upon a mix of disciplines. I argue that the apparent messiness of science communication scholarship and practice is also its wealth. If blame can be avoided in developing and applying science communication models, and if the coexistence of all science communication models can be embraced then both the scholarship and practice of science communication is likely to be more effective.

Keywords Science communication: theory and models

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Despite 'science communicator' being a recognized profession across the world, I still struggle to explain what I do. I try and resist the easy explanation that 'I'm a journalist and I write about science so people can understand it'. I think part of my struggle is that science communication practitioners can take on many roles: writer, editor, presenter, facilitator, trainer, designer, consultant and relationship manager. Science communication is a messy but delightful mix of so many things.

In addition to being a science communication practitioner, I have become increasingly involved in scholarship that considers theoretical perspectives. In this commentary, I describe my journey exploring the messy conundrum of science communication practice, research and theory. The order of these words is deliberate. My review of the research literature shows that science communication practice drove the early focus of science communication research, from which emerged a number of well-known theoretical perspectives. In a circular process, these theoretical perspectives have, to some extent, influenced practice and have the potential to be themselves further shaped by the empirical analysis of practice.

Wading into the messy field of science communication

In its early days, the field of Cultural Studies was described by Raymond Williams as a "vague and baggy monster" [Murphy, 1992]. Science communication is similarly a messy mix of academic disciplines and professional endeavors. While this mix brings youthful strength, vigor and excitement to the field, it also makes the links between science communication practice, research and theory difficult to decipher.

The 'science communication' profession encompasses a multitude of possible roles. Burns, O'Connor and Stocklmayer [2003] point to the lack of clarity about what a science communicator does or should do. They postulate that it is not merely an offshoot from the field of 'communication'. Instead, they define science communication as "the use of appropriate skills, media, activities, and dialogue to produce one or more of the following responses to science… awareness… enjoyment… interest… opinions…. [and] understanding of science" [2003, p. 191]. This definition emphasizes at least some of the breadth and diversity of roles that a science communicator may occupy, including roles in public relations; journalism and science writing; museum and science center visitor engagement; and facilitating debates, discussions or public participation.

Likewise, as an academic field of research, science communication draws its theories, models, approaches and methodologies from a range of disciplines: sociology, humanities, psychology, linguistics, philosophy and, more recently, communication and media studies, education, library science, information and technology, and political science [Gascoigne et al., 2010; Trench & Bucchi, 2010; Rauchfleisch & Schäfer, 2018].

Regardless of this diversity in the roles that science communicators take on or the disciplines that scholars identify with, the term 'science communication' is used within the field to describe communication between those associated with scientific endeavors in some way (scientists and science communicators) and those without formal scientific expertise (e.g. laypersons, publics). In contrast, the science communication models that have emerged over the years describe the various relationships that exist between *scientists* and publics. Interestingly, there is scant consideration of the science communication practitioner in these models.

The boundary between the practice and research of science communication is also often blurred. In 2011, I was part of a team who conducted an online survey with Australian Science Communicators [Metcalfe & Gascoigne, 2012] where almost half (30) of the 65 participants claimed to be involved in both science communication research and practice. At the Public Communication of Science and Technology (PCST) Network conference in New Zealand (April 2018), I asked participants in one of the sessions to raise their hands if they were (a) a science communication scholar only; (b) a science communication practitioner only; or (c) both. Most participants claimed to be (c) and wear both hats.

Of course, this doesn't mean unproblematic relations between science communication practitioners and scholars; the differing cultures of scholars and practitioners often create tensions [see, for example, Miller, 2003, 2008]. Tensions arise with the differing pace of activities, with practice usually moving quicker than research [Featherstone, Manners, Nerlich & James, 2014]. Scholars often question the efficacy of practice, and practitioners question the relevance of

research [Miller, 2008; Han & Stenhouse, 2015]. Scholars and practitioners can also have different priorities. For example, project evaluation research, a central focus of much of the collaboration between scholars and practitioners within the field, often focusses on short-term and localized practice projects, rather than developing generalized knowledge, which is what often drives more scholarly research.

Regardless, science communication practice and research have co-evolved over the past decades, and from this co-evolution theoretical discussions have emerged, which have further strengthened the connections between both.

Science communication gets even messier when its controversial

From my research and observations, it appears that practice often drives the research agenda. For example, much of the scholarly literature published over the past 20 years has centered on publicly controversial science issues challenging practitioners. For example, in their 2017 publication, *Communicating Science Effectively: A Research Agenda*, the U.S. National Academies of Sciences, Engineering, and Medicine define science communication: "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" [2017, p. 2]. This instrumental definition of science communication focuses on publicly controversial science by highlighting 'viewpoints', 'diverse public views and concerns', and 'contentious issues'.

I think that a consequence of this focus on publicly controversial science (for example, the science associated with genetic modification of food, biotechnology, nanotechnology, climate change, synthetic biology) in the last few decades has led government policy makers and practitioners to talk more about science 'engagement' rather than 'communication'. This has, in turn, driven a research focus on more dialogical forms of communication. In the U.K., the House of Lords' Science and Society report in 2000 [U.K. House of Lords Select Committee on Science and Technology, 2000] led the way for a series of other reports that called for and articulated the need for greater public *engagement* in science [Joly & Kaufmann, 2008]. When science is publicly controversial, public engagement is perceived to be needed to critically review research, solve problems or to support behaviour and policy changes [Few, Brown & Tompkins, 2007; Höppner, 2009; Marquart-Pyatt et al., 2011].

Bultitude [2011] argues that the change in terminology from communication to engagement may have arisen because some practitioners and policymakers perceived science communication to be about just one-way communication of knowledge rather than two-way 'engagement' where scientists interact and work together with the public. Scholars considering the direction and nature of engagement between scientists and publics started to theorize models for such engagement. These models arguably arose from the public science controversies in the United Kingdom and the United States of America towards the end of the last century.

Science communication models create a messy blame game

Much of the expansion in scholarly science communication research from 1990 to 2010 focussed on models. Trench and Bucchi [2010, p. 2] claim that the "near-20 years of discussion of models of science communication — since the naming of the 'deficit model' — is the most solid thread of theoretical work in this field".

It is my view that the three dominant models imply blame. The dissemination model or literacy model (commonly referred to as the deficit model) assumes that publics need to be knowledgeable about science, and they are blamed if they are not literate in science.

The public understanding of science model encourages interaction between scientists and publics so that publics can better understand science and scientists can better understand publics. This model is commonly referred to as the 'dialogue model', because two-way conversation occurs between scientists and publics. Scientists seek to understand the perceptions, concerns and needs of publics, and also recognize that publics may also have knowledge that is useful for scientific research. With this model, scientists may be blamed for not properly understanding publics or considering various publics' knowledge in their research. Publics may be blamed for not participating in dialogues with scientists or for still not properly understanding the science.

In the third model, the science in society model, science is one of several sources of knowledge and expertise in solving societal problems, along with other equally valid sources. This model is commonly referred to as the 'participatory model' where scientists engage with various publics on a more or less equal basis. Scientists and various publics may both be blamed for not participating effectively with each other to create positive societal change.

According to Brossard and Lewenstein [2010] such models are "frameworks for understanding what the 'problem' is, how to measure the problem, and how to address the problem" [2010, p. 13]; the 'problem' being the public's understanding of and relationship with science. Alternatively, the problem is conceived to be scientists' lack of understanding or relationship with publics. Regardless, these conceptions generate 'blame' models. Further blame can be apportioned to scientists and practitioners when they appear to be stuck in the 'deficit model' and not progressing or evolving to the more participatory forms of science communication.

Thus, instead of the models being helpful for explaining and informing science communication practice, they can be used to criticize the efforts of science communicators. Perceptions of blame may increase the disconnection between science communication scholars and practitioners. Miller [2008] noted that science communication practitioners may perceive social scientists as dismissive of science communication practice. He previously also noted that the scholar-practitioner divide was exacerbated by the scholarly attention given to the 'science in society' model of science communication that grew out of published research critiques of practical science communication activities [Miller, 2003].

Science communication models all messed up together

Despite these criticisms, science communication models can be helpful for practitioners. Trench [2012] provides a clue to how science communication models may be relevant to practice when he says that science communication models construct the relations "between participants in a communication process and provide the basis for the strategies adopted in communication acts or initiatives" [2012, p. 2].

In one of the very few studies looking at how science communication practice reflects science communication models, Brossard and Lewenstein [2010] analyzed the Human Genome Project's Ethical, Legal and Social Implications outreach. They found in practice that projects took a pragmatic approach and adopted parts of each science communication model according to the different contexts and needs of various publics, showing that these models typically co-exist and overlap in practice. This reflects the findings from my own research, which show that it is very rare for a science communication activity to reflect just deficit, dialogue or participatory communication characteristics [Metcalfe, 2019]. Even when the overt objectives of the organizers of a project are explicitly devoted to one model, the activities reflect a mix of model characteristics. This concept of coexistence is not new and other scholars have discussed this phenomenon [e.g. Brossard & Lewenstein, 2010; Bucchi, 2008; Hetland, 2014; Jensen & Holliman, 2016; Trench, 2008]. However, it has not been recognized in the literature as ubiquitous. A dominant notion in the literature is one of distinct and evolving science communication models [e.g. Höppner, 2009; Palmer & Schibeci, 2014; Stocklmayer, 2013]. Instead, my research findings show that it is often necessary for models to coexist in practice.

Deficit-style communication practices often coexist with that of dialogue-style activities as science communicators converse with publics about their lectures, popular publications or exhibits. Dialogue-style communication coexists with deficit-style activities as the dissemination of information often stimulates conversations or initiates consultations.

In reflecting about this coalescence of deficit and dialogue-style communication, I do not find it surprising. When the 'great men of science' gave their public science lectures in the 19th Century, it is probable that they engaged in conversations with people before, during and after these events. Audience members were likely to attend such lectures in the first place because they were interested in the science and ideas being presented; not because they or the scientists believed that they had a gap in knowledge that needed filling. There is a strong case to be made for referring to this one-way communication as dissemination rather than deficit.

My analysis of science communication practices has shown that participatory-style communication always includes characteristics from the other two models; it never exists by itself. Participants in more deliberative science communication activities demand that background knowledge and contextual information is delivered through dissemination and simple dialogue techniques.

Even more importantly, relationships of trust are developed through participatory processes. When trust is developed, dissemination and dialogic techniques are often more effective. Participation needs dissemination and dialogue techniques, but also enables such techniques to create real changes to the attitudes, behaviors and decision making of both publics and scientists.

Effective science communication embraces messy deficits, dialogue and participation

When I started my PhD (2012), I was committed to 'deficit denial'. I argued that science communicators needed to be much more proactive in implementing more deliberative communication through dialogue and participatory techniques, and they needed to renounce their 'misguided deficit' ways. I even wrote an article about it for Australia's *The Conversation* [Metcalfe, 2013]:

> Science engagement in Australia is trapped by the 20th Century. It operates under an outdated model that aims to promote and celebrate science, rather than encouraging the public to participate in, and critically evaluate scientific endeavours.

But, as I found out during my PhD research, establishing more deliberative objectives and activities is only part of the science communication story. My PhD research findings revealed to me, that science communication happens in a multitude of directions according to differing social, political and cultural contexts, complexities and characteristics. The coexistence of activities informed by the different models in practice appears to be not merely unintentional or accidental but a necessity for science communication to achieve its objectives. I now believe that there is nothing inherently *wrong* with deficit-style science communication, especially if we talk about it as 'transmission-style', where information is transferred, often in response to publics' demand. Such a transfer of information can meet the demands of interested publics, seek to educate people who need such knowledge for decision-making, and it can promote the importance and excitement of science to latent or interested publics [Broks, 2006].

Making the most of messy science communication

In my view, good science communication practice and scholarship means embracing the chaos and messiness of what we do. Science communicators now have opportunities to apply a rich array of elements from all three theorized science communication models to their practice for greater chances of success. This strategic approach to science communication recognizes that each model has benefits as well limitations. It recognizes that scientists and publics play multiple roles; they can seek out and receive scientific knowledge; they can discuss and debate scientific knowledge; and they can determine and shape the direction of scientific knowledge.

Science communication scholars could better recognize and investigate the rich mix of cross-model objectives and activities pursued by those involved in science communication practice, including the possibility that participatory communication may provide a necessary foundation for making linear forms of communication more effective, especially when the science is controversial or politicized.

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